Vol II wants No XI = Aug 27th

[SUPPLEMENT TO "INDIAN ENGINEERING," FEBRUARY 18, 1888.]

INDIAN ENGINEERING:

An Illustrated Weekly Journal.

EDITED BY PAT. DOYLE, C.E.

VOL II.—FROM JULY TO DECEMBER, 1887.

Calcutta:
PRINTED BY C. J. A. PRITCHARD, AT THE "STAR" PRESS, 19, LALL BAZAR STREET.
1887.

GENERAL INDEX.

ILLUSTRATIONS.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India ...	Rs. 12 ...	Rs. 7 ...	Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong Shanghai*, and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, JULY 2, 1887.

OURSELVES.

THE history and development of this journal is well known to the majority of our readers.

Without undue vanity we may fairly say that *INDIAN ENGINEERING* is now accepted as *the* Engineering newspaper of India.

The labour of editing the paper has been one of love.

The Editor has proved that the Engineering and Architectural Professions are capable, willing, and able to maintain a journal of their own.

Contributors will kindly note that the non-appearance of their favours is due to circumstances over which the Editor has had no control; some matter has been set up for three months in type.

ANOTHER WHITE ELEPHANT.

ALTHOUGH enveloped in a cloud of words, it is, after all, not so difficult to penetrate through the flimsy device, the "official apologist" has resorted to, in a recent inspired article on Railway communication with Simla. The subject has been discussed from various stand-points, but in no single instance has the writer succeeded in making the worse appear the better cause, with even a shew of plausibility, or in conveying the shadow of a conviction into the mind of his readers. The arguments adduced are all based upon the assumption that a strong case has been made out for the annual exodus to the hills, and that no further discussion is necessary to establish the point at issue. We beg to dissent from such a conclusion, as we hope presently to shew. It is alleged that Simla being for seven months of the year the administrative capital of India, it is a reproach to Government that it should be cut off from all Railway connections by one hundred miles of difficult road. Such a line of reasoning may well emanate from the sanctum of our Allahabad contemporary, but we doubt whether any sane man in all India will concur in such a view. It amounts to this: first create a necessity and then expend a hundred lakhs of rupees to keep up a huge and glaring scandal at which the whole country looks aghast. If Government deserves a reproach, it is not for having hitherto failed to squander away large sums obtained by squeezing the pockets of the down-trodden tax-payers of India, but for going to Simla at all, and passing its time in picnicing, masquerading, and indulging in such light frivolities, more than a thousand miles away from the actual metropolis. The only rational method of meeting the difficulty is not to go up there at all.

The 'discomforts of dâk-gharries,' the 'weariness of tongas,' and 'bullock-carts toiling through the sands,' are picturesquely described, but these could easily be avoided altogether by the birds of passage giving up their migrations, and confining themselves to the habitat which nature and the Home Government have provided for them for close upon two centuries past.

It is, however, when the writer 'attempts to ascertain' how the 'financial position of the so-called luxury stands' that he flounders hopelessly in the slough of despond. According to his own shewing, and from figures published in the *Gazette of India*, it appears that the estimate for the 38 miles from Umballa to Kalka, amounted in round numbers to thirty-two lakhs, "which included indirect paper charges, such as loss of interest, loss of abated land revenue, &c., to the amount of 2·74 lakhs, but did not include rolling stock, for which a further additional sum would have to be added, presumably not a very large one if the line were worked in connection with the North-Western system."

O, no, rolling stock never cost a large sum, until it was finished, and when the heavy excess over the estimate can no longer be kept a secret from the public, a mass of irrelevant and indignant correspondence follows, the responsible party, who has friends in high places, slips through the meshes of the net laid for the smaller fry; and some unfortunate under-strapper, who could not, by any stretch of imagination, be implicated in the failure of the scheme, is offered a victim to the wrath of Government and vicariously punished for the offence committed by his superior.

Upon that outlay, 'based upon incomplete and in some respects obsolete registration of traffic,' a return of 4 per cent. was anticipated, and the matter referred to the Punjab Government for opinion. The authorities there were still smarting under some painful reminiscences of the Pathankote Railway, and when the estimate was submitted to the crucial test of experience, it was found, what any other man but an enthusiast for the expansion of Railways would have discovered, that it was misleading, and the happy prospect was reduced to 2 per cent. But the disappointed visitors to the hills are not of the stamp of men to be discouraged by trifles. There is balm in Gilead, the traffic has not only developed since then, but the former registration was at fault, and as the statist thinks so the bell clinks, fresh surveys and estimates were ordered to be prepared, in accordance with 'more rational views,' to be 'placed in a much more favourable light.' These were undertaken in 1884, during the *régime* of Lord Ripon, the 'friend of India,' and were completed six months ago.

Now, as to some of the natural obstacles to be encountered in the construction of the line. The distance between Simla and Kalka is 68 miles, but as necessary deviations will have to be made owing to excessive gradients, the Railway will be some ten miles longer; "the steepest portions of the line would be the first sections from Kasauli to Dharmpur, and the last bit from Badhai Ghât into Simla, for parts of which the ruling gradient would be 1 in 33, necessitating extra engine power. ....As any one who has made the journey by tonga will readily realise, about half the line must be on curves more or less sharp, though the sharpest has been limited to a 70 feet radius. Over these gradients and round these curves high speeds would equally obviously not be feasible, and between Kalka and Dharmpur and on the last bit into Simla, a limit of 7 miles an hour is proposed, and of 10 miles an hour over the remaining lengths." Now comes a piece of confession which in its candidness and simplicity is truly charming and refreshing; after all these difficulties are overcome and one hundred lakhs are expended, the speed to be attained is so ludicrously low that "it would seem an express tonga might even still afford to give points." This is the most amusing part of the business; but it is not all.

In the paragraph which follows Mr. Morris just throws out a hint which it would be well for the unfortunate tax-payer to make a note of. He says: "An outlay of somewhere about one lakh per mile—and, as we know, these Railway estimates are apt to grew—for a try line of so absurdly narrow a gauge may at first sight seem startling, but any line of the kind having to deal almost the whole way with treacherous rock-cutting, or costly retaining walls cannot fail to be costly, even though, as we believe is the case with the present project, there are hardly any large works of importance throughout the whole length." The next point discussed by the surveyor is a comparison from a financial point of view between the Simla-Kalka and the Darjiling Railway. Here too he is unhappy. Because the latter has paid a dividend of 8½ per cent. last year, "it might not seem by any means unreasonable to expect a similar line made to Simla to pay 4 per cent." By what process of logic, inductive or deductive, the result has been arrived at, it is difficult to say. Argument of this nature may be accepted as 'proofs from Holy Writ' with the good folks at Simla, but we toilers of the plains fail to detect its cogency.

We confess our patience has been exhausted. That it will be found impossible to float the scheme in the open market, we have not the slightest doubt; therefore, an attempt will be made to reach the too willing ears of Government and persuade it to undertake the construction of the Railway on its own account; and we trust that such clap-trap as "the question of direct return might surely well be subordinate to the administrative, political, and military considerations involved," will find no place in a discussion of the subject. With the Exchequer at a low ebb and discontent throughout the land in the matter of Imperial expenditure, it would be a grave blunder—worse than a crime—if the responsible advisers of Government did not raise their united voice against such a shameful waste of the public revenue.

DISTRICT ROAD FUND—BENGAL.

It was a casual observer who remarked that if the English ever voluntarily withdrew from India, the only monument of their occupation of the country would be a pyramid of beer bottles. How far this is in accordance with facts, one has only to look around, to find traces of the handiwork of advancing civilization in almost every nook and corner of the country. A comparison of the condition of the people during the earlier period of British rule, and at the present day will show what material improvements have been wrought for their personal convenience. We need not point to institutions established for their intellectual advancement or for the amelioration of suffering humanity; or to the network of Railways, that contribute in more ways than one to the comforts of life. Slowly, but as surely, the construction of Railways is being pushed forward in every district throughout the Peninsula, into closer communication with each other.

When a road-cess was first talked of, great clamour was raised, and there were not wanting prophets of evil, who prognosticated dire calamity to the country, and the utter ruin that awaited the zemindar and ryot alike. But how their prophecies have been falsified may be found by a reference to any old number of the *Calcutta Gazette.* Of course, the work is carried on silently, without any flourish of trumpet or proclamation from house-tops; but nevertheless it is going on year after year, and instead of any voice being raised against it, we are glad to find that private funds go a great way in swelling the annual expenditure on account of road and bridge-making, and what is more, as a rule, it is not the aristocracy of the land, who unloose their purse-strings for the benefit of the public, but the middle and the poorer classes that are prominent in conferring such favors.

Let us, for instance, take the local Government publication of last week, and the following is the happy result of the operations of the Road Cess Act in the several districts noted below :—

24-Pergunnahs.—A sum of nearly Rs. 20,000 was placed at the disposal of the several branch committees for the improvement of village roads in seven different sub-divisions. Contributions to the extent of Rs. 1,200 were received from private individuals for the same purpose. A further sum of Rs. 2,500 was received from Baboo Radha Mohun Mundle, zemindar of Bowali, out of his promised contribution of Rs. 5,000, for the metalling of the Buckrahat Road. There are 140 miles of *pucca* roads under the charge of the Committee, and the amount expended in their repairs for the year 1885-86 was Rs. 52,422, or Rs. 374 per mile. There are nearly 2,000 young trees along the sides of the roads, and some of them have begun to bear fruit. It will therefore be seen that arboriculture is carried on in the division, not only with a view to utility, but for profit as well.

Nuddea.—The year under review was a most trying one. It was marked by a disastrous flood causing considerable damage to the roads throughout the district. The requirements to keep them in order were much greater than were either anticipated or provided for. The funds at the disposal of the Committee were Rs. 44,906, whereas the ordinary demand was Rs. 53,934. The consequence was that thirty roads of comparatively minor importance were left unprovided for in the Budget. The floods which occurred after the preparation of the Budget left the Committee in a still more embarassing position. The special repairs required an outlay of Rs. 54,130, the total requirements therefore rose to Rs. 1,03,664. Government gave a grant of Rs. 5,000, which, of course, was quite inadequate. There are in this district metalled roads aggregating 133 miles. The allotment for village roads, exclusive of what was spent on those undertaken as relief works, was Rs. 5,700, which was distributed among five sub-divisions.

Jessore.—The receipts under the Road Cess Act were estimated at Rs. 97,535, and the expenditure at Rs. 90,726. The actual receipts however, together with a balance from last year's accounts, were Rs. 1,03,533, and the expenditure Rs. 1,00,800. Of the principal works carried out during the year, surface repairs have been executed on 487 miles of roads, metal has been renewed on eight of the principal roads, and then 1¼ mile of new construction. A sum of Rs. 556 was expended in repairing the roads in the several sub-divisions and Rs. 4,486 in constructing and maintaining village roads and bridges. The following well-deserved tribute has been paid to the Engineer in charge of the works :—

"With regard to the Engineering Department, I consider that the district is peculiarly fortunate. Mr. Burt's services and reputation need no praise from me, but (especially as I am leaving the district) I wish to put on record the very high opinion I have of him and his work. In no season of the year has he failed to see to *details* of work, often at great personal inconvenience. Like master like man, his overseers have given me satisfaction."

Presidency Division.—The Commissioner of the Presidency summaries thus the annual accounts of income and expenditure of the several District Road Funds of that division. The total income of the districts, including the balance of the previous year, amounted to Rs. 5,36,999 in the year under report, against Rs. 4,98,580 in 1884-85 ; and the total expenditure amounted to Rs. 5,04,064, against Rs. 4,27,134. The sum expended in original work was Rs. 52,906 only, or 10·4 per cent. of the total expenditure, against Rs. 43,368, or 9·8 per cent. in the previous year. The percentage in the 24-Pergunnahs was 6·8, in Nuddea 9·3, in Jessore 8·3, in Murshedabad 1·6 and in Khulna 24·5. The expenses on arboriculture amounted to Rs. 640 in Nuddea, Rs. 591 in Jessore, Rs. 399 in Murshedabad and Rs. 793 in Khulna. All the above reports point to one important fact, which is highly suggestive. In regard to the working of the Branch Committees, we find that the gentlemen composing them take an interest in their work in the inverse ratio of their distance from the metropolis. Those living in the suburbs cheerfully undertake the duties of superintending the construction of roads, bridges, &c., and as the locality recedes from the city, the less do they concern themselves in such matters. This proves, if anything were necessary to prove, the influence English education directly exercises on local self-government.

STONEY'S PATENT IMPROVED SILENT SELF-LUBRICATING PUNKAH WHEEL.

Mr. Stoney's name is too well known in connection with many useful and economical inventions to require introduction at our hands. One of the latest triumphs of his ingenuity is instanced in the "Improved Silent Self-lubricating Punkah Wheel." which bids fair to eclipse all others in the market. The whole arrangement consists of (1) the wheel proper, (2) the bracket, (3) the gun-metal axle, and (4) the rope guard. The wheel is cast hollow, having two diaphragms, inner and outer, enclosing within them the self-contained oil reservoir. On the inner diaphragm there are six holes, through which the oil is fed, and centrally a large hole which receives the axle. Surrounding all these holes, circumferentially, is a raised ridge or wall made convergent from the surface of the inner diaphragm towards the axle to catch and return to the reservoir through the small holes all oil escaping from the axle or otherwise from over-lubrication. So long as the wheel vertically placed or fixed is not in motion the oil remains below within the space enclosed by the diaphragms, and the oil when filled should never be allowed to rise above the lowermost hole: when the wheel is in motion the centrifugal force carries up the oil to the inner circumference of the oil reservoir—which is circular—and thence it gravitates towards the axle which it effectually lubricates.

The bracket, like the wheel, is cast-iron, quadrental in shape, having a tapped hole at each bossed-end to receive the screwed end of the axle.

The axle is made of gun-metal accurately turned, and carries the wheel at one end, receiving the bracket at the other. The rope guard is mounted on the axle between the wheel and the bracket and so arranged as to be possible to be securely fixed in any required position for the protection of the rope. The *modus operandi* of charging the reservoir with oil may be described as follows. The wheel is held horizontal with the perforated diaphragm or the oil concentrator upward, and the oil, about a quarter of a sherry glass, poured in at one of the six holes until it is found to be level with one of these, when the wheel is held vertical.

The device is an admirable one and the advantages claimed for the new wheel are—

(1.) That unlike ordinary wheels it is perfectly silent and self-oiling.

(2.) It does not leak and soil the floor, the wall and the door with the discolored oil.

(3.) It is easily fixed either horizontally or vertically to suit circumstances and convenience.

(4.) It is provided with guards which effectually prevent overriding or falling of the rope.

(5.) Properly charged with oil and properly set up it should run for a long period.

As to these advantages we are in a position to speak from experience, having had a wheel working with *one oiling* over a month; and to the above advantages we would add that it is *economical in the consumption of oil and renewals.* To those of nervous temperament, to the sick in hospitals, to the soldier in barracks, to newspaper writers desirous of mental concentration and to the sleepless at night from weariness and external causes, this wheel will be found a *boon.* Messrs. Spencer & Co., of Madras, are the Agents for the Patentee.

Notes and Comments.

A Suggestion to the Legislature.—We commend the following views on the granting of Patents, which provide for all the interests concerned in the matter of granting these rights:— "The patentee seeks to obtain a special privilege by which he hopes to make money, perhaps a subsistence, perhaps a fortune, and it is a simple matter of justice that he should pay something for it. On the other hand, the granting of patents by the State implies a recognition of the principle that the encouragement of invention by this means is for the public interest; and as many inventors are poor—especially at the time when their applications are made—it may not be expedient to call upon them to pay such sums at the time of making them as would defray the whole expense. The right principle of action appears to be for the State to demand a moderate sum at the outset, and more substantial payments at subsequent intervals, whilst the patent rights are in force. Then, if the patent should prove a failure within the first few years, the patentee can let it drop, and so escape further charge. But if it be a success, he can maintain his rights by making a fair return to the State."

A Bold Collector.—Mr. H. G. Turner, C.S., officially declares on the subject of roads that, they are mean, common things and thought little of when we find them outside our front gate every morning of our lives. But go to a country where there are no roads, where every able-bodied man is turned into a beast of burden, and every woman too. He adds: There is no greater boon to give to a populous country like the Jeypore plateau than roads. Roads raise a man from a beast to stand upright. What would our own land be now without roads? Fancy the condition of half of Scotland, if every man had to bend his back to carry his bag of oats to market. These things cry aloud. If I asked money for a jail, a court-house, or even a school, I would get it. We are all ready enough to lock people up, and some delight in teaching the hungry how to write and the naked how to cypher, but let me make the roads and hospitals of a country, and let who will build its jails and its schools. This cause is a just and righteous cause. I believe it to be, after hospitals, the honestest way to spend public money. I believe it confers more good on a people than anything that laws can cause or cure, and I earnestly submit the matter again to the consideration of Government.

Public Service Commission.—The following note on the question of the admission of natives into the Indian Forest Service has been submitted to the Sub-Committee of the Public Service Commission by Mr. B. Ribbentrop, Officiating Inspector-General of Forests:—In recording my opinion on the organization and recruitment of the Indian Forest Service, I pre-suppose that it is the desire of the Government of India that the State should secure the best servants in proportion to the outlay the Government are enabled to devote from State Revenues for any special purposes of administration, and I refuse to believe in the existence of valid reasons which would make it advisable that the State should be burdened with inferior servants. I do not in any way prejudge, and have carefully weighed my experience of the services of the different classes of servants available for the Forest Department, without a sentimental leaning to either class; but I cannot accept, without a direct assurance to that effect, that the Government is bound to provide employment for educated natives because they *are* natives. It is, in my opinion, the duty of the Government to provide the State with the best servants for each kind of work, and to pay them at such market rates as will ensure the maintenance of an efficient service. Every other consideration must land us in uncertainty and doubt.

Current News.

Mr. G. Palmer, Secretary to Government, P. W. D., returned on Monday night from Coonoor.

Captain H. Campbell, of the Indian Marine, is granted the Distinguished Service Order for the Burma campaign.

A railway collision occurred at Melbourne, Victoria, on the 12th May, whereby six persons were killed and fifty injured.

It has been resolved to make a railway tunnel through the Simplon. It will be ten miles long and will probably be 7½ years under construction.

A bridge is to be built across the river St. Lawrence at Quebec which will have three spans; the centre span will be a quarter of a mile wide, and from high water mark to the bottom of the bridge will be 150 feet

A single sheet of paper, 72 inches wide, and seven-and-three-quarter miles long, without a single break, was recently made at the Remington Paper Company's Mill at Watertown, New York. The sheet weighed 2,207 lbs.

Alarming rumours have been current in Lahore that owing to the occupation of Khojah Saleh by Russian troops, orders have been given to push forward the Kandahar Railway, and to arrange for the passage of troops to the front.

Rich gold mines have, it is said, been found in Eastern Siberia, some few hundred miles from Yakutsk, extending over a district hitherto unexplored. Report declares that the region is a perfect New California in its greatest days of gold diggings.

The Military Telegraph Committee at Rurki consists of Colonel Blood and Major Leach, of the Bengal Sappers, Captain Goldie, R.E., from Poona, Captain A. C. Macdonnel, from Bangalore, and Mr. Luke representing the Government Telegraph Department.

The B. B. and C. I. Company are, we understand, quite willing to begin the construction of the Simla-Kalka Railway, concerning which we gave some details recently, at once. The matter, therefore, now only awaits the initiative of the Honourable Member for Public Works.

In order to bring the Sind-Sagar Railway into direct communication with the main line of the North-Western system, it is contemplated to bridge the river at Mooltan. This would materially increase the strategic value of the frontier railways east of the Indus.

A native railway driver in trying last Wednesday to jump on to his engine which had just started from Nyaungbyidaik, on the Sittang line, fell between the engine and the platform. He was dragged a short distance and had one of his arms broken and was otherwise severely injured. He was sent to the hospital at Tounghoo.

A railway ticket a yard and a half long was lately sold in Boston, and the incident is so remarkable that the name of the ticket seller as well as that of the passenger is being repeated in the papers. The ticket contained thirty-five coupons, and carried the passenger diagonally across the Continent to Texas, then due east to Florida, and up along the Atlantic coast to Boston again.

We learn that the survey has been ordered for a railway from Peshawur to Jumrood. The order has been given merely that full information may be available should it become necessary to construct the line. The Government has no immediate intention of undertaking the work of the railway. When required the line could be made in a short time, as the distance is only some dozen miles.

An experiment was lately made in using the coal from the Singareni fields in an engine attached to a train running from Secunderabad to Hyderabad and back. The engine driver reported that with this coal he could obtain speed equal to that when English coal was used, and faster than with the use of Raniguuj or Chota Nagpur coal. After burning, the coal gave only a small percentage of ashes, and it emitted a very small volume of smoke. A specimen of the coal is being packed up in 12 boxes, each of 8 cubic feet, for transit to England, with a view to its being tested for steam navigation and manufacture.

It is reported that, at the instance of the Chambers of Commerce of the three Presidencies, the Agents of the various Railway Companies in India have been requested to give their views upon the existing law relating to railway receipts in India, which, it is alleged, is unsatisfactory, owing to the disadvantages the public and the railway administrations are put to by these documents not being transferable and negotiable instruments carrying a title to property in the same way as bills of lading.

Major Sydney Smith, R.E., the Deputy Consulting Engineer for Railways, Madras, has just gone to Secunderabad to inquire into the circumstances of the accident on His Highness the Nizam's line on the 14th ultimo, by which some of the vehicles attached to the up-mail train were derailed at Lingampalli station, and some passengers injured thereby. All traces of the accident have, it is said, been carefully preserved in order that a definite conclusion may be arrived at as to the cause of it.

On Tuesday last, a goods train left Madras for Jollarpett at 5-20 A.M., with a cargo of miscellaneous articles. When the train had reached the 64th mile stone, the guard observed some sparks of fire flying about. The train was brought to a stop, and it was discovered that two waggons, loaded with dry bark, intended for use in distilling arrack, were on fire. All attempts to put the fire out being useless, every precaution was taken to isolate it. The two waggons were completely burnt down; the rest escaped any damage.

General Annenkoff, who directs the construction of Russian Railways in Central Asia, has apparently no limit placed upon his expenditure, judging by the results he has achieved. The Trans-Caspian line from Oujoun Ada on the shores of the inland sea to Charjui on the Oxus is 544 miles in length, and the 418 miles west of Charjui have been laid in 18 months, the Turkoman steppes, of course, offering no great physical obstacles. The line is said to be complete along its length, with the telegraph wire laid alongside and fair accommodation for the railway staff.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

TALC IN "PAPER-MAKING."

Sir,—In your issue of 11th June 1887, heading "Letters to the Editor," page 356, I saw a letter, dated 31st May, in which a paper-maker has failed to dissolve talc for finishing and glazing paper.

I know two processes for dissolving talc: one neutral and the other alkaline, which I have used in cosmetics, but I am not sure whether they will succeed in finishing paper or not. Let the paper-maker make experiments with both of them.

1

Take any quantity of talc, divide it into laminæ, and calcine it with sulphur. Then pound it, and wash it in a quantity of warm water. Gently pour off the water, and leave the residue at the bottom of the vessel to dry. When dry, calcine it in a furnace for two hours with a strong fire. Take a pound of this calcined talc, and reduce it to powder, with 2oz. of hydrochlorate of ammonia (sal-ammoniac); put the whole in a glass bottle, and set it in a damp place. All the talc will spontaneously dissolve; then pour off the liquor gently, taking great care not to disturb it. The liquor will be as clear and as bright as pearl.

2

Take one part of Venetian talc and two parts of calcined borax (biborate of soda); perfectly pulverize and mix these substances, put them into a crucible, cover it, and place it in a furnace. Expose it for an hour to a very violent heat, and at the end of that time the mixture will become a glass of greenish yellow color. Reduce this to powder and mix it with two parts of carbonate of potash, and again melt the whole in a crucible. Place the mass thus obtained in a cellar upon an inclined piece of glass, with a vessel underneath it, and in a short time the whole will be converted into a liquid, in which the talc will be perfectly dissolved.

Chandra Cantha Bhattacharjee.

STAFFORDSHIRE COAL SEAMS.

Sir,—I have received from a friend copy of Dr. Saise's report on the methods of working the thick seams of Staffordshire, and its perusal has caused me no small amount of disappointment. I was prepared for something *new*, something *interesting* and *instructive*, but alas! was brought face to face with an *old* friend in a new but *stunted* garb. It is not my wish to be too severe or unduly captious; but cannot conceal from myself the fact that there is *nothing, absolutely nothing*, in the report deserving notice or study. As a report it is a sad failure, inasmuch as it is silent as to the various circumstances under which the three systems referred to by him are carried out, and the comparative advantages and cost of the said systems. For instance, the merits of the Long Wall over other methods and the practicability of its adoption under favorable circumstances are recognised in the fact of its suitability to all depths so long as the surface is maintained for the protection of buildings and prevention of inundation; its application to small areas undisturbed by dykes and other dislocations; its economical working when confined to thin, hard seams with soft top and bottom; and the comparatively larger acreage outturn. Now, there is not a single word in the report of Dr. Saise as to the depth at which the thick seam is worked, its nature, dip and other important points, which enter into the calculation or consideration of a Mining Engineer before the inauguration or adoption by him of one or the other system. Nor do I find a scrap of information as to the methods of haulage in vogue in the collieries working on this coal; their comparative cost; the total daily output of each colliery; the cost of getting; ventilating powers used; pumping and winding Engines and other economical and statistical particulars. As the result of his long inspectional observations and study the report is as *poor* as can be and only significant of the dim light it throws on so important a subject.

MINER.

Literary Notices.

ALUMINIUM ALLOYS. Abstracts from a report of Prof. Unwin on the results of the tests of a bar of aluminium bronze produced by the Cowles process. Gives breaking weight, 37 tons per square inch; elongation, 30 per cent.; elastic limit, 18 tons per square inch. *Engineer*, Jan. 7, 1887; also see *Engineer*, Jan. 21, 1887.

ALUMINIUM BRONZE *for Ordnance and Armor Plate.* Defects in present steel guns and probable advantages to be gained by substituting aluminium bronze. By R. C. Cole, in *Engineering and Mining Journal* for Jan. 22, 1887.

ARCHES. Simple method of tracing the joints in elliptic arches. *Eng. News*, Feb. 19, 1887.

——, *Iron.* By W. Airy. Examines the conditions for equilibrium of a voussoir arch and then investigates the strains of a continuous iron arch. *Van Nos. Eng. Mag.*, Vol. III., pp. 450 and 641.

AXLE FRACTURE *and the Remedy.* By W. B. Adams. Treats of wheels and axles, longitudinal shocks, haulage resistance, torsion, etc. *Van Nos. Eng. Mag.*, Vol. IV., p. 174.

BRIDGE *at Pato.* By M. T. Leyrig. Interesting account of this great bridge, 180 m. in span; with plates. *Mem. de la Soc. des Ing. Civils*, Jan., 1886, pp. 38-79.

——, *International, across the River Minho* (Spain and Portugal). Detailed description of foundations and superstructure, lattice continuous girder, 5 spans, 61·5 to 69 meters, progress of the work, tests of material, etc. *Revista de Obras Publicas*, 1886, Jan. to June.

——, *Barrel Pier.* Detailed drawing and description of. Used by the C., B. & Q. R. R. in renewing pile piers and wooden bridges. *R. R. Gaz.*, Feb. 11, 1887.

BRIDGES. *Analytical and Graphical Methods for Calculating Continuous Bridges.* By M. Bertrand de Fontviolant. Takes account of flexure of piers, expansion, etc. Contains little that is not given in the works of Winkler, Levy, Mohr and Cullmann. *Mem de la Soc. des Ing. Civils*, Sept., 1885, pp. 255-348.

——An illustrated description of the *Latimer Improved Re-railing* Bridge Safety-Guard. *Eng. News*, Feb. 12, 1887.

—— *and Culverts.* Detailed drawing of a number of bridges and culverts recently constructed on the Eastern and Midland R. R., England. *Engineering*, Jan. 14 and 21, 1887.

BOILERS, *Kemp's High and Low Temperature Marine.* Gives illustrated description of the boiler put in the steel ship "Bléville." *Engineering*, Jan. 21, 1887.

BOILER EXPLOSIONS. By Zerah Colburn. Very valuable. Treats of overheating, electricity, decomposed steam, overpressure, etc. *Van Nos. Eng. Mag.*, Vol. IX., p. 209.

——, Experimental. By Prof. R. H. Thurston. Gives details of the experiments made at Hoboken and Staten Island, on full-sized boilers. *Van Nos. Eng. Mag.*, Vol. VI., p. 473.

—— Report of Mr. Fletcher, Engineer to the Manchester Steam Users' Association. Treats of the overheating of furnace crowns and other boiler plates when covered with water. *Van Nos. Eng. Mag.*, Vol. I., p. 961.

BORING APPARATUS. By Theo. Allen. An illustrated description of a boring machine worked by hydraulic pressure. *Trans. Am. Soc. C. E.*, Vol. II., p. 33.

BLUE PRINT FRAME. Detailed drawings of the frame used in the Water Department, Philadelphia. *Eng. News*, Feb. 19, 1887.

CULVERTS. Description of iron culverts, with full drawings, used in Iowa on the Chicago, Burlington Quincy Railway. *R. R. Gaz.*, Feb. 25, 1887.

CERAMITE PAVEMENTS.—By M. A. Gouvy. Method of use, and comparison with other pavements. *Mem. de la Soc. Ing. Civils*, Oct., 1885, pp. 454-461.

CONDENSER, *Surface.* By W. B. Coggswell. Gives details of the use of a surface condenser in connection with a set of blast furnace boilers at the Franklin Iron Works, Oneida, N. Y. Illustrated. *Trans. Am. Soc. C. E.*, Vol. II., p. 41.

DREDGES *for Bristol, England, and the West Indies.* Descriptions of a steel, four-screw and single-ladder hopper dredge, 218 feet long, built for the Dock Committtee of the Bristol Corporation. Also of a twin screw dredge "Dolphin" for the West Indies. Illustrated with full page drawings. *Engineer*, Jan. 7, 1887.

DYNAMITE, *Use of, in Mines.* By M. G. Cerbeland. *Mem. de la Soc. des Ing. Civils*, Dec. 1885, pp. 792-806.

EARTHWORK, *Calculation of*, by the use of the slide rule. By M. Le Brun. Considerable discussion of the methods of calculating excavations and embankments, with use of graphical scales of various kinds and the slide rule. *Mem. de la Soc. des Ing. Civils*, Aug., 1886, pp. 152-216.

ELECTRIC RAILWAY. A short illustrated description of the proposed electric railway to be constructed in New York City on the Bentley-Knight system. *Engineer*, Jan. 28, 1887.

ENGINES. Illustrated description of the compound engines of the twin-screw dredge "Dolphin," recently constructed for harbor work in the West Indies. Gives section and elevation of one pair of the engines. *Engineer*, Jan. 14, 1887.

————, *Petroleum.* An illustrated description of the Spiel petroleum engine. Also contains results of tests made by Dr. Hopkinson. *Engineer*, Jan. 21, 1887.

————, *Non-condensing, Friction of.* Paper read at the New York meeting of the American Society of Mechanical Engineers, Nov. 30, 1886, by R. H. Thurston, Ithaca, N. Y. An account of some experiments tending to show that the friction in automatic cut-off non-condensing engines does not vary with change of load, and is correctly represented by the "friction card." *R. R. and Eng. Jour.*, Feb., 1887; The *Mechanical World*, Dec. 24, 1886.

————, *The Quernel.* A brief illustrated description of an engine which can be worked with economy. Experiments show that its consumption of steam can be reduced to about 14lbs. per horse-power. *Engineer*, Jan. 28, 1887.

FIRE BOATS. By William Cowles. A paper read before the Am. Soc. Mech. Engrs. Gives descriptions of the fire boats at New York, Chicago and Cleveland. Fully illustrated. *Engineering*, Jan. 14, 1887.

FLOW OF WATER *through pipes.* By James B. Francis. Memorandum and tables exhibiting the results of some of Darcy's experiments on the flow of water through pipes. Darcy's formula and results are reduced to English measures. *Trans. Am. Soc. C. E.*, Vol. II., p. 45.

FORCES. On the mutual forces acting between masses of matter, with application to mechanical, physical and chemical phenomena. By M. P. Berthot. Considers molecular forces as well as forces acting at finite distances, application to liquids and gases, capillarity, chemical phenomena, etc. *Mem. de la Soc. des Ing. Civils*, Nov., 1885, pp. 588-626.

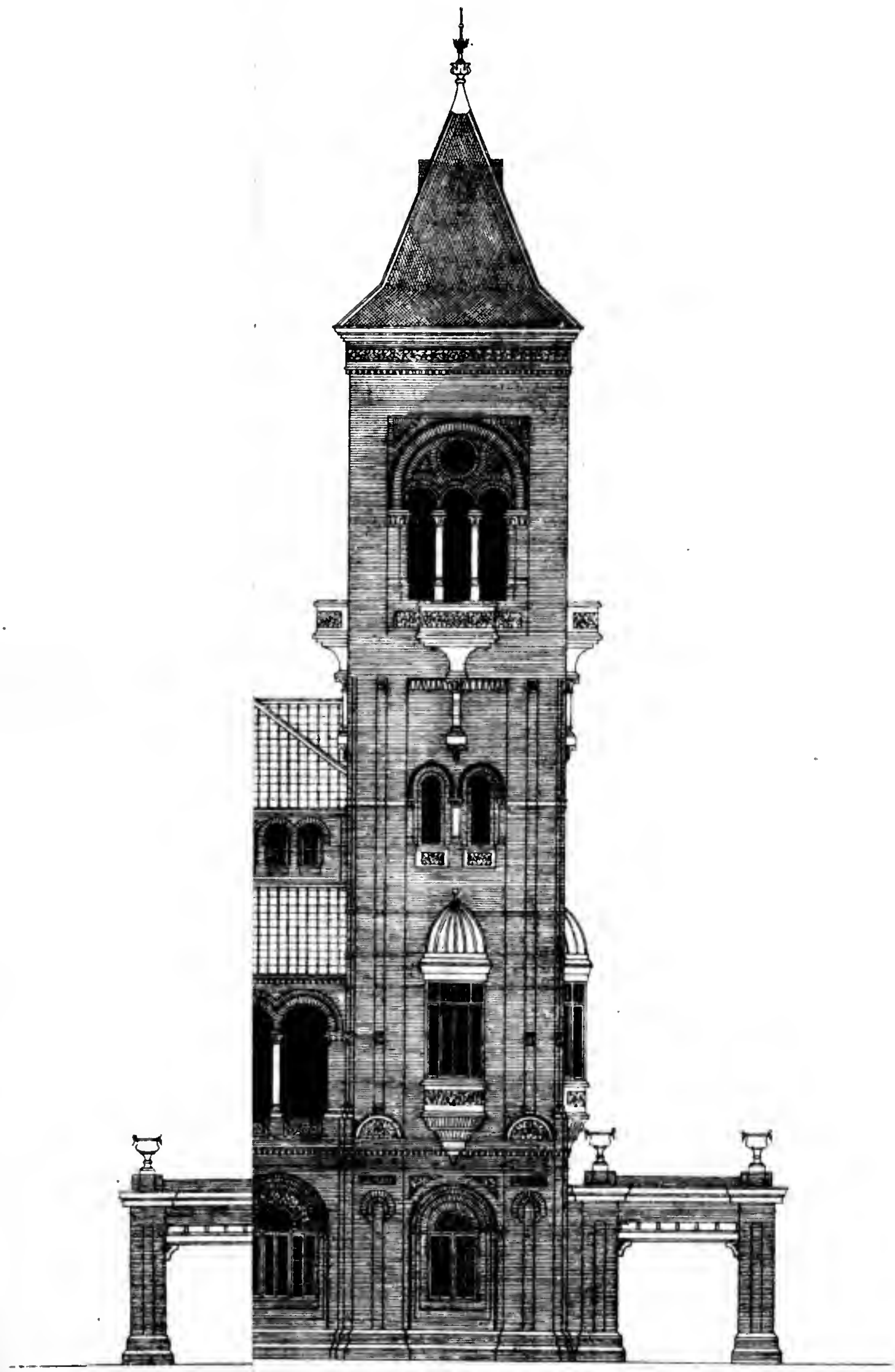
FRICTION IN NON-CONDENSING STEAM ENGINES. *See Engines, Steam.*

GAS, ILLUMINATING, *Price of.* Chart showing the net price of gas in 100 cities of the United States from 1878 to 1887, inclusive. *Progressive Age and Water Gas Journal*, March, 1887.

GAS, NATURAL, *Geologic Distribution in the United States.* Abstract of a paper read at the St. Louis meeting of the American Institute of Mining Engineers, October, 1886. By Charles A. Ashburner, Geologist, Pennsylvania Survey, Philadelphia. In the *Engineering and Mining Journal* of Jan. 15, 22, and 29, 1887.

FRENCH INDUSTRIAL PRIZES.—Among the prizes offered for 1887 by the French *Societe d'Encouragement* for discoveries and inventions of value to French industry, the following have been quoted in the Continental press: Prizes of 1,000*f.* (£40) each: 1. For the utilization of residue in factories. 2. For the discovery of a new alloy for industrial purposes. 3. For the industrial utilization of a cheap and abundant mineral substance. 4. For the useful application of metals which have hitherto been only used to a limited extent for industrial purposes. 5. For the construction of a heating appliance to produce, in small industrial workshops, elevated temperatures by a quick and economical method. Prizes of 2,000*f.* (£80) each: 1. For a small motor for workshops, acting for itself or in connection with a larger factory. 2. For suitable improvements in the mechanical spinning of flax. 3. For improvements in the usual form of grain mills. 4. For a motor for heavy oils. 5. For the economical production of ozone, and its application. Prizes of 3,000*f.* (£120) each; 1. For a mode of transmitting natural mechanical forces over long distances, when their immediate utilization is impossible. 2. For the manufacture of glasses for chemical purposes. 3. For the manufacture of fine stoneware. 4. For the construction of a simple and solid appliance which will indicate the progress of a train at any distance, in a reliable, automatic, and regular manner. 5. For the construction of an appliance which will indicate, at a distant point, the temperature of a heated room. It is stated that models, etc., must be sent to the Secretary of the Society, 44, Rue de Rennes, Paris, by 1st January. Competitors are reminded that the communication of processes to the Society does not afford them the protection of a patent, which should be applied for before the competition.

A., ARCHITECT.



The "STAR" Press. 19 Lall Bazar Street, Calcutta

General Articles.

MADRAS TOWN HALL.

THE Madras Town Hall, of which we give an illustration, is built to meet a want much felt in Madras. Although for its size Madras is richer in halls than many other cities, they are all so peculiarly endowed that none of them are available on public occasions when a hall of large dimensions is required.

The Hall itself measures 110 feet long by 40 feet broad. It is on the upper floor, and is reached by a staircase at the east end, where cloak and retiring rooms are placed. Above the staircase, a commodious gallery exists reached by a separate staircase in the Tower.

At the west end are retiring rooms for performers of both sexes, each set with its private stairs and entrance.

Broad verandahs on either side of the Hall form promenades. The ground floor contains a dining hall 73 feet long by 40 feet broad—with Board room, Secretary's room, kitchen and other offices.

The design was obtained by public competition. Three or four leading architects in India being offered an honorarium to compete.

The plans bearing the device "point within a circle" by Mr. Chisolm were selected.

The materials are red brick with grey gneiss dressings.

INDIAN LIGHTHOUSE ILLUMINATION.

THE PROPOSED RED SECTOR LIGHT FOR CADIAPATAM.

CAPTAIN J. H. TAYLOR, Port Officer, Madras, reporting on the subject of a red sector for the first-class light at Cadiapatam, says that having lately returned from the spot, and having had ample opportunities of considering the question from practical as well as theoretical points of view, he must recommend that no further action be taken in the matter. His reasons are, in the first place, that the white light is so very brilliant that no small red one, either above or below, could be depended upon, and any doubt on the mind of any navigator would terribly complicate the situation. Dr. Hopkinson, F.R.S., a specialist in such matters, who was consulted, admits that great difficulty would be felt in carrying out any plan, and his letter clearly shows that very large expense would be entailed. If therefore the scheme is doubtful in theory, it must be dangerous in practice, and under all circumstances, the red sector is considered by the Port Officer an unnecessary expedient.

The cost of the apparatus recommended by Dr. Hopkinson for the subsidiary light at Cadiapatam, *viz.*, a portion of a first order fixed light specially prepared and with a suitable pressure lamp and 4 wicks Trinity burner, and with three spare burners and accessories, a cast-iron column and table, ruby shades, glass chimneys, wicks, &c., would not exceed the sum of £350, delivered as usual.

Dr. Hopkinson's report on the subject is of scientific interest. He says:—

I have examined the chart and drawing and read the papers from the India Office, and have also made certain experiments and calculations to ascertain how far, and in what way, the addition to the Cadiapatam light proposed in the correspondence can be attached. Broadly speaking, the end in view is to warn vessels coming within a radius of 5½ miles of the Cadiapatam light. Three modes of attaining this end are proposed. The first is to display a red light of the 5th or 6th order at the base of the present tower or lower down the face of the point. On this plan it would be impossible to obtain any well-defined change at a distance of 5½ miles. Wherever the subsidiary light of the 5th or 6th order was placed, the distance at which it would cease to be visible would be wholly dependent on the state of the weather. If the transparency of the atmosphere were seriously impaired by rain or mist, the light might not become visible until the observer was very close in shore, and the reliance which he placed upon the lighthouse to give him warning of danger might induce him to neglect precautions which he might otherwise adopt.

The second plan proposed is to make the red light visible all over the sea horizon. I fail to see how this plan would attain the end in view.

The third plan proposed is to cut off the white light altogether in the vicinity of the dangers within a radius of six miles, and display a red light from the present arc. It is physically impossible to accomplish this.

The plan which has the greatest promise of giving a satisfactory result is a modification of the first of the plans proposed, and if the cost is not felt to be too great for what is essentially a new departure, I should recommend the Government of India to try it.

Exhibit a fixed light from the foot of the present tower to show red to a distance beyond the dangers and white beyond this distance. The mariner would then be assured that he was in danger if he sees the red light, he would be assured that he is safe, if he sees the white light; but he would not have the slightest excuse for relaxing any precaution if the light is invisible. He will have no justification for considering himself safe unless he either sees the light white or has independent information of his position.

The difficulty in producing the effect described is great, and has never yet been attempted in circumstances even approximately similar: but I have great hopes that if great care were taken in the erection, at the lighthouse, of an apparatus which would be prepared, a satisfactory result would be obtained. It would be necessary to place the subsidiary light at the foot of the tower fifty feet below the main light and one hundred and thirty feet above sea level. The apparatus would consist of the central belt and four rings of a 1st order fixed apparatus extending over 180°. It would be better that it should extend over more than 180°, but as the apparatus is special, a considerable increase in cost would be caused thereby. The lamp would be a 4-wick Trinity or Douglass, as most convenient, with a special addition. From the experiment tried on a temporary apparatus, I estimate that the following result might be expected. If the line of separation of red and white for an observer 15 feet above mean sea level were placed at a distance of 5½ statute miles from the lighthouse, such an observer would see, when at that distance, a light of doubtful color, but as he approached the lighthouse, the light would become to him unmistakeably red before he came within a distance of 4½ miles; on the other hand, as he receded from the tower, the light would become unmistakeably white before he reached a distance of 7½ miles. When the observer is at a distance of 5½ miles, the light would become unmistakeably white if he ascends the mast before he reaches a height above mean sea level of 40 feet. It is possible that if this plan were adopted, it would be found that the much greater brilliancy of the main light would drown the subsidiary light. If this were found to be the case, I would recommend that the main light should be distinguished by periodically recurring eclipses, for example, eclipse of 3 seconds duration every 15 seconds. Mechanism for producing this effect has been at work now for a long time in several lighthouses and has given complete satisfaction.

In the consideration of this question I have assumed that it is practically impossible to place the subsidiary light 50 feet above the main light; if, however, it is practicable to do this, either by the erection of a special tower or by taking advantage of the configuration of the ground in the immediate neighbourhood of the lighthouse, the effect upon the sea, which I have described, would be very greatly improved and rendered more certain and accurate.

THE JHILMILI WINDOW.

By A. Ewbank.

II.

Fig. 3.

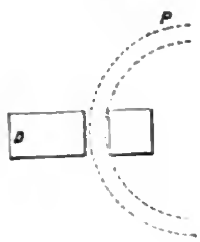
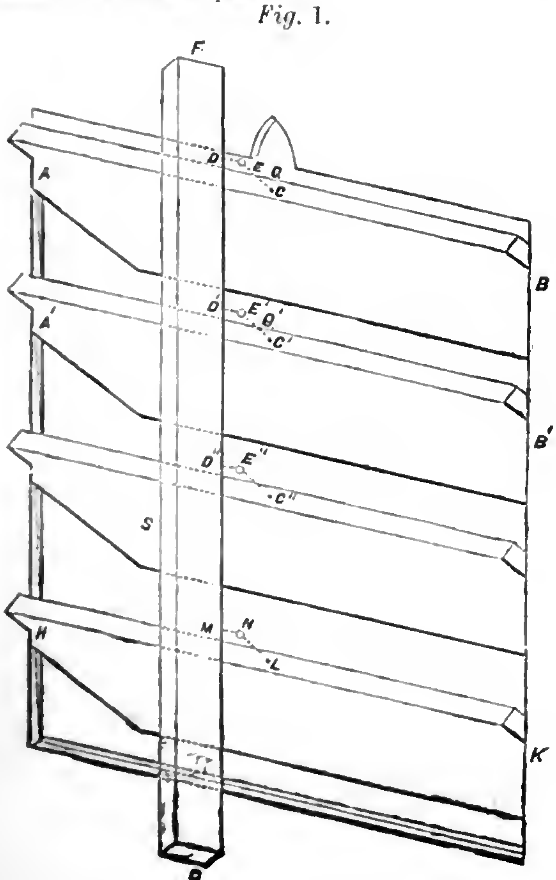


Fig. 4.

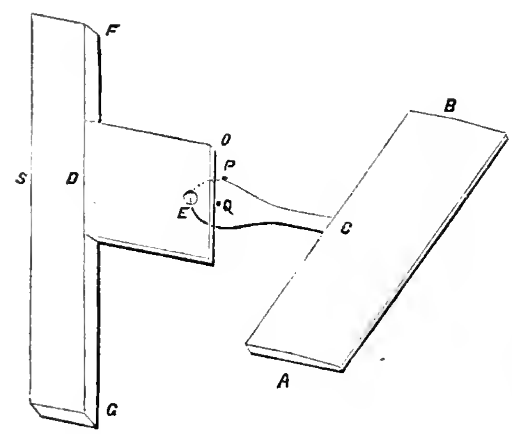
The last paragraph may need further explanation. If the present paragraph does not suffice to make matters clear the reader may pass on and in some of the following paragraphs he will probably find his doubts resolved. We suppose the venetians to be in some given position. They may be as nearly vertical as they can be; or they may be partly open; or they may be entirely open, in which case their planes are horizontal. The bar is supposed to have its plane in the meridian. If the bar were immoveable, or were held fast by the hand, any one leaf could, as we have stated, only take a rotation about the line through Q. Here the connection between the leaf and bar is remembered, but *not* the connection of the leaf with the bearings at A and B. If the bar moves in any way the leaf must take the same motion. But, having taken this same motion (which reduces the relative motions to zero) it may in addition take any relative motion about the line through Q. Now let us remember the bearings at A and B. This motion of the bar *with* the leaf, followed by a motion of the leaf without the bar, would be possible if the effect of this additional motion would so cancel, or would so partly cancel, the former *joint* motion of bar and leaf as to leave or bring back the line A B of the leaf within the bearings A, B of the framework. But this whole or partial cancelling is impossible for the motion of the bar (which we suppose not sideways but up or down so as to close or open the leaves) carries the line A B of the leaf away from the line of the bearings but these lines remain parallel.

Fig. 1.



Now the line through Q is not parallel to the line of the bearings. In fact the former line is at right angles to the latter no matter what may be the position of the leaf. Therefore a rotation about this line through Q acting on the line A B of the leaf will make this line *change* its direction. Thus such a rotation cannot have the effect of replacing the line A B of the leaf within its original bearings. Therefore the up or down motion of the bar, followed or not followed by a movement of the leaf, must tear the leaf from its bearings and, as we do not suppose breakage or distortion to take place, we must conclude that the bar cannot be raised or lowered. Thus the bar is practically immoveable and then as before the leaf is practically immoveable. If the line through Q were parallel to the line A B of the framework the argument would fail. The non-parallelism of these two lines is thus the real cause of the immobility of the venetians.

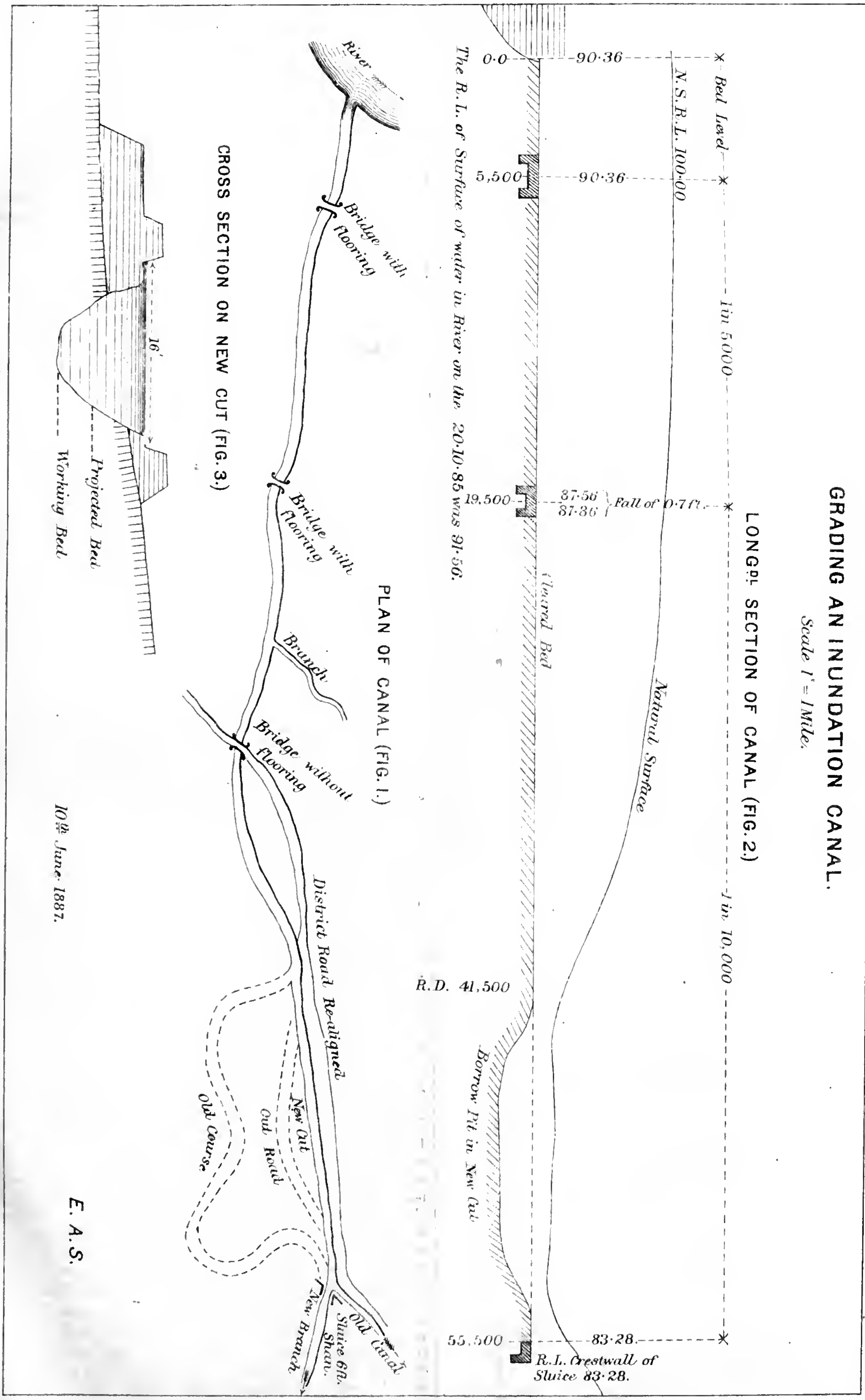
Fig. 2.



In this way we are brought back to our rule that the lamina D O E must be very thin. If it is thin we may treat the arc of the ring inside the tunnel as a short straight line. Then an *additional* motion becomes possible. This short tunnel is a straight cylinder with an axis through its middle. About this axis the whole figure E P C B can rotate when F S G is stationary. Thus the material of the ring inside the tunnel moves round without any part leaving the tunnel. This movement, however, requires the tunnel or ring to be circular in section. Thus a very thin lamina can be supposed pierced by a straight tunnel truly circular in section, and this tunnel can be supposed completely filled by a part of the material of a circular ring. In this case, even though the plane F S G remains in the meridian, the plane A B C can rotate as we shall shew. Unless we consider the lamina D O E to be very thin, we must make the hole so large that it is never completely filled by that part of the ring which is at the time in the tunnel.

This reasoning about the shape of the tunnel may be expressed in another way, which perhaps may be thought more satisfactory. Let the ring have given dimensions. Then for some assigned, say small thickness of the lamina D O E, the tunnel will have a volume $V_1 + V_2$ when V_1 is actually occupied by the ring material and V_2 is extra space to allow of a certain motion or play of the ring and leaf. If the thickness of D O E be now increased it is obvious that V_1 and V_2 will each increase. It is perhaps not so obvious that the ratio of V_2 to V_1 will increase, yet such is the fact. If the thickness of the lamina D O E be decreased not only will V_1 and V_2 decrease, but what is more important the fraction $\frac{V_2}{V_1}$ will decrease, and when the thickness of the lamina D O E is very small the fraction $\frac{V_2}{V_1}$ will be also very small. Thus we may be said to allow the existence always of extra space V_2 for play, but we consider this extra space to be negligible in comparison with V_1 when the lamina thickness is very small.

Supposing then V_2 negligible there are only two

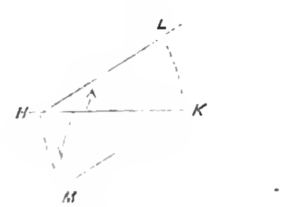


The "STAR" Press, 19 Lall Bazar Street, Calcutta

possible motions of C P E relative to F S G. If F S G do not change its plane and we wish to move the leaf, the movement of the ring about Q is resisted by the bearings at A and B. There only remains, therefore, the movement of the ring about the axis of the short tunnel. This axis is parallel to A B and on this parallelism, the possibility of the leaf actually moving depends.

The leaf can really only move by turning about A B. This lowers the point E, if we suppose the venetian to become more open. The bar F G must move parallel to itself and the plane F S G is not changed in direction by the rotation of the leaf. The plane B C P E, that is, the leaf plane, *is* changed in direction. Therefore, practically, the leaf and ring have rotated about the tunnel axis. That is, the motion of the ring and leaf has been equivalent to two motions: (1) The bar and leaf have had the same motion of translation, that is, there has been no relative motion between them. (2) The bar as a lamina remaining motionless in its new position, the ring and leaf have been rotated about the tunnel axis so as to bring the line A B back to the position from which the translation motion carried it away.

Fig. 5.



This point is illustrated by *fig.* 5. H K is a rod which can really only turn about K. It turns into the position K M. But this motion may be replaced by (1) a turning motion about H which takes the rod into the position H L; (2) a motion of pure translation by which L is carried back to K and H taken to M. The angle L H K must be equal to the real angle of rotation H K M. The real axis of rotation is a line through K perpendicular to the plane H K M. The auxiliary axis, so to call it, is a *parallel* line through H. Thus when the bar F G moves down or up, remaining parallel to its original position and the plane F G S is still the meridian, each leaf may be supposed first to move *with* the bar and then to rotate about the corresponding tunnel axis, so as to bring the lines AB, A'B'......back to their proper positions.

This replacement of the real angular motion about A B by an angular motion about the tunnel E axis and by a certain motion of translation may be considered more than a mere mathematical fiction. For let the leaf A C B have at A and B cylindrical projections of radii c,c and let these rest in hollow cylinders in the frame work A H K B (*fig.* 1). Let these hollow cylinders have radii $c+d$, $c+d$ where d is small. The extra breadth d is to allow the leaf to turn easily, *i.e.*, to avoid undue friction. Now, let the bar whose plane is the meridian sink a very little and carry the leaf A C B with it, this leaf not rotating. This will carry the cylindrical projections at A and B to the lower sides of the hollow cylinders until further motion is checked by the pressures produced. Then keep the bar at rest and let the leaf rotate through a very small angle till the cylindrical projections have taken a more central position in their respective hollow cylinders. Then move bar and leaf again as one rigid body for a little distance downwards. Keep the bar at rest in its new position and relieve the pressures at A and B by another small rotation round the E axis. By a great number, (or perhaps a moderate number say 50) of such steps we ultimately lower the bar to the required amount and the leaf has rotated through some finite (*i.e.*, not very small) angle. Here the actual rotations were round the E axis and the rotation round A B is—so to say—a mathematical fiction.

(*To be continued.*)

INUNDATION CANALS.

Some of the Defects and the Attempts to Remedy Them.

As a rule the Executive Divisions on these canals are very large and the Engineering staff is very small. If the area irrigated is taken as the standard of comparison, the canal, the improvements on which it is proposed to describe, represents one-tenth of the charge of a lower subordinate. This is not after all a great drawback, because sweeping improvements want money and on a working canal the existing minor system of distribution may be thrown so much out of gear by some over-sight as to cause widespread discontent. On the other hand, it is not always easy to ensure continuity of design when a little is done year by year.

The canal selected as an example is one of the worst of its class. It silted heavily; it was very tortuous in its course; and in the reach between the first two bridges the sub-soil is so yielding, that the heavy spoil banks forced the bed up and forced the sides in.

The length of the canal is about 22 miles, and there are besides the new branch four badly aligned and troublesome little branches. It irrigates 6,000 to 7,000 acres. The slope of the country is about 0·9 ft. per mile.

In grading this canal the difficulty was the flooring of the first two bridges. The canal is now dry to a dead level in the branch between the Head and the first bridge to increase the depth of water and the required draw is sought in giving the comparatively great slope of 1 in 5,000 between the first and second bridges. The bed is given a drop of 0·7 ft. over the flooring of latter and then continued on a slope of 1 in 10,000 (See fig. 2). To increase the velocity above that due to the gradients given above an escape back to the river has been given to the branch that takes out between second and third bridges, and this, when opportunity offers, is used as a scouring sluice. Then in the new cut the bed being of stiff clay a continuous burrow pit was made in bed to obtain spoil for the banks and district road. This burrow pit gives practically a semi-circular section (see fig. 3) and it is well known that the semi-circular section gives the maximum velocity. A comparison of the discharges in the trapezoidal and semi-circular sections will show the appreciable difference in velocities. The rising of the bed from a yielding sub-soil has been partially stopped by cutting down to some extent the spoil banks. There has not been hitherto sufficient labour available to make the side slopes which are about ½ to 1, say 2 to 1. The smaller kinks and bends have been greatly reduced in successive annual clearances. In the case of the new cut, this we find only made to a bottom width of 5 feet and the loop line was also cleared. Now that the new cut has been widened to the full width required the loop line has silted up completely. The new cut would probably not have been made to this day if one had waited to do the whole thing in one season.

Formerly when the canal was opened, the water did not reach the tail in from 10 to 14 days. When last opened, it reached in 18 hours. The heavy silting is now confined to the Head reach of 6 miles. The limit for flow irrigation for *kharif* has also shifted 4 to 5 miles *up*-stream. One would be inclined to think that the improvements would make it shift down-stream.

The rule is that if the labour available is not sufficient to make a thorough clearance, the widths of clearance are sacrificed, but the full depths of clearance are maintained—*i.e.*, if the proposed bed width of clearance was 15·0 feet, this would be reduced to any smaller width, say 12 or even 10 feet, but the full depth would be excavated. Such being the case, statistics of maintenance could not be given, because one has to make one's "coat according to one's cloth."

E. A. S.

Koreishi; *June* 18, 1887.

NOTES ON IRRIGATION IN THE MADRAS PRESIDENCY.

By A Pierres deClosets, C.E., F.R.S. of Arts and Sciences, Mauritius.

III.

Hydraulic-power could be also applied with much advantage, where rivers or streams may afford a sufficient volume of water: but the cost ot machinery, including pump, &c., for raising water, would require a certain amount of capital. This mode of raising water for irrigation will be found the cheapest, for a stream of 10 H.-P., for instance, the quantity of water raised daily at 20 feet would be 147,600 cubic feet, or per cubic foot 0·0027 pie, taking in account the working and depreciation on the machinery. It could be seen, that the windmill is, for irrigation, the cheapest machinery which could be used.

In localities where no streams or tanks exist, it would be necessary to erect the windmills upon existing wells, or upon wells constructed for the purpose.

As the volume of water raised by the mill is large, it is probable that the majority of existing wells would not be large enough to supply the machinery without lowering very much the water into the well, and thus causing the water oozing out, to deteriorate the bed of the well or of the sides; as it is obvious that water will tend to rise through the earth at the bottom of the well, with a velocity equal to the difference of level between this bed and the natural level of the still-water in the well.

The following are the velocities per second at which water begins to deteriorate different soils:—

	Foot.
Moist clay	0·41
Soft clay	0·50
Sand	1·00
Gravel	2·00
Pebbles	2·17
Broken stones	3·75
Conglomerates	5·00
Rocks in layers	6·10
Hard rock	10·00

It would be therefore important before excavating a well for supplying the windmill, to ascertain the velocity with which water will be oozing out for a certain depression of the water-level in the well, that is, for a certain hydrostatic pressure.

From experiment made in the month of April upon a well of 6 feet diameter, and excavated into the Cortilyar alluvium, about 25 miles from the sea, I have found out that the water under an hydrostatic pressure of 5 feet, was oozing out with a velocity of 0·016 foot per minute, or 0·0002 foot per second. This result, which is not in accordance with the velocity of water running freely, is to be attributed to the obstruction offered by the stratum of earth forming the bottom of the well; with the velocity observed, there would be no danger of disintegration of the sides or bottom of the well; it would be therefore very importont to ascertain, before excavating a well for an horizontal windmill, the velocity of the water gushing out of the bed with a given hydrostatic pressure, in order to determine the diameter to be given to the well proposed.

In the above paragraph, the supply from the well, that is, the volume extracted by a pecottah for 1 minute, was 10·56 cubic feet; the surface of the bed or bottom of the well being 201 square feet. Then if a well was to be excavated for a horizontal windmill raising 36 cubic feet of water per minute, the surface of the bottom of such well should be 684 square feet, and the diameter of the well about 29 feet.

The cost of establishing a horizontal windmill and excavating a well of 29 feet diameter for the supply of the water necessary, would be as follows:—

	Rs.
Excavation of the well, 10 yards diameter and 5 yards deep, at 4 annas per cubic yard (average) ...	98
2,700 c. ft. of staining wall, at 1·50 as. per c. ft. ...	253
Horizontal windmill in place, complete	500
Total Rs. ...	851

This estimate refers to localities where the soil is alluvial, as, for instance, in the Cortilyar, Palar, Vellar, Poncar and Cavery valleys. The cost will be enhanced in localities where decaying gneiss predominates.

Taking the cost at say Rs. 900 and the number of acres to be irrigated by horizontal mill at 30 acres only (the duty of 1 cubic foot of water per second being 60 acres), and admitting that a water-rate of Rs. 2 per acre should be charged by the Government, the interest on the capital invested in the construction of a well and horizontal mill will be at the rate of 6 per cent. per annum.

Some years ago a horizontal windmill was constructed for pumping the water necessary to supply some salt-pans established at Ennore by a Madras gentleman; water was raised at 6 feet, and the work of the mill was equal to that of 6 pecottahs, that is, 1,320 cubic feet of water per hour.

THE STEAM ENGINE AND ITS HISTORY.

II.

George Stephenson, the most eminent Engineer of our time, was born at Wylam in 1781. His father, Robert Stephenson, was a man of very considerable talent in his profession and the son early manifested abilities of the same kind. After having finished his education at Edinburgh, he began his career as a working Engineer under his father. In 1812 he was appointed to Killingworth Colliery and there he formed the acquaintance of Foster who used to invite him over to see Hedley's Engines working, and being naturally gifted with an inventive turn of mind, he discovered that he could accomplish what others had done before him, and, like his great predecessor Watt, he saw the defects and the best means of remedying them, and after several trials he succeeded, two years later, in constructing his Engine, the "Blucher," which was the first Locomotive built for a public railway. It went at the rate of 6 miles an hour. Stephenson's undoubted ability and perseverance led to his becoming connected with two enterprising capitalists, Messrs. Richardson and Pease, who appointed him in 1823, Engineer to the then proposed Stockton and Darlington Railway; and now commenced his great struggle to push forward the scheme, for the ignorance of the people and opposition of the times was so great that none but his undaunted spirit could have resisted it. Here is a gem extracted from the *Quarterly Review* of March 1825. It runs as follows: "What can be more palpably absurd and ridiculous than the prospect held out of locomotives travelling *twice as fast* as stage coaches? We should as soon expect the people of Woolwich to suffer themselves to be fired off upon one of Congrieve's ricochet rockets than trust themselves to the mercy of such a machine going at such a rate. We will back old Father Thames against the Railway for any sum." Mr. Broughton, who was asked to carry the Bill through Parliament, frankly told Stephenson (who spoke of being able to impel his locomotive at twenty miles an hour) "that if he did not moderate his views and bring his engine within a reasonable speed, he would inevitably damn the whole thing and be himself regarded as a maniac fit for Bedlam." In October of the same year the Stockton and Darlington Railway was opened out, which was the Parent Railway of the world. The *Times* thus describes the Railway on the opening day: It consisted of —1*st*, the Locomotive Engine with its Engineer and assistants; 2*nd*, the Tender with coal and water; 3*rd*, six wagons loaded with coals and flour, then an elegant covered coach with the Committee and proprietors, then 21 carriages fitted up for the occasion for passengers, and last of all six wagons loaded with coals, altogether 38 carriages, 90 tons in weight. The length of the road was 26 miles and it took the train after starting from Darlington three hours to reach Stockton. This was essentially a Mineral Railway. In 1829 Stephenson's "Rocket" gained the £500 prize offered by the Directors of the Liverpool and Manchester Railway, and the following year Stephenson had the pleasure of seeing this Railway opened out, which was the first Passenger Railway. It was during the inauguration ceremony of this grand scheme that a most deplorable accident took place, by which Mr. Huskisson, M.P., lost his life, having been run over by the "Rocket" whilst crossing the lines, and as the latter was moving into place. He was the first to head the long and ever-increasing list of casualities which unhappily for this adventure are, alas! of too frequent occurrence. Many other Railways were executed by Stephenson in England and abroad in rapid succession. The London and Birmingham, the Midland, Blackwall, Northern and Eastern, Norfolk, Chester and Holyhead—and among works abroad may be enumerated several executed by him, or in which he has acted as Consulting Engineer in Belgium, Italy, Norway, Egypt, France, Holland, Canada, New Zealand and here in India.

In 1884, Europe had 114,262 miles open for Railway traffic. America, excluding English colonies, 136,304, with about 20,000 Locomotives; Africa, 3,926; Asia, 746; British possessions, 28,177 miles; Germany, 22,617 miles; the United Kingdom, 18,681 miles, with about 15,000 Locomotives; India about 5,000 miles. In India it was thought the natives would be too poor or too timid to travel by rail; that pilgrims who flock in uncounted millions to their grand festivals, would, of course, always walk for the merit of it and that the different castes would not travel together; but, as we see, all these ideas have proved mistaken. With this we must conclude our brief account of the history of the Locomotive.

In 1826 Mr. J. Perkins invented a steam gun, which discharged 300 bullets a minute and which was exhibited before the Duke of Wellington. The balls an ounce in weight were propelled at the distance of about 110 feet through a ¼ inch plate, and a little later on he produced a piece of artillery which discharged balls weighing 5lbs. at the rate of 60 per minute.

J. N. C.

(To be continued.)

THE MAIN DRAINAGE OF THE HOUSES OF PARLIAMENT, WESTMINISTER.

By Isaac Shone, c.e.

(1). In 1839 Sir Charles Barry laid down, under the middle of the Houses of Parliament, from north to south, a large nearly flat-bottomed brick sewer, which discharged into a similarly constructed sewer in Abingdon Street, near the Victoria Tower.

(2). This sewer, owing to its bad form, excessive size, little fall, and absence of any means for flushing it, accumulated a large amount of sewage deposit, the gaseous emanations from which continually polluted the air of the Palace.

(3). In 1846 the smells from the Palace sewer were so bad that Sir Charles Barry consulted Mr. John Phillips, c.e., who was then the Chief Surveyor to the Westminster Commissioners of Sewers, with a view to its improvement. Mr. Phillips, after examining the sewer, recommended that a narrow, deeply curved invert, with a reversed fall, should be substituted for the old invert, and that it should be continued northward, across the Speaker's Green, into the outlet of a sewer in Bridge Street, which latter he found to be about five feet lower than the sewer in Abingdon Street.

(4). Sir Charles Barry not only adopted and carried out these recommendations, but the increased depth enabled him to construct two main branch drains from near the lower end of the new portion of the sewer. for draining the east and west sides of the Palace at a much lower level than they were originally.

(5). By the better gradient thus obtained, and by the narrow and deeply curved invert put in, the sewer as altered, supplemented with ample flushing power, became self-cleansing, and it continued in this improved condition for a quarter of a century, until twelve or thirteen years ago.

At that time, about 1873, the Metropolitan low level sewer—seven feet nine inches in diameter—was put down through Westminster, and the Palace sewer was connected with it; its bottom at the junction being about twenty-one inches above the bottom of the Metropolitan low level sewer.

(6). Ever since this work was done there has been daily, in dry weather, from three feet six inches to four feet in depth of sewage flowing on the bottom of the Metropolitan low level sewer, and this created a constant head of sewage against the Palace sewer outlet, converting it into a creek, for a length of about two hundred feet—containing from one foot nine inches to two feet three inches in depth of nearly stagnant sewage, which was always present upon the bottom of the Palace sewer.

(7). But besides this: in wet weather the Metropolitan sewer was not only always filled with sewage water, but sometimes this water has risen to ten feet above the crown of the Metropolitan sewer, or thirteen feet above ordnance datum. During wet weather, therefore, the Palace sewer, and its main branch drains, have been filled with sewage and rain water, which could not be discharged until the flood-water contained in the Metropolitan low level sewer had subsided, by being cleared out by the pumps at Abbey Mills, Bow, and by running it off through the sluices at Blackfriars and elsewhere into the Thames.

(8.) Hence, for twelve or thirteen years past. the Palace sewer, as well as its main branch drains, have been periodically converted into a series of sewage reservoirs; and from these the sewage water, as it accumulated and filled them, pressed out the foul gases contained within them, up the various contributing drains into the Palace. This discharge of sewage-gas into the Palace has been going on more particularly at night time, during the Sessions of Parliament, when the gas has been burning throughout the Palace, and when the waste hot water and steam from the warming and ventilating appliances of the Palace were discharged into the drains and sewers, and fermented the sewage lying therein.

(9.) The unpleasant effects, caused partly by the Metropolitan low level sewer, and partly by the sewer and drains under the Palace, as already described, became at last so intolerable that Parliament had no alternative but to refer the subject to a Committee of the House of Commons.

(10.) But until the first Session of Parliament in 1886, no remedy was found for the evils complained of, which then had become so pronounced as to cause the House of Commons to suspend its sitting on one occasion.

(To be continued.)

A credit has been sanctioned for the speedy extension of the Trans-Caspian Railway to Samarkand *viâ* Bokhara, and the powers given to General Innenkoff have been materially enlarged.

Manila.—It is reported that a British company intends shortly to make an offer to the local authorities to light Manila with gas. Tramways meet such an acknowledged want in the city, and the construction of additional lines was being actively proceeded with by last advices.

A Company, La Societe Belge de Chemins de Fer et des Tramways de Perse, is in course of formation at Brussels. It will commence operations by constructing a Railway in Persia, ten kilometres in length, from Teheran to Shah-Abdul Azin, the holy city.

NOTES FROM HOME.

(From our own Correspondent.)

THE Emperor of Germany to-day lays the first stone of the lock at Holtenau, about two miles from Kiel, thus inaugurating the construction of the new canal which is to unite the Baltic with the North Sea. This canal is to pierce Sleswig-Holstein, and will have a length of 61 miles, the distance round by sea being about six times as great. The average saving of ships using the proposed canal will be about 237 miles: and a vessel going from Hamburg to Cronstadt would shorten its voyage 424 nautical miles. It is estimated to cost £7,800,000: two-thirds of this sum is to be raised by the German Government, whilst the remaining third will be provided by the Kingdom of Prussia. It is calculated that the receipts will about pay 1½ per cent. upon the outlay.

Although commercially this canal cannot but be a great convenience, it is its military value that has decided the German Government to no longer delay its construction. At present the two naval stations—Wilhelmshaven and Kiel—are separated, the canal would afford communication between them and enforce an enemy to provide two blockading squadrons instead of one as at present.

It appears that the business of the London Hydraulic Power Company is making good progress. In 1884, 54 hydraulic machines were worked from their mains, whilst now there are no less than 458. These hydraulic engines are used for all sorts of purposes, such as coffee-grinding, ventilating, working elevators and crushers, driving dynamos and general machinery. The use is so far confined to small machinery requiring to work intermittently. The Company have at present about twenty miles of hydraulic mains laid in London. The reservoir of power consists of capacious accumulators loaded to a pressure of 700lbs. per square inch, producing the same effect as if large supply tanks were placed at 1,600 feet above the street level. The water is drawn from the Thames, care being taken to remove sediment from it before it reaches the supply mains. The mains are laid at the cost of the Company—the service pipes being charged to the consumer. The quantity of power used is measured in gallons through meters and is supplied on a sliding scale commencing with a minimun of 30s. per quarter for 3,000 gallons per quarter. Five gallons of the Company's supply is said to be of equal power to about 100 gallons of water taken from tanks 80 feet high.

The Tay Bridge is to be opened on the 20th of this month, great efforts are being made to push forward the work. There are 1,000 men employed on the works. Men are working overtime in order to get the bridge open for the summer tourist traffic. Commencing with the opening of the bridge several new trains are to be run from Edinburgh and Glasgow to Aberdeen by the North British Railway. Meeting at Larbert, the Edinburgh and Glasgow trains will cross the Forth by the Railway Bridge there and will proceed through Fife crossing the Tay by the new bridge. The journey is computed to be accomplished in about 4 hours and from London in 13 hours and 40 minutes.

The Nordenfeldt submarine boat has recently been tried at Southampton. In form the Nordenfeldt may be said to resemble an exaggerated Whitehead. Whereas the latter is propelled through the water by means of a supply of compressed air, the former when totally submerged is driven along by the force of a reservoir of stored-up steam after the fires have been extinguished and the scuttles hermetically sealed. The boat measures 125 feet in length and 12 feet beam amidships with a displacement of 250 tons. She is constructed entirely of steel. In her submerged condition, it is said the boat can remain for 5 hours with a continuous speed of 4 knots, and this speed can always be increased. The normal bunker capacity of the Nordenfeldt is equal to 8 tons, which will drive her 1,000 miles and from 8 to 9 knots. In the trial she was immersed until the base of the conning tower was just awash, she proceeded down Southampton Water. The neutral tint she was painted rendered her invisible at the distance of a few hundred yards. At future trials her sinking powers and performance under water will be tested.

The fastest passenger ship in the world now is the *Queen Victoria* She recently made a trip at a speed of 25½ miles per hour from Greenock to Liverpool in spite of gale and wind. She is intended to run between Liverpool and the Isle of Man.

The death of Sir Horace Jones has just been announced. Sir Horace was the City Architect; he died of heart disease in his 68th year.

The death is also recorded of Mr. William Jacomb, the Chief Engineer of the London and South-Western Railway. He was 54 years of age, was one of Brunel's pupils, commenced his career on the Great Western system; he had charge of the building of the unfortunate *Great Eastern* steamship. In August 1870, when he was thirty-six, he was appointed Chief Engineer of the London and South-Western Railway and during the time that has elapsed, especially during the last few years, many most important works have been carried out, notably the enlargement of Waterloo Station to its present proportions. The new bridge across the Thames at Fulham is also being carried out from his plans, and his various works prove him to have been a good architect as well as an engineer.

The amount paid to the Ordnance Surveyors for the past year was considerably more than £212,000. As the whole area surveyed was under 4,000 miles, the cost of surveying a square mile of country would seem to exceed £53. In 1885 a good deal more work was done for about the same amount of money.

Some interesting evidence transpired at an inquiry recently held at Bournemouth on the utilization of sea water for watering roads and flushing drains in several towns of England, in all of which sea water had been used with a consequent economy and general advantage.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

AN electrical winding rope has been recently introduced at Wingate Grange Collieries, Co. Durham. It consists of an ordinary iron wire rope, in which the core is replaced by an insulated copper wire. This insulated wire is used for electric signalling purposes, and enables the occupants of the cage to communicate with the engineman upon the surface whilst the cage is in motion in any part of the shaft.

Improvements are being suggested in the Kosmann cartridge which depends for its force upon the production of large volumes of hydrogen gas by the reaction of zinc and diluted sulphuric acid. In one form hydrochloric acid and finely powdered chalk or carbonate of lime are employed.

A very ingenious apparatus has been invented by Messrs. Archer and Robson for the purpose of laying dust in mines. It consists of a circular bristle brush placed upon a hollow spindle, projecting through a stuffing-box into a water-tub, arranged to run upon the mine tramways. This brush is driven by means of an endless chain and bevel wheels from one of the axles of the tub. The apparatus saturates the gallery with moisture in a single journey and the tub can be easily arranged so as to carry a quantity of water sufficient to moisten more than a mile of gallery, with a surface of upwards of 150,000 superficial feet. It appears to be a most efficient and economical form of apparatus, and thoroughly qualified to perform its intended purpose.

Seismic observations continue to confirm the fact that the surface of the earth is never absolutely at rest, and that earthquakes are simply extreme cases of continuously acting forces. More recently it has been suggested by scientists in different countries that these disturbances lead to, if they are not the primary cause of, out-bursts of gases in mines. Considerable attention continues to be accorded to the question by Mining Engineers, and the recent earthquakes, experienced in various centres of Europe and America, have caused them to adopt special and additional precautions to prevent the occurrence of colliery explosions. The bogus prophecies of Herr Falb of Vienna upon this question are greatly to be regretted, as they have tended to throw discredit upon the theory, and may prevent its attentive examination by more competent experts.

A very interesting exhibit at the Newcastle-upon-Tyne Royal Mining Exhibition consists of a system of mine haulage shewn by the Tredegow Iron Company and actuated by an electric-motor provided by the Walker Coal Company. The motor is a 5 horse-power "Immisch" machine, and runs at about 1,200 revolutions per minute, the driving pulley being connected with the motor by means of a screw and worm-wheel, working in an oil box. The motor is driven by a current of 100 volts, supplied by a Victoria dynamo. The mode of haulage shewn is a variety of the endless rope system, applied to a single line of rails, provided with one or more sidings arranged at proper intervals for the passage of the tubs which are arranged in group or "setts." The endless rope is placed in the middle of the way, one branch being diverted into each of the sidings. The setts of full and empty are attached to the rope at intervals which enables them to pass each other at the sidings. Points are used to divert the tubs into the proper sidings, together with loose rails which are moved for the passage of the rope, when the tubs are attached to it by means of the bogie or dumb carriage.

NOTES FROM MADRAS

(From our own Correspondent.)

MADRAS—always loyal—has been doing honor to itself by keeping up the Jubilee in a befitting manner. All have shewn their loyalty according to their means, from the humble fifty-rupee clerk, who has subscribed *one* towards the Imperial Institute, to recipients of bewildering incomes like Rajah G. N. Gajapati Row, who has presented the city with a bronze statue of Her Imperial Majesty. The unveiling of this statue was performed with much *éclat* on the evening of Jubilee Day, His Excellency Lord Connemara himself coming down from Ooty for the purpose. The donor was not present but was represented by our popular Sheriff, Sir Savlai Ramasawmy Modelliar, who formally made it over to the city, which was represented by Colonel Moore, the President of the Municipality. The work is by Boehm and represents Her Majesty as seated on a high-backed chair wearing a small crown with a sceptre in her right hand. It has been mounted on an unpretentious granite pedestal in the Tuscan style, about nine feet in height. The site is an admirable one—in the Chepauk grounds, just opposite to, and not far from, the south face of Mr. Chisolm's noble Senate House. The grand Government buildings in the vicinity give it an official air, and it is a favorite place of public resort. I am only afraid that the sea breeze will disagree with Her Majesty.

Our Municipality are inviting tenders for the concession of laying tramways in the town. An English Syndicate represented by a local firm applied for it some little time ago, and others have come forward since then. But the Municipality, anxious to make the best terms for the city, have now publicly advertised for tenders which will be received up to the 3rd October next, till which time nothing will be settled. Tramways have already been tried here. We had a Madras Tramway Company which came to grief about ten years ago, and I do not think that prospects have improved for such an undertaking since then, for the South Indian Railway now runs through the town from its western limit to the beach with stations within stone's throw almost of each other On the other hand, the town has grown richer and more populous since then, so that there is now a larger riding population.

Work, which had been partially suspended upon our Harbour Works during the last five or six weeks on account of probable cyclones, has now been resumed. Those pet monsters of Harbour Engineers—Titan cranes—are again in operation at the ends of the piers. Mr. F. N. Thorowgood, the Superintendent, goes home next week on private affairs. The works will not, however, suffer in consequence of this, as the Assistant Superintendent, Mr. A. Lee Pogson, will have charge of them. I believe a considerable saving is likely to be effected in the cost of restoring the ruined arms of the Harbour by this young Engineer's ingenuity. He has contrived a pontoon by which the blocks of the ruined portions can be recovered and utilised as wave-breakers. The old foreshore being thus cleared can also be built upon again, so that a double saving is effected. Also the new work can be laid straight as before, which would not have been possible had the ruined portions remained, as in carrying it round them ugly kinks would have resulted. The new blocks, I observe, are an improvement upon the old: these were perfectly plain and laid without bond; but the new have joggles and chases and are laid so as to break joint. I fancy father Neptune will not find it quite so easy to shake the new work as he did the old. *Nous verrons.*

21st June 1887.

SIMPLE TEST FOR GOLD.—Take a piece of flint and rub against it the metallic object to be tested, until the latter leaves a sufficiently marked trace upon the stone. Upon bringing the flame of a sulphur match in contact with the spot, the latter will remain intact if it has been made with gold, but will disappear if the contrary be the case.

REPORT ON THE AURIFEROUS TRACTS, MYSORE.

(Continued from Page 293, Vol. I.)

BELLIBETTA SERIES.

I PROCEEDED from Ternenahalli to examine Bellibetta and found in the Government Kaval, within half a mile of the West slope of Hill, the asbestos formation very well defined. We did not examine the mineral, as I was anxious to make an examination of Bellibetta itself, the weather being then favorable for so doing. On ascending the hill to the West, I found two old workings and made a test as to the mineral that had been extracted from them. I found gold in all the washings, but in small quantity, the same as that found in Karimuddenahalli and Sonnahalli. On ascending to the top of the hill, I again found old workings near the site of a ruined temple. I tested the *debris* from these old workings and found gold. I then proceeded to the North-East point of the hill and found several very large old workings with thousands of tons of quartz that had been removed by the ancients lying on the surface, with many hollowed-out places in the country rock where the auriferous quartz had been pulverized; but these did not appear to me to be sufficient for the reduction of the great quantity of quartz that had been removed, convincing me that some other metal had been worked for as well as gold. This caused me to make a more accurate investigation upon which I found that the hill was composed of alternate courses of carbonate of silver and auriferous quartz, the quartz lying between a well defined head and foot wall of chloride schist rock, while the silver ore was cased in highly micaceous schist running parallel with the auriferous quartz series, both minerals running North and South with their dip to the West. No doubt, the silver was the most paying mineral, as it required no pulverizing, but simply had to be taken to the furnaces, which I found at the foot of the hill, and there smelted. As far as I could judge, only the quartz which shewed visible gold had been treated for that metal by the ancients, as by a rough calculation I estimate that not less than a million tons of auriferous quartz raised by the ancients are now lying built up into protection walls round the old workings. This hill is most favorably situated for mining operations, being at least a thousand feet above the level of the surrounding valley, where drives could be commenced and carried through the hill from East to West, intersecting the alternate courses of gold and silver ore. The expense in opening up these mines would be, comparatively speaking, very small, as the ore extends down both sides of the hill to very near the level of the valleys on either side. In my opinion paying ore would be found in the first 50 feet drive on the East side.

For the reduction of the auriferous quartz the River Hemavati is within one mile, where reduction works could be set up. It is a very rapid stream, shewing a great fall, where any amount of motive power could be arranged. I have taken ores of both gold and silver from this hill and shall, when I have time, give the assay results.

After examining Bellibetta, I proceeded North-West to examine the asbestos formation I found to the West of the hill in the morning. On my way, I came across a large boulder or rock, or what appeared to be at a distance quartz, which, upon exmaination, I found to be pure white felspar, the finest I have seen in my travels. This would be invaluable in pottery and glass making; the portion of the boulder that stands out of the ground weighs some thousands of tons, and the formation continues downward to what depth I cannot say. This boulder lies one mile North-West of Bellibetta. About half a mile to the West of this boulder, I came upon the asbestos formation found in the morning, and on examination found asbestos in sufficient quantity to convince me that it was a true asbestos series. I made no examination further than picking up a few small pieces of the mineral, sufficient to convince me that it was a continuous series, as from here to where I met it to the South was some two miles and more.

I proceeded again to the North face of Bellibetta to endeavour and verify the opinion I had formed regarding the extraction of the silver ore from the hill, and on a close examination of the valley to the North of the hill and close to a tank, I found a line of old furnaces, 16 in number, where the silver ore was smelted. These furnaces appear to me to be those that had been used when Mr. Purniah, the Dewan of Mysore, tested whether these mines could be made a paying concern to the State or not, and as far as I can gather, the metal extracted barely covered the working expenses. This I am in no way surprised at, seeing that the whole side of a hill had been made an open quarry of, for the extraction of the ore, to obtain one ton of which there must have been at the least 500 tons of quartz and country rock broken and removed by hand to enable the miners to get to the silver ore that was carried to the furnaces to be reduced for the metal. No doubt, the attempt was a very laudable one on the part of the Prime Minister, and had he the experience of modern science in mining at his disposal, with his energy, he would have made this attempt a great success. I say with his energy, judging from the great irrigation works that he constructed in the Mysore Territory without the aid of a theodolite or levelling instrument, or a man who knew how to use them. From these furnaces, I proceeded North slightly East, where I came on another large line of old workings running North 7° East. The mining on these workings must have been carried on at a very remote age. They are continuous, varying in depth from ten to twenty-five feet, this being only the present depth. Some of them must have been carried down to 150 feet. This I determined by the breadth, as the ancients worked in an open pit they had to enlarge the opening in proportion to the depth. All these workings I tested and found gold in the *debris* taken from them. They are about 40 in number; the country rock is chloride schist with its strike to the North and dips to the West, flanked at quarter of a mile to the East by granite. This granite continues for miles until it meets Shravanabelagola, cutting through the auriferous series about half way between Bellibetta and the above-mentioned place, the granite taking its bearing 10° West of North, while the auriferous series continues its bearing 7° East of North or a difference of 17°.

Between this series of old workings and the Salubetta Range, which is a spur, its bearing being 250° or 110° West of North, comes in a large granite intrusion which cuts off the true auriferous zone from the spur or line of outlying hills. This spur is auriferous and some of it would prove very good mining property. The South-West portion of these outlying hills is well worth the attention of investing capitalists. The auriferous series is completely cut off by the granite at the Hemavati River to the North-West and close to Hemgiri Hill, on whch stands a Hindu temple.

Kempinkote Field.

I left here and passed over the zone of granite to Shravana belagola, where 4½ miles to the North-East, I again came in on the auriferous zone in the same bearing as the Karimuddenahalli, Sonnahalli and Bellibetta series of old workings. Close to the village of Kempinkote, I again found very large ancient workings. These workings were exclusively worked for gold, and the very first piece of quratz that I picked up I found to contain visible gold; the length of the largest old working is 600 feet, breadth 225 feet and present depth about 60 feet. This working must have been carried down to a great depth and worked some hundreds of years ago, as no *debris* is now to be found upon its edges as in other old workings, clearly showing that it must be of a very ancient date. I found several mullers or stones where the quartz was reduced, and the system must have been an excellent one in the remote ages when these workings were carried on. The stone was hollowed out in the shape of a deep basin, with a small hole in the bottom, where the pestle or muller fitted in so that no portion of unground quartz passed through the hole until it was reduced to a very fine consistency. Professional men were brought by the Pollegar of Channarayapatna, who reigned about 200 years ago, from the North for the extraction of the gold from the pulverized quartz and the silver from an adjacent mine, which will be described hereafter. The Pollegar is supposed to have had a mint of his own at Channarayapatna, and with the gold extracted from these and other mines to the North, which will be reported upon hereafter, he struck his own gold coin. About 300 yards to the South-East of the large old working lies another old working, but not so large as the one already described. Here there are small particles of quartz lying among the *debris*, and from appearances, I judge that this old working was not so rich in the precious metal as the large one to the North-West of it. No doubt this mine had been carried to considerable depth and had been worked much more recently than the former, and the reduction of the quartz could not have been carried on with the same care as that taken from the large old working. I found no mullers or reducing stones about this old mine, but about 1¼ mile to the north upon a granite band or rock, I found, where the reduction of the quartz from this mine was carried on, several holes cut in the rock where the quartz had been reduced by pounding with iron bars, but not by grinding. In the large old working and about it, after a most diligent search, I could not find more than 25lbs. of quartz, and this apparently was from the fallen in head and foot-walls. On examination, I found visible gold in some of this quartz, not specks of gold, but a regular vein filled with the precious metal. In fact there is not a mine working at present in Kolar that could shew more visible gold out of the same quantity of unpicked stone than in the stone I found in this old mine. It is the richest ancient working that I have met with during my investigation of Southern India.

Silver.—About a mile and a quarter North slightly East and lying close East to the granite band, where the reduction process for the auriferous workings just described were carried on, runs a band of highly micaceous schist carrying silver in sulphide (samples taken). These silver mines are very recent, and, as far as I can judge, it is not more than 60 years since they were worked, the reduction process of this ore being the same as that carried on for the reduction of quartz by the natives of Urigam. The ore was carried to the band of granite and there reduced by grinding in the same manner as the native grinds his curry-stuff. Professional men were brought from Channarayapatna for the treatment of the ore after it was reduced. An old native in the village describes the process thus:—The ore was reduced to a fine powder, placed in large caldrons (similar to the sugar boilers) with sulphur) blue sulphate of copper, nitre, and the white and yolk of egg, and boiled for 12 hours. When washed off afterwards, the metal was found in the bottom of the caldron. This treatment of the ore, although it appears to be a crude one, combines two of the principal ingredients used in the treatment of silver ore in Mexico. There common salt and blue sulphate of copper are used with mercury (quick-silver) to take up the silver after being reduced to a chloride. The boiling process is omitted in Mexico and tramping by mules resorted to. The effect of common sulphur and the egg I do not understand, and I am not aware whether it will collect or form an amalgam with chloride of silver, but I mean to give this process a fair trial, as it will be most useful while investigating the country, as egg, salt and sulphur are to be had in almost every village.

Nagamangala Taluk.

I examined Halti-betta. There is a large reef of barren quartz lying on the West flank. I then crossed to the West to Hulmandi-betta. There are several reefs of very fine quartz lying along the crest of this low ridge. I excavated and washed close to the foot wall of these reefs and found gold, but in very small quantity. Cloride schist runs here in very narrow bands, with gneiss rock in the valley beneath them, and as far as I can judge, form the underlying strata of that part of the country. The ancients have done no mining, but it is reported that Jalagars washed and found gold in the small ravines during the time of storm-floods, but from my tests, I come to the conclusion that they must have found a very small quantity of the precious metal. I continued the investigation of those hills as far as Girigudda, or within a mile and half West of Nagamangala, but on coming South, I found the gold decrease in quantity and it wore out as I came South near Nagamangala, where some mining operations are going on at present. The country rock in this locality is micaceous schist interstratified with granite, the granite predominating.

I examined Honnu-betta and made several tests, but found no gold, the rock being micaceous schist, granite and small hornblende trap dykes. Gold had been reported here, but after a most diligent search I failed to find even a color.

Nagamangala and Mandya Taluks.

The gold-bearing series running East of the road leading from French Rocks to Nagamangala was examined by Messrs. Rodgers, Hamilton, Bray and myself some six years ago, and although the country rock is most favorable for gold and the quartz-reefs most magnificently defined, the quantity of gold we found in the tests we made did not satisfy us sufficiently to declare it a good mining property.

SERINGAPATAM TALUK.

Asbestos being reported at Gaudigere, I proceeded to a ow range of hills to the North of the village lying to the East of the Melkote hill and found soap-stone, the formation not being that which carries asbestos at all. I then proceeded up the East face of the Melkote hill and found some very shallow old workings from which the ancients used to take some very clear rock crystals (samples taken.) Some of these have been taken recently and cut by the Shanbhog of Ketanahalli in the Seringapatam Taluk, and I believe sold in Mysore, but the profit was so small that he gave it up. I then proceeded on the North-West slope of the hill where I discovered some magnificent kaolin clay (large samples taken.) This clay, I have reason to believe, will be mined for, and should a pottery factory be started in the Province which I believe is contemplated, this clay will be brought into use and eventnally will bring a revenue to the Government; if not direct, indirect by an increase of railway traffic from the French Rocks Station. This clay is also to be found within the Fort of Melkote, but not so fine as that found on the North-East slope of the hill. Similar clay is also to be found near Tannur under the Motikere tank about 4 miles from the French Rocks Station. There is a very good road from the latter to both the places where the clay is to be found.

CHANNARAYAPATNA TALUK.

On arrival at Nuggihalli on the 13th July 1886, the Amildar of Channarayapatna Taluk gave me some fine specimens of corundum got at the village of Gollarahosahalli in the Baugur Hobli of the Taluk. The korundum is of the finest quality and to be had in large quantities lying close to surface. Next morning, I proceeded South about $1\frac{1}{2}$ mile along the road leading to Channarayapatna and at a hundred yards to the right of the road, came upon an old gold working about 40 feet long, 30 feet wide and 20 feet deep. From there I proceeded still South leaving the road crossing to the East under the Jembur tank, and found another old working on the side of a rising ground to the South-East of the tank, about 20 feet long, 60 feet broad and 15 feet deep. This latter old working is in the same bearing as that at Kempinkote and about 4 miles distant to the North of it. The country here has an iron ore cap which does not extend to more than a few feet deep overlying finely laminated chloride schist rock, the chloride schist where exposed to atmospheric influence being in a highly decomposed state, but considering the large quantity of iron on surface, the chloride schist carries very little of that mineral. Some very fine specimens of dendrite of manganese is to be found in the chloride schist slate here. This is very ornamental and rather rare in Europe, but of no intrinsic value. This ground tested in the afternoon as the weather was unfavorable in the morning owing to heavy rain. I found gold at the old workings as also in the water-courses adjacent to them. After examining the above workings, I proceeded North of the village about one mile and came upon an old working in the same bearing as the first one described. This old working is in a cross course of chloride schist, bearing 55°. The chloride schist here is a narrow band about 300 yards wide, flanked on the North and South by granite, the dip of the gold-bearing strata being North-East with its strike Eastward. This old working had not been carried down to a very great depth. Its length is about 75 feet, breadth 45 feet and present depth 15 feet. From here I proceeded about $\frac{1}{4}$ mile Eastward and came on another old working about 5 feet long, 30 feet broad and 15 feet deep. This old working is situated under a large outcrop of chloride schist rock, and as far as I could judge from surface examination, the working had been carried to considerable length under the outcrop of country rock, it having the appearance of a fallen in old drive. On proceeding Eastward, I found this cross course butting upon the granite hill of Joginadanagudda, the elevation of which is 3,141 feet above the level of the sea.

Next morning I proceeded North-West to Rayasamudram Amrit Mahal Kaval, where I discovered another old working about 3 miles from Nuggihalli. The old working is in the same bearing as the first one. The gold-bearing series here is thrown to the West by the granite range, of which Joginadanagudda is the highest point, the chloride schist here taking its course due North. I tested the ground about this old working and found a very fine sample of gold. The country here is most favorable for gold-mining and although many reefs of quartz are not to be found in outcrop, those that are visible are very fine strong reefs and the quartz looks most favorable for the yield of the precious metal. They can be traced for miles to the North and South, and the old workings are upon them.

(To be continued.)

BURMA.

(From our own Correspondent.)

THE depression of the iron trade at home during the past year has caused quite a revolution here, and in consequence of the low prices a large number of merchants and petty tradesmen have been induced to import steam machinery. We have at the present time a number of Rice and Saw steam mills being erected ; indeed, the low prices have been so marked, that even bakers and printers have been enabled to use steam as a motive power. The great improvements in the larger mills have also been noticed this year, as almost all the European mills are filled with the electric light, in lieu of mill parafine lamps hitherto in use. Government also appear to take advantage of the low prices now ranging, as all the old 5 H.-P. portable engines are being dispensed with in the different bakeries, &c., and 10 H.-P. Cornish boilers substituted. The progress now made, and the low prices prevailing for steam productions, has been most marked within the short space of the past three years. The milling hire for rice, and timber has fallen to one-third. Ice sold at 2 annas per pound three years ago is now retailed at two pice per lb. At this rate of progression, with the increase of steam machinery, a few years hence will wonderfully improve our staple products.

OKPO COAL FIELDS.—The question of opening the coal fields at Okpo is again before the local Government. This locality is said to contain rich deposits, and an attempt was made to work it in the year 1884, but was abandoned after a while through the country being pronounced unhealthy and communications difficult. These obstacles have, however, been partially removed, as the surrounding country has been rid of the dense jungle and considerably reclaimed. But we fear this the second attempt, if undertaken by Government, will also end in a miserable failure as the general run of Government undertakings—where favored rather than eligible men are selected to conduct technical operations.

MARINE SURVEYS AND TIDAL OBSERVATIONS.—The Marine Survey of India have made a survey on a scale of 2 inches to the mile, of a part of the Mergui Archipelago, opposite the port of Mergui, which is the most intricate portion of the beaten track. The southern portion of the work is still to be surveyed and work will be resumed during the current year. The work at Elephant Point has also begun. Periodical surveys of different parts of the Rangoon harbor have been made by the Port Officer, but no change has been detected in the channel. The tidal observations at Rangoon, Amherst and Moulmein appear to have worked well, with the occasional exceptions of the instruments getting out of order.

STEAM BOAT ACCIDENTS.—We are surprised to note that at the time of our writing an accident should happen on the S.S. *Tenasserim* through the defects of her machinery. She is one of a line of steamers belonging to Patrick Henderson, so extensively patronised by the public—trading direct between Rangoon and Liverpool. The result of the accident is that two firemen were instantly killed and the 2nd Engineer and another dangerously wounded. This serious matter is much to be regretted when we hear that although the cause was known before the accident that safer precautions were not taken. It is said that the cast-iron steam throttle chest, where the main steam pipes lead to the boiler, was cracked on one side before the disaster ; this in itself should have been a warning to the Engineers on board, that the pressure of steam was too great within, and that proper means were necessary to see that the outlet valves blew off all extra steam, more than the pressure brought to bear within the receptacle—or a new chest substituted. This slight, though serious, error of judgment might have led to graver results, endangering the whole crew, but through the timely interference of the Chief Engineer, matters were rectified, and the chest was found to have burst on the opposite side of the old crack. The vessel will in consequence be delayed a week or so. Meanwhile the port authorities are investigating the matter.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Central Provinces, June 25, 1887.

Establishment.

Rao Sahib Dhondo Sakaram Sathye, Assistant Engineer, 1st grade, is posted to the charge of the Hoshangabad Division, as a temporary measure.

Madras, June 21, 1887.

The following posting is ordered :—

M.R.Ry. V. R. Rangaswami Aiyar, B.C.E., Overseer, 3rd grade, sub *pro tem.*, to the IV. Circle, Coimbatore Division, for duty in No. IV Survey Party, Tank Maintenance Scheme.

The transfer of M. Arumanayakam Pillai, Supervisor, 2nd grade, sub. *pro tem.*, to the IV Circle, notified in Part II. page 652, of the *Fort St. George Gazette* of the 3rd May 1887, is cancelled.

Burma, June 18, 1887.

With reference to *Gazette of India*, Public Works Department, Notification No. 186, dated the 2nd June 1887, Mr. A. R. Lilley, Executive Engineer, 3rd grade, reported his arrival at Rangoon on the forenoon of the 30th May 1887, and his services placed at the disposal of the Manager, Burma State Railway.

With reference to *Gazette of India*, Public Works Department, Notification No. 186, dated the 2nd June 1887, Mr. E. T. Faulkner, Assistant Engineer, 1st grade, reported his arrival at Rangoon on the forenoon of the 30th May 1887, and his services placed at the disposal of the Manager, Burma State Railway.

With reference to *Burma Gazette* Notification No. 68, dated the 19th May 1887, Mr. H. G. Billings, Assistant Engineer, 2nd grade, joined the Pegu Division on the forenoon of the 8th June 1887.

N.-W. Provinces and Oudh, June 25, 1887.

Irrigation Branch.

Mr. G. E. Coles, Executive Engineer, 3rd grade, has been granted by Her Majesty's Secretary of State for India six months' extraordinary leave on medical certificate without pay, in extension of the leave notified in Public Works Department Notification No. 62E.I., dated 12th January 1887.

Assam, June 18, 1887.

The following Notification by the Government of India in the Public Works Department is republished for information:—

The undermentioned officers, employed on the Bengal-Assam Railway, are transferred from the Establishment under the Chief Commissioner of Assam to that under the Chief Commissioner of Burma for employment on Provincial Railways :—

Mr. A. R. Lilley, Executive Engineer, 3rd grade.
,, E. J. Alexander, Assistant Engineer, 1st grade.
,, E. T. Faulkner, Assistant Engineer, 1st grade.

The following Notification by the Government of India in the Public Works Department is republished for information:—

The Governor-General in Council is pleased to order the following temporary promotions and reversions to and in the classes of Chief and Superintending Engineers, with effect from the dates specified :—

Mr. F. J. Johnstone, Superintending Engineer, 1st class, temporary rank, to Chief Engineer, 3rd class, with effect from 7th April 1887.

Rai Durga Das Das, Bahadur, District Engineer, Lakhimpur District, is granted privilege leave for three months, under section 138, Chapter X. of the Civil Leave Code (Sixth Authorised Edition) from the 19th July 1887, or such date as he may be permitted to avail himself of the same.

Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, is, in the interests of the public service, transfered temporarily from the Khasi and Jaintia Hills Division to the Lakhimpur District, and appointed to officiate as District Engineer of Lakhimpur, *vice* Rai Durga Das Das, Bahadur, proceeding on privilege leave.

India, June 25, 1887.

Director-General of Railways—Establishments.

Mr. G. T. St. A. Nixon, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India extraordinary leave without pay for one month in continuation of the leave previously granted to him.

Mr. G. T. St. A. Nixon, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Sind-Pishin State Railway, Northern Section.

Baboo Bhoobun Mohun Bose, Executive Engineer, 3rd grade, sub *pro tem.*, is granted leave on medical certificate for six weeks in extension of that granted to him in Director-General of Railways' Notification No. 50, dated 18th May 1887.

Bengal, June 29, 1887.

General.

"Language leave" for one month and 19 days is granted to Mr. B. K. Finnimore, Assistant Engineer, with effect from the 23rd of May 1887, under Public Works Code, chapter II., paragraph 24.

Mr. J. F. Williamson, Executive Engineer, is appointed to be Inspector of Local Works, in the Chittagong Division, *vice* Mr. J. T. Simpson, whose services have been placed at the disposal of the Government of India.

Irrigation.

Mr. A. S. Thomson, Executive Engineer, Acquapada-Jajepore Division, is granted furlough for 12 months, with effect from the 18th instant, or such subsequent date as he may avail himself of the same.

Mr. C. J. K. Watson, Executive Engineer, 3rd grade, Acquapada-Jajepore Division, has been granted by Her Majesty's Secretary of State for India furlough for six months, in extension of that sanctioned in Notification No. 207, dated the 22nd of May 1886.

Sumbhoo Chunder Auddy,
No. 58, WELLINGTON STREET,
Calcutta.

NEW AND SECOND-HAND
ENGINEERING AND SCIENTIFIC BOOKS
In stock or procured at LOWEST TERMS.
Agent for the Sale of

INDIAN ENGINEERING.

NEW BOOKS.

By Rai Bahadur Kunhya Lal, M.I.C.E., late Executive Engineer, P.W.D., Punjab, Fellow of the Punjab University.

SPECIFICATIONS OF WORKS, with a few Useful Rules, Formulæ, and Tables, Illustrated with Examples. Re. 1-0-0.

USEFUL RULES AND TABLES relating to Measurement of Timber, Illustrated with Practical Examples. Second edition, revised and improved. Rs. 2-8-0.

_ These Tables give at sight the cubic and superficial contents of Timbers. They are designed for the use of Engineers, Overseers, Contractors, and others.

THE NEW IMPERIAL PRESS, Lahore.

TRAUTWINE'S
ENGINEERING WORKS.

CIVIL ENGINEER'S POCKET-BOOK (25th thousand, 1886, revised and enlarged; 866 pages, morocco flaps ... ... $5·00

Prices and descriptions of manufactured articles, etc., revised to date.

RAILROAD CURVES. Twelfth revised edition. 1886. Limpcalf .. 2·50

EARTHWORK, MEASUREMENT AND COST. New revised edition, shortly ... . 2·00

John Wiley and Sons,
15, ASTOR PLACE, NEW YORK.

THE DESIGNING OF ORDINARY
IRON HIGHWAY BRIDGES.
Illustrated by Numerous Engravings and 7 Folding Plates. Showing Bridges Actually Constructed and giving their Dimensions; also containing 42 Tables. By J. A. L. WADDELL, C.E., B.A.Sc., MA.E., Late Professor of Civil Engineering in the University of Tokio, Japan; Member of the American Society of Civil Engineers, Price, £1·00.

JOHN WILEY AND SONS, 15, Astor Place New York

THE ENGINEERING & MINING JOURNAL
SUBSCRIPTION PRICE, including postage for India and all countries in the Postal Union, $5=20s.=Rs. 14 per annum. All payments must be made in advance.

The Scientific Publishing Co.,
27, PARK PLACE, NEW YORK,
Agents for *Indian Engineering.*

PATENT POCKET SLIDE RULES,
For Engineering Calculations,
For giving at sight results which would otherwise be only obtained by working tedious mathematical formulæ.

Designed and patented by LALA GANGA RAM, A. M. I. C. E, M. I. M. E., Ex. Eng., P. W. D., Punjab

Mark Reduction in prices!!

No. 1.—For Scantlings of Timber in Beams and Joists, and for Strains on Trusses, Applicable to all forms and Spans. Price Rs. 10

No. 2.—For Thickness of Retaining Walls (level topped and surcharged), all shapes and heights, under all possible conditions. Price Rs. 6

No. 3.—For Strains on Girders (plate, braced, lattice, warren, &c., all form and spans); Bending and Shearing Strains found direct WITHOUT CALCULATIONS Bars requiring counter-bracing determined at sight. Price Rs. .. 2

FULL SET FOR Rs. 24

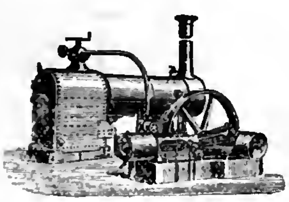
Illustrated Pamphlet of Instructions, shewing several examples worked out, accompany each instrument. Pamphlet separate, 8 annas.

JOHN FLEMING & COMPANY, BOMBAY

BALMER, LAWRIE & CO.,

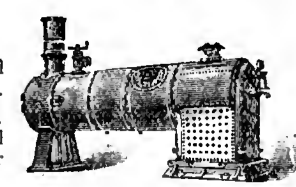
ENGINEERING DEPARTMENT, 103, Clive Street. | MACHINERY DEPOT, Canning Street.

CALCUTTA.



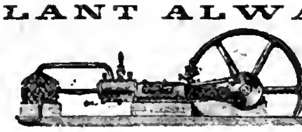
SOLE AGENTS for MESSRS. MARSHALL SONS & Co.'s celebrated **Portable, Semi-Portable, Horizontal and Vertical Engines.**

BALMER, LAWRIE & Co. having made special arrangements with MESSRS. MARSHALL SONS & Co., are in a position to furnish quotations such as will compare favorably with those given by any firm who manufacture similar machinery.



WORKSHOP PLANT ALWAYS IN STOCK.

IRON BUILDINGS
Supplied from our own designs.



Skilled Mechanics sent up-country for the erection of all kinds of Machinery.

Illustrated quarterly circular sent free on application.

GREAT EASTERN HOTEL COMPANY, LD., CALCUTTA.

CAMP REQUISITES.

Portable Wood Camp Stretcher Bedsteads
As used in the Afghan and Burmah Campaigns.

They are portable, light and strong; the length is 6′ 6″; and can be packed into convenient size, as per illustration "folded."

Weight 18lbs. ... ... cash Rs. 23 0
With Mosquito Curtain Rods ,, 27 0

The Iron Camp Bedstead.
Similar to above.
Very strong; packs into a bag which can be carried in the hand.
Weight 30lbs. Price, cash Rs. 20-8.

The Portable Folding Wire Spring Bedstead.

Useful at Hotels, Boarding Houses, Bungalows, &c.; also makes a good Camp Bed.
Price, cash Rs. 25 0

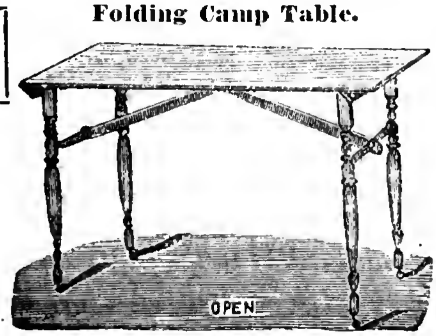
Camp Cork Beds.
A light and useful description of Bed, strongly recommended to the notice of sportsmen; exceedingly portable; neat in appearance; and a complete preventive of fever and ague. With waterproof cover, having space for a pillow, secured with leather straps.
No. 5, size 6 feet long by 30 inches wide, cash Rs. 19 0

THE
CAMP COMPANION
As supplied by us to Officers in the late Burmah Expedition.

Made of block tin, consisting of 3 saucepans, 2 fryingpans, kettle and tripod stand, with a moveable handle and canvas cover and strap, all packing in the largest size saucepan. Height 6-in., diameter 8-in., total weight 8lbs. Price, cash Rs. 11-4.

N.B.—The Kettle is made so as to contain an enamelled iron tea cup, and the small saucepan, a saucer for same.

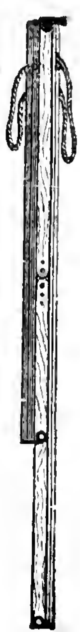
Folding Camp Table.



Size 43 in. long, 24 in. wide, 30 in. high.
Weight 18lbs.
Cash Rs. 10-0.

Folding Camp Basin.
Price, cash Rs. 8-0.

Closed.
Folding Camp Stool.
Price, cash Rs. 5-0.



Closed.
Folding Camp Easy Chair.
High or low back. Rs. 9-0 cash.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai*, and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.

An allowance is made for continuous insertions.

OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, JULY 9, 1887.

THE UNEMPLOYED CIVIL ENGINEERS IN INDIA.

FOR some time past a circular, addressed, by one of their number, to the unemployed Civil Engineers in India, has been lying on our table, but owing to press of matter we have been quite unable to take up the subject. It is certain that the appeal about to be made to Government by these gentlemen will meet with ready sympathy from their brethren both inside and outside the Public Works Department, but it is open to question whether all the arguments set forth in the circular under reference will hold water. But we hope that whatever we have to say on the subject will be taken in the spirit in which it is written, for in criticising the circular we have endeavoured to do so in a friendly spirit, and in such a manner as to suggest to the author of the same certain modifications which we consider to be desirable.

Referring to the fact that, owing to the large number of works now in progress in India, the number of unemployed is happily few, the writer says :—

"We have, however, to look forward to the time when this exceptionally large number of works will have been completed, and when all the Company Railways in India have been taken over by Government, to bring the matter home. Government will not then concern itself on the behalf of any one, however, hard he may have worked for them in temporary employment, and should the budget necessitate a reduction all will be dismissed."

And further on :—

"To any outside appointments D. P. W. men have no right whatever, and as they hold nearly all the higher paid posts, no outsider has a chance of distinction in his own field. There is a conspiracy among Government men, as there would be among any number of men similarly situated, against outsiders. It may be argued that Companies and States have asked for Government Engineers and no doubt many of them have done so, preferring in fact that it should be so, that no after reflection may be cast on the work done. The anomaly is that to carry out similar work with Government, outsiders are employed who it is presumed are capable men from the very fact of their employment."

Now we have no hesitation in saying that at the present moment Government is in a most difficult position. It is well known that some steps will have to be taken shortly to reduce the number of Officers in the Public Works Department, and that the reason of this is that more than a hundred Engineers are simply doing nothing, on account of the transfer of several Railways to private Companies. Surely this is not illiberal treatment to outside Civil Engineers. Many officers serving under Government will have to be got rid of somehow, either by compulsory furloughs or retirement. No one can insist, or even assert, that Government is putting pressure on new Companies to employ Public Works Department men, when it is known that the Companies are now recruiting men in England, whilst over one hundred Engineers on the P. W. D. staff are wanting work out here in India. To an unprejudiced mind, it would seem to be bad policy that Government, in return for the guarantee it gives, does not make it a condition that its surplus servants should be employed by the new companies, instead of which the men are allowed to draw their pay for doing nothing.

There is another paragraph in the Circular which we cannot help considering to be unfortunate. It is as follows :—

"Elsewhere private enterprise has succeeded in doing whatever has been wanted and it only requires a little encouragement to do so in India also. There is no want of capable Engineers, graduates of English and Indian colleges, and articled men, who have both the ability and experience to carry out all outside works without the assistance of Government men. The Engineering colleges in the United Kingdom, where technical education of a very high order is imparted, have very properly taken exception to their being left out in the cold, while the loaves and fishes of the Indian service are kept a closed preserve for Cooper's Hill and Woolwich, and that these two sources should have reserved to themselves nearly the whole of the appointments in India is an anomaly and an injustice to the colleges in the country."

If there were no dearth of men in India to carry on all outside works, why is it necessary for private Railway Companies and other concerns such as Cotton Mills, Jute Mills, Workshops, &c., &c., to keep on recruiting Engineers from England? And yet it is well known that new men are continually being imported into this country.

We consider the passage regarding Cooper's Hill to be especially invidious. The writer of the circular should remember, that a young man entering that College has to expend about £1,000 in College fees and other incidental expenses, pass through a curriculum of four (and sometimes five) years hard study, and then take his chance, in fair competition, of gaining one out of say fifteen Indian appointments. Surely, after all this, he has some right to consideration. It is not as if the Public Works Department were a closed service, the competition is publicly held, and is open to all who care to enter the College, which again has for its main object the training of young men for the Indian services. On the same principle, solicitors and barristers in want of practise might claim the right to enter the Covenanted Civil Service, for which service again special training and public competition are in vogue.

In what we have said we have no desire to depreciate the great services rendered by out-side Civil Engineers to India. We only wish to draw attention to the difficult position in which Government is now placed, and to point out that so long as it has more men than it wants, it must allow them to take service under the new Railway Companies, provided that the Companies prefer to engage them. After all said and done, the employers have the right to choose as they like, and no complaint can be made, so long as Government refrains from using pressure to compel them to provide for unemployed officers of the Public Works Department.

OUR DEFENCES IN EASTERN WATERS.

In our issue of 25th ultimo we had occasion to refer to the defenceless state of the Indian Empire, and pointedly referred to Bombay and Madras with thousands of miles of coast stretching between them, which are virtually left unprotected, and completely at the mercy of a foreign invader, who might at any moment choose to harass the Peninsula and commit immense mischief—to say nothing of the danger of having our trade crippled at the very commencement of hostilities.

We are glad to observe that Lord Brassey, now on a cruise in the Eastern Seas in the historical *Sunbeam*, has taken careful notes of our defences in those parts and written to the *Times* a very sensible letter on the subject. It is bristling with practical suggestions. His experience ought to be a guide in such matters, and the plain, unvarnished way in which it is stated, certainly recommends it to the careful consideration of the Admiralty. There can be no excuse for adhering to the *laissez faire* any longer, and it is time that those whom it behoves to look into these things, should set their house in order and look to the bolts and bars, before our enemy steals a march upon us.

The writer has had opportunities of personally inspecting the progress made for the security of Bombay, Trincomalee and Singapore; while in the former place the works are well advanced and an armament could be improvised for the occasion, until the arrival of guns of the latest types, in the two latter the position is more critical, as there are no guns at all. In our article, reference had been made to two monitors lying in the Bombay harbor. But Lord Brassey thinks, and very properly too, that a third one might be added for greater security. He suggests that the two steamers, the *Orion* and the *Bellisle*, now lying in the hands of the Admiralty, and which are unsatisfactory as sea-going vessels, might be utilised for defensive purposes, the one at Bombay and the other at Singapore. The next point to be considered is the manning of the protective works, this might be done by supplementing the inadequate garrisons at the former place and Trincomalee by Volunteers; as regards the latter, by training the Sikh Police to handle the guns.

Lord Brassey takes advantage of this opportunity to invite the attention of capitalists and engineers to the Malay Peninsula and its productive resources. A line of railway from Tavoy to Bankok, to be subsequently extended to the western provinces of China would throw open a fertile country and bring in handsome returns. That it has been hitherto altogether neglected, is not owing to the want of energy or the will to do, in speculators, but to the crass, stolid conservatism of the Chinese people that will not permit the growth of enterprise in the land. He also proposes to cut a canal through the Peninsula towards its southern extremity, which would connect the Indian Ocean with the China Sea, thus shortening the voyage to Hong-Kong and the Treaty ports by hundreds of miles.

We are, however, sorry to observe that the Russian scare haunts Lord Brassey at such a distance from Home. It appears that a short while ago two Russian cruisers called at Brunel, and made surveys of the harbor and the coal mines—the obvious inference being that they meditate the establishment of a coaling station. Now a glance at the map of Southern Asia will show that the territories of the North Borneo Company, those of the Sultan of Brunel and the Sarawak country are on the highway to China and extend along a coast of 1,200 miles. There seems at present to be a little complication, between the Sultan and the Dyaks of Brunel, and it is not improbable that the Russians, taking advantage of this circumstance, intend to obtain a footing there, by offers of help to the people against their ruler. This country is under a *quasi*-protectorate of England, and so long as the relations between the governor and the governed are strained we cannot hope much by such a suzerainty. Lord Brassey, therefore, proposes that the influence of England should be more clearly defined and her position clearly ascertained. Without such an assurance any Foreign Power may play fast and loose between the Sultan and his subjects.

With regard to the North Borneo Company and Raja Brooke of Sarawak, he thinks their position is anomalous, and although the latter is loved by the people over whom he rules and there is contentment throughout the land, it would strengthen both those territories if they were more directly connected with the British Empire than heretofore. It would tend to strengthen the bands of union and make them naturally dependent on one another. The coal mines at Labuan having failed, Lord Brassey is of opinion that its existence as an independent colony can no longer be recognised. We shall look forward with great interest to the publication of other letters from his Lordship's facile pen, as he makes further progress in his voyage.

RAILWAY ADMINISTRATION REPORT—1886-87.

THE rapid stride which railways have made throughout the country forms one of the brightest chapters in the history of modern India. Notwithstanding the proverbial conservatism of the people, they have taken kindly to improved methods of communication, and the iron horse has contributed more largely towards educating the people, and helping to demolish the barriers of caste prejudices than the preachings of Missionaries, or the spread of Western education and ideas, through the agency of educational institutions. Not that they have submitted to the inevitable with the stoicism of an Oriental, but have gladly welcomed the change, which ministers to their comforts and does not indent largely on their purse. The Brahmin travels with a Sudra in the same railway compartment without a murmur or complaint, more concerned in reaching his journey's end in the shortest space of time and at a minimum cost, than with the result of contamination in the company of a low born class. The old means of locomotion have been numbered with the things of the past, except in circumscribed local areas, and even here they are fast dying out. We therefore hail with pleasure the appearance of such a publication as Colonel Conway Gordon's Railway Administration Report for 1886-87.

It appears that 13,390 miles of railway were in full work, of which 4,538 miles are in the hands of guaranteed, assisted and other companies; 7,952 miles are State lines, and 899 miles belong to Native States. The total capital outlay on the railways and connected steamer services amounted, on the 31st December, to £170,498,911. The gross receipts during 1886 amounted to £18,704,536, as against £17,989,625, in 1885. The working expenses have been £8,930,983, as compared with £8,863,294 of the previous year. The nett revenue amounted to £9,773,553, of which the East Indian Railway, including the branches worked by the Company, contributed £3,133,232, the guaranteed lines £3,654,186, the assisted companies £124,003, the State lines £2,702,533 and the lines in Native States £159,602. The total nett earnings on all lines in 1886 yielded a return of £5-14-8 per cent. per annum, as compared with £5-12-9 in 1885. In regard to the coaching traffic we are told that the number of passengers conveyed was 88,436,318, as compared with 80,864,779, in 1885, and the receipts under this head amounted to £5,793,152, as compared with £5,538,126 in the previous year. Goods to the extent of 19,576,365 tons were moved in 1886, as against 18,925,385 tons in 1885, and the receipts from this source amounted to £12,385,914, as compared with £11,915,375 in 1885—that is, 1,560 tons were carried over every mile of railway at a cost to the owners of even less than one-fourth what it would have cost to transport them by carts. As a reply to the charge brought against all railway companies on the subject of the employment of Europeans in preference to natives we learn that for the management of traffic 220,000 permanent employés were entertained, of whom 95·77 were natives of India. The working expenses cost 884 lakhs of rupees. During the year under notice there was an increase in the nett receipts of 63 lakhs, which means a return of 5·90 per cent. on the capital expended in open lines, as against 5·54 of last year. There are 3,000 miles of sanctioned lines which still remain to be finished. The number of train accidents decreased from 0·07 to 0·06 per thousand train miles run. One out of every 29 and a half millions passengers carried was killed and 44 injured, thus making one accident per two million passengers, a very safe mode of travelling, considering the percentage of deaths and injuries received in other railways, all over the world.

THE P. W. D. IN BOMBAY.

THE state of affairs in the Bombay P. W. D. is rapidly becoming unbearable and is a scandal to the Administration. For the last three months chaos has reigned supreme, and a sense of uncertainty and distrust has prevailed throughout the department. Yet the patience which has for so many years characterised the members of the service under injustice and neglect has not deserted the officers on the Bombay establishment, though we can imagine the weariness of spirit and the half-heartedness with which their duties are carried on. Two of the senior officers on the list were retired on 1st April and it would naturally be thought that steps of promotion would follow. No. For the last three months there has been no Secretary to Government. His duties have been carried on by the Under-Secretary, a 2nd grade Executive Engineer. Another 2nd grade Executive has been posted "temporarily" as Superintending Engineer in Sind. The Chief Engineer for Irrigation has had to take over the duties of Superintending Engineer, Central Division, in addition to his own, to the exclusion of the senior Executive Engineer. All appointments are made as a temporary measure, and the air is full of rumors as to impending changes, concerning which, however, no one in the department knows anything, for no one has been consulted. H. E. Lord Reay has, we understand, no confidence in any one outside the pale of the heaven-born service, and thus his ideas are unknown in the P. W. Secretariat. It is generally believed that he has formulated two or three schemes, all of which have been vetoed by the Supreme Government, and one of which we presume was that which included the placing of the department under a junior Civilian, a scheme upon which we have already commented. It is time that this playing with an important department should cease, that something definite should be done, and the tension of anxiety and unrest to which the department is now subjected, be relaxed. It cannot be that the Bombay P. W. D. is incapable of furnishing an efficient Secretary, or that the whole of the 1st grade of Executive Engineers are unfit for appointments as Superintending Engineers. Of the six Administrative appointments on the sanctioned Establishment why should three remain unfilled? And why are members of the department deprived of the steps of promotion to which they naturally looked forward as a right? It is not fair to the department that things should any longer remain in the state they now are, and Government work will surely suffer if responsible officers have their legitimate hopes crushed and are made to feel that their interests and prospects are matters in which Government has no concern.

Advantage is to be taken of the presence of the representative Royal Engineer officers from the Madras and Bombay Presidencies, who have been appointed members of the Committee on Field Telegraphs, assembled at Rurki, to extend the scope of the Committee's work by requiring it to inquire into and report upon the following points which equally concern the Corps of Sappers and Miners in the three Presidencies:—(1.) Recodification of the regulations relating to the issue of working pay to native ranks. (2.) Settlement of the relative positions of the native officers and British Warrant and non-Commissioned Officers in Corps of Sappers and Miners. (3.) Introduction of a short manual of drill for Sapper Companies on parade with their equipment and mules.

Notes and Comments.

SURVEYOR-GENERAL'S OFFICE EXTENSION.—The building at the corner of Wood Street and Park Street, Calcutta, destined to be the new Mathematical Instrument Department, Servey of India, is now well in hand. The concrete is finished, and the foundation brickwork has been commenced.

PORTRAIT OF COLONEL S. TREVOR, R.E.—A portrait of Colonel Salisbury Trevor, R.E., was unveiled privately on Thursday last at Writer's Buildings at 2 P.M. The picture is the work of Babu Annoda Prosad Bagchi, the well-known native artist, and has been presented to the building by Rai Gunga Bisto Roy Bahadur. It is hung in the grand staircase, and is a three quarter life size portrait. It is a good likeness and well executed.

BENGAL-NAGPUR RAILWAY.—With a view to judge as to the comparative advantages of the two localities—Asansol and Sitarampur—mentioned in connection with the formation of the junction of this Railway with the E. I. R., the Consulting Engineer to Government proceeded to Asansol to personally inspect the grounds traversed by the alignment and the site of the proposed alternative junction.

RAILWAY CARRIAGES.—The B. B. and C. I. Railway Company are engaged in constructing a few vehicles for the coaching traffic on the trains running between Bombay and Ahmedabad. Ten third class carriages have already been finished. Each of them is 38 feet in length, contain eleven compartments each, and are capable of accommodating 133 passengers, thus economising space to the utmost extent possible. These vehicles are mounted on four-wheeled bogie trucks, one at each end and have the patent spinal and other springs to minimise oscillation when running.

COAL SERVICE LINE.—A series of short trial surveys, with a view to the construction of a coal service line, to be worked in connection with the Asansol or Sitarampur end of the Bengal-Nagpur Railway, are in course of execution by the local staff of the said Railway. It is intended to so arrange the line as to accommodate the coal concerns interlying the Sitarampur Railway Station and Sanktorea, a colliery 5 miles south-west of the said Station and situated on the north bank of the Damooda River. This we presume will be the arrangement should the Bengal-Nagpur Railway junction be located at Asansol.

A COAL BRANCH RAILWAY FROM SITARAMPUR.—It is rumored that in the event of the Bengal-Nagpur Railway not running from Sitarampur Station of the E. I. R., Messrs. Gladstone, Wyllie, who are interested in coal, will launch a Limited Liability Company with a capital of Rs. 3,00,000 to take over from Government the original site of the B.-N. Railway from Sitarampur to Damooda River, and construct a mineral line for the accommodation of themselves and all other coal concerns not served by the private line belonging to a well known firm in Calcutta. Why this line is not carried beyond its present terminus we are unable to understand.

PROJECTED RAILWAYS IN SIAM.—Of all Asiatic Powers, Siam takes the lead in improving the material condition of its people, and in general progressive reforms. Education and trade are especially encouraged. Slowly but as surely the country is being opened up to Western enterprise. The latest information on the subject is that the King has granted concessions to a European firm for the construction of two railway lines into the interior and a steam tramway at Bankok, the capital. The representative of the firm has left for England to make the necessary arrangements, and it is expected that within two years from the date of their commencement the schemes will be an accomplished fact.

WATER WORKS—COLOMBO.—The water impurity question has been settled satisfactorily by flushing and was due to want of proper circulation. The population is 120,000, but it is spread over an area greater than most cities in Europe of 200,000, and the authorities up to date, again, have only 900 service connections, apart from the street wells, so that the demand is not sufficient to keep the supply moving, for the temperature of the water at Labugama even is 78° Fahr. and in Colombo 83° Fahr. in the pipes. For this purpose flushing valves were provided at intervals below the roadway into the storm-water channels.

SANITARY ENGINEERING.—For the third time has the proposal to appoint a Consulting Sanitary Engineer for the Madras Presidency been vetoed by the local Government. The Sanitary Commission reports that in many instances the works which were executed are so faulty as to do more harm than good, as in the absence of professional advice, the overseers and others who are devoid of any technical knowledge of the subject, act on their own responsibility and the work is a failure. The Government of Madras have, however, negatived the proposal on the ground that there was not at present sufficient work of a character to justify the appointment. Local Boards and Municipalities are empowered to call in the assistance of the District Medical and Public Works officers whenever required, and in the case of large projects the Government have shewn themselves ready to lend the services of a competent officer for their preparation or execution.

BENGAL-NAGPUR RAILWAY.—Mr. T. R. Wynne, the Engineer-in-Chief of the Bengal-Nagpur Railway, was in Calcutta for a few days last week, and left for Nagpur on Sunday last. Mr. Wynne marched over as much of the line as was practicable at this season of the year, and has no doubt found that there is a great amount of heavy country to drive the new line through, but does not appear to be in the least dismayed by that fact. The new experiment of entrusting such a great work to a comparatively junior man will be watched with the greatest interest, and for our part we can only say that we wish Mr. Wynne and his staff every success in their undertaking. It is reported that Mr. R. A. Way, late of the Gunduck Bridge, is to have charge of the Asansol end of the line; if this rumor is correct, Mr. Wynne has secured a most valuable and energetic co-adjutor. Both gentlemen have had great experience in heavy railway work. Asansol has been definitely fixed, we understand, as the point of junction with the E. I. Railway.

CIVIL ENGINEERS FOR UPPER BURMA.—Referring to the recent transfers of Civil Engineers to Upper Burma, we cannot help asking why some Military men or Native Engineers are not sent there. The latter draw the same pay (though working in their own climate) as Civil Engineers, and should take the same risks. Instead of this they, as a rule, steadily object to be transferred out of Bengal to any other province. What would be said to a European Civil Engineer who made a similar objection? We fancy he would be ordered to go, and if he refused, his services would probably be no longer required. A case has been mentioned to us, which ought to be known. A certain Executive Engineer in Bengal had a Native Assistant, who some time ago was transferred to Beluchistan. He declined the appointment, and was then ordered to go at once. His reply to this was a medical certificate, on which he took sick leave. Some time after men were wanted for Burma. The Executive Engineer was transferred, and went at once without demur, and the Native Assistant Engineer, who had refused frontier duty, obtained, in consequence of his Executive Engineer's departure, charge of one of the best divisions in Bengal. If he had been the servant of any one, but Government, we fancy he would have received very different treatment.

THE CALCUTTA CEMETERY EXTENSION.—The Cemetery question is now being debated by the Committee recently appointed by the Government of Bengal. In spite of the opposition of the inhabitants of Baniapookur the present ground will probably be extended eastwards, though it is quite possible that it may not be advanced southwards to the Kurryah Bazar Road, on account of the expense which would be incurred in taking up the *pucca* buildings lining that road. While on this subject, we would draw the attention of the local Government to the disgraceful state of the Mahomedan cemetery in the outskirts of the town. No regulations appear to be enforced, and the bodies are interred only about two or three feet below the ground level. The result, *horribile dictu*, is that they are promptly disinterred and dismembered by jackals, and the offensive nuisance to the people living in the neighborhood can be more easily imagined than described. It is no doubt a delicate matter to interfere with such an important religious ceremony as the funeral rites of the Mahomedan community, but we believe that the common sense of the educated Mussulmans would prevail over any fanatical feeling that might arise amongst the ignorant classes. Some action in this matter is absolutely necessary, as the present arrangements constitute a great danger to the public health.

RAILWAYS IN CHINA.—Some sanguine capitalists in Europe have again started the idea of laying down railways in China. This time the proposal comes through the Belgian Minister at Pekin, who has proposed to place the sum of thirty-two millions sterling in the hands of the Government to be repaid in ten annual instalments. If the project be accepted the route suggested by Mr. Holt Hallett to join Burma with the Chinese province of Yunan will be adopted. If this portion of the line could be accomplished, there would be little or no difficulty in making the proposed railway to Pekin. Thus the productive resources of the Yangtze Valley, of which only the imagination can draw a picture now, will be tapped to the great development of commerce. The next point to be considered is the sea-borne trade between this country and China, the bulk of which is conveyed to the capital of the Celestial Empire. The railway will serve the purpose of speedy carriage without the risk and tediousness attending a sea voyage, to say nothing of the increase of traffic and the return trade or import, which is at present a trifle compared to the exports. All these calculations may be very comforting, but will China be awakened from her lethargic sleep of centuries to introduce such a reform in the heart of her country at the bidding of a European syndicate. That is the question.

Current News.

The subscriptions to the Imperial Institute from India will probably aggregate five lakhs.

Mr. S. R. Cary, c.e., Chief Engineer, Bengal Central Railway, is now on a tour of inspection of the line.

Colonel J. H. Jenkins, Agent of the Oudh and Rohilkhand Railway, will, it is said, probably resume charge of his duties early in October.

The net increase in the earnings of American railroads for the first four months of the current year over the corresponding period for 1886 was Rs. 4,92,68,516.

Sir West Ridgeway has returned to St. Petersburgh from London. A settlement of the Afghan boundary question based on mutual concessions is shortly expected.

It is said to have been almost decided to hold another Railway Conference at Simla next year, at such time as may be most convenient to the various railway administrations.

Sir Henry Daly, formerly Governor-General's Agent for Central India, has been appointed a Director of the Great Indian Peninsula Railway, in succession to the late Mr. Chapman.

From 1st July a new station at Gulsi, on the Chord Line, situate at 80¾ miles between the Khanu Junction and Mankar stations, has been opened for the local booking of passengers, parcels, and luggage.

The latest remedy for cholera is said to have been discovered at Buenos Ayres, where there has lately been a very bad outbreak of the disease. The remedy is to chew the leaves of the Peruvian coca.

It is stated that good relations have been established with the Shan tribes east of the Ruby Mines district, while the Bhamo-Chinese traders are showing marked confidence in the stability of our rule there.

The Lieutenant-Governor has sanctioned the removal of the head-quarters of the Inspector of Local Works and Divisional Superintendent of the Road Cess and District Board Works, from Chinsurah to Burdwan.

Dr. J. Anderson, Superintendent of the Indian Museum, Calcutta, who has been on furlough for some months now, has resigned his appointment, and will be succeeded by Mr. J. Wood-Mason, Deputy Superintendent.

The German *St. Petersburg Gazette* states that the Council of the Empire has sanctioned the Vote of Credit and the law for the extension of the Trans-Caspian Railway to Samarkand, by way of Bokhara, with instructions for the work to be speedily carried out.

Mr. H. Wood, the new Assistant Controller of Stores, East Indian Railway, has just proceeded to England on three months' privilege leave. Mr. Humphrey, the Store Verifier at Howrah, has been posted as Store Accountant, *vice* Mr. Wood, appointed Assistant Controller.

We understand that the Government has recommended to the Secretary of State that Major-General Sir A. Cunningham, k.c.i.e., c.s.i., r.e., late Director-General of the Archæological Survey of India, be granted a pension of £150 per annum in addition to the military pension he receives.

The Brennan torpedo has by no means fulfilled the sanguine anticipations of the Admiralty when they purchased it for the trifling sum of £110,000. It was supposed to be able to strike a moving object even at a considerable distance. It now appears, however, that it is only avaliable for short ranges, and even then only if the object will kindly remain quite still to be shot at.

On Saturday last some excitement was caused in Old Court House Street by a report that a horse in a hackney carriage, which was standing at the north-east corner of the Government House compound, had been struck by lightning. The horse was discovered to have been struck on the nose, from which it was bleeding profusely, while the coachman, who was on the box, received no injury beyond being temporarily stunned.

The Public Service Commission is expected in Bombay on the 18th instant, and will hold its sittings in the Bombay Secretariat. For the convenience of some of the witnesses, the Commission is likely to sit for a short time in Poona. A Sub-Committee has been appointed for taking evidence in the Bombay Presidency, and their work is expected to extend over a couple of weeks. The Sub-Committee will consist of Sir Charles Turner, President, the Hon'ble J. W. Quinton, Mr. Kazi Shabudin, Mr. Nulkar, and Mr. Fernandez, the last three being representatives of the Muhammadan, the Hindu, and the Eurasian communities, respectively.

The recent amalgamation of the several State Railways with the Eastern Bengal State Railway having greatly simplified the compilation or preparation of accounts of the several lines, considerable reductions are said to have been made in the office of the Examiner of Railway Accounts. The services of about 70 assistants or clerks have been dispensed with. Those who entered the service before the year 1881, and were in pensionable grades, were allowed a gratuity of three months' pay, and those who entered it subsequently when the "Provident Fund" was established, were permitted to draw the whole amount of the subscriptions, together with that of the interest accrued thereon.

An extraordinary occurrence is reported to have recently occurred at a station on the Eastern Bengal Railway. A native, accompained by his wife, who was decked with jewels, presented himself at a station and purchased two tickets for Calcutta. They also had with them a large tin-box which was represented to contain valuable medicines, and which they were anxious to book. The station clerk, on examining the box, found some filthy matter exuding from the bottom of the box. He declined to book it in the state in which it was, but on the man persisting that there was nothing but medicines in the box, and appearing very eager to have it booked, the clerk's suspicions were roused. He had the box opened, and on the lid being taken off, an infant, richly dressed and covered with jewels was disclosed to view, the child being nearly at its last gasp for want of air.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

MAJOR GRACEY'S SUCCESSOR—N. W. P.

Sir,—The numerous friends of Major R. R. Pulford, r.e., will be glad to see his appointment as Deputy-Chief of the State Railways of the N.-W. P. and Oudh in place of Major Gracey gone to Burma. Major Pulford is well known in the N.-W. P. and Oudh as an able, zealous, energetic and popular officer, and his numerous friends and well-wishers would be heartily glad to see him permanently posted to the Direction Department of Indian State Railways.

Exceptionally able officers for special branches of the service are hard to find, but when found, should be secured for special work. We hope, therefore, that it will not be long before Major Pulford will be seen ruling the destinies of some one of the numerous State Railway systems in India.

Gup.

A GRIEVANCE.

Sir,—The promotion of Sub-Engineers, in the P. W. D., to the grade of Honorary Assistant Engineer, seems to be an anomaly. While 3rd grade Sub-Engineers are getting this promotion in one province, the claims of Sub-Engineers of higher grades, in the other provinces, are totally ignored.

Then, again, while Sub-Engineers, of all grades, have, almost to a man, been dubbed Rai Bahadur in Bengal, the senior Sub-Engineers, in the other provinces, have not been favored with this distinction.

Such invidious and haphazard distinctions are very objectionable, and unfair, and it is time that certain hard-and-fast rules in conferring these distinctions were enforced at once to put a stop to the growing discontent and heart-burning amongst the members of the Sub-Engineer grades.

To conclude, I would suggest that all persons, as a rule, when promoted to the 2nd grade, should be considered eligible for both the above distinctions. I would request you to kindly take up the case, and do the needful towards getting the above rule enforced.

P. W. D. Subordinate.

RE-BURNING PORTLAND CEMENT.

Sir,—Experience acquired in Burma long ago makes it doubtful whether it is, in every case at least, necessary to re-burn cement. When I was posted to Rangoon in 1865, I found that it was the practice there to re-burn the cement which was then in the Public Works Stores, because it had become hard-caked ; but on taking charge of the Arakan Division in 1867, I found that cement, imported, I believe, at the same time as that which the Rangoon authorities thought it necessary to re-burn, was being used with success without any such expense being incurred. There were still several hundreds of barrels of it, which were so many solid blocks, the barrels having been in many cases destroyed by white ants or damp. My predecessors, Colonel Tennant, and Mr. W. Dunn, the Assistant Engineer in charge of the Harbor Works, had found out that the cement was good and I continued to use it, as they had done, merely breaking it up and pounding it with hammers. The sea wall in front of the Custom House was built of ship's ballast and this cement mixed with sand and the arches over all the openings in the Custom House were set in the same manner. I also built the heavy cornice at the top of the building, which projects I think 18 inches, with ordinary bricks, and 12-inch square flat tiles, set in mortar made with this cement. And finally the whole building was plastered with cement and sand, and it set very hard. I have not seen the building since 1870: but perhaps some of your readers can state how this cement work has stood the test of time.

Another thing I learned at Akyab was that ordinary stone-lime keeps very well although slaked, if protected from the weather. Merely about one inch of the outside of a heap absorbs damp and becomes yellowish in color. The lime used at Akyab was all brought ready slaked from the south of the Island of Ramree, about 120 miles distant, in native boats by sea, covered only with mats, or roughly planked decks, and as it could not be made or carried during the rains it was necessary to store some before each rainy season, so that the works in progress might not be delayed. After one season's experience I arranged for a large supply for the Public Offices then under construction, and built a shed on purpose for storing it in, with a raised earthen floor, mat walls and palm-leaf thatched roof, and if I recollect aright 40,000 cubic feet was the quantity I so stored. This lime kept very well.

The sand used at Akyab was chiefly sea sand, and I was very particular about washing it with fresh water; but I afterwards learned that the lime was slaked with sea water. Yet the masonry was good, and up to the time I left the Division in 1870 I had seen no signs of the walls I built being damp.

C. W. Hope.

Literary Notices.

Gas, Natural. *A Monograph.* By Charles Paine. The Railroad and Engineering Journal, January, 1887.

Harbor Work. Abstract from specification for the construction of a screw pile wharf at Karrachee, India. Details illustrated. Engineer, Jan. 21, 1887.

Heating, of Dwelling Houses. By F. E. Kidder. Discusses the heating and ventilation of low and medium cost houses by the different methods, and gives estimates of cost. Building, Feb. 5, 1887.

Indicator. Practical directions for applying and taking care of the instrument. Van. Nos. Eng. Mag. Vol. I., p. 412.

Irrigation in Egypt. An abstract from a paper before the French Soc. of C. E. Gives illustrated description of the large centrifugal pumps being erected to carry out the programme of irrigating the Bihara district. Engineering, Jan 28, 1887.

——An illustrated series of articles describing works constructed in Egypt. Engineer, Jan. 21, etc.

Iron and Steel, Some Notes on the Working Stress of. By Benj. Baker, before the American Society of Mechanical Engineers. R. R. Gaz., Feb. 18, 1887; also Engineer, Jan. 21, 1887.

Liquid Fuel. Dorsett's System. Gives result of experiments on the steamer "Retriever." Van. Nos. Eng. Mag. Vol. I., p. 57.

Lock Gates. Which to open and shut. Annales des P. & C. Nov. 1886.

Locomotive. An illustrated description of a passenger locomotive built at the Old Colony shops. It is designed to carry 175 lbs. of steam. R. R. Gaz., Feb. 25, 1887.

——,Illustrated description of the Strong locomotive Duplex, an engine of many novel features, weighing 140,000 pounds, of which 90,000 pounds is on the drivers. R. R. Gaz., Feb. 18, 1887.

——Compound Freight. An Illustrated description, with table of dimensions of the first compound freight engine constructed. Engineer, Jan. 14, 1887.

——, on the Compound Principle. By A. Borodine. Results of experiments carried out on Russian railways, with a locomotive built as a compound engine. The author concludes that the use of the compound system effects a saving in fuel and steam of from 15 to 20 per cent. Mem. de la Soc. des Ing. Civils. Sept. 1886, pp. 261-346.

——, How to Run a. By R. H. Buel. Considers the action of the stationary engine to see how nearly the same action is possible for the locomotive, and advocates a close study of the same. Gives details of some experiments made with locomotive, with observations of every change of throttle, valve and link. R. R. and Eng. Jour., February, 1887.

——, Straw-burning. Description of a locomotive exhibited at the Vienna Exhibition. Van. Nos. Eng. Mag., Vol. IX., p. 109.

——, Four-cylinder. An illustrated description of an engine designed for heavy work on the Mexican Central R. R. The tender is provided with driver and cylinders. Engineering, Jan. 28, 1887.

Marine Engineering, at the Univ. Expos. of Anvers. by J. Gaudry. Mem. de la Soc. des Ing. Civils. Nov., 1885, pp. 627-668.

Material, A new View of the Resistance of. By Prof. W. C. Unwin. Discusses Bauchinger's experiments and shows the relation between them and Wähler's experiments. Engineer, Jan. 7, 1887.

Metallic Railway Track. By M. S. Cantagrel. A very complete and interesting account, historical and descriptive, of the various systems of iron superstructure for railways, which have been proposed or used, with illustrations and statistics. Mem. de la Soc. des Ing. Civils., July, 1886, pp. 59-104.

Ordnance. See Aluminium Bronze.

Patents By A. K. Mansfield. Discusses the present practice of patent solicitors, and advocates the establishment of educational institutions, or of special courses, which shall be designed to fit men for the specialty of patent attorneys. R. R. and Eng. Jour., Feb., 1887.

Petroleum. By H. E. Wrigley. Gives description of the oil regions of Pennsylvania, methods of drilling, pumping and transportation, also treats of liquid fuels. Van Nos. Eng. Mag., Vol. VII., pp. 225, 353 and 513.

Port of Lisbon. A series of articles giving an interesting account of the harbor improvements, Statistics, cost, results accomplished, etc., with maps. Revista de Obras Publicas, 1885; and July to October, 1886.

Rack-Railway, The Mt. Pilatus. Illustrated description of the rack-way up Mt. Pilatus, near Luzerne, Switzerland. Maximum gradient is 48 per cent., and total length about 2·8 miles. R. R. Gaz., Feb. 4, 1887, also Eng. News, Feb. 19, 1887.

Rail Heads. The Form of the Under Side of. Gives a number of illustrations of worn rail and discusses the causes of the wearing. Eng. News, Feb. 26, 1887.

Railroad Policy and Rates in France. By Herr Ulrich. Interesting account of discussion on this subject in the French Chamber. Archiv für Eisenbahnwesen, Nov. and Dec. 1886, pp. 725-748.

Railroads in Belgium. By S. Sonnenschein. Organization of branch and local roads, with laws respecting them. Archiv für Eisenbahnwesen, Nov. and Dec. 1886, pp. 748-784; also statistics of Belgian Roads for 1883-84, on pp. 785-792.

Railroads, Working Single Track. Abstracted from a paper by W. K. Muir before the Montreal meeting of British Asso. R. R. Gaz., Feb. 4, 1887.

——, Early History of. By J. Dutton Steele. Gives short account of the early history of railways and origin of gauge in England and United States. Trans. Am. Soc. C. E., Vol. II., p. 53.

——, Resistance of Trains on. By M. Desdouits. Gives the results of a long series of experimental investigation of the resistance of locomotives and trains and railways. Abstracted from Annales des Mines, Vol. VIII., p. 481, in R. R. and Eng. Journal, Feb., 1887.

Riveting. Abstracted from M. Considèr's article in Annales des ponts et Chaussées, giving the results of a series of experiments made to ascertain the additional strength obtained in riveted connection by the frictional resistance caused by the shrinking of the rivets. R. R. Gaz., Feb. 11, 1887.

Sea Wall, Scarborough. A short description of the sea wall recently commenced at Scarborough. Length, 1,200 yards; width of base, 17 feet: at 5 feet face to be curved on radius of 17 feet and constructed of concrete block, 2 feet × 12 in. × 12 in. The outer wall to be made of Portland cement. Engineer, Jan. 17, 1887.

Sewage, Utilization of Town. By Dr. A. Carpenter. A reply to Dr. Tedy's paper. Gives much valuable information regarding sewage farming, of which he is a strong advocate. Also contains reports from a number of farms. Jour. Soc. of Arts, Feb. 4, 1887.

Sewerage of Toulon. Note on the project of M. Dyrion, by A. Hanet. Pop., 58,000; mortality, 33·8 per 1,000. Project is to exclude rain-water and pump the sewage to the sea, with possible use for irrigation to some extent. Est. cost, 3,200,000 fr. Mem. de la Soc. des Ing. Civils, Dec., 1885, pp. 766-776.

Steam-Engine. Experiments on a steam-engine. By M. A. Quernel. Account of test, with tables. Mem. de la Soc. des Ing. Civils, Oct., 1885, pp. 464-488.

Stone Arch Bridges. Description and complete statistics of three bridges of 140, 170 and 203 feet span, with a multitude of facts concerning the construction of other such large stone arches. One of the most sensible, practical articles that has appeared in Engineering literature for a long time. Annales des P. & C, Oct., 1886.

Street Cleaning in Paris. By H. Virarrez. Examination of the methods adopted by the Municipal Government of Paris for the removal of mud, etc., from the streets. Engineer, Jan. 7, 14, etc., 1887.

Street Grade Intersection. By F. A. Calkins. Gives a number of examples of actual practice in the city of New York. Eng. News, Feb. 26, 1887.

Testing Machine, Six Hundred-Ton. By Charles Macdonald. Abstract from a paper before the Am. Soc. of C. E., giving details of the large testing machine at the works of the Union Bridge Co., Athens, Pa. Also gives results of the testing of a full-sized eye-bar of the Hawkesbury Bridge. R. R. and Eng. Jour., Feb., 1887.

Tunnel, The St. Clair River. A brief account of the tunnel proposed under the St. Clair River at Port Huron. Total length, 5,280 feet, of which 2,310 feet will be under the river. Clear internal diameter, 20 feet. R. R. Gaz., Feb. 25, 1887.

Water-Pipe. Drawing of the standard Philadelphia water-pipe, with table giving dimensions of the parts for various sizes. Eng. News, Feb. 5, 1887.

Water-Supplies, The Waste of, in Town. Abstract from the report of Mr. A. R. Binnie to the Bradford Corporation upon the amount of water saved during thirteen months of inspection. Cost of inspection, including cost of all necessary apparatus, less than one-third of value of water saved. R. R. and Eng. Journal, Feb., 1887.

Water-Supply, Liverpool. A series of illustrated articles giving details of the construction of Vyenwry Lake and masonry dam and the Liverpool water-supply. Engineer, Jan. 24, 1887.

Wood, Preservation of, from Decay. By Herman Haupt. Gives results of his investigation into a number of processes. Van Nos. Eng. Mag., Vol. VI., p. 181.

Wrought Iron. By J. Starkie Gardner. A lecture before the section of Applied Art of the Society of Arts, treating of the use of wrought iron in ornamentation. Jour. Soc. of Arts, Feb. 25, 1887.

General Articles.

CALCUTTA PORT IMPROVEMENTS.

THE KIDDERPORE DOCKS.

IV.

Report of Diamond Harbor Committee, 1881.

For a long time after the Committee of 1865, whose report was dealt with in the last article of this series, had reported in favor of massing the passenger traffic of the East Indian and Eastern Bengal Railways at Sealdah, and bringing the goods traffic together at a site near Chitpore, near which place also they recommended that the proposed wet docks should be constructed, nothing seems to have been done to realise either consummation. But we know that the proposal to keep the central passenger station so far away from the centre of business as Sealdah did not meet with universal approval, for the Bentinck Street site was strongly advocated, and Mr. Bruce, the Vice-Chairman of the Port Commissioners got out a project for a high level station on a viaduct, with storage accommodation underneath, to be constructed on the Strand Bank, and about that time a Committee appointed by Government proposed the erection of a goods station at Halsee Bagan alongside the Circular Canal. The question of the wet docks site stood over until that of the site for the railway station and the position of the railway bridge over the Hughli was settled.

In 1881 the Secretary of State for India having sanctioned the construction of a branch line from the Calcutta and South-Eastern Railway to Diamond Harbour and also accorded his approval to the formation of a Committee for the purpose of considering the question of constructing wet docks at Diamond Harbour in connection with the railway, the Lieutenant-Governor of Bengal appointed a Committee composed as follows:—

Honorable H. J. Reynolds, C.S., Chairman of the Port Commissioners, *President.*

Members:

- Mr. H. C. Levinge, C.E., Secretary to the Government of Bengal, P. W. D.
- Colonel S. T. Trevor, R.E., Joint-Secretary to the Government of Bengal, P. W. D.
- Mr. Bradford Leslie, C.E., Agent to the East Indian Railway
- Mr. R. Steel, of Robert Steel & Co.*
- " G. H. Morrison, of Turner, Morrison & Co.
- Mr. C. Wawn, C.E.

In the instructions given to the Committee, through the President, it was explained that though the question of constructing docks at Diamond Harbour was not a new one it was presented for consideration under new circumstances. Then the question was weighted by the necessity of constructing a railway to the docks. Now the railway to Diamond Harbour was being constructed on its own merits and independently of the docks. Formerly, also, all goods landed at the docks would have had to be unpacked and warehoused at Calcutta prior to despatch to the provinces. But now a bridge was about to be built over the Hughli which would connect the E. I. Railway with Calcutta and the Railways of Eastern Bengal. Goods landed at the docks could, therefore, now be transferred direct from a ship's hold to the railway wagons which would take them up-country; and, similarly, goods for export and coal for steamers could be run down and delivered at the ship's side. The main question which remained for consideration was whether wet docks at Diamond Harbour would be of such use and benefit to the shipping of Calcutta as to make them an undertaking remunerative to Government or to a Company; and to arrive at sound conclusions on that point it appeared desirable that the Committee should pursue their investigations under eight heads which were named. These, shortly stated, were:—

(1.) The risks and delays to ships in navigating the Hughli above Diamond Harbor, and lying at anchor in it during storms, and the extent and probable money value of the immunity which docks at Diamond Harbour would provide. The sufficiency of the existing appliances of the port to meet the probably increasing size of steamers was also to be considered in this connection.

(2.) The present charges on shipping compared with the like charges which would be incurred by vessels using docks at Diamond Harbour either wholly or in part.

(3.) The present charges on shipment or unshipment of goods, as compared with the like charges at docks at Diamond Harbour, together with carriage to and fro by rail.

(4.) The advantages to be expected from bringing the East Indian Railway across the Hughli to the present port, as compared with connecting it with docks at Diamond Harbour, specially designed to suit an expanding trade.

(5.) The possibility of reducing the charges on shipping, while providing docks, with the view of enabling Bengal to compete better in the markets of the world.

(6.) The general design of the docks, and provision to be made for the necessary accessories.

(7.) The general prospect of the docks proving a remunerative undertaking.

(8.) Should the Committee be unable to recommend docks at Diamond Harbour, what other minor works could be constructed there, in view of the approaching completion of the railway.

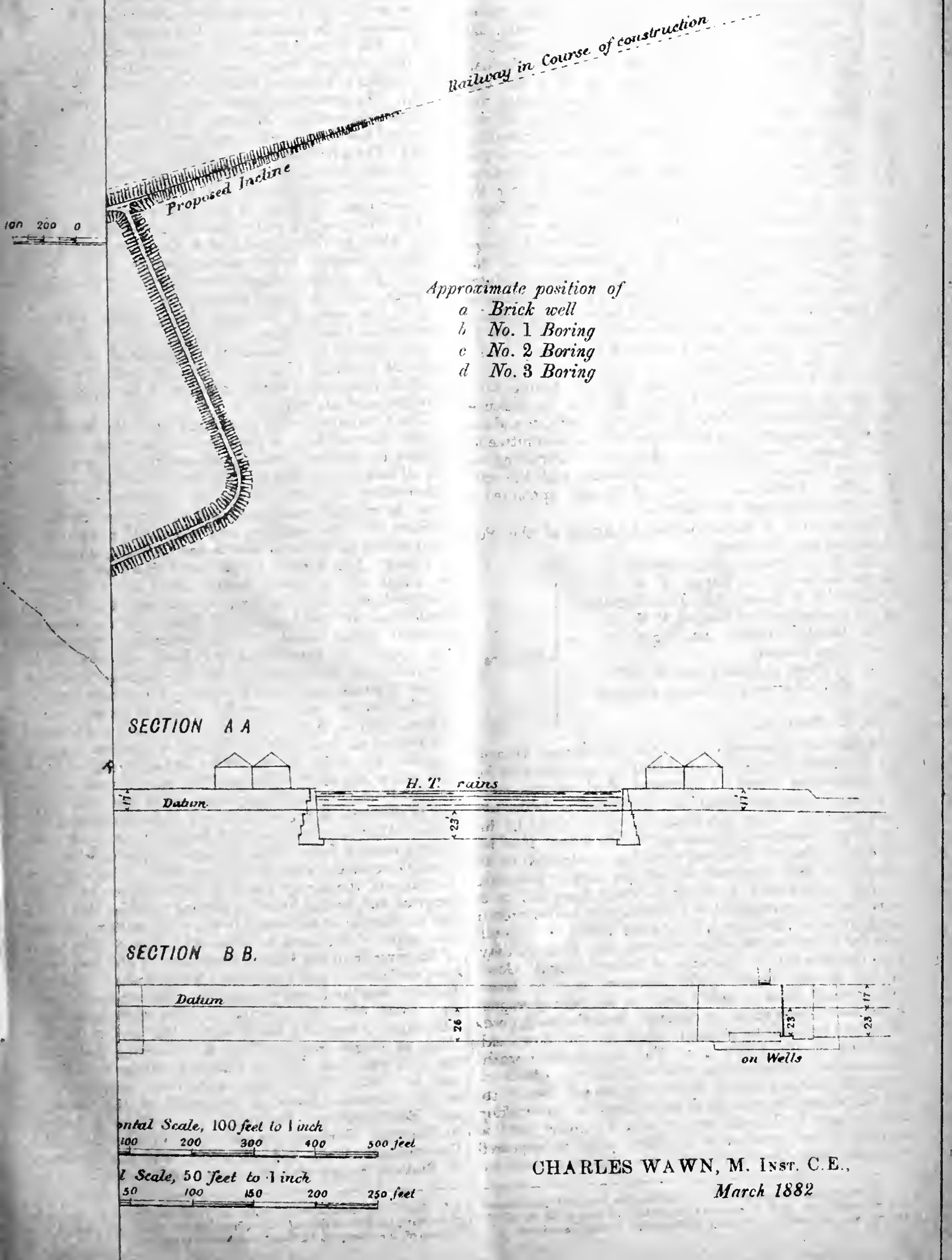
The Committee were authorised to take such evidence, documentary or oral, from either Government officers or private persons, as might be procurable. On all technical questions they would be furnished with information by Mr. Wawn, a member, who had been specially selected and appointed by the Secretary of State for that purpose, and who would prepare such designs and estimates as the Committee might require.

Though the railway to Diamond Harbour was said to stand on its own merits, and was undertaken independently of the proposed docks, there is no doubt that the Government of Bengal, or its advisers, at that time looked to the shipping frequenting the Hughli to supplement the traffic expected to be derived from the district of the "24-Parganas" through which it passes, and from the country across the Hughli; for the branch was originally intended, after leaving Magra Hât, a large rice mart, to run not to Diamond Harbour at all, but to Kulpi (Culpee), a place on the river considerably south of it, where the shipping would be met nearer the sea. * But the Railway Branch of the Bengal Public Works Department was at that time groping in the dark, as the incident now to be mentioned will show. After a trial line had been run to Kulpi, the Government of India woke up and enquired what the Local Government were doing down there. The Engineer in charge of the survey was then called upon to report progress, and, having found on getting to Kulpi that there was no channel or anchorage in the river within perhaps two miles of the place, he obtained a chart of that reach of the river from the Marine Department (who had never been consulted!) and shewed in his report that Diamond Harbour was the lowest place on the river whence a railway could ever be expected to draw traffic from ships. Thereupon orders were issued to stop the project, for the time, at Magra Hât; and in the following year, 1879, the line was laid out to Diamond Harbour. There can be little doubt that a serious misgiving as to the ultimate financial prospects of the Calcutta and South-Eastern Railway, even fed by a branch to Diamond Harbour, had weight in inducing the Governments, Local and Supreme, and the Secretary of State to reopen the question of site of wet docks for

* After the second meeting of the Committee, Mr. Steel left Calcutta, and was replaced by Mr. J. J. J. Keswick, of Jardine, Skinner & Co. Mr. C. W. Odling, Executive Engineer, acted as Secretary to the Committee.

* The Kulpi reach is considerably south of the limits of the map given with the first article of this series, but the Chart prefixed to the Report of the Diamond Harbour Committee shews it.

Plate No. 2.



CHARLES WAWN, M. Inst. C.E.,
March 1882

Calcutta, which had already been so exhaustively considered and long before reduced to a choice between the two sites close to the city—Kidderpore and Chitpore.

The Committee, as a body, visited Diamond Harbour once; and Mr. Wawn, the professional member, did so frequently between December 1881 and April 1882, and he took borings to a depth of 82 feet, and sunk a brick well which on getting into a quicksand at 28 feet depth was abandoned. "The condition of affairs disclosed by the borings and well," Mr. Wawn said, "should it prove to be alike over any considerable portion of the area, introduces an element of uncertainty as to the cost of at least one part of the contemplated works." Questions, carefully prepared, were issued to about 100 gentlemen, officials and mercantile firms by the Committee, along with a note explaining generally the scheme, and the replies received, together with a number of letters addressed to the Committee on the subject are printed with the Report in the Blue Book. Letters from Mr. Wawn, written before the Report was framed and recapitulating the various suggestions which he, as the Special Engineer, had at various times made to the Committee, and the drawings of site and works he submitted with them, are given in the Blue Book. The plan of the site and the arrangement of works approved of by the Committee will be found in Plate II. given herewith.

SPECIFICATION OF CAST-IRON PIPES FOR PESHAWAR CITY WATER-SUPPLY.

By Lala Ganga Ram, A.M.I.C.E., M.I.M.E., Executive Engineer, P. W. D., Punjab.

The cast-iron pipes, including the special castings, required for the Peshawar City water-supply are to consist of the sizes and weights given in drawings, wherein figured dimensions are to be taken in preference to scaled measurements.

Quality of Metal and Method of Casting.

All pipes to be cast vertically in dry sand moulds, without the use of core nails, chaplets or thickness pieces, or any substitute thereof. The castings to be of the best gray metal, remelted from the cupola and perfectly free from scoria, sand holes, air bubbles, cold shuts, laps, washes and other imperfections, and shall be truly cylindrical in the bore, straight in the axis, smooth within and without, with uniform thickness of metal throughout. All pipes to be cast with the socket downwards with a sufficient head of metal to ensure solidity. All pipes in which imperfection shall appear or wherein any sand holes shall be found plugged up, or which shall not agree with the terms of specification, will be rejected.

Marking and Numbering.

Each pipe shall have the letters P. M. W. (or Peshawar Municipal Works), name of the foundry and year cast in relief upon its socket. Each letter and numerical to be $1\frac{1}{2}$ inch wide. Immediately beneath the said letters and numericals the bore and thickness of the pipe should be cast on the outside of the socket. The consecutive numbers with the weight of each pipe shall be distinctly painted on the inside of the socket before it leaves the foundry.

Mean Weight.

The mean weight of each kind of pipe will be prescribed by the Consulting Engineer in England from which the utmost deviation to be allowed will be one pound per inch of diameter, beyond which in case of overweight no payment will be made for such overweight.

Coating.

All pipes to be dressed and oiled while hot and then to be carefully coated internally and externally by being immersed in a hot mass of coal pitch oil, according to Dr. Angus Smith's process, the coating to be applied at a proper heat before any rust sets in and the process continued until the composition enters the pores of the metal so as to present when dry, a smooth glazed surface. This process to be carried out in the presence of the testing officer.

Testing.

Each pipe is to be tested by hydraulic pressure equal to a column of water 400 feet high, and while being subjected to such pressure, it is to be thoroughly sounded from end to end and all over with a hammer of 10lbs. in weight.

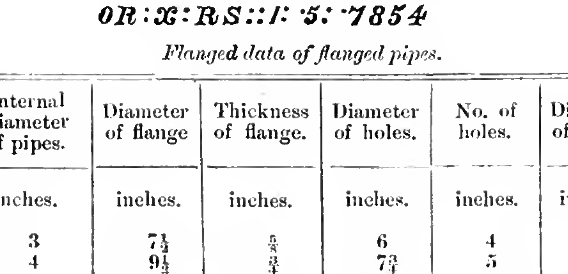
Measuring the Thickness.

The testing officer will then measure the thickness of all or any of the pipes by means of callipers. Any pipe found defective in its power of resistance to hydraulic test or in proper thickness or in any other respect that may in the opinion of the Consulting Engineer seem objectionable will be rejected and the contractor will immediately erase the letters and numericals cast on the pipe.

Table showing the test, pressure and strength of all pipes required, together with leading dimensions.

Diameter of pipe in inches.	Test pressure in feet of water.	Length of pipe in work.	Thickness as required by formula and practice elsewhere.						Proposed for this project.				
			Hawksley $t = \cdot 18\ t\ d$.	Humber $t = \cdot 00054\ h\ d + x$	As adopted in Lahore W. W.	Do. Do. Peshawar Cantt.	Do. Do. Glasgow.	Do. Do. Mr. Binnie's Delhi project.	Thickness.	Safe head, factor of safety 6.	Safe head, factor of safety 10.	Weight of each pipe.	Weight per foot in work.
in.			in.	in.	in.	in.	in.	in.	in.			lbs.	lbs.
3	400 feet.	9 feet.	$\frac{3}{8}$	$\frac{13}{32}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	1500	900	126	14
4			$\frac{13}{32}$	$\frac{13}{32}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	1125	675	150	17·66
5			$\frac{7}{16}$	$\frac{7}{16}$	$\frac{13}{32}$	$\frac{3}{8}$	$\frac{13}{32}$	$\frac{7}{16}$	$\frac{7}{16}$	1050	630	234	26
6			$\frac{15}{32}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	875	525	279	31
7			$\frac{1}{2}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	857	514	363	40·3
8			$\frac{9}{16}$	$\frac{15}{32}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	750	450	411	45·6
9			$\frac{9}{16}$	$\frac{15}{32}$	$\frac{9}{16}$	$\frac{7}{16}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{9}{16}$	750	450	531	59·0
10			$\frac{5}{8}$	$\frac{15}{32}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{9}{16}$	675	405	586	65·1
11			$\frac{19}{32}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{10}{16}$	613	368	642	71·33
12			$\frac{11}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{9}{16}$	562	337	696	77·3

All such pipes as are passed by the Consulting Engineer will be stamped by him on the inside of the socket in such a manner that the mark may not be obliterated during transit. If the supply of pipes is to be entrusted to a contractor, who is not a manufacturer, he will have to obtain the approval of the Consulting Engineer as to the foundry where they are to be manufactured.



$OR : x : RS :: 1 : \cdot 5 : \cdot 7854$

Flanged data of flanged pipes.

Internal diameter of pipes.	Diameter of flange	Thickness of flange.	Diameter of holes.	No. of holes.	Diameter of bolts.
inches.	inches.	inches.	inches.	inches.	inches.
3	$7\frac{1}{2}$	$\frac{5}{8}$	6	4	$\frac{5}{8}$
4	$9\frac{1}{2}$	$\frac{3}{4}$	$7\frac{3}{4}$	5	$\frac{3}{4}$
5	$10\frac{1}{2}$	$\frac{3}{4}$	$8\frac{3}{4}$	6	$\frac{3}{4}$
6	12	$\frac{7}{8}$	10	8	$\frac{7}{8}$
7	14	$\frac{7}{8}$	$11\frac{3}{4}$	8	$\frac{7}{8}$
8	15	1	$12\frac{3}{4}$	9	1
9	$16\frac{1}{2}$	1	$14\frac{1}{4}$	10	$1\frac{1}{16}$
10	$17\frac{1}{2}$	1	$15\frac{1}{4}$	10	$1\frac{1}{8}$
11	19	1	$16\frac{3}{4}$	12	$1\frac{3}{16}$
12	20	1	$17\frac{3}{4}$	12	$1\frac{1}{4}$

The distance between the bolts centre to centre has been kept between 4 inches and 5 inches.

Orifice of Entry.

All pipes at their orifices of entry are to have bell mouths and this to be of the form of *vena contracta*. Following are to be the dimensions:—

Internal bore in inches.	O. R.	A.	R. S.
inches.	inches.	inches.	inches.
3	4	2	4¾
4	5	2½	6½
5	6½	3¼	7¾
6	7¾	3¾	9¼
7	9	4½	10¾
8	10½	5¼	12½
9	11½	5¾	14
10	13	6½	15½
11	14	7	17
12	17½	7¾	18½

Junction vires to have curves as shewn in drawings where the depth is the same as shewn above for *vena contract r*, but other curve is ¼.

Data of Bends.

Internal bore of pipe.	Radius of ¼ bend.		Radius of ⅛ bend.		Radius of 1/16 bend.		Chord.		Thickness of metal.	Mean weight of bend.
inches.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	inches.	lbs.
3	1	2	2	2	4	3	1	7⅛	⅜	42
4	1	2	2	2	4	3	1	7⅛	⅜	53
5	1	4	2	6	4	10	1	10⅝	7/16	84·5
6	1	4	2	6	4	10	1	10⅝	7/16	100·75
7	1	6	2	9¼	5	5½	2	1½	½	144·5
8	1	6	2	9¼	5	5½	2	1½	½	163·6
9	1	8	3	1	6	½	2	4¼	9/16	226·2
10	1	8	3	1	6	½	2	4¼	9/16	250
11	1	10	3	4½	6	8	2	7⅛	9/16	297·2
12	1	10	3	4½	6	8	2	7⅛	9/16	322·2

Junction Pipes and Special Castings.

Special sockets will be cast for all junctions of 3 inches and over. But for junctions of wrought-iron pipes of 2 inches and 1½ inches bore with the mains and branches, extra sockets need not be cast, as the joint can be effected by saddle pieces.

Pipe Laying and Fitting.

The rate entered under this head is to include the following works: —

1. Digging the trenches to receive pipes, including the shoring of sides where necessary.
2. Fixing and joining of all pipes, bends and special castings.
3. Fixing and joining of all valves, fire-cocks, air-valves, street-post, double-acting air-valves, surface-boxes, &c., &c.
4. Tools and plant required for jeining.
5. Materials such as lead, &c., required for jointing.
6. Cost of temporary measures (materials, labor, and supervision) required for guarding the traffic by proper railings and light at night time.
7. Cost of ropes, stakes, &c., required for marking the line.

Reduced Level.

The standard level to which all levels are referred to, is a datum 200 feet below the lowest step of Mackeson's monument.

Excavation.

The excavations to be carried down to the levels shown in drawings, to be very neatly made so that each pipe rests evenly for its whole length. In narrow streets, where the trenches may seem likely to endanger the safety of the foundations of the buildings adjoining, the sides should be very carefully shored in the manner that may best suit the circumstances.

Laying and Jointing of Pipes.

The pipes shewn in detailed statement are to have turned and bored joints with a taper of 1 in 32 universally applicable to all pipes. Those separately detailed are to have wide sockets for lead joints, so that when put together, an average annular space of ⅜" shall be available for the lead joint in case of pipes over 4" bore, and an allowance of ¼" only for those of 4" bore and under. Previously to the pipes being lowered in the trenches they shall be fitted together and matched on the surface.

Lead Joints.

The wide socket joints as shewn in drawings are to be made by a double turn of the best white spun yarn, to be caulked to the back of the socket, the spigot of the pipe having been previously driven home, after which the best tarred spun yarn to be caulked home against the white yarn leaving a space of 1½" for lead joints which are to be run in one ring and not in parts and afterwards well caulked, trimmed off and set up in a workman-like manner so that every joint becomes perfectly water tight. After being firmly set up the lead flange must be pared off and the joint left neat and even with the socket of the pipe.

Flange Joints. -

The flange joints to be properly made either with lead-lapped or gutta-percha rings secured with bolts and nuts of the dimensions above given, and afterwards if necessary run with lead. The flanges should be slightly warmed before the ring is put in.

Turned and Bored Joints.

All such joints before being lowered into the trench or placed in position are to have their joints carefully scraped and cleaned. They are to be lowered singly into the trench brought to a proper inclination, firmly bedded and made to rest throughout their whole length on solid ground. As far as practicable they shall be laid in a straight line, but when slight deviation from straight line does occur, the joints should be run with the lead as above, and the turned or bored joints, after being properly cleaned and bedded, shall be painted round with a wash of Portland cement, the pipes then to be driven together in a careful manner with a wooden maul, the blows being directed all round the socket ends of the pipe, and continued until the pipe is driven quite home. The annular space shall then be plugged with Portland cement and sharp sand in equal proportions, which must be pressed up to the turned joints and neatly finished off.

Sluice Valves.

The sluice valves to be of the most improved pattern as may be approved by the Consulting Engineer in England, and they are in all cases to be double-faced with removable spigot and socket ends, sbolted on to the flangeso a to permit of easy removal in case of breakages or repairs.

Fire Cock Air-Valves.

(Bateman and Moore's pattern). To be provided every 300 feet apart on all branches and mains in the City.

G. R.

THE NEW G. I. P. R. VICTORIA TERMINAL BUILDINGS, BOMBAY.

The central keystone of the large dome of these extensive and important buildings was successfully fixed on Jubilee day, the 20th instant, and the event was marked by the contractors—Messrs. Burjorjee, Rustomjee, Maistry & Co.—presenting their sub-contractors and Maistries with shawls, turbans and money for the satisfactory manner in which they had each and all executed the work. The dome is entirely of cut-stone masonry and was built without any centering or supports whatever. It is, we believe, the largest masonry dome constructed on scientific pricipIes. We hope at some future time to give a detailed account of this interesting and skilful piece of masonry. There remain now the embellishments such as the mouldings, carving and statuary of the interior and exterior, which will be completed by the beginning of next year. The dome will be terminated with a colossal stone figure of "Progress." The other portions of the work are fast approaching completion, and the dome, from what we see, will form a handsome crowning feature to this noble pile of buildings. We hear that a statue of H. M. the Queen Empress, representing the State, is to be placed under a canopy in the centre of the building. The unveiling of the statue by the Viceroy or some other high State officer would be an appropriate and graceful manner of marking the completion of the greatest public work of its kind in India, and, we believe, in the world. The buildings were designed by Mr. F. W. Stevens, F.R.I.B.A., A.M.I.C.E., late of the Public Works Department, and the construction was supervised by that officer from their commencement, assisted by Mr. S. Khanderao, Assistant Engineer and Supervisor Mohaderao Janardhun.

NOTES ON IRRIGATION IN THE MADRAS PRESIDENCY.

By A. Pierres deClosets, C.E., F.R.S. of Arts and Sciences, Mauritius.

IV.

Artesian Wells.

When the country where irrigation is wanted contains artesian water-sheets, as the case is generally into soils of alluvial formation, artesian wells could be bored so as to supply the water necessary for irrigation; but it must be observed, that the diameter of such wells should be large enough to allow the water-rate paid for irrigation to yield a return of interest at the minimum rate of 5 per cent. per annum on cost of construction.

Artesian waters have been found in the alluvial strata above-mentioned, by borings from 19 feet to 450 feet below the surface of the ground. It is probable that other sheets of water exist at greater depth, the limit being the gneiss upon which all the alluvial soils on this coast lay.

Some of these artesian waters rise below the surface; some others overflow the ground with an hydrostatic level which does not exceed 10 to 12 feet, as far as I know of.

The following table will shew the variations of the depth at which some of these waters have been found. The observations were taken from wells bored by ourselves, and from wells bored by the Public Works Department of the French Settlement of Pondicherry, and some others.

Hydrostatic Levels.	Number.	Names of Wells.	Nature of soil, &c., and number of sheets.	Wells. Depth of water below ground.	Artesian Wells. Depth of water sheets.	Artesian Wells. Level at which water rises.
ft.				ft.	ft.	ft. in.
	1	Amalric ...	Tertiary and Cretaceous	12	25	− 9 0 below ground.
	2	Madura ...	Gneissic ..	14	14	− 14 0
2	3	Modeliarpett ...	Alluvial ..	6	46	+ 2 0 above.
4	„	Do.	do. 2nd sheet	...	51	+ 4 0 do
5	„	Do.	do. 3rd „	...	57	+ 5 0 do.
	4	Modeliarpett 2nd	Alluvial ..	13	60	− 1 6 below.
	„	Do.	do. 2nd sheet	...	61	− 1 4 do.
	„	Do.	do. 3rd „	...	73	− 0 9 do.
in.	„	Do.	do. 4th „	...	86	− 0 6 do.
4	„	Do.	do. 5th „	...	140	+ 0 4 above.
	5	Chounambar ...	Alluvial ...	12	19	− 6 0 below.
ft.	„	Do.	do. 2nd sheet	..	31	− 4 0 do.
8	„	Do.	do. 3rd „	...	68	+ 8 0 above.
	6	Comouty Shavedy	Tertiary ...	16	19	− 6 0 below.
	„	Do.	do. 2nd sheet	...	114	− 6 0 do.
	7	Ariancoupam ...	Alluvial ..	15	43	− 10 0 do.
	„	Do.	do. 2nd sheet	...	53	− 3 0 do.
6	„	Do.	do. 3rd „	...	100	+ 6 0 above.
	8	Pitchevakkum ...	Alluvial ...	12	43	− 4 0 below.
	„	Do.	do.	...	84	− 4 0 do.
	9	Moorgapakkum	Alluvial ...	6	12	− 10 0 do.
	„	Do.	do. 2nd sheet	...	46	− 5 0 do.
	„	Do.	do. 3rd „	...	80	− 5 0 do.
4	„	Do.	do. 4th „	...	130	+ 4 0 above.
	10	Nellicoopam ...	Alluvial ...	6	420	− 5 0 below.
	11	Colonial Garden	Alluvial ...	7	35	− 3 0 do.
1	„	Do.	do. 2nd sheet	...	188	+ 1 0 above.
4	„	Do.	do. 3rd „	...	229	+ 4 0 do.
5	„	Do.	do. 4th „	...	245	+ 5 0 do.
6	12	Savana 1 ...	Alluvial ..	...	176	+ 6 0 do.
6	13	Oupalom ..	do. ...	...	118	+ 6 0 do.
2	14	Cornet ..	do. ..	...	206	+ 2 0 do.
4	15	Ariancoupam ...	do. ...	...	193	+ 4 0 do.
3	16	Savana 2 ..	do. ...	...	87	+ 3 0 do.
5	17	Do. 3 ..	do. ...	—	247	+ 5 0 do.
4	18	Do. 4 ...	do. ...	...	150	+ 4 0 do.
5	19	Bahoor ..	do. ...	...	393	+ 5 0 do.
3	20	Col. Shermann ...	do. ...	...	73	+ 3 0 do.
0	21	Shingacovil ..	do. ...	...	180	Level with ground.
6	22	Ariancoupam ...	do. ...	...	110	+ 6 0 above.
4	23	Papanchavdy ...	do. ...	...	60	+ 4 0 do.
3	24	Talacoopam ...	do. ...	...	180	+ 3 0 do.
6	25	Chounambar ..	do. ...	...	70	+ 6 0 do.

The number of wells bored in Pondicherry is nearly 30 or 35. As far as I have been able to ascertain, the hydrostatic levels of the artesian waters supplying those wells, vary from 3·20 metres to 6·00 metres (9 feet to 13·00 feet) above M. S. L.; the reduced level of the ground at the Colonial Garden is 3·21 meters, that is, 10 feet above mean sea-level.

It could be seen by the above table that the deeper the borings are conducted, higher is the hydrostatic level.

All the wells above, which overflow the ground, are of small diameter, and cannot be applied for field-irrigation. The diameter of all these wells is $7\frac{1}{2}$ inches, the No. 11, of a diameter of 9 inches, has been bored in 4 months, to a depth of 264 feet, and the discharge of this well is 666 litres per minute, or 23·52 cubic feet, or, per second, 0·392 cubic foot.

Colonel Mullins, in his report (9th September 1879) remarks, "that this quantity of water is sufficient for the irrigation of 25·87 acres, taking 66 acres as the duty of a cubic foot.

"The cost of the well with the establishment has been Rs. 3,616. It may be assumed therefore that the water of such well for irrigation, would be utilised for eight months out of twelve, and that two crops would be obtained, making a total of 51·74 acres. The cost of water-supply per acre would be then very nearly Rs. 70. To obtain 5 per cent. on this sum, the water-rate per acre would have to average for the two crops $3·5 \times 0·35 = 3·85$ rupees an acre, and as ordinarily the water-rate per second crop is about the half that on the first, the rates would be $4\frac{2}{3}$ and $2\frac{1}{3}$ respectively. These rates are higher than usual in Southern India, and Colonel Mullins concludes, that the cost of such well is too high to admit of general application of the system to ordinary irrigation, but it could be applied to the water-supply of towns."

But if wells of a small diameter do not apply favorably to irrigation, it is to be thought that the case will be different with large diameters, as by increasing the diameter the discharge will be great in proportion, but the cost of construction would not be in the same ratio.

The cost of boring wells in alluvial soil, computed upon a number of wells of $7\frac{1}{2}$ inches bored by ourselves, could be found approximately by the formula

$$x = \frac{y^2}{2p}$$

x = being the number of days employed in boring,
y = the depth at which the boring is to be made, in yards,
p = the parameter of a parabola representing graphically the daily progress of the boring.

The value of p is variable, according to the time employed in boring, and for the above formula I have deducted the value of p from observations upon eight different borings of same diameter. I have therefore constructed a curve, which is the mean of the eight curves of the above wells, and found out that $2p$ was equal to 28·30. There is the different values of p for the wells mentioned.

		p.		$2p$.
1.	Savana Well ...	7·75	—	15·50
2.	Oupalom ...	10·00	—	20·00
3.	Acclimatation Garden ...	28·50	—	57·00
4.	Calvé College ...	71·10	—	142·20
5.	Modeliarpett ...	8·68	—	17·36
6.	Ariancoupam ...	16·90	—	33·00
7.	Nellicoopam ...	17·14	—	34·28
8.	Moorgapakkum ...	10·50	—	21·00
		170·17	—	340·34

Then the mean value of p will be $= \frac{170·17}{8}$ or 21·27, and $2p = 42·54$, but it will be observed that the well No. 4, having been bored very fast owing to the softness of mud strata, it will be well to consider only the seven other wells, and their curves; the parameter of the mean curve will be $= 14·15$ and $2p$ will be 28·30, and the equation will be:

$$x = \frac{y^2}{28·30}$$

The value of x once found out will be multiplied by the daily expenditure, and the product will represent the cost of the proposed well in rupees.

The above formula refers to wells of a diameter not exceeding 9 inches and bored in alluvial soils, where no rocks or hard strata are to be found, except perhaps eventually in thin layers. If wells of diameters larger than 9 inches diameter were to be bored, it would be necessary to multiply the cost by a co-efficient k, of which the value is variable and probably as indicated in the following table.

For Diameter.	12"	18"	24"	30"	36"	42"	48"	50"
Value of k.	1·25	2	2·37	3·33	4	4·66	5·37	6

As regards the discharge of artesian wells, with a large sectional area, the volume of water per square foot and per second, discharged by the well of the Acclimatation Garden in Pondicherry, could be theoretically taken as a basis for calculation. The discharge of this well was estimated very accurately at per second 0·392 cubic foot for its sectional area of 63·61 square inches, or 0·44 square foot. This represents a discharge per square foot of sectional area at the rate of 0·87 cubic foot per second.

The following table shews the theoretic discharge for several diameters, the acres irrigated, the probable cost of well, and the interest on Capital of construction derived from water-rate.

Theoretical discharge for different diameters and depths not exceeding 200 feet.

Diameter of well in inches.	Sectional area of the tubing.	Discharge in cubic feet per minute.	Acreage irrigated.	Water-rate at 2 Rs. per acreage irrigated.	Cost of the well.	Interest on Capital of construction.
In.	Sq. feet.	Cub. fee.	Acres.		Rs.	Per cent.
9	0·29	23·00	25·09	50	2,450	2
12	1·00	53·00	58·00	116	3,258	3
18	1·70	90·00	98·00	196	4,900	4
24	3·14	166·00	181·00	362	6,517	5
30	4·90	259·00	283·00	566	8,158	6
36	7·07	371·00	406·00	812	9,800	8
42	9·00	477·00	522·00	1,044	11,417	9
48	12·00	636·00	696·00	1,392	13,058	10

Shewing that to yield an interest of 5 per cent., the diameter of the well should not be less than 2 feet. I have supposed the water-rate at Rs. 2 per acre; if less, the diameter of the well should be increased.

Several trial borings have been made in or near Madras Town, into the Cooum river alluvium, but without success. The alluvium of the Cooum is not of a sufficient extensive area and thickness so as to induce to believe that ascending sheets of water might be found underground; but it is not probably the case in the Cortilyar alluvium, and it is to be desired that trial borings should be made, particularly into that portion of the alluvium near the sea.

Artesian well boring is rather a difficult work to conduct, I mean practically. It requires skill and ingenuity, not only when the work proceeds regularly, but particularly if any accident occurs. In some instances, if the Engineer in charge is not of an inventive engineering mind, the boring is to be abandoned. We have had more than one difficulty of this sort, when tools were broken or jammed fast, either by breaking or by being covered by loose *débris* falling upon the tools. Such occurrences are well known by those who have charge of boring operations. We have been stopped ourselves for one month at the Nellicoopam well, on account of the handle of a shell having broken, and it was only by contriving to invent a particular kind of grapnel, that we have been able to extract the shell from the depth of 350 feet, at which it was buried under 4 feet of sand.

In boring wells, great attention should be kept so as not to pass through water-bearing strata without noticing them. This is generally the case when tubing is forced at a speed too fast. It appears generally when a thin water-bearing stratum is reached, that water oozes from below with a certain difficulty; but if the tubing is forced at the same time through this stratum, the water cannot rise, and it may be thought that there is no ascending water at the extremity of the tubing. Another essential condition is not to allow the tubing to be loose in the boring hole. In such case, when an ascending water-sheet is tapped, water rises inside and outside the tubing, and if the water outside meet any permeable stratum, it loses itself into this stratum, and the discharge above the pipe or tubing is considerably reduced, and sometimes there is no discharge at all.

This occurs in the majority of the wells bored in Pondicherry by natives. Their apparatus for forcing down the tube are generally of so weak a description, that they could not lower it without having it free of pressure below, and they bore the hole accordingly of a larger diameter. Such deficiencies in boring artesian wells may be very injurious to the public in general, and to the wells already bored in the neighbourhood, and also to the natural springs or fountains, upon which the population rely for its supply.

There are some wells which have discontinued to discharge water, owing to the careless boring of new artesian wells in their vicinity; and it would be very desirable that Government should interfere and satisfy themselves, that no boring should be made without their knowledge so that careful superintendence and proper boring apparatus, &c., should be used; and to satisfy themselves, that necessary precautions are taken so as to obviate loss of artesian waters either during the boring process, or afterwards by a defective or perishable tubing.

THE MAIN DRAINAGE OF THE HOUSES OF PARLIAMENT, WESTMINISTER.

By Isaac Shone, C.E.

II.

(11.) In the early part of 1886 a Committee was appointed, Sir Henry E. Roscoe, F.R.S., being the Chairman. It is evident from the reports of the Committee that the members set about their work in a thoroughly exhaustive and business-like way.

(12.) One of the members, Mr. L. H. Isaacs, fortunately had a thorough practical knowledge of the subject upon which the Committee was asked to report. He deemed it desirable personally to examine the interior of the main sewer under the Palace, from the Victoria Tower to the point of discharge at the Speaker's Green; and, having regard to the then state of the main sewer (which is exemplified by Fig. 22, Plate 1), this was a disagreeable, not to say courageous, work to undertake.

(13.) From what Mr. Isaacs observed, he came to the conclusion that the smells so much complained of, and so frequently experienced within the Palace, were mainly due to the faulty sewers and drains under the Palace, and more especially to the connection of the main sewer with the Metropolitan low level sewer running through Westminster.

It appears from his evidence before the Committee that at the termination of his subterranean survey he presented himself as a witness, and deposed to the state of things which he found to exist beneath the Palace. Subsequently, he repeated his examination of the main sewer, and deposed a second time to what he had seen.

(14.) Mr. John Phillips, who had had a large practical experience as a Sanitary Engineer, and who had advised Sir Charles Barry as to the improvements which were effected in the drainage of the Palace about 1848, as already mentioned, was also asked to give evidence before the Committee.

(15.) With that object Mr. Phillips made examinations of the sewer, and of some of the branch drains, under

Plate I.

ER.

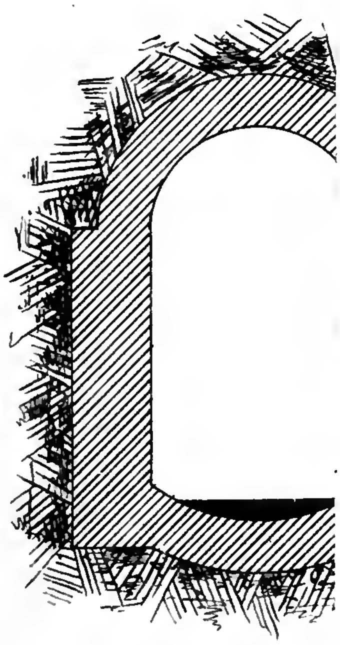


Fig: XXIII

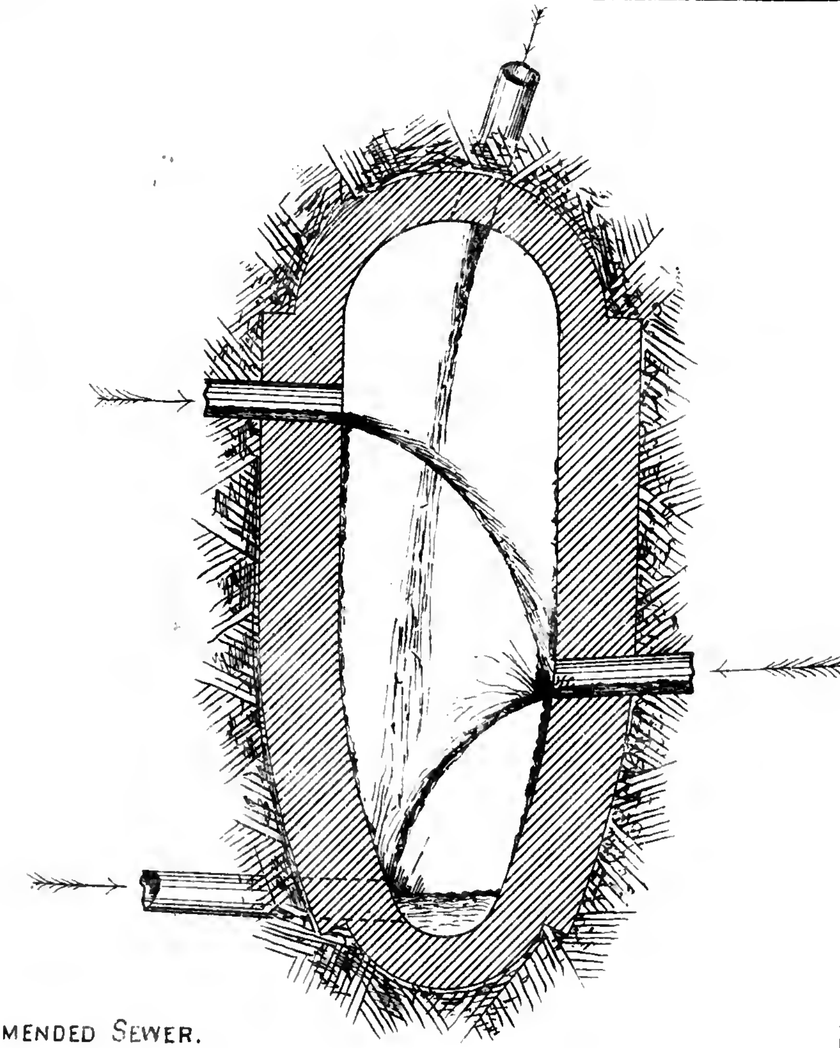
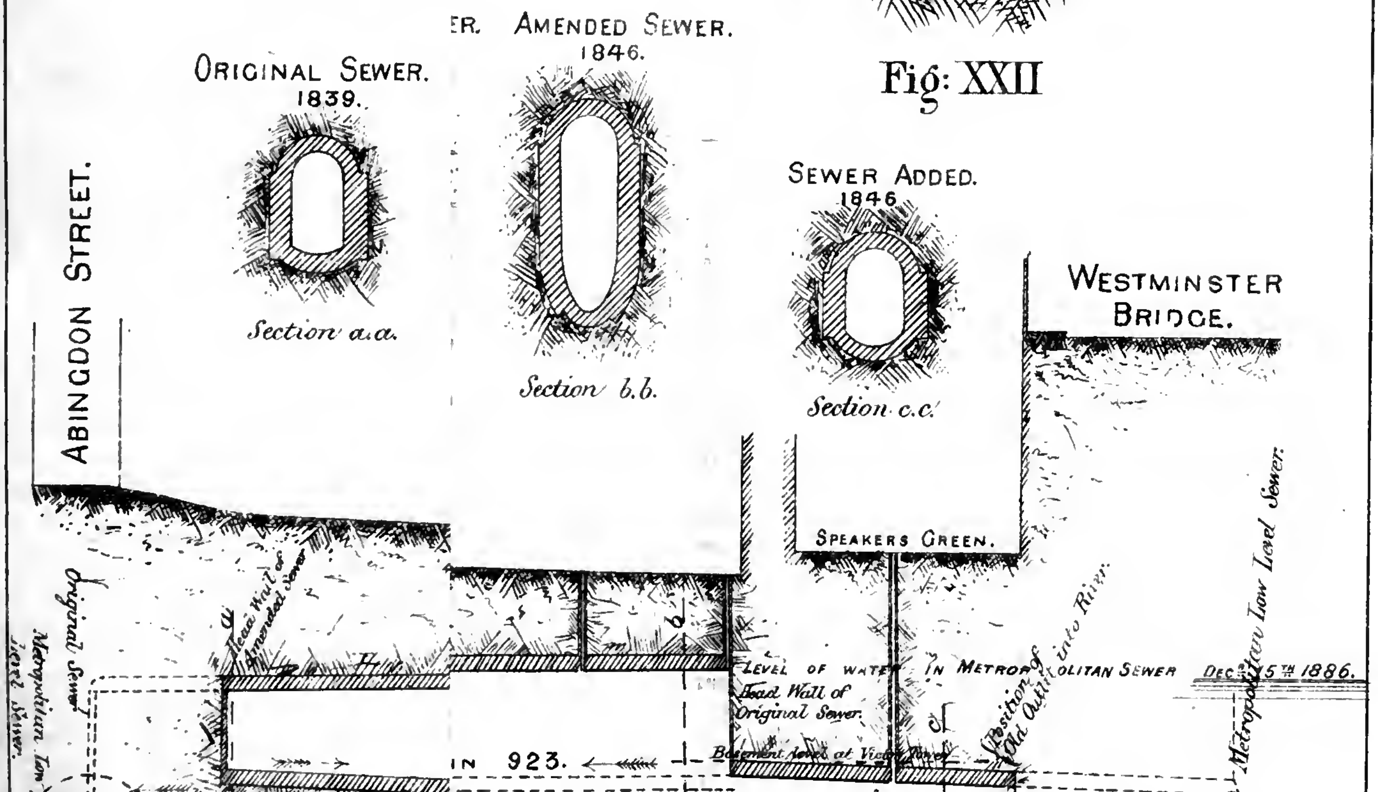


Fig: XXII



The "Star" Press, 19 Lall Bazar Street Calcutta

the Palace, and endorsed the views of Mr. Isaacs in regard to the faulty character of the same. He subsequently, from his special knowledge of the circumstances connected with the drainage arrangements both inside and outside the Palace, submitted to the Committee a thoroughly practical and scientific plan for again improving the main sewerage arrangements of the Palace, and rendering them perfectly independent of the Metropolitan low level sewer as a means of discharge by gravitation.

(16). This plan of Mr. Phillips' was supported by Major Hector Tulloch, R.E., Local Government Board Inspector, who had previously reported to the President of the Local Government Board upon the defects of the drainage of the Houses of Parliament.

(17). The Committee, after due consideration of the subject in all its bearings, recommended to Parliament that the plan, as proposed by Mr. Phillips, on the Shone Hydro-Pneumatic System, should be adopted; and their recommendations have been substantially carried into effect.

(18). It would swell this pamphlet to the proportions of a good-sized book were the new and improved works adequately described by drawings and otherwise in detail; but such a book, interspersed as it necessarily would have to be with more or less technical matter, would be inappropriate under the circumstances; and, therefore, the author's aim in the following pages will be to give, as plainly but as briefly as possible, a general outline only of the salient features of the new works.

(19). The statements already made as to the main sewer constructed in 1839, of the improvements effected in it by Sir Charles Barry in 1848—at Mr. Phillips' suggestion—and the subsequent alteration which was made in it when it was joined to the Metropolitan low level sewer, about 1873, will be better understood by reference to the drawings which accompany this pamphlet.

(20). Fig. 23, Plate 1, is a cross section of the 1839 sewer, showing, by black colour, the invert waterway necessary to pass through it the maximum quantity of sewage obtaining at the Palace when Parliament is in Session. Fig. 20 is a longitudinal section of the same sewer, amended and otherwise.

(21). It will be seen that the original sewer had a gradient of 1 in 923 only, but by the alteration suggested by Mr. Phillips in 1846 it was increased in 1848 to 1 in 215.

(22). Fig. 21 is a sketch plan, showing the Bridge Street sewer outlet into the Thames, as Mr. Phillips recollects it to have been in 1846, and it also shews how the Palace sewer was subsequently connected with the Bridge Street sewer outlet.

23. The other figures on Plate 1 are all self-explanatory, excepting Figs. 22 and 24. Fig. 22 indicates the erratic way in which the branch drains were connected with the Palace sewer in 1839 and 1848. Fig. 24 will be referred to more particularly hereafter, when the nature and value of the new works are explained.

(24). There were about 122 subsidiary drain connections made with the main sewer originally, and these were formed at various levels on either side of the sewer as shewn by Fig. 22.

(25). The new works, briefly described, consist (1) in improving the gradients of the main sewer and its principal tributaries; (2) in reducing the sizes of the sewers—the main sewer, for example, from ten feet six inches high by three feet wide, as per Fig. 22 on Plate 1—to one of twelve inches in diameter, as illustrated by Fig. 24; this latter figure also shows the waterway on the invert of the new main sewer, with its improved gradient, when that sewer is charged with the maximum quantity of sewage which obtains during the Parliamentary Sessions.

(*To be continued.*)

NOTES FROM HOME.

(From our own Correspondent.)

THE maps of the heavens which the international astronomers, now assembled at the Paris Observatory, are taking steps to prepare will be composed of from 1,800 to 2,000. By this means these gentlemen, with the aid of the new and improved instruments used at the Paris Observatory, will be able to diagnose the 100,000,000 of stars which according to the statistics, exist in the firmament.

On Wednesday last the President of the Institution of Civil Engineers held his annual conversazione at the South Kensington Museum. Over 3,000 invitations had been issued and judging from the crowded state of the extensive galleries it is fair to assume that they had all been accepted. Mr. Woods received the guests in the main corridor leading to the North Court where the string band of the Royal Artillery played a series of selections throughout the evening. There was also a lengthy programme of glees and madrigals relieved by two entertainments given by Mr. Correcy Grain.

On the following morning the *Daily Telegraph* gave a leading article upon the profession of the Civil Engineer referring to it as of all scientific bodies the most interesting and the most unpretending. The Civil Engineer is a soldier who has never claimed that rank in the great army of civilization which is his due. The fruits of his conquest are appropriated too eagerly by the world and the conquerors themselves too busy in fresh fields of warfare to think of those they have left behind. Hence the gigantic strides that have been made during a single lifetime are by the majority of the public altogether unrealized. A comparison is then made as to the foremost country in the world in engineering, and although the foremost place is given to England there is reason to show how closely she is run by other rivalling powers.

Engineer of this week has an article on defective weapons and gives a short account of the history of the conversion of bayonets on which so much has been said. The reports of the Committees are referred to, and while agreeing with them, points out that the whole story is illustrative of the evils of the five years' system. Nor should the blame, as it may be suggested that it should, be too harshly placed upon the Manager or Chief of the Permanent Staff at Enfield, for it is pointed out that as a subordinate gets little credit for what his department achieves, therefore he should get little blame, and that such an individual cannot altogether take the blame of a failure which results from a dislocated and disorganized system.

The Parkes' Museum has recently given a series of Sanitary demonstrations. The first was by Professor Corfield on the defects of sanitary appliances, and bad materials and workmanship and the dangers that arise therefrom. The second by Rogers Field who pointed out the necessity of giving particular attention to all the details of sanitary arrangements as well as to the general principles. The drainage of the Museum has been specially arranged by the Council to illustrate the principle of House Drainage.

At the annual dinner of the Civil and Mechanical Engineers' Society, Mr. Brewster, in responding to the toast of "The Society," referred to one of its main features which was the cultivation of the spirit of friendship among Engineers, the Society being in itself supplementary to the Institution of Civil Engineers to which most of its members belonged, but which cannot perform the social functions or meet those requirements which are the special feature of the smaller society.

Major Flower recently gave a lecture on the River Lee, and after giving the history of the river passed in review the districts that were contributing towards its pollution. The reform of many of these was acknowledged and an account given in each case of what had been done from Luton down to West Ham, a district near the mouth of the river, containing now upwards of 170,000 people. Here the authorities adopt Hanson's sulphurous powder to deodorize their sewage.

The *Building News* remarks that as the designs for the Imperial Institute went in on the 14th, and as it is stated that the Queen will lay the foundation stone on the 4th July, this leaves a curiously brief interval for coming to a decision on the designs and preparing the working drawings

Another telephone has been patented by Mr. C. S. Bell, of Columbus, Ohio. The inventor covers a multipolar magnet composed of a magent having a longitudinal bore with a soft iron core inserted therein and an insulating cylinder of iron magnetic material surrounding the core with a helix surrounding the parts in combination with the diaphragm of a telephonic instrument and is intended to work in any place where a telephone with a battery can be worked.

Engineer of this week gives an illustration of the feathering paddles of two steamers that run between Newhaven and Dieppe. These wheels are fitted with Stroudley's floats that are curved to a radius of 8ft. 6in. and have a flange 4 inches deep fixed at each end. The adoption of this principle has been the means of increasing the speed. The South-Western boats plying to the Channel Islands have fitted their paddle steamers with these floats and here too the increase of speed is also reported.

The Spring Meeting of the Iron and Steel Institute commenced yesterday at the Institution of Civil Engineers, when the President, Mr. Daniel Adamson, delivered his address.

The Telegraph Engineers held their meeting yesterday and a paper was then read on Underground Telegraphs.

AMERICAN ENGINEERING NEWS.

(From our own Corerspondent.)

The Railroad Commissioners of New York have been engaged in a very complete inspection of the bridges of the State. The railroads were required to file with the board a plan and strain sheet of every truss bridge. An engineer was employed to examine the plans and when necessary examine the bridges themselves. "As soon as a bridge plan is received it is subjected to a preliminary examination to detect any obvious defects of construction which exist, and it is then laid aside until all the bridge plans of that road are received. As soon as possible thereafter these plans are taken up in order, minutely examined, and the stresses in all members of each structure computed, using as nearly as can be ascertained the actual moving loads which are customary on each particular.road. Whenever defects are found they are at once reported to the Railroad Company with the recommendation that they be remedied. An opportunity, however, is always afforded the road for a hearing, should the Company consider the Board's recommendation uncalled for. So far every recommendation of the kind has been promptly complied with. The Board also requires a plan and a strain sheet of every new railroad bridge erected in the State to be filed as soon as the structure is completed. A record of every bridge in the State is thus kept at Albany."

The work is supplemented by the employment of a competent Engineer to inspect all the bridges for the State.

The workings of the Inter-State commerce law are not apprehended by those who seek after ocean freights of grain and provisions and who attribute the present unremunerative freights and general lack of them to the operations of the law. Directly connected with this class are the grain and provision commission merchants and brokers, who assert that never before was there such a general dulness of the export business, and that it is due to the adjustment of freight rates under the long and short haul clauses of the law. While both of these classes are discouraged, they are not despondent; inasmuch as they look forward to the early opening of canal and lake navigation. It is said and believed that the Inter-State commerce law will give to the water routes a large increase of business as compared with many previous years. The canal boatmen are in excellent spirits in anticipation of a much larger business the coming season, and at better rates for transportation, as there will not be that strong competition from the railroads.

An instance of rapid tunnel work is noted in one of our Western papers. It is the Stampede tunnel through the Cacade Mountains in Washington Territory. About 4,100 feet have been bored. The combined progress made from the two ends of the tunnel is about $16\frac{1}{2}$ feet per day. The work thus far has been accomplished in a little over a year's time, a portion of which time the work of drilling was without the aid of steam. Two years was the time occupied in building the Mullen and Bozeman tunnels, the lengths of which are not as great as the finished work of the Stampede tunnel.

The Annual Convention of the American Society of Civil Engineers will be held this year on top of the Catskill Mountains at the Hotel Kaaterskill, beginning 1st July. During the sessions, several interesting papers will be read. Some of the subjects to be considered are—Vibration of Bridges; Structural Steel; Disposal of Sewage; Care and Maintenance of Permanent Way; Cable Railway Propulsion; Irrigation; Size of Sewers; Heights for Bridges. During the convention an excursion will be made to the works of the Poughkeepsie Bridge, now in course of construction and to the immense natural cement works of the Rondout Valley.

NOTES FROM CEYLON.

(From our own Correspondent.)

Nanu-Oya Railway Extension.

The proposed deputation to the Secretary (Colonial) has been suspended, owing to Mr. Brown of the Uva Company at the meeting held at Mr. Lethbridge's having declined to drop the question of gauge and also to demand that the said Railway should be sanctioned the whole way to Badulla at once. His argument was that in the event of the railway being constructed the roads would be neglected so as to force the Badulla planters to use the railway. He also now contends that the Lower Badulla road is the only thing needed, for him it is true, but neglects to think of other interests such as Haputale and Makalsima. This road is the shortest route to Badulla by many miles: it was partially cut many years ago, then the trace was improved with the intention of making it into a cart road. It has hung fire since for some cause or other, may be the unhealthiness of the jungle through which it passes. Sir James Longden took up the scheme again and money was voted for its construction, the work was given in charge to the Hangurankitte Road Officer and pioneers' lines and a bungalow built at Gonagamuwa, but little progress was made, above clearing the trace, owing to fever and the consequent desertion of coolies. I remember the officer indenting for 6lbs. of sulphate of quinine. Now after five years work they have bridged the Maha-oya, the Bilhul-oya, and the Kurundu-oya and built masonry culverts galore, and still the Uma-oya has yet to be spanned and a tuvalam road will be the outcome. A trace was also made for a railway starting from the Kandy side of Katugartolla, hugging the course of the Mahawilleganga till the Uma-oya is reached and from thence branching off to Badulla. There are few difficulties to be met with along the whole trace either in point of gradient or construction. The loose nature of the steep sides of the Hangurankitte hill, "Diyatalawa" towards Kimbulkettiya would no doubt prove troublesome, but not insurmountable. I should not think myself that this line has been abandoned, but rather postponed, as although it goes through a sparsely inhabited district, still it would tap a large native trade now carried on by that wonderfully energetic and 'cute trader, the Moor and his tavalams and of course would serve Badulla far better and cheaper than the present route over the 6,000ft. rise, but then it would have to travel back to Haputale, as it were. This indecision produces results which one would look for if the Government was a contractor seeking his own interests and providing for himself two works where only one was necessary, and as an illustration of this, is not the Galmal-oya opened up as far as Nugateum Estate now that the estates are lying waste, (when the coffee was flourishing there was no need) so that now it is pushed on in purely native interests to Mechanuwerd and Bintenne from whence a road runs to Batticaloa, to open up the Vedah country and so clash with a proposed narrow gauge railway from Uma-oya to Batticaloa. I fancy this Vedah country scheme is due to the love of physiology (like the renewing Tanks and Dogoba is stated to be of archæology, in fact anything notable rather than the slow honest banking up of streams and irrigation to stop the inundation of districts where there is already a population) for has not a scientist been living amongst these Vedahs and studying them and did he not excite our curiosity by giving us a description of his stay in the Vedah country. And of course a chance for catering to notoriety must not thus be lost and the Vedah (who turns out to be truthful and moral) must be disturbed and the tens of thousands who have their property spoilt and are barely able to exist through annual floods *are* to do as their forefathers have done.

REPORT ON THE AURIFEROUS TRACTS, MYSORE.

(*Continued from Page* 13.)

NEXT morning I proceeded about $2\frac{1}{2}$ miles North-East of Nuggihalli and East of the public road leading to Tiptur, where I came across an old working in hornblende schist. This working had not been carried to any great extent, its length being about 45 feet, breadth 24 feet and present depth 6 feet. The country rock here is massive and very compact. The ancients endeavoured to remove it by wedges or as is called pooling, but they found it too strong for their primitive appliances, and no doubt on this account were compelled to abandon this working.

I proceeded this morning to Tagadur Ranganadanabetta, about $1\frac{1}{2}$ mile west of Dyavalapur, the elevation of which is 3,192 feet above the level of the sea. This is a very remarkable hill having a large tamarind tree and a temple on the top. It can be seen for miles to the North. About a quarter of a mile North and slightly East of the hill, I came across another old working. It was not carried to a great depth, being only 120 feet long, 60 feet broad and 5 feet deep. This old working is in the same kaval, in the same bearing and on the same reef as that already described. Large quantities of disintegrated iron ore lay all over the surface here, but as in the former case extends to no depth. The chloride schist rock is very free from iron, and no doubt for the small depth sunk, a considerable quantity of gold must have been taken from this old working, as to the North I found several places where the quartz had been reduced. Proceeding North, at a couple of hundred yards, I came upon 4 small old workings, and at 400 yards, from these, upon a large old working, all the workings described to-day being upon the same lode of quartz which can be seen in outcrop for miles to the North. About $\frac{1}{2}$ mile to the West, I discovered another small old working near which the reduction of the quartz, taken from the whole of these mines, had no doubt been carried on, as here I found old mullers, and the surrounding country rock showed where the reduction of the quartz had been carried on to a large extent.

The breadth of the field described above is about $4\frac{1}{2}$ miles, the general bearing being due North, with a dip to the West at an angle of about 50°. The country here is most favorable for gold mining, being what the miner would call "kindly country." From information gathered from the old villagers, it would appear that these workings had not been carried on by the ancients of the surrounding villages, but by a class of men known in those days in Mysore as Jalagars, who were brought by the Nabob of Nuggihalli. These Jalagars located themselves temporarily along this gold-bearing zone; and those who worked the mines around Nuggihalli were driven out by the villagers, after the removal of the Nabob by the Raja of Mysore to Honnali, for taking improper liberties with their females; and to prevent their return or reworking of the mines, the villagers threw their dead into the pits, a practice which is kept up to the present day. This accounts for these workings not being carried down to a greater extent. I have requested the Amildar to prevent the making of these workings a burial ground, as it may interfere with the sale of the property hereafter. I found that every information that could possibly be got was placed at my disposal by the Amildar who accompanied me through this Taluk. No doubt the information was collected under the instructions of the Deputy Commissioner of the Hassan District, whose subordinates have given us every assistance in their power. The distance from the Railway under construction at Tiptur to Nuggihalli is 19 miles, 3 miles of which is a good road, and 16 miles a District Fund road requiring construction. From Nuggihalli to Hulikere is 2 miles and from Hulikere to Kempinkote is 4 miles. The latter 4 miles of road will have to be constructed. Building materials are in abundance and cheap. Timber for mining can be got from Hassan, 33 miles from Nuggihalli. Fuel will have to be brought from some distance, but sufficient local fuel can be got to last the mines for years. Labor can be had in abundance and very cheap. Ordinary man coolie can be had for 2 annas and woman coolie for $1\frac{1}{4}$ anna per day.

TIPTUR TALUK.

I proceeded from Tiptur to Iralgere, crossing a low range of hills. This range is granite intersected with hornblende dykes carrying considerable quantities of iron ore, but no other mineral of any value.

CHIKNAYAKANHALLI TALUK.

I proceeded from Iralgere to Chiknayakanhalli. The country lying to the East slope of this low range is intersected with chloride schist bands, but the predominating rock is granite. Many reefs of white barren quartz are to be seen traversing this tract from South to North. These reefs are not productive of gold, neither is the country here favorable for the production of that metal. As Chiknayakanhalli to the East is approached, the predominating granite begins to wear out and is replaced by hornblende schist and therefore becomes more favorable for the production of gold.

HONNEBAGI FIELD.

Mr. Marsh joined the Party yesterday. We proceeded this morning to Mr. Prideaux's famous Honnebagi and commenced regular prospecting in the most likely places where gold would be found on the banks of the Devarhalla stream leading to Durgadakere. On both banks of this stream, we found a thick iron conglomerate deposit containing imbedded quartz and other country rock which had been disintegrated from the Honnebagi hill on the West and from a low long range to the East, and overlying an alluvial drift from which I took several of my tests. I also examined the different water-courses leading to the stream and all I can say is that I found gold, but in small quantities only.

We then proceeded to the Honnebagi hill which lies close by, where we found some shallow old workings. A narrow band of chloride schist rock runs North and South on the East slope of Honnebagi, but the prevailing rock is gneiss, and the ancients have done little or no work on the slope of the hill. As far as I can judge, there was a trial made, but abandoned almost immediately. There are also a few shallow pits or trenches recently excavated by Mr. Prideaux on the part of Messrs. Wilson and Co. There are also on the South-West face of the hill a few shallow pits sunk by the ancients, but like those on the East, abandoned because they were unproductive. From here we proceeded South-West some two miles, where we discovered some very fine kaolin clay, which may yet prove of some value. The kaolin is of the very finest quality, and I have sent a sample to the School of Arts in Madras with the view of bringing it to public notice. On the 23rd July, we proceeded North-East of Chiknayakanhalli and examined a low range of hills called Kadekallugudda where we found some of Mr. Prideaux's workings, and after a most careful investigation and mechanical tests in the way of washings, not a trace of gold could I find. The country rock here is gneiss with bands of hornblende schist. There are some old workings here, but they happen to be for slab stones that were carried to the village for building and other purposes.

The Chiknayakanhalli gold-field, as it is called, is a continuation of the Shethalli-Nagamangala auriferous zone, and like the portion to the South, is gold-bearing, but whether in paying quantity remains to be proved. We employed two of the Jalagars who were supposed to make very good wages by washing in the Devarhalla stream, and I can say with confidence that working for 6 hours daily in this region, they would not collect two annas worth of gold in the month, the men themselves stating that they did not wash for gold in the nullahs, and that their employment was washing jewellers' ashes.

TIPTUR TALUK.

We proceeded this morning to Kamalapur, where we discovered nothing. Near the village of Hosur, iron-smelting is carried on, but not to a great extent. The smelting and puddling is carried on in the same manner as elsewhere in the Province, *viz.*, smelting in small furnaces, drawing off the slag through a vent hole in the side, and removing the iron by taking down a small portion of the furnace where the tewel hole of the bellows enters it. The iron ore used in these furnaces is clay iron which smelts readily without lime flux, and produces a magnificent malleable iron. On the North near the Balavanerlu tank of the Honnavalli Hobli, Tiptur Taluk, we came across four large old (gold) workings. The country rock is micaceous schist.

We found this morning some very fine crystal korundum but in small quantities in a rising ground to the South of Anivala. Lately trials have been made by the contractor here, but apparently he was unsuccessful. On the 29th July 1886, we proceeded to Lakkihalli and inspected a pit excavated by some European gentlemen in a rising ground to the West of the village. There is a fine reef, but the country rock is unfavorable for the production of gold. I examined a considerable quantity of stuff from this pit yesterday, but could find no trace of gold.

In investigating this portion of the country for the last 3 days, several traces of minerals were found, such as asbotite, erythrite and rutile. All these compounds of cobolt are to be found to the East and West of the range of hills called Malikal Tirupatibetta continuing North.

ARSIKERE TALUK, BELAGUMBA AMRIT MAHAL KAVAL FIELD.

We this morning proceeded 3 miles West from Annenahalli, where we came across a series of 6 old gold workings. Some of them have been carried down to a considerable depth, the length of one old working being 120 feet, breadth 60 feet and present depth 20 feet, another being about 100 feet long, 75 feet broad and 20 feet deep, and the other four being minor workings. These workings are on a continuation of the auriferous zone followed by us from the Hunsur Taluk, although thrown out of the bearing first taken, by granite protrusions, the country rock being the same throughout. But as we advance Northwards the granite cuts the schistian rock more frequently and throws it from one regular bearing of due North and South to some degrees East and West. The last old workings are in a chloride schist slate forming bands running North and South and about 2 miles wide. Long granite protrusions then occur running North and South parallel with the auriferous zone, the breadth of the granite to the West being about 1¼ mile. Here another large tract of auriferous country comes in. From here to the West, alternate series of chloride schist and granite form a basin from Janakalsiddarabetta to Jalagarnahalli to the South, and to Malikal Tirupatibetta to the North, the auriferous series narrowing in as it passes the South-West corner of this range of hills. I made several tests upon these old workings and in each test found a fair show of gold. We also found several stones on which the quartz was reduced. No doubt large quantities of gold have been taken from these old workings.

YELAVARI FIELD.

We proceeded to Yelavari, about 3 miles from Arsikere, and about ½ mile to the East of the village, we came across 4 old workings:—

(1)	Old working about	600 ft. long,	120 ft. broad	and 40 ft. deep.	
(2)	Do.	180	,,	90 ,,	35 ,,
(3)	Do.	90	,,	90 ,,	4 ,,
(4)	Do.	120	,,	30 ,,	4 ,,

These workings had been first commenced at a very ancient date and were more recently tried by the Dewan Purniah about the same time as he made an attempt at working the Bellibetta and the Kolar-Betamangala mines. Large quantities of gold must have been taken from here, as we found a very good show of gold in the washings, and the old mullers for reducing purposes were in great numbers. The country rock is chloride schist with its dip here to the East and strike to the North. The heavier or more massive portion of the reef these workings are on, stands in outcrop, being apparently too strong for the native appliances to work. The dip of the country here and all to the West of the granite band described in yesterday's observation, is to the East, while the auriferous country to the East of the band of granite just described dips to the West, with its strike to the North. The breadth of the gold-bearing land here is about 10 miles.

(To be continued.)

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Bombay, June 23, 1887.

Mr. J. Tate, Executive Engineer, Hyderabad Canals, is appointed to act as Executive Engineer, Eastern Nara Canals, in addition to his own duties, during Mr. Coghlan's absence on privilege leave.

India, July 2, 1887.

The services of Mr. E. J. Alexander, Assistant Engineer, 1st grade, State Railways, are transferred from the Establishment under the Chief Commissioner of Burma to that under the Director-General of Railways for employment on the Tounghoo-Mandalay Extension of the Burma State Railway.

Mr. A. D. Rollo, Class II of the Subordinate Revenue Establishment of State Railways, Management Department, is promoted as supernumerary to Class IV. of the Superior Revenue Establishment of State Railways, Stores Department, with effect from 1st April 1885.

Mr. H. Bell, Chief Engineer, 3rd Class, temporary rank, State Railways, is transferred from the Establishment under the control of the Government of Bengal to that under the Director-General of Railways.

Mr. Bell is appointed to act as Director of the North-Western Railway during the absence of Colonel W. A. J. Wallace, R.E., on privilege leave or until further orders.

Madras, June 28, 1887.

The following Public Works Department Notification, published in Part I. page 305 of the *Gazette of India* of the 18th June 1887, is republished :—

Mr. C. C. B. Knapp, Executive Engineer, 3rd grade, sub. *pro tem.*, Burma, temporarily employed on the Establishment under the Director-General of Railways, is appointed to officiate as Deputy Consulting Engineer for Railways, Madras.

The following reversion is ordered :—

Mr. F. W. Ashpitel, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 23rd May 1887.

The following promotions are made :—

Mr. F. W. Ashpitel, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 25th May 1887.

Mr. C. H. T. Norfor, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 3rd June 1887.

Rai Bahadur S. Subharaya Chariyar, B.C.E., Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 3rd June 1887.

Mr. G. E. Manson, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 3rd June 1887.

The following intimation, received from the Secretary of State, is published :—

Mr. A. B. Todd, Executive Engineer, 4th grade, sub. *pro tem.*, Madras, permitted to return within period of leave.

Burma, June 25, 1887.

Upper Burma.

Mr. James Donnan, Assistant Engineer, 1st grade, is transferred from the Mandalay to the Myingyan Division. Mr. James Donnan, Assistant Engineer, 1st grade, will officiate as Executive Engineer of the Myingyan Division from the date he takes charge until further orders.

Burma State Railway.

Mr. E. T. Faulkner, Assistant Engineer, 1st grade, received charge of the office of the Toungoo District from Mr. H. G. Billings, Assistant Engineer, on the forenoon of the 2nd June 1887.

Mr. F. R. Bagley, Executive Engineer, made over, and Mr. H. Groves, Executive Engineer, received, charge of the 5th Division, Tounghoo-Mandalay Railway ; on the afternoon of the 20th June.

Mr. F. R. Bagley is attached to the office of the Engineer-in-Chief, Tounghoo-Mandalay Railway, from the date of his making over charge of the 5th Division to Mr. Groves.

Punjab, June 9, 1887.

Major-General Æ. Perkins, C.B., R.E. (Aide-de-Camp to the Queen) Chief-Engineer, 1st class, and Secretary to the Government of the Punjab, Public Works Department, having vacated his appointment in the Public Works Department on promotion to his present military rank, is reappointed to the Department in the same rank and post.

The Governor-General in Council is pleased to order the following promotions of Chief and Superintending Engineers, with effect from the dates specified :—

Lieutenant-Colonel F. J. Home R.E., Superintending Engineer, 2nd class, and Chief Engineer, 3rd class, temporary rank, to be Superintending Engineer, 1st class, sub. *pro tem.*, with effect from 26th November 1886.

Mr. T. Higham, Superintending Engineer, 3rd class, sub. *pro tem.*, to be Superintending Engineer, 3rd class, special, with effect from 1st January 1887.

The Governor-General in Council is pleased to order the following temporary promotions and reversions to and in the classes of Chief and Superintending Engineers, with effect from the dates specified :—

Colonel J. P. Steel, R.E., Superintending Engineer, 1st class, to be Chief Engineer, 3rd class, with effect from 14th March 1887.

Mr. J. W. Wright, Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, with effect from 14th March 1887.

Colonel J. P. Steel, R.E., Chief Engineer, 3rd class, temporary rank, to be Chief Engineer, 2nd class, with effect from 17th May 1887.

Mr. T. Higham, Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, with effect from 17th May 1887.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "Star Press," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—Street & Co., 30, *Cornhill, E.C.*

NEW YORK.—The Scientific Publishing Co., 27, *Park Place.*

ROME.—Loescher & Co.

STRAITS SETTLEMENTS.—"The Straits Times," *Singapore.*

CHINA and JAPAN.—Lane, Crawford & Co., *Hong-Kong, Shanghai,* and *Yokohama.*

JAVA.—G. Kolff & Co., *Batavia.*

AUSTRALIA.—Gordon & Gotch, *Melbourne, Sydney,* and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.
An allowance is made for continuous insertions.

Owing to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, JULY 16, 1887.

VISCOUNT CROSS ON RAILWAY EXTENSION.

We confess having had some misgivings when noticing Mr. Jeans' paper read before the members of the East Indian Association on the subject of railway extension in India, that it was not a purely disinterested advocacy in the cause of the dumb millions of India, which actuated the Secretary of the Iron and Steel Institute to pose as their champion. We were not far wrong in our apprehension. The address was meant to be a feeler for the purpose of gauging public opinion before any further step would be taken in enlisting the sympathy of Government in the movement.

By a recent mail we learn that the Association of the Chambers of Commerce of the United Kingdom, through their representative, the Barrow-in-Furness Chamber of Commerce, had addressed a memorial to the Secretary of State for India, urging upon the Government the very great importance of developing the railway system in this country, and expressing a hope that the rate of progress in constructing railways here will be beyond that decided upon, when the views of the Secretary of State and of the Government of India were before the Select Committee of the House of Commons in 1884.

Every one interested in the development of India will be glad to learn that the reply given by Viscount Cross was, under the circumstances, the only one that could be vouchsafed. It is a pity that the Chambers of Commerce and other Associations at Home do not see the futility of the arguments they employ on the discussion of a subject of which they are not partially, but thoroughly ignorant. No one can for a moment doubt that the present systems of railway are insufficient to meet all the requirements of the Peninsula; and to this end extensions are being carried on almost every year, whenever necessity for them arises. But is it at all prudent to proceed with lightning speed. Those who clamour for it would be the first to condemn such a proceeding if they could only bring themselves to see what is so patent to the most ordinary understanding.

Over and over has it been represented to these philanthropists that in the carrying out of gigantic undertakings, the conditions that obtain in England, America, or on the Continent, are conspicuous by their absence here. In the former countries the Governments have scarcely anything to do in the matter beyond giving a formal consent to the registration of the companies, under whose auspices the works are executed. But in India there exists quite a different state of things, the Executive are inseparably connected with schemes of improvement, inasmuch as for their successful prosecution they must be accompanied by a guarantee from the Government of interest on the capital employed. And in order to carry out this part of the programme its financial position will have to be taken into account, and that we know to our cost is one of chronic deficit. What with the serious loss in exchange and other impediments a serious demand is entailed upon the resources of the State.

The next question is how is this pressure to be relieved. Although the English Chambers of Commerce do not say so in as many words, there is little doubt that if their opinion were taken, it would recommend fresh taxation. Now this is the only way of meeting the difficulty, but for which there is no room left in the present state of the country. It would be a dangerous game to play even to satisfy the clamours of the moneyed and influential classes. And it is satisfactory to find that Viscount Cross has reminded them of this little fact in as delicate a way as his position would permit; referring to the imposition of a further burden on the exhausted taxpayer of India he says this "was clearly recognised in the Report of the Select Committee on Indian Railways of 1884, of which you were a member." It should also be remembered that the Committee emphatically endorsed a declaration of the Government that the proposed extension of railways should not involve additional taxation.

To prove to the Association how earnest the authorities here have been to promote inter-communication by steam between the several provinces, notwithstanding serious difficulties in their way, we are told that within the last five years several extensive railway works have been undertaken, which include frontier lines in the North-West, lines in Burma and in various parts of the country, which, besides serving important political and commercial purposes, will assist to mitigate the effect of famine, and all these have cost in the aggregate about thirty-five millions sterling. In conclusion the Secretary of State assures the memorialists that although little help can be afforded from the public exchequer, the field of private enterprise is unlimited, and he is willing to offer all reasonable facilities in his power or in that of the Government of India to the free exercise of such an agency, at the same time that he invites suggestions from them in view to the application of the principle. Here is a splendid opportunity for the employment of British capital in the prosecution of undertakings that are calculated to develop the material resources of this country, and if British capitalists believe in what they say, they should not any longer sit with folded hands and appeal to Jupiter for help when the only thing necessary is to apply their own shoulders to the wheel.

SURVEY OPERATIONS IN THE STRAITS SETTLEMENTS.

The Government of India have, at the request of the local Government, lent them the services of an experienced survey officer with the object of having the whole of the survey operations of the Straits Settlements placed on a proper footing. The idea is that such an officer should test the triangulation already completed in Penang and Malacca, mark out and measure a base line, and, after gaining acquaintance with the manner in which the survey work has been actually carried on, advise the Straits Settlements Government how to organise its Survey Department. The Revenue Survey at present in progress is unconnected with the triangulation and it is considered advisable to effect such a connection in order to insure accurate plans and gradually to arrive at a complete registration of titles and eventually to furnish accurate maps for general administrative purposes. Colonel W. Barron, the officer selected for the purpose, is well known for his distinguished services in connection with the Great Trigonometrical Survey of India. He is also familiar with Revenue Survey work, having been lately in charge of the Mozufferpore Cadastral Survey.

In process of time it will be found feasible to connect the triangulation of the Malayan Peninsula with that of the Great Trigonometrical Survey of India whose Eastern frontier series has been carried down, we believe, as far as the Pakchan river, which forms the southern boundary of the British province of Tenasserim. Not far from the southernmost limit of the extension of this vast Indian survey a base line was measured as a final check upon the calculations of the triangulations carried down through Arracan, Pegu and Tenasserim. This base line is not, as one might expect, upon the mainland, but was laid down upon one of the islands of the Mergui Archipelago by the late Mr. Beverley of the G. T. Survey and the party under his direction. The primary base line from which this Eastern Frontier triangulation started is in Bengal, and the survey work between the Bengal and the Mergui is reported to be of marvellous accuracy. Any Trigonometrical Survey organised by the Straits Settlements authorities will naturally seek the Mergui base as its objective. The Siamese Government should be invited to co-operate whenever these extensive survey operations are proposed to be carried out. In fact, we believe that many prominent points within the Siamese frontier are already fixed and the extension of the triangulation into Siam would be comparatively easy. At all events, the initial expense of providing a base line at the northern end of the Peninsula need not be incurred. Further, the Survey Department of Siam is at present in the hands of Mr. J MacCarthy, who along with his second in command, Mr. D. G. Collins, was largely concerned in the work of the Eastern Frontier Series before the G. T. Survey of India was abolished. It will be easily seen, then, that whenever the Straits Government shall decide to connect the Trigonometrical Survey of the Malayan Peninsula with that of India they may possibly receive effective aid from the Siamese Government, who have the very men in their service at present that did much of the work in Tenasserim. When that connection takes place, which it will do sooner or later, we shall have a series of perfectly measured triangles and polygons extending from peaks of the Hindoo Khoosh on the Afghan frontier and others on the Pamir plateau on the confines of Kashmir, across the whole of India to where China and Assam meet, and south through Burma and the Malay Peninsula to Cape Romania. For administrative purposes such a survey is invaluable, for it furnishes the essential data upon which are based the minor Topographical and Cadastral Surveys, and these latter again, cannot be dispensed with if a satisfactory land revenue system is to be created.

The Straits Settlements service is recruited from Ceylon, which is partially triangulated and whose triangulation has just been connected with the Indian system.

THE AGRA MUNICIPALITY.

THE annual report of the Agra Municipality, says the *Pioneer* of the 7th instant, "gives evidence" that the citizens of that town are continuing in their "good works." But what we would like to see is a report from some Government officer of the P. W. D. regarding the public works carried out by the members of the Board. What the public requires is an honest and unbiassed opinion from an outsider.

As far as we are aware the Municipality keep up most of their main lines of communication in very fair condition, but most of the branch and link lines are anything but in good order. And yet last year we were informed that the finances of the Committee were in a flourishing condition. If these branch roads are not required they should be done away with, and the land utilized for other purposes; but if the roads are required, they should be put into good order. In our opinion the Executive Engineers of Divisions should be deputed annually to inspect and report on the condition of Municipal Public Works. Until lately the local works affairs were just as bad, but since alterations have been made in the system of *construction* and *supervision*, notably in the N.-W. P. and Oudh, things are getting into better condition.

Regarding the artesian well there is still a hankering after the "old love" in spite of the *veto* put upon its construction by a specialist. Water appears to have been *found* in the pipe at a depth of 30 feet below the surface of the ground *during the rainy season*, but there it remained. Now, as far as we can remember the history of this well, the total depth of pipes underground was about 650 feet, the last 50 feet or thereabouts being in *soft* and *hard sandstone.* The hard rock lying below all. It is therefore reasonable to suppose that the end of the pipe had not struck an artesian spring. We conclude from this that the "phenomenon observed" was nothing more nor less than the result of dripping of rain water from the scaffolding above and the steam crab, which was directly over the mouth of the 9-inch pipe and completely exposed to the rain.

If the President is not satisfied with the opinion of a geologist, and experience attained from the "sad past," and is moreover competent to spend money belonging to the tax-payer *ad libitum*, we would advise him to procure plant for a boring of 2,500 feet, together with the necessary skilled labor. When this is at hand, the rest will be plain sailing. But they should commence work with the resolve of steadily boring until an artesian spring is found between ground and the extreme range of their resolve, *viz.* 2,500 feet, and when this depth is obtained with no results, then operations should cease.

We have elsewhere referred to the proposed artesian boring at Lucknow where the grounds of possibility and hope are sufficient to recommend a trial. These prospects are considered more favorable than those under which the Agra boring was undertaken. The *locale* of the latter was declared to be the worst place that could be chosen for the purpose in the Gangetic basin of Upper India, on account of its great distance from northern sources of water-supply and its actual proximity to the southern edge of the basin. The total cost of the experiment has been roughly estimated at Rs. 19,000; and we think that the Commissioners should rest satisfied after this.

THE WORKING OF THE E. I. RAILWAY CO.

MR. R. W. CRAWFORD, Chairman of the E. I. R. Co., has published a memorandum, embodying a statement of the actual outcome in sterling and rupee currencies respectively, of the working of the undertaking, during the seven years 1880-86 inclusive. It appears that the revenue receipts from all sources during the term were Rs. 32,61,59,517 and the working expenses Rs. 11,49,34,921—the latter includes a sum of Rs. 36,13,674=3·144 per cent. of the entire working charges, being the cost of replacing 143 locomotives and 57 tenders by the same number of much more powerful engines of a newer and more approved style. The nett receipts were, therefore, in round numbers, Rs. 21,12,24,595.

Out of the last mentioned amount Rs. 14,10,18,384 was paid towards the Annuity under the Purchase Act, and all interest on Debentures and Debenture Stock, on Debentures paid up and on overdrawn capital. Rs. 29,95,343 was paid as interest on moneys advanced on outlay for capital purposes, Rs. 28,00,203 towards interest on value of stores in hand, and Rs. 21,12,286 as contribution to Provident Fund. Deducting these several items from twenty-one crores quoted above there remains a nett profit of Rs. 6,22,98,378. This sum was divided between the Government of India and the E. I. Railway Co., the former receiving about five crores as their share of the profit on the working of the undertaking under the Purchase Act and Contract. But this is not the only gain which has accrued to the State. During the term of seven years covered by the report it provided upwards of two crores of rupees for the capital purposes of the undertaking, for the enlargement and improvement of their own property. There was no occasion to float a loan in the market for the purpose, or for the levy of a tax to meet the requirement. The demand was met by the profit they received every succeeding half-year from the concern. These advances returned an interest of nearly thirty lakhs at the rate of four per cent., in addition to twenty-eight lakhs, the interest on the value of the stores kept in hand, so that taking one thing and another the Government has received as revenue, without deduction of any kind whatever, five and a half crores of rupees. Besides the above the State has also received a sum of four lakhs, being the weekly gross traffic earnings, *minus* the working charges. In all these calculations the rupee has been estimated at 1*s.* 7·59*d.*, the average during the seven years under review, of the official rates of exchange. In conclusion Mr. Crawford says:—"This memorandum is written and made public as an indication of the broad principles which underlay the principles of 1879; as a record of the magnitude of the interests involved in the prosperity of the East Indian Railway undertaking and as a factor in the consideration of any re-settlement of existing systems which may come under discussion."

Notes and Comments.

Bengal-Nagpur Railway.—Orders have been received by the officer in charge of the Ragoonathpore-Chandil Division of the above Railway to arrange for the immediate commencement of work in this division.

A Probable Appointment.—Who succeeds the late Mr. G. H. Bayly, B.A., C.E., Executive Engineer, of the Ashtagram Channel Division of Mysore, is not known, but many expect that a certain native Engineer, who was an able and trusted assistant of Mr. Bayly, will take his place, and the Engineer's seniority and experience in the department quite warrant these expectations.

The P. W. D., Bombay.—A correspondent writes: "You will have lots to write about this Presidency soon and its P. W. D. The Sind supersession will be nothing compared to what is now about to overwhelm us all—A 2nd grade Executive raised to 1st grade Chief Engineer!!!" We fancy that all the disturbances in the Bombay P. W. D. are not yet over.

Burrakur Iron Works.—The Iron Works are very slack at present, for *want of orders*. It was thought that the *Nagpore Railway* would have taken their *sleepers*. It would have been a good thing for the collieries if they had, for it was *intended* to blow in the *second furnace* to meet the *orders*, and more *lime, iron, coal*, and *coke* would have been required. As it is they have large stocks of all on hand. The collieries are also *stacking coal—no sale.*

E. I. R. Collieries.—*Rumor* has it again that the *East Indian Railway* Company are going to begin to sell steam coal next month to one of the *State Railways.* "Another attempt to kill *the dog without hanging.*" The outturn of steam coal from the Company's collieries for the whole of the year 1886 was 167,018 tons, against 183,847 tons in 1885. The quantity consumed by the undertaking was 187,818 tons, at an average cost, including carriage, of 8*s.* 10¼*d.* per ton.

The Ganges Canals.—It is notified for general information, that the Upper Ganges Canal will be closed for repairs as soon after the 1st July 1887, as the state of the weather will permit. The Cawnpore Branch, Lower Ganges Canal, will also be closed during the same period as the Upper Ganges Canal. The head of the Lower Ganges Canal at Narora was closed on the evening of the 17th June 1887, in order to clear out the inlets and outlets of silt tanks, and re-opened on the evening of the 29th idem.

The Lucigen.—An interesting trial of this new light was made the other night at Bombay in the presence of several gentlemen connected with the Port Trust. As there was a strong wind blowing at the time, but the night was not dark enough, the experiment was carried on under unfavorable circumstances. The trial, however, proved that as a beacon light it would answer the purpose admirably well, but it was doubtful whether it would serve to light a shed stored with any materials, but iron and other metals, as the heat which emanates from it is intense.

A Railway School.—The employés of the B. B. and C. I., and Rajputana-Malwa Railways are to be congratulated on the successful establishment of a school for their children in the bracing atmosphere of mount Abu where they will grow up "physically strong and healthy, full of self-respect and self-reliance, proud of their work, and of doing it well, whatever it may be; and not as many of those brought up in this country are, ashamed of any work with their own hand in even the most skilled branches of mechanical art." The two railways have contributed the entire cost—Rs. 1,10,000—and they will also pay something like one-half of the cost of maintenance.

Proposed Artesian Boring at Lucknow.—The Municipal Board of Lucknow hope to commence the sinking of an experimental artesian well for the water-supply of the city as soon as the rainy season ends, and they expect a year hence to be able to report the result. The importance of the object at stake, and the difficulty of otherwise securing an adequate supply of water for a population exceeding a quarter of a million, justify the expenditure of Municipal funds on the projected experiment, even though the failure of similar borings at Agra should render success in any locality within the alluvial basin of the Ganges problematical. Lucknow is one of the "propitious positions" indicated by Mr. Medlicott.

West of India Portuguese Guaranteed Railway.—From the 41st mile, to which the railway is being worked to the 51st mile, its termination at the British frontier, very little remains to be done beyond the erection of two spans of 90 feet of the ironwork of the escapement viaduct. This ironwork is in India and the masonry is finished. The structure will be completed during the monsoon and the rails laid through to the Southern Mahratta Railway. Unless, therefore, damage should occur during the rains, the West of India Portuguese Railway will be finished in November next, and it is believed that the Southern Mahratta Railway will be ready about that date.

An Inconvenient Question.—Mr. King, in his place in the House of Commons, asked the Under-Secretary for India, three weeks ago, whether it was true that special allowances were granted to two military officers—namely Lieutenant-Colonel J. Brown, R.E., Engineer-in-Chief of the Sind-Pishin State Railway, and Major T. Gracey, R.E., Superintendent Engineer, Burma,—while civil engineers assigned to similar duties in the same districts were refused the same privilege; if so, under what circumstances and on what grounds the distinction was made. Sir J. Gorst said:—"The Secretary of State has no information of any such allowances having been made to the officers mentioned in the question." The fact is he never has. *Vide* our "Note" on Major Gracey's appointment in the issue of the 16th April.

Indian Gold Mines.—Mr. William Abbott reports that business in this market at Home has been fairly active during the past month, but there has not been anything like excitement. It is far better that the place of the mere speculator should be taken by the real investor, who can pay for his shares and hold them in spite of temporary checks and market fluctuations. The process of sinking is slow—indeed, very slow—but when it is remembered that the deepest mine—the Mysore—has got rich quartz throughout the mine from 170 to 400 feet, while in Queensland the shafts are down below 1,000 feet, it must be admitted that facts and prospects are in favour of Indian gold mining, and I know by experience that prospects command a higher market value than actual results.

The Khojak Survey.—A telegram to the *Bombay Gazette* says that Mr. O'Callaghan and staff, having completed the Railway survey over the Khojak Pass, break up their large camp at Shellabagh and return to Quetta. Mr. Wood, with a small survey party, will remain at Chaman for the present. Rumour says that the Engineers will return in September, when the actual work of construction will be commenced. Captain Duperier, R.E., and Captain Harvey, R.E., are surveying for a new road with gradients of 1 in 25, as the old military road is considered too steep, although it has been repaired and widened. The correspondent adds that the weather is very hot, the thermometer standing at 103° in the tents.

Purchase in India of Iron-work.—In January last the President of the District Board, Tinnevelly, applied to Government for permission to purchase from Messrs. Richardson and Cruddas in Bombay, the iron-work required for the Srivaikuntham Bridge. The Madras Government now say that the Government of India have found themselves unable to sanction the purchase in India by the Tinnevelly District Board of the iron-work required for the bridge. The iron-work will therefore have to be obtained through the Secretary of State in the ordinary way. It may be mentioned that the bridge to be constructed over Srivaikuntham anicut is situated 15 miles east of Palamcottah. The girders will be erected at a height of 24 feet above the bed of the river (which is sandy) and 17½ feet above the crest of the anicut. The total estimated cost of the bridge is Rs. 1,10,000.

North-Western State Railway.—The Engineering staff of the North-Western Railway are having an anxious time of it just at present, the break of the line by floods between Umballa and Saharanpur, almost in the same place where an accident occurred last year, followed by those on the Oudh and Rohilkund and the Hurnai line, have seriously interfered with the traffic. Temporary arrangements have been made for the conveyance of passengers and mails across the breaks, but these will hardly stand against a repetition of the floods; the Beas and Sutlej have risen very high. The Ferozepore bridge recently erected was visited by a special committee of Engineer officers to see how it has been affected by the rise of the waters. It is apprehended that one of the abutments has suffered and protective works must be resorted to to prevent further damage.

Mineral Prospects, Hyderabad—Deccan.—The mining interests of His Highness' dominions are looking up. Messrs. Hughes and Molesworth have been directed to survey the Singareni Coal Fields in view of an estimate of their value being obtained; it is further reported that the Hyderabad Mining and Trading Company have disposed of these fields for the sum of one million sterling. The old Golconda mines are also being overhauled by an expert of the diamond trade. He examined the old working, as well as those on the Kistnah river, in December and January last; so that an industry which in the days of Tavernier employed many thousands may yet again be revived. Mr. Hughes has also been prospecting for gold, as yet unsuccessfully, in the vicinity of Shantageri. That the Nizam has faith in the producing powers of the mines in his dominions is evident from the fact that his Government has invested very largely in the Company's shares.

Irrigation Works in Sind.—A few weeks ago we stated that the increase in revenue in Sind for the year 1885-86 was due to Colonel (now General) LeMesurier's Administration. We now find that another Engineer was in charge of that circle in 1884-85 and for three-fourths of 1885-86, and that much of the increase in revenue was due to new works, which were constructed while he held the Acting Superintending Engineer's office. It was he who supported and obtained sanction for the opening of new mouths, new branches and new protective embankments, that had long been advocated by the Executive Officers in Sind, and they were carried out while he was in charge. The results were the greatly increased revenue we have been noticing. We do not say for one moment that Colonel LeMesurier's general policy had not also led to increase of revenue, new settlements and new terms, but we do consider that the immediate increase in the year 1885-86 was due to what was done while another officer was in charge.

The Buckingham Canal.—A wordy war is now raging in Southern India in consequence of some remarks of Mr. J. H. Garstin, C.S., C.S.I., at the Prize Distribution of the Engineering College relative to the constructor of this waterway. Mr. Garstin fell into the mistake of giving Captain Henderson, R.E., more credit than was his due in connection with this great work. In doing so, he quite ignored the services of Mr. J. O'Shaughnessy, who had the organization, the management, and the direction of the undertaking, on which Captain (then Lieutenant) Henderson served under Mr. O'Shaughnessy who was the Engineer in charge. The feat achieved by Mr. O'Shaughnessy is without a parallel we think in Canal Engineering. A length of 120 miles of canal was opened for traffic within 13 months after the work was commenced. The excavation amounted to over 9½ million cubic yards, about ¼ of which was taken out of water from 3 to 7 feet deep. The average number of work people employed daily was 32,000. This was during the Madras Famine of 1876-78.

Kilby's Patent.—Another experiment has been tried with Kilby's patent salt weighing machine. We take the following account from a contemporary:—The weighing machines may be compared to huge open cauldrons with a scale and beam running across the top, and seem about seven feet in length, four in breadth, and about a foot in depth. These are placed over wooden stages erected on the sides of the vessel, and a patent automatic counter on the outside of each machine registers the number of times the machine is tilted over and discharges a "draw" of salt. Each of these machines discharges 15 maunds of salt, and the handling of a small lever is all that is required to tilt it over and bring it back to position again. The salt is drawn up from the hold by means of patent buckets, some of which open out underneath and others at one side, handling another small lever being all that is necessary to open them and close them at each discharge of the salt. The salt is discharged from these buckets, by steam power, on to a platform on which the scale stands, and it is then shovelled on to the scale by coolies. During a full day one scale alone discharged 7,080 maunds of salt, the like of which has never been known before, another vessel, the *Ethington*, having previously discharged with the aid of one scale 6,210 maunds during the day.

Current News.

Mr. Horace Bell has assumed charge of the North-Western Railway at Lahore from Colonel Wallace.

From the 1st proximo the Nellore-Cuddapah State Railway, which has been taken over by the South Indian Railway Company, will be open for passenger and goods traffic.

The heavy rains in the Bolan are severely damaging the railway. On the night of the 6th instant the line was washed away in several places between Mach and Bebinani.

The Nizam's Government has deputed one of its Educational officers to prepare a monograph on the art products of the Dominions in compliance with a request from the Government of India.

Sir W. Davies' name is mentioned in Simla—though the matter so far is probably the merest supposition—as a possible successor to Sir Theodore Hope.

The charge of the Public Works duties in the Baroda cantonment has been transferred from the Executive Engineer, Ahmedabad, to the Executive Engineer of Kaira and Panch Mahals.

According to the report of the external land trade for Sind for 1886-87, the imports by rail and road have fallen off from last year's figures by a lakh and a half, and the exports by fourteen lakhs.

The "Indian Explosives Act, 1884," came into force on the 1st instant, and the rules to regulate the transport and importation of explosives are published in the *Gazette of India* of the 25th ultimo.

The Guntakul-Nundial Section of the Bellary-Kistna State Railway, a distance of 90 miles, will be opened for passenger traffic on the 11st instant. It will be worked by the Southern Mahratta Railway Company.

The rainfall at Cherrapunji, in the week ended the 23rd of June was 41·35 inches, making a total fall from the beginning of the year up to date of 220·07 inches. Last year the fall up to the same date was only 111·76 inches.

The Government of India have sanctioned the purchase of a new first-class dioptric light from England for the lighthouse of Manora, Karachi, on the understanding that the value of the old light is credited to the defences.

Rurki is to be the "Chatham" of India for scientific instruction. It is intended to carry out siege operations there on a grand scale, for which purpose it will be occupied by three garrison batteries of artillery and no infantry.

The B. B. and C. I. Company are, it is understood, quite willing to begin the construction of the Simla-Kalka Railway at once. The matter, therefore, now only awaits the initiative of the Hon'ble Member for Public Works.

Lieutenant-Colonel H. L. Prendergast, Royal (late Madras) Engineers, and Lieutenant-Colonel J. H. Bedford, Royal (late Bombay) Engineers, have retired from the service on a pension, extra annuity, and with the honorary rank of Major-General.

We learn that the well-known firm of Government Contractors, Messrs. Edmund Jones and Co., of Rangoon, have again secured the contract for the supply of general stores to the Public Works Department, both in Lower and Upper Burma.

Captain Abbott and Lieutenant Hilyard, Military Works, P. W. D., will be transferrred from the Punjab to special duty under the Government of India, on the "defence works," which we recently announced as about to be undertaken.

The extension of the Madras Civil Engineering College buildings, which Assistant Engineer Mr. Stephens, the officer in charge of the work, has pushed on so rapidly, has been suspended for almost the last two months for want of the necessary iron girders for the roofing.

The Madras P. W. D. authorities are evidently not satisfied with the present designation of the Tank Department, they have just decided to change it from "The Tank Maintenance Scheme Branch" to "The Tank Restoration Scheme Branch," which was the designation selected in 1884 by the then Chief Engineer.

We hear that the survey for extending the railway from Peshawur to Fort Jamrud has been begun. It is to be hoped that Government will order the line to be laid down with the utmost rapidity. The situation in Afghanistan continues to look gloomy, although it is not as bad as it was ten days ago.

It has been notified that Indian Service, so far as regards service for pension of officers of Royal Engineers who have elected for continuous service in India, will reckon, as in the case of other officers, from the dates of arrival in India, three years of British service being, however, also allowed to reckon as India service.

Funds have been placed by the Accountant-General, with the approval of Government, at the disposal of the Nizam's Guaranteed Railway Company for the construction of a railway between Bezwada and the frontier of His Highness the Nizam's dominions.

It never rains but it pours: and when it pours overmuch the Railways have a bad time. In quick succession, the Oudh and Rohilkhand and the Hurnai line have followed the example of the Railway near Umballa, and have developed breaches of continuity. On the former, floods near Saharunpur have stopped the traffic; and on the latter a landslip is reported to have done the same.

It has been decided that the existing stock of the Madras Railway shall be augmented by 370 goods vehicles at a cost of Rs. 6,00,000, and that the rolling stock be brought up to its full sanctioned equipment. Of these 370 vehicles, about 70 are to be capable of carrying 16 tons, and are to be used for the conveyance of permanent way and other heavy material, stone and laterite.

Lieutenant-Colonel E. D. O. Twemlow, R.E., has been appointed to act as Executive Engineer, Bombay Defences, during Colonel Merriman's absence; and Major W. H. Haydon, R.E., to be Executive Engineer in charge of the Karachi Defences. The latter officer will make over charge of the duties of Executive Engineer, Lower and Central Sind, to the Executive Engineer, Karachi.

Our Mysore correspondent writes:—Mr. McLaughlin has been appointed to be the late Mr. G. H. Bayly's successor. He leaves for Bangalore in a day or two and will return early to take over charge. Mr. Govinda Charlu will, in the meantime, continue acting for him. It is hoped that in Mr. McLaughlin, the Irrigation Department will find an officer like the one they have just lost.

While sanctioning the scheme for creating the post of Assistant Controller of Stores of the East Indian Railway, and, also the proposed appointment of the Store Accountant of the Company to that post, the Government of India is said to have decided that the incumbent should commence at Rs. 600, his present pay, instead of Rs. 700, as has been proposed, progressively rising to Rs. 750 a month.

The Bengal and North-Western Railway Company has, we understand, made a proposal to the Government of India to purchase and complete the Assam-Behar system of lines, including the Tirhoot lines, upon what is known as "South Mahratta terms." That is to say, the Company would raise the required capital by $3\frac{1}{2}$ per cent. debentures, guaranteed by the Secretary of State, and receive a quarter share of the net earnings.

The Municipal Commissioners met to-day to try the well sunk in the bed of the Saburmuttee for the water-supply scheme, and declared it a success. The steam pump of the well supplied more than 850 gallons per minute, giving ten gallons per head in twenty-four hours. The well has been sunk, as recommended by Colonel Ducat, under the superintendence of the Municipal President and the Secretary.

The basis of agreements between the Government of India and the Bombay-Burma Trading Corporation is that the Corporation shall continue to work the forests up to the termination of the leases granted to them by Theebaw, paying, however, a royalty per log cut instead of a lump sum yearly. This provision is, of course, designed to provide against a state of things which would make it the Company's interest to cut down all the timber they could lay hands on while the forests remain in their hands.

We understand that the whole of the defence works throughout the country, including the entire coast line, are to be brought under the administrative control of the Military Works Branch of the Public Works Department. There are, moreover, signs of the probability of greatly increased activity in this direction, by a demand for some 30 additional junior Royal Engineer officers, to be drafted from other branches of the Department or other available source.

We are glad to learn that Mr. Geoghegan, the Engineer-in-Chief of the Madras State Railway Surveys, who has been on special duty at Madras for the past month, has so far recovered from his recent illness as to be able to return to his head-quarters at Bangalore, having completed the submission to Government of his reports upon the Villupuram-Paikal and other lines of survey executed by the State Railway Department. Mr. Geoghegan proceeds Home on furlough at once.

Colonel Lovett, C.S.I., Superintending Engineer, Military Works, Rawal Pindee, and Colonel Stewart, R.A., along with Major Warburton, lately paid a visit to Landi Kotal, returning to Peshawar on the 30th of June. What the place requires more than anything else is an improved water-supply. Tanks, wells, and dams to hold and collect the rainfall are matters of essential importance to both the residents and travellers using the Pass. Whatever money is spent on such works will one day be repaid.

Mr. Wynne, Engineer-in-Chief of the Bangal and Nagpur Railway, has decided to make Asansol, rather than Sitarampur, the junction of that long-looked-for line with the East Indian Railway. The wisdom of this decision will appear to all who know what a large and important station Asansol is, being a head-quarters of the East Indian Railway, where trains are made up and engines changed, and where, therefore, there is always a large reserve of locomotives for emergencies and extra trains.

Mr. G. M. Stewart, the Agent of the Southern Mahratta Railway Company, retires in September next, and will be succeeded by Colonel Lindsay, R.E., the present Chief Engineer, who will then conduct the duties of both Chief Engineer and Agent. Mr. J. Craik, the Traffic Manager, is also going home on three months' leave. There is a rumour that the head-quarters of the Southern Mahratta Railway will be removed from Dharwar to Poona, when Colonel Lindsay becomes Agent, as he is said to be opposed to the former station being his head-quarters.

THE coal obtained from the Makum field is meeting, as anticipated, an extensive demand in many quarters. It is sold in increasing quantity to the tea factories of Lakhimpur and adjoining districts, and large use is made of it by the steamers trading on the Brahmaputra. Many ocean-going steamers trading with Calcutta also find its use profitable, and a demand is growing up for it in that direction. The coal is found to suit many of the requirements of the Bengal railways, and large quantities are delivered to the Eastern and Northen Bengal State Railways, the Dakka line, and the Kaunia-Dhubri and Darjiling Railways.

THE break in the North-Western Railway appears to have occurred on the Umballa-Saharanpur section between the stations of Barara and Kesri. This is just where the line was breached this time last year, and it is evidently the same story of heavy rain on the lower hills where the forests have been allowed to go to destruction. The principal damage done is the washing away of one girder of the new three-span bridge between the two stations, but the damage is being rapidly repaired and the water apparently as rapidly subsiding. A temporary service across the break for passengers has been organised, but the line can hardly be safely recommended to nervous persons or invalids for two or three days to come.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

A CRY FOR IRRIGATION.

SIR,—I request you to give insertion to the following in your valuable Journal. The Anantapur District, Madras Presidency, is a very dry country and presents to an observer a naked and desolate scenery everywhere, except in the Madaksira Taluq, which was once styled the garden of the late Bellary District. Even this small oasis of this almost barren land has since become a waterless place. Such is the state of the district, even though the Pennar and its tributary Chitravaty traverse it.

It is much to be regretted that the precious liquid of the main river is not utilized for irrigation purposes to any considerable extent, except for a few spring channels which are taken here and there to irrigate small patches of wet lands. The Chitravaty is better appreciated and it is first led into the Bukkapatnam Tank which has a large ayacut of 3,541 acres with assessment of Rs. 22,401. The surplus water of this tank goes to the Dharmavaram Tank which is 20 miles below it and which has an ayacut of 1,401 acres with Rs. 10,015 assessment. The Chitravaty then reappears from the five waste weirs of this tank. Except these two solitary instances, nowhere is the water of the two rivers used for irrigation purposes.

As some of your readers are aware, these rivers take their source from the Nundydroog in the Mysore Provinces and pass through this district—the one traversing a great portion of the west and north and the other a portion on the south-east. The district is, as it were, encompassed by the rivers.

It is a subject for regret that the Madras Engineers have shut their eyes and do not look to a chance of converting this barren district into a granary of plenty by means of some anicut systems. From my observations of the whole country and the Pennar at different points, *viz.*, Hindupur, Pethamanathoor, Calooipully, Buthigumma, Penoblam, Pamidly, Ekkalur and Tidpatri, I am perfectly convinced that its water can be brought into the Anantapur and Singanamallai Tanks, if not of some other minor ones, which are seldom, if not at all, filled with sufficient quantity of water to irrigate the lands under them. This project, if adopted by the Madras Engineers, who are averse to new schemes, will be better by far than the Protective Railway works such as Guntakal, Hindupur and Tirupaty-Dharmavaram lines. Prevention is better than cure. This adage if acted upon, will prevent the decennial famines completely and the necessity for constructing such protective works at enormous expense to the State will totally disappear.

I hope the Madras Government will be induced to make further trials on the lines here proposed.

If the experiment prove a success, which I firmly believe it will do, the railway works which are under construction, and which are proposed to be constructed, instead of being "protective works" as they are intended to be, will become "productive works." When the project becomes a *fait accompli*, these railways will carry the produce of this district to other places where it will be much needed in times of scarcity. As it is, the district is poor and entirely depends upon the fickle *Varuna*—the god of rain. The revenue realised from lands under some of the principal tanks is but small owing to the scarcity of rainfall in the Ceded Districts, which is on the average only 14 or 15 inches a year. This will be obvious from the following :—

Tanks.		Acres.	Assessment.	Revenue for *fusli* 1295. Rs.
1. Anantapur ...	...	3,108	14,450	8,120
2. Bukkapatnam ...	...	3,541	22,401	10,998
3. Dharmavaram	...	1,401	10,015	1,527
4. Singanamala ...	...	3,661	18,253	8,021
5. Parigi ...	...	2,744	11,450	10,429

It becomes, therefore, necessary that every drop of water should be utilized to the fullest extent in this district. Besides these, there are innumerable small tanks or *coontahs*, none of them river fed, and all of them dependent upon the 14 inches of rain, which falls in showers few and far between.

C. N. S.

MAIN'S LATTICE BRIDGES.

SIR,—I trust your readers will not think I have any grudge against, or rivalry with, Messrs. Main, if I write again to criticise their design for lattice girder bridges in your issue of 25th June.

Such is not the case, and a fair criticism can do no harm to them, as, if well founded, the objectionable details can easily be altered, while if their design is proved to be unimpeachable, the discussion will still not have been a waste of time or space.

Firstly, then, I ask, why when there is a load on every bottom apex in the bridge, does the strain sheet shew the loads applied at top only ?

Secondly, as regards the detail of the structure itself, I should say that sufficient attention has not been paid to securing uniform distribution of stress.

There is nothing in either elevation or cross section to indicate a hanger direct from the cross girders to the top apex from which they are supposed to depend. If there is nothing more than the stay, as shewn in figure, they cannot be considered to be hanging by two rivet heads, and with the strain not even fairly applied to these, but with considerable leverage to wrench them off.

If they are carried by the bottom boom, on which they rest, they produce in it a bending moment of 18·75 inch tons, which divided by 3·03 inch units (the moment of resistance of the T-iron as a beam) gives a strain on the ultimate fibres of $6\frac{1}{4}$ tons per square inch.

The uniform strain on the T-iron is from the strain sheet 24·42 tons, the gross area 4·25 square inch, and deducting for $2\frac{5}{8}''$ rivets the net area 3·36 making the strain 6·7 tons per inch (from which it appears to be a T-steel).

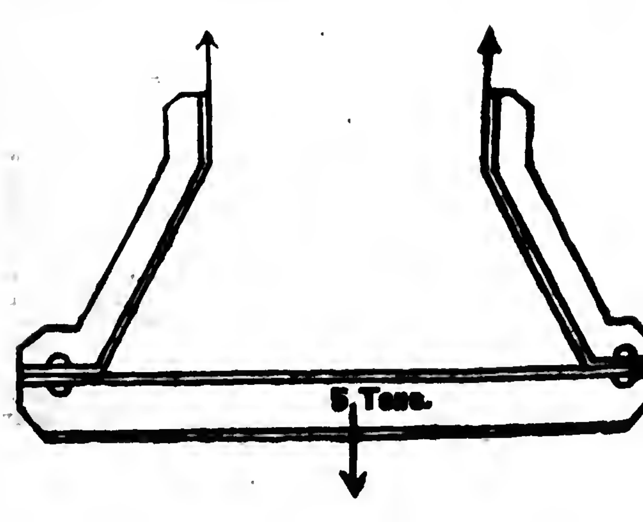
The strain therefore at the centre of centre bay *may* amount to $6·7 + 6·25 = 12·95$ tons on one edge and $6·7 - 6·25 = 0·45$ tons on the other edge. I say, *may*, because the stay will transmit an uncertain amount of the load to the top apex as the T-iron bends, but unless a direct hanger, well fitted, is provided, the bottom boom must have some transverse strain.

If this is arranged for, there is still an objectionable arrangement in those bays where the cross girders are placed about 9″ from the apex, resting on the bottom boom. Here the bending moment over the apex will be (approximately) 5·6 inch tons. which divided by 3 inch units as above, gives 1·86 tons per square inch.

The uniform stress is $\frac{22·47}{3·63} = 6·19$ inch tons, so that the strain on the different edges of the T-iron will be $6·19 + 1·86 = 8$ and $6·19 - 1·86 = 4·33$ tons per square inch.

The exact solution of the strains in this bottom boom, loaded as it is, can only be arrived at by the tedious method of secondary strains, taking into account the deflections of the girder. The figures given above, indicate, however, with sufficient accuracy, how necessary it is to arrange the cross girders so as to distribute the load direct to the braces, and if this is impossible, to take into consideration the bending strains in the booms.

F. E. R.



General Articles.

PONDICHERRY HARBOUR PROJECT.

By A. Pierres deClosets, C.E.,

Introduction.

The question of constructing a Harbour at Pondicherry is not a novel one, the extremely favorable situation at the mouth of the Ariancoupam having always struck those interested in the project of a Harbour of refuge on this coast. Even at the end of the last century a company had proposed to the Government, to construct at their own cost, a Harbour at the mouth of the Ariancoupam, asking, in return, for certain privileges; but the Government did not see fit to agree to their terms.

Later on, some Engineers thought of bringing forward some plans, but the question of funds seems to have proved an insurmountable difficulty.

It is therefore no novelty that I propose in presenting this plan of a Harbour for the town of Pondicherry, and it is useless to explain the importance, in every respect of such a construction, both as regards the capital of the French possessions in India, and the maritime commerce of the Bay of Bengal.

A consideration arguing greatly in favor of the project, are the new lines of railway shortly to be laid down by the English Government. The branch line of Pondicherry and Villapouram will soon be extended as far as Chittoor, through the great centres of Trikaloor, Trincomalie, Arni, Arcot and Vellore; there is also an idea of joing Trincomalie to the Mysore section by Bangalore.

These lines of railway offer to the products of N. and S. Arcot, Salem and Mysore, an outlet to Pondicherry, and as trade expenses will be proportionally but slightly increased, this reason, in addition to the facilities for steamers in a Harbour like the proposed one, would inevitably open out to this place the products of the South and West of the Peninsula.

Before going into the proposed plan of the Harbour, I have thought it best to dwell on the nature of the coast, on the sands, currents and prevailing winds, in order that the arrangements adopted for the proposed port may be the better understood.

The Coast and Sands.

In connection with the coast and sands, a serious question arises—a question already raised in 1865 at the time of my proposal of an inland Harbour for Madras; I refer to the sand bank of the channel leading to the sea, inside the proposed Harbour; it is, therefore, necessary to go into some details on the action of the coast, the sands, winds and tides.

The Coromandel Coast, that is the region extending from Lat. 15 to Point Calimere, is formed by a deposit of sands which cause decomposition by atmospheric influences of gneiss from the interior; these sands dashed down by the rains into the water-course are brought down to the sea by the rivers, and are deposited at the bottom, as soon as the force of the current which held them in suspension, ceases.

Disturbed again by the swell and the littoral currents as well as by the tides, these sands are thrown up again on the coast, where they form sandbanks of a rather considerable size.

The winds, which have also some influence on the movement of the sands, are principally those of the two monsoons, the N. E. and S. E. The currents of the littoral sometimes attain a speed of 3 knots and the tides may reach from 1 metre to 1 metre 25 * above high water mark. The coast being but slightly curved, † there is produced a bar, which stirs up the sand at the bottom with more or less violence, according to the height of the waves, and the current gradually carries the sand thus agitated, sometimes in a northerly, sometimes in a southerly direction, following that of the monsoon then prevalent.

This takes place with greater violence during the N. E. monsoon; the swell and the currents being much stronger than during that of the S. E. monsoon, the volume of the sand swept away is greater and the shifting much more marked towards the south than towards the north which will account for the immense quantities of sand deposited in the south between Point Calimere and the northern extremity of Ceylon.

It should be remarked that this shifting of the sands in ordinary weather, does not extend to a greater depth than 3 fathoms; sometimes a rapid deposit is thrown up near the river which reaches the height of one metre in 24 hours, and sometimes this deposit disappears in a very short time; these occurrences are due to the changes in the directions of the winds and currents.

As soon as an obstacle is found in a position perpendicular to the littoral current a deposit is immediately thrown up, of sand brought along by this current. Thus when a ship runs aground between the shore and the bar, a deposit of sand is formed in a very short time, enough to allow of walking dryfoot from the beach to the steamer.

This peculiarity is often taken advantage of. Thus, at Tranquebar, and Madras, in order to arrest the erosion of the shore, cut-waters have been placed at certain distances and deposits of sand have collected between them which have stopped the erosion and formed a new shore.

Latterly, when the jetties of the Madras Harbour were constructed, jetties which are perpendicular to the coast, and therefore to the littoral current, immense deposits of sand rapidly formed to the depth of 4 fathoms, in the exterior angles of the jetties. It was feared that these deposits might reach to the extremity of the jetties, although they would seem to have attained a certain amount of solidity, and not to be spreading out to sea; however this may be, the color of the water at the head of the jetties and along the length of the external wall, shows that the waters hold the sand in suspension; but it should be remarked that up to the present time, no sand-bank has formed in the empty space serving as entrance to the Harbour.

When the rivers of the coast cease to carry their waters down to the sea, which happens in many instances shortly after the rainy season, their mouths are choked up by the deposits of sand from the shore carried about by the currents, and thrown back to the land by the waves; the sands from the shore are also swept away by the winds, and bury themselves in the bed of the river, helping to obstruct it.

This effect of the sand carried by the winds is very marked on the coast where it produces considerable sand-banks; it has been observed that a deposit of sand carried by the wind would attain a height of 0m. 33 in about an hour.

The effect of the monsoon on rivers of an unvarying current, is to turn the mouth of these rivers gradually in another direction by means of the alluvium formed by the sands.

Thus, during the S. E. monsoon, the waters of the rivers are turned towards the north-east by the deposits formed south of the mouth, and during the N. E. monsoon the waters of the current are on the contrary thrown back towards south, but, as at this season the currents of the rivers are much stronger, the mouth keeps an almost easterly direction or rather E. S. E.

The river of Ariancoupam, which has not a continual current, is choked up every year after the rains, by a deposit of sand, which can be reckoned as being from 15,000 to 20,000 cubic metres, but the deposit is carried off by the waters of the river as soon as their volume is increased by the rains of the N. E. monsoon.

All these observations result necessarily in this—that to construct an interior port, we must seek as much as is possible, to approximate existing conditions, as remark-

* 1 Metre = 3·2808992 ft.—Trans.

† During the cyclones, the agitation caused by the bar extends 6 fathoms deep.

ed in rivers with unvarying currents. In these rivers, it is evidently the current of the waters which keeps the mouth of the river open by washing away the sandbanks and forcing these back to the north or south of the mouth; according to this, in the construction of the proposed Harbour, which will have a channel protected by two jetties, it will be necessary—

1. To construct these jetties at a very oblique angle to the line of coast, not to oppose any obstacle to the movement of the littoral current.

2. To approach the heads or extremities as nearly as possible, having allowed for the passage of vessels, in order that a current towards the sea during the rains, might have force enough to carry off the sand which would have collected at the bottom near the entrance of the Harbour.

3. To prolong the North jetty in such a manner as to sufficiently shelter the channel from the force of the waves produced by the winds of the N.-E. monsoon.

4. To give to the entrance between the jetties, such a position that a vertical line, passing across the heads of the two jetties would be perpendicular to the direction of the S.-E. winds.

5. To establish, if possible, an unvarying current of sufficient swiftness to sweep away the sands tending to gather at the entrance of the Harbour, either by utilising the waters of the rivers or by means of reservoir basins placed on either side of the channel between the jetties and the shore; these basins would be provided with locks to open at high water.

6. If capital is not limited, it would be very advantageous to construct, more in the open and in front of the Harbour, a breakwater, to diminish the force of the waves at the entrance, and in this case, it would be unnecessary to construct the jetties to so great a depth of water.

(To be continued.)

THE STEAM ENGINE AND ITS HISTORY.

III.

THE application of natural laws gave rise to the "Steam Engine," for Nature is the foundation of science. Many have heard of the great boiling springs of Geyzer in Iceland. These are nature's own proofs of the powerful effect of confined steam. From the description of one who has seen the phenomena, the following may be particularized. When there is about to be an eruption, a loud rumbling noise is heard like the roaring of a cannon, then a violent trembling of the earth, which increases, till the water gushes forth in great jets from 80 to 100 feet high carrying everything before it. The anecdote of the little boy watching the rise and fall of the kettle lid, is perhaps the most truthful illustration of applied science that can be conceived. It must have occurred to young Watt that if the bubbling of the heated liquid raised the lid of the vessel, by confining the agent an increase of power would be the result. This argument gave rise step by step to those experiments being tried by him which have given us such brilliant productions.

We have already read a short account of the history of the Locomotive and Land Engines, it now remains for us to follow up the history of the "Marine Engine." The adoption of steam as a means of navigation was undoubtedly a great advance over that of manual and wind power, the former is weak, the latter capricious, and as every portion of our existence has a motive, so every new scheme or invention has its advantage. The origin of the steam boat must be traced back to 1543 when Blasco de Garay propelled his little craft before a number of deputies appointed by the Emperor Charles V. of Spain to report on the invention. It was pronounced a success, but owing to the Inquisition the idea had soon to be abandoned.

In 1737 Jonathan Hulls took out a patent for a plan for propelling vessels through the agency of steam, but beyond this we hear nothing further of him. In 1778 Thomas Paine started the idea in America. Claude de Jouffroy, a native of Bescancon, constructed a steam boat in 1782 and tried to get the French to adopt the scheme, but failed.

In 1785 Oliver Evans published a description of a mode of driving boats by steam and a short while after produced his wonderful "Eructor Amphobolis" which he employed for dredging the harbour of the Delaware. In 1797 John Fitch propelled a steam yawl with side paddles on the Collect Pond, New York.

The first steam boat constructed in Great Britain was one by Miller and Symington, 1787, which went at the rate of 4 miles an hour. It was a twin boat with a wheel in the centre and Mr. Miller was the first that patented paddle wheels. This apparent success had induced them to try many important experiments, but as with every other innovation opposition was in the way and the public were too inconsistent to approve of the scheme. Watt was called in to give his aid, but he was too taken up with his Land Engines. They endeavoured hard to push the invention forward, and years elapsed without anything proving in their favor. Several others in the meantime had promulgated devices which were to attain the most startling results. Paper and time were consumed in proving the gain to be ensured, but these offended originators withdrew from the scene of the scientific struggle in high dudgeon at the want of respect and belief displayed by the Goths and Vandals of the age. Truly must they have felt the lamentations of the poet who said—

> "Truth would you teach to save a sinking land
> All fear, none aid you and few understand."

But one more enterprising than the rest broke through the barriers of opposition and ventured forth with his tiny craft, which was named the *Comet*, 1812.

This was the first ship in Great Britain in which steam was made practical use of for trading purposes, and the owner, Henry Bell, is fairly entitled to the merit of being the first to introduce steam navigation into Europe. This vessel was 42′ long × 11′-6″ beam × 5′ deep, 25 tons burthen and 4 H.-P., and was small enough to be carried in any of the merchant vessels of the present day. The public now stared on with mingled astonishment at the realization of what was all along thought a fable. The *Comet* afterwards plied between Glasgow and Greenock carrying passengers three times a week. A few years before this Robert Fulton brought steam navigation into use in America. He was one out of the few who had taken an interest in the Miller and Symington scheme, and finding his chances of success very doubtful here, he crossed over to the Continent, but to meet with no better reception there, until finally he made up his mind to try the other hemisphere. To what extent his plans succeeded may be judged from the following account, which is given in his own words, and which perhaps will be a little interesting to read:— "When I first thought of the Steam Engine," he said, "the project was viewed by the public either with indifference or contempt as a visionary scheme. As I had occasion to pass to and fro from the ship-building yard whilst my boat was in progress I often loitered unknown near the idle group of strangers gathering in little circles, and heard the various enquiries as to the object of the new vehicle. The language was uniformly that of scorn, sneer or ridicule. At length the day arrived when the experiment was to be put into operation. To me it was a trying and interesting occasion. The machinery was new and ill made, many parts were constructed by men unaccustomed to such work. I invited the public and my friends to witness this first trip. The moment arrived and the word was given for the vessel to start. The boat moved on, but after going a short distance it came to a dead stop and now came murmurs of discontent and shrugs. I could hear repeated words to the effect, I told you it would be so, it is a foolish scheme; but I wasn't to be baffled, I went below, examined the machinery and discovered that the cause was a slight mal-adjustment of some of the works; in a short while it was obviated. The boat went on again. All were still incredulous. None seemed willing to trust the evidence of their own senses, and even when we arrived at our destination, imagination superseded the influence of fact, and it was doubted if it could be done again; or if done, it was doubted if it could be made of any great value. J. N. C.

(To be continued.)

THE MAIN DRAINAGE OF THE HOUSES OF PARLIAMENT, WESTMINSTER.

By Isaac Shone, c.e.

III.

The chief tributary is reduced from twenty-four inches high by fifteen inches wide, and laid at an average gradient of 1 in 372, to a pipe sewer of nine inches in diameter, laid at a gradient of 1 in 309; (3) in providing superior flushing appliances (Shone's Automatic Hydraulic Flushing Ejectors) for the sewers, at a considerably reduced expenditure of water; (4) in providing an improved method of ventilating the main sewers; (5) in forming proper connections between the drains and the main sewers, and giving extraordinary facilities for inspection at the junctions; (6) in severing absolutely the large tunnel-like connection between the Palace sewer and the Metropolitan low level sewer by means of a "Dam," constructed as per Fig. 4, Plate 2, within the former sewer; in dispensing with the big cumbrous penstock and flap valve arrangements connected therewith, and substituting therefor a small twelve-inch iron sewer with sluice and reflux valve; (7) in providing, in case of need, improved automatic arrangements for permitting the Palace sewage and rainfall to flow into the Metropolitan low level sewer by gravitation, on the principle heretofore adopted, independently altogether of the Ejector system, but without the possibility of the foul gases from the Metropolitan low level sewer getting into the Palace sewer; (8) in preventing the hot water and steam from the boilers, &c., from passing into the drains and sewers, and providing a separate and independent outlet for same into the Thames; (9) in providing means whereby the sewage and rainfall proceeding from the Houses of Parliament shall flow uninterruptedly therefrom both in dry and wet weather, irrespective of the height at which the Metropolitan low level sewer is discharging sewage, or sewage and rainfall in combination.

(26.) This latter all-important desideratum is effected by means of Shone's Pneumatic Sewage Ejectors, which are fixed in a chamber under the Speaker's Green, near the Clock Tower. These Ejectors are placed below the level of the Houses of Parliament main sewer, so that the sewage and rainfall flows to and into them by gravitation. There are three Ejectors, one of 500 and two of 350 gallons capacity. They can be worked separately or unitedly, just as the flow of sewage or rainfall is small or large.

(27.) These Ejectors do not, as is the case with pumps, permit sewage-sludge or road detritus to accumulate in the pit, sump, or well, pumped from; for they themselves become, as it were, the equivalent of so many pits, sumps, or wells, into which the sewage and rainfall flows by gravitation. All foreign matter heavier than water settles on the bottom. The longest time, however, during which this temporary settlement of heavy matter takes place, does not exceed fifteen minutes at most, even with the large Ejector, and this comparatively long interval of rest to the Ejector only happens when the minimum flow obtains—*viz.*, at the time when Parliament is not in Session.

(28). But, owing to the wash-out shape of the delivery-pipe proceeding from the bottom of the Ejector, the action of ejection results in the heavier matter being expelled first out of the Ejectors, which are thus rendered self-cleansing.

(29). Moreover, they are self-ventilating; and so completely do they hermetically seal the sewage and air within them that they might be made to work in a drawing-room, without tainting in the slightest degree the atmosphere.

(30). The Ejectors are always receiving fresh compressed atmospheric air when the sewage is being expelled out of them, and the surplus of this air—*i.e.*, the volume of air which exerts a pressure superior to that of the atmosphere—and which is innocuous—after each charge of sewage has been ejected, escapes through the exhaust ports of the automatic gear into a pipe which conveys it to the ventilating shaft in the Clock Tower, whence it escapes into the atmosphere.

(31). The fresh air, at atmospheric pressure, which remains in the Ejector after each action of ejection, flows out of the Ejector as rapidly as it is displaced by the fresh charge of inflowing sewage, and that air, which is also innocuous, takes exactly the same route to and out of the Clock Tower shaft as the exhaust compressed air does.

(32). The Ejectors are also self-acting; they will work only when they have work to do, as fast or as slow as the work accumulates—a function which the Honourable Alan de Tatton Egerton drew particular attention to, at the enquiry before the Select Committee of the House of Commons, of which he was a member.

(33). The Ejectors at the Houses of Parliament are emptied in about half a minute; but they take in dry weather, when Parliament is not in Session, from ten to fifteen minutes to fill. Whether, however, they fill in half a minute or in half an hour, they will be invariably emptied in about half a minute. Moveover, they form the most perfect sewage-gas trap, as between the Houses of Parliament sewer and the Metropolitan sewer, which it is possible to invent.

(34). The compressed air required by the Ejectors to expel the sewage and rainfall is supplied by air-compressors, driven by Atkinson's admirable Patent Differential Gas-Engines. There are four of these (of four horse-power each) situated in the basement of the Palace, about 650 feet from the Ejector Station.

(35). But were the Gas-Engine Air-Compressors at Charing Cross, and the three Pneumatic Ejectors a mile, more or less, apart, instead of being in a cluster in one chamber, as they are at the Houses of Parliament, their automatic action and effectiveness would neither be improved nor impaired by the change!

(36). The four Gas-Engine Air-Compressors at the Houses of Parliament occupy a room which is twenty feet long, sixteen feet wide, and nine feet high. They, like the Ejectors, occupy little space, and may be fixed under the streets in cases where land is expensive or otherwise difficult to obtain.

(37). Plate 2 contains a plan and section of the Pneumatic Ejector Station, as well as a plan and section of the Air-Compressing Section, &c.

(38). The minimum lift for the Palace Ejectors is twelve feet, and the maximum lift will probably never exceed twenty feet.

(To be continued.)

THE JHILMILI WINDOW.

By A. Ewbank.

III.

We come now to the peculiar method of fixing the leaves or venetians open. As the connection at E is such as to allow the plane A C E only two motions about the fixed plane F S E, so, if A C E remains at rest, the plane F S E has only two motions. One of these is about the tunnel axis, and this motion while keeping the plane F S E in the meridian would make the *line* F G of fig. 2 slope to the vertical. This motion, possible as far as E is concerned,

PLATE II.

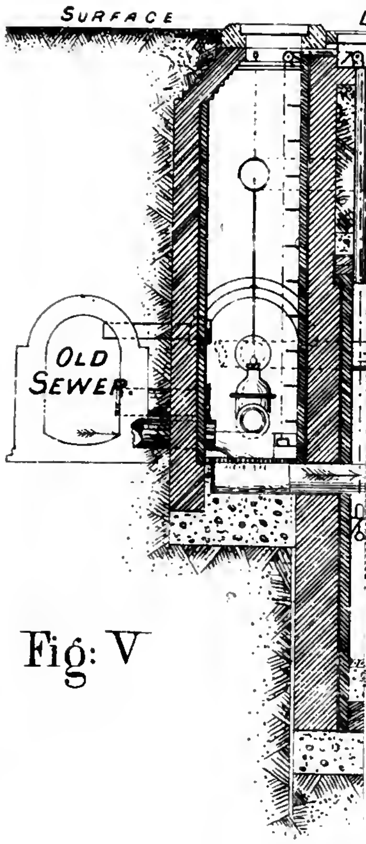
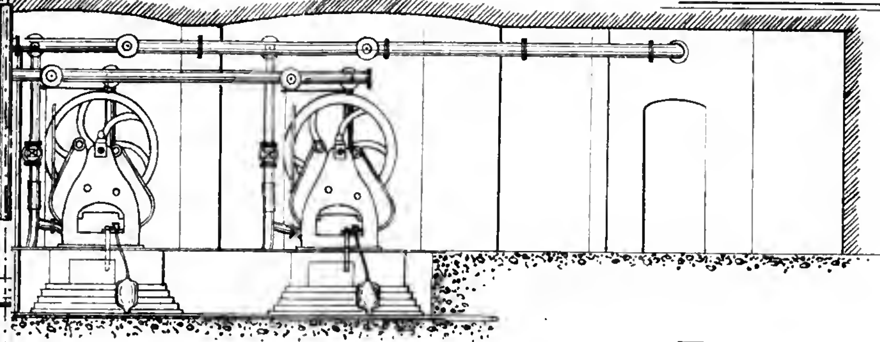
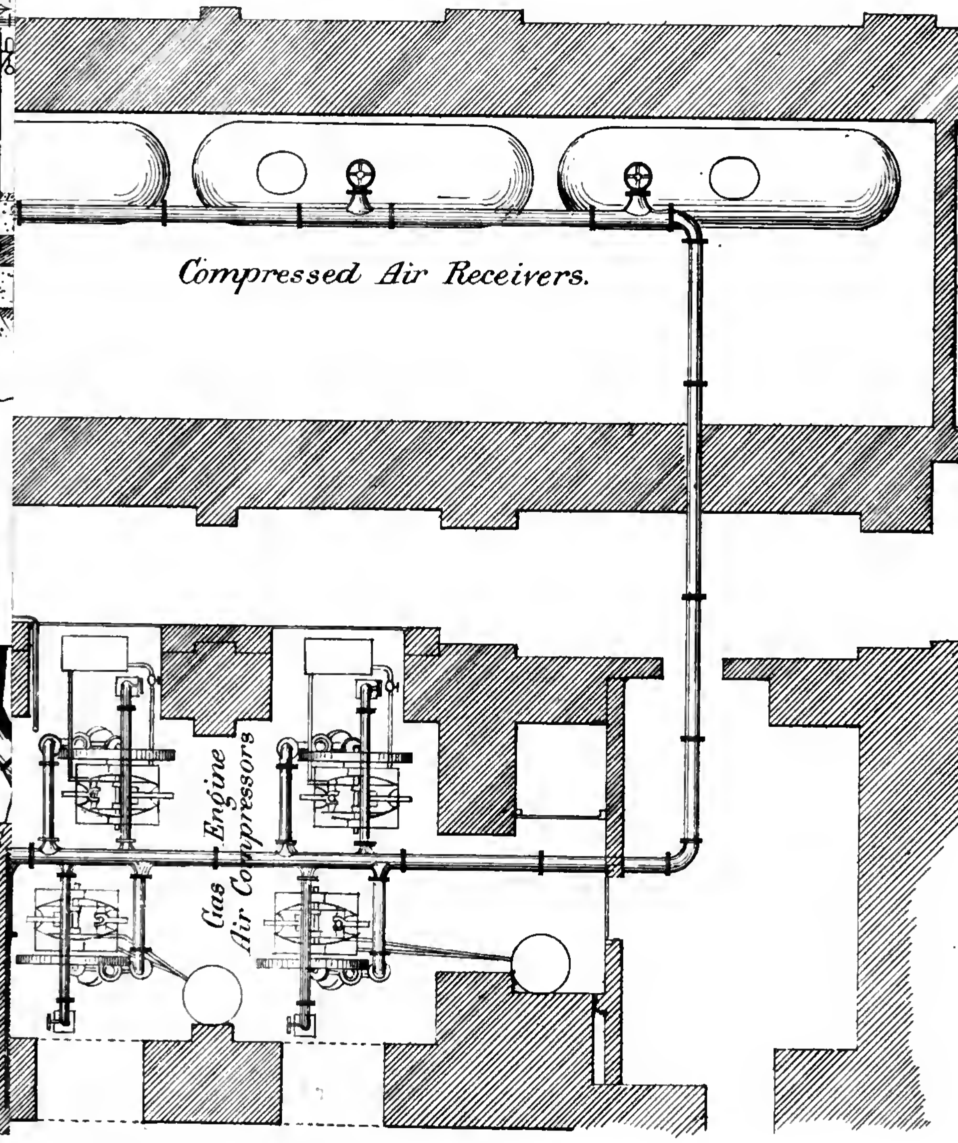


Fig: V



SECTIONAL ELEVATION.

Fig: XI



SECTIONAL PLAN.

Fig: X

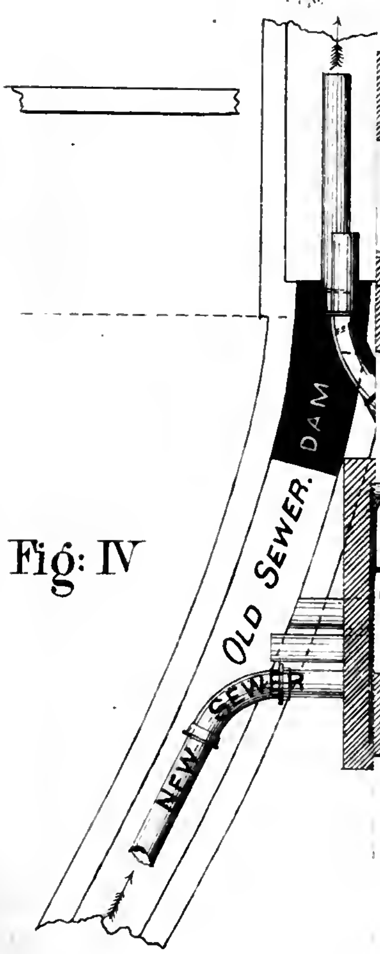


Fig: IV

Atkinson's Patent Differential Gas-Engine Air-Compressors.

Hydro-Pneumatic
S

The "STAR" Press. 19 Lall Bazar Street, Calcutta

Fig. 1.

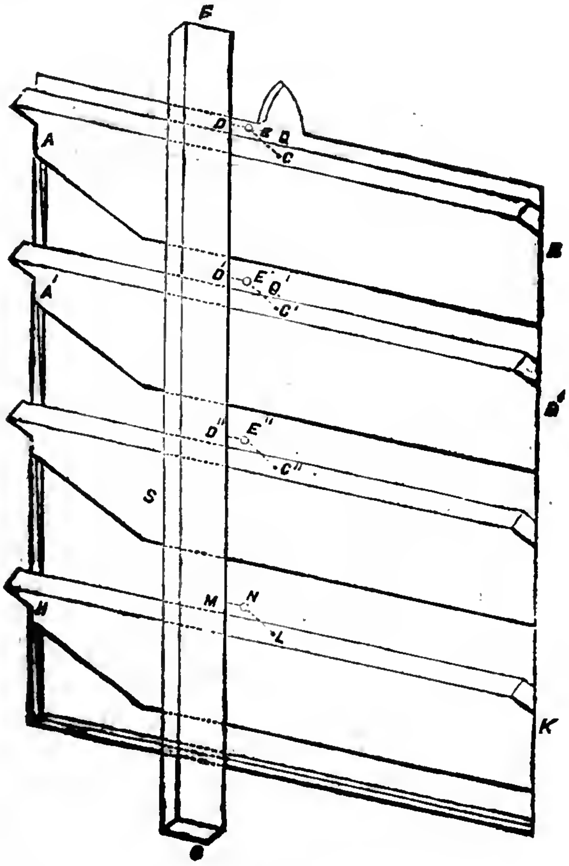
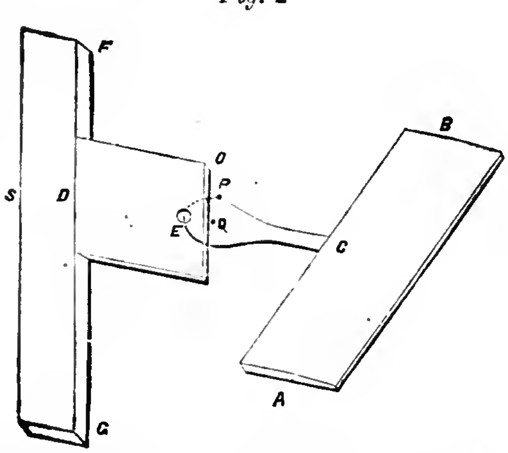


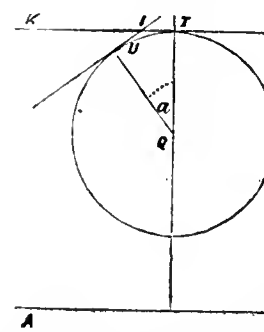
Fig. 2.



is made impossible by the co-existence of E^1 or N (fig. 1). Therefore, the only motion which may be possible to the bar while the leaves are at rest is to rotate about the axis through Q. But similar considerations apply to the leaf A^1 C^1 B^1 and the connection E^1. The bar cannot rotate about the axis of the tunnel E^1, for this would give the bar a slope to the vertical, so if the bar moves, it must rotate about the line through Q^1, which is the centre of the ring through E1. Each of these lines—the line through Q and the line through Q^1—must be a vertical line. For if the bar rotates about a line which is not vertical, the bar must cease to be vertical. But if the line through Q is vertical, the plane of the ring and leaf is horizontal. Thus we come to the remarkable fact that when the tunnels E E'..... are not made unnecessarily wide the leaves or venetians must be pulled into the horizontal position before the bar can be shifted sideways. When the leaves are horizontal the line through Q, perpendicular to the ring P E, passes also through the centres of the other rings. When the leaves are not horizontal each ring has a separate line for the normal through its centre and each of these normals is not vertical.

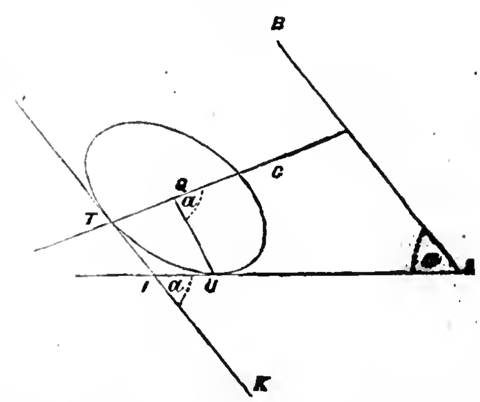
In practice when the leaves have been made horizontal the bar is rotated through 90° or through as near an approach to 90° as the materials will allow. This is done to prevent the bar slipping back to its original position, and, then, by rising allowing the leaves to descend and to close on each other. We shall now show that if by some contrivance easily imagined we move the bar through *any* angle sideways and fix it so as to prevent it returning to the meridian, but so as not to prevent it moving up or down if the leaves can make it move—then no matter what the angle may be, the leaves are practically locked or fixed open and thus that the bar being prevented by the special contrivance from rotating is also itself practically fixed altogether. This applies only to the case where there is no appreciable extra volume V_2.

Fig. 6.



In *fig.* 6 T is that point or small arc of the ring which is in the tunnel E when the leaf A C B is horizontal and the bar lamina F G S in the meridian. The bar being rotated takes its tunnel to the point U of the ring. The tunnel axis is now the tangent at U to the ring. The radius Q U makes an angle α with the initial radius Q T. This angle is also the angle between the new position of the tunnel axis and the line A B of *fig.* 6 or *fig.* 2.

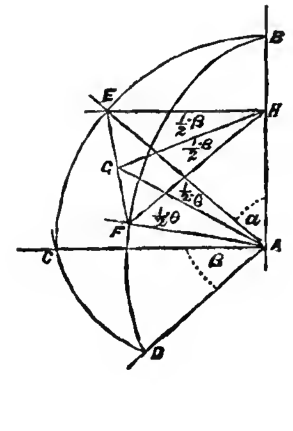
Fig. 7.



In *fig.* 7 the same new tunnel axis or line I U is shewn more in perspective, the initial position of this axis being T I K. The angle α is also that through which the bar lamina F G S has revolved about the vertical line through Q.

We have now to study the effect on the line I U of a rotation about A B—that is, of a sinking of the leaves if they can yield to their tendency to leave the horizontal position. In *fig.* 2 C is on the south side of the line A B. The centre of gravity of the leaf and ring is on the opposite or north side. In the absence of sufficient friction at the bearings the weight of a leaf will make it tend to rotate about A B.

Fig. 8.



In *fig.* 8 A B is any line and A E a line making an acute angle A with A B. In the plane B A E draw A C at right angles to A B. Let A B=A E=A C. Let a lamina B A C rotate about B A through an angle β. β may possibly be small while α is not supposed small. The lamina rotates into the position B A D. Draw E H parallel to C A. Then H remains at rest and E moves to F on the circle quadrant B F D. That is, the line A E moves into the position A F by the rotation β about the line A B.

Thus E A F is the angle between the old and new positions of A E.

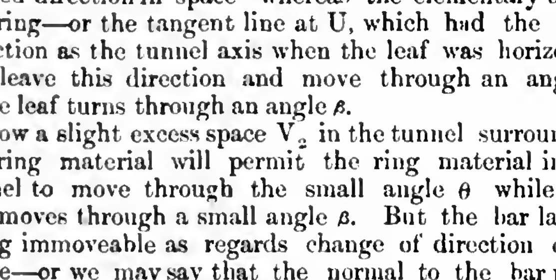
Call this angle θ. Bisect the straight line E F in G. H G bisects the angle E H F which$=\beta$ and A G bisects the required angle θ.

Then $E\ G = E\ H\ \text{Sin}\ \frac{\beta}{2}$; $E\ G = E\ A\ \text{Sin}\ \frac{\theta}{2}$ $\therefore\ \text{Sin}\ \frac{\theta}{2} = \frac{E\ H}{E\ A}\ \text{Sin}\ \frac{\beta}{2} = \text{Sin}\ \alpha\ \text{Sin}\ \frac{\beta}{2}$. This angle θ is the angle through which an elementary arc of the ring at U (of fig. 6 or 7) would have to move if the leaf yielding to its weight could turn through an angle β. As the bar lamina is by hypothesis prevented from changing its plane—by friction or some special clamping arrangement—though no attempt is made to prevent it taking a motion of translation horizontally or vertically or both if it is so disposed,—it follows that the tunnel axis (considered as belonging to the tunnel and to the lamina F G S) keeps a fixed direction in space whereas the elementary arc of the ring—or the tangent line at U, which had the same direction as the tunnel axis when the leaf was horizontal, will leave this direction and move through an angle θ if the leaf turns through an angle β.

Now a slight excess space V_2 in the tunnel surrounding the ring material will permit the ring material in the tunnel to move through the small angle θ while the leaf moves through a small angle β. But the bar lamina being immoveable as regards change of direction of its plane—or we may say that the normal to the bar plane cannot change direction—this movement of the ring material in the tunnel will soon be checked by a sort of couple. And if we deny the existence of any appreciable excess volume V_2 then the angle θ is inappreciable. But $\text{Sin}\ \theta = \text{Sin}\ \alpha\ \text{Sin}\ \beta$ and α is not a small angle. Therefore β must be correspondingly small to θ. That is, **if we have no appreciable excess volume V_2 the leaf cannot rotate appreciably after the bar has been moved sideways through any angle α which is moderately large.** We might for example suppose α to be 15°.

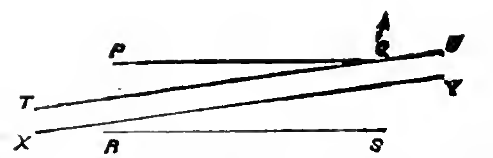
The manner in which two forces in opposite directions come into action may need a little elucidation.

Fig. 9.



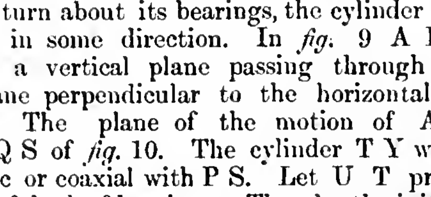
In *fig.* 9 we have a line A L making the angle α (not shown in the diagram) with A B. A lamina, BAL revolving about B A through an angle β comes to the plane B A E H. The angle B A H$=\alpha$. Thus the line A L has by the rotation moved to the position A H. This moving line A L corresponds to the moving line A E of *fig.* 8. It also corresponds to the line I U of *fig.* 6 or *fig.* 7. By its actual or attempted motion it leaves or tends to leave the tunnel axis which we think of as a line belonging to the tunnel and which therefore cannot change in direction unless the plane F G S of *fig.* 2 so moves as to change the direction of this plane. We shall have occasion to return to *fig.* 9. Meanwhile let us consult the simpler diagram of *fig.* 10.

Fig. 10.



P Q R S is the tunnel shewn in section, but drawn on a magnified scale, and the length P Q compared with the diameter P R is not to scale. T U X Y similarly shews the ring material in the tunnel elongated and treated as a straight cylinder. The axis of this cylinder may be the line A L of *fig.* 9. If the leaf tends to turn about its bearings, the cylinder T Y begins to move in some direction. In *fig.* 9 A L begins to move in a vertical plane passing through A L, that is, a plane perpendicular to the horizontal leaf plane B A L. The plane of the motion of A L is the plane P Q S of *fig.* 10. The cylinder T Y was initially concentric or coaxial with P S. Let U T produced cut the line of the leaf bearings. Then by the initial rotation about the bearings U moves a little faster than does T. Thus the ring material comes into contact with the tunnel material at some place Q. This tends to lift the bar and by hypothesis it is left free to rise if so disposed. Accordingly it begins to rise. But the bar by being connected with more than one leaf must, if it rises at all, take a motion of translation. That is, the point R moves with exactly the same speed as the point Q. For we suppose no material anywhere to suffer compression, *i.e.*, change volumes. But T must be moving less fast than Q. Therefore the point R overtakes the ring material and this ring material gets jammed in the tunnel as shown in *fig.* 11. The motion of the bar must then stop unless the ring material bends or the tunnel gets distorted which changes our discussion disallows.

Fig. 11.



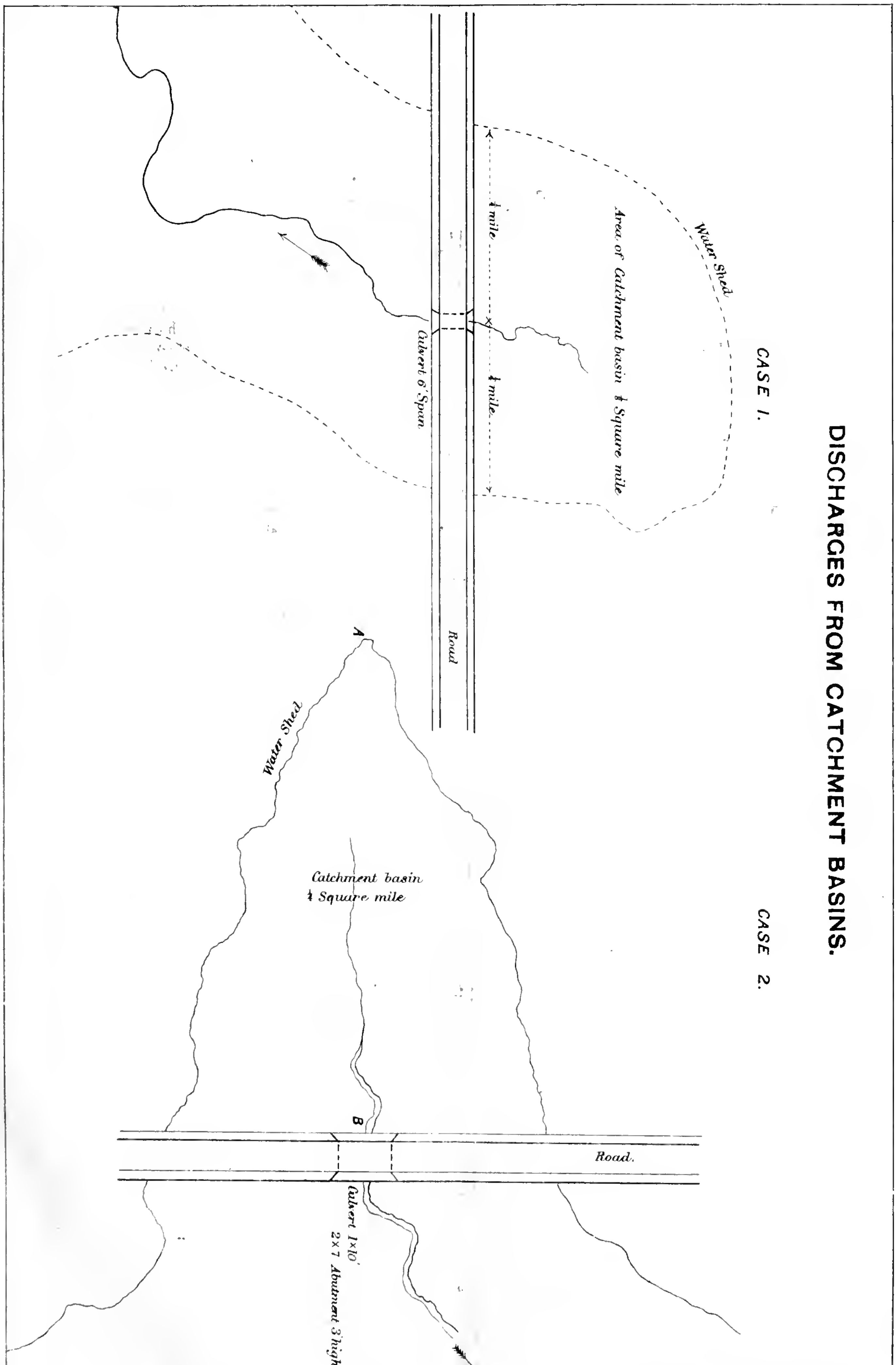
(To be continued.)

DISCHARGES FROM CATCHMENT BASINS.

THIS is one of the most important subjects which requires thorough investigation. It is a subject that demands great skill on the part of the Engineer in fixing *correct co-efficients* to the formula $D = x\sqrt[4]{m^3}$, a formula introduced by Colonel Dickens. The examples here illustrated came under the direct observation of the writer, and he would be glad if Engineers *au fait* with this subject would give their experiences in this Journal.

Case 1. The shape of the basin is as nearly as possible a *semi-circle* and area $\frac{1}{8}$ square mile. The fall round from the water shed to the centre, when the culvert is situated, is about 8 feet. The following phenomenon was observed after a very heavy fall of rain, *viz.*, 5″ in two hours. The water accumulated very rapidly at the mouth of the culvert, which is one of 6 feet span and 3 feet abutments and eventually went clean over the road for a depth of 6 inches, cutting up partially the *kunker* road and scouring out a hole below the culvert. The height of the roadway from the floor is $4\frac{1}{2}$ feet.

Now, by Dickens' formula $D = 325\sqrt[4]{m^3}$, and for a basin of $\frac{1}{8}$ square mile, we get a discharge of 173 feet per second and a culvert of 7 feet span with abutment 4 feet high. But even this is obviously insufficient when it is



The "STAR" Press, 19 Lall Bazar Street, Calcutta.

considered that the flood passed completel yover the road. The culvert as it actually existed had an area of $6 \times 3 = 18$ s.ft. The area of the opening arrived at by Dickens' formula is $7 \times 4 = 28$ s.ft., *i.e.*, only 10 s.ft. more than the existing opening. Practically nearly double the quantity is needed, *viz.*, about 50 s.ft. or an opening of $12' \times 4'$. Such an opening would give a discharge of 300 s.ft. per second at 6 feet velocity through the opening and be equivalent to the formula $D = 1{,}500 \sqrt[4]{m^3}$. Thus it is clear that for a catchment basin of the shape and size above described and a fall of about 8 feet, the proper co-efficient to use with Dickens' formula would be 1,500 or thereabouts.

Case 2. The catchment basin is of triangular shape, and area $\frac{1}{4}$ square mile. The area of the opening that passes the drainage is 72 s.ft. The fall from A. to B. and *laterally* is about 11 feet. The following phenomenon was observed. After a heavy fall of rain, 2·70 inches in an hour, the *maximum* discharge just *filled the opening* up to the spring of the arches, a height of 3 feet from the floor and there was a very slight scour below the openings. This proves conclusively that the *area of discharge through the culvert* is about what is really needed. Now if we investigate the matter by the formula, $D = 825 \sqrt[4]{m^3}$ we get a discharge of 292 s.ft. and a waterway of 49 s.ft., but this is obviously wrong, for the existing culvert which has an area of 72 s.ft. *just fits.* Experimenting with different co-efficients it will be found that a co-efficient of 1,200 will give results that suit the case.

R.

NOTES FROM HOME.

(From our own Correspondent.)

THE annual meeting of the Institution of Civil Engineers was held on Tuesday the 7th June, and was largely attended. In the Council's report it was stated that the Institution had now purchased the adjoining buildings, which will enable the Library and other departments to take up more room, which has been long wanted. The portrait of Sir Frederick Bramwell, painted by Mr. Frank Holl, subscribed for, was hung in the theatre. The new Council was elected as follows:—President: Geo. Barclay Bruce, Vice-Presidents Sir John Coode, Messrs. Berkeley, Hayter and Giles. Members: Anderson, Baker, Barry, Bessemer, Cowper, Douglass, Fox, Hawkesley, Mansergh, Preece, Rawlinson, Reed, Shelford, Stileman, and Thomson.

At the last meeting of the Society of Engineers a paper was read "On the new Roof at King's Cross Station, Great Northern Railway." This new roof is of the same shape, size and section as the old one. The old ribs were of wood in laminated form. These had become rotten, and were replaced by iron. No provision was made in the old roof to let smoke and steam escape, but in the new roof a louvre is made, which adds considerably to the appearance. The principal feature in the work is the travelling stage, which is of great weight and size, serving the purpose of strutting the walls and doing all work connected with putting up the new work and taking down the old ribs, while allowing the usual work of the station, and the traffic on the roads to be carried on as usual. The roof has no wind ties, the purlines being said to do this duty. Several speakers, in the discussion which followed the paper, considered that this was an omission, while on the contrary others endorsed the author's view that there was no necessity for them in this case. Where glass occurred Hellmell's patent system of glazing was adopted. This obviates the necessity of using *putty* and offers facilities for renewals.

The Association of Municipal Engineers paid a visit to Portsmouth on the 4th and were received by the Mayor in the Council Chamber, where Mr. Boulnois, the Borough Engineer, read a paper on the drainage of Portsmouth describing the improvements that had been made in the outfall works which had been constructed by Sir Fred. Bramwell and lately completed. The members then paid a visit to the pumping station and the reservoirs at the outfall. The peculiarity lies in the flatness of the whole area to be drained, the trunk sewer having a fall of 1 in 5,180 to the sump at the pumps from which the sewage is pumped into the outfall reservoirs. These are situated on the extremely south-east corner of the island. These reservoirs are covered, and are divided into three compartments, and they are emptied at the top of high water; the time occupied in their emptying being limited by the War Office authorities to an hour and a half. The valves are opened by a turbine worked by the head of sewage in the fall tank, thus enabling the fullest capacity of the three four-foot discharge pipes to be quickly available. The members, returning to the town, next paid a visit to the Town Hall Works, where the Borough Engineer gave a short description of the Town Hall now in course of construction. The Association holds its annual meeting at Leicester on the 14th of July and two following days. Mr. Gordon, the Borough Engineer of Leicester, is the President elect.

The fifty-seventh annual meeting of the British Association for the Advancement of Science will commence, at Manchester on the 31st August next, the President being Sir H. E. Roscoe, M.P., L.L.D., &c.

An electric tram-car with Jarman motor was lately run experimentally between Brixton and Westminster Bridge. The motive power was contained in 70 E.P.S. cells arranged under the seats, which cells can be run out on to trolleys and charged in the same time (or less if necessary) as is now occupied in changing horses. The car used was an old-fashioned one and weighs with the motor and batteries 5 tons 6 hundredweight, or with a full load of passengers something under 8 tons. As to cost, it will be remembered it was stated in a paper read before the Society of Arts that the cost need not exceed 4*d.* per car mile for an electric locomotive weighing about 7 tons, but from the experience already gained and the known cost of charging E.P.S. accumulators it is probable that the cost of running the Jarman motor would not exceed 3*d.* per car mile, and as the lowest known cost of horses is $5\frac{1}{2}$*d.* per mile, there is evidently a large margin of profit available. The experimental journey gave great satisfaction, the speed being thoroughly under control and the car could be stopped in half its length.

Messrs. Mather and Platt, with the special intention of showing the application of electrical driving in works where, for various reasons the principal machines and tools are not driven from one common system of shafting, but have each an independent engine, have designed their exhibit at the Manchester Exhibition. As a typical case, and one in which the conditions to be met are most stringent, they have chosen one of their 10-colour calico printing machines for printing calico with 10 colours simultaneously. If electrical driving can be proved to be advantageous and economical for complex machinery of the class where a low speed under the most perfect control and at the same time high efficiency are essential, there is no doubt about its applicability in other cases where the conditions are less exacting.

Messrs. Williamson and Sons, of Pall Mall, have obtained the contract for supplying 150,000 Enfield Martini sword bayonets. The terms of the contract provide for a very stringent test. The blade has to stand 160 pounds weight on the point without the slightest deviation. This for a light blade under 1lb. is a far more severe test than has been ever before applied to an arm. They have also to be struck in a mechanical proving machine on the back of the edge with a 170lb. blow.

NOTES FROM CEYLON.

(From our own Correspondent.)

NANU-OYA RAILWAY EXTENSION.

THE answer given by Sir H. Holland to the question asked in the House (which you will have seen no doubt) is surely diplomatic, as only a few years back it is on record that Sir M. Hicks-Beach and Lord Kimberley both refused permission to form a private Company to make and work the above said extension to Badulla—*vide* the letter from Sir M. Hicks-Beach, Bart., M.P., to Governor Sir J. K. Longden, K.C.M.G.

CEYLON No. 90. Downing Street.
23rd March 1880.

SIR,—I have the honer to acknowledge the receipt of your despatch No. 42 of the 6th February forwarding two memorials from the Chamber of Commerce and the inhabitants of Uva respectively for the extension of the line to Haputale.

I am unable to alter the decision conveyed in my despatch No. 16 of the 20th January, to the effect that this extension cannot be undertaken by the Government at the present time, nor am I prepared to approve of power being granted to a local company to undertake tho work.

I have &c.,
M. E. Hicks-Beach.

The Right Hon'ble the Earl of Kimberley,
To Lieutenant-Governor Sir J. Douglas, c.m.g.
Downing Street, 29*th April* 1881.

To the construction of the line by a private company there appears to me to be grave objections ; and I am not prepared to reverse the decision conveyed to Sir James Longden in my predecessor's despatch No. 90 of the 23rd March last year, even supposing that it were found possible to form a company for the construction of a line which the Government had declined to build on the ground of its unremunerative character, and for which it refused to grant either guarantee or concession of pecuniary value. I see no reason for concluding that the same results would not ensue in this instance as in the case of the majority of railways constructed by private companies in the colonies. There is every probability that in a few years the Colonial Government would find itself again confronted with the same difficulties as those which surrounded the Colombo and Kandy line in its early days and would be compelled to buy out the interests of the company at heavy premium and to incur heavy expenses for the restoration of the line.

Additional weight is given to the general objection, in this instance, by the fact that the proposed railway is an extension of the Government main line and that its mismanagement or imperfect maintenance would affect the whole of the system and greatly aggravate the local pressure brought to bear on the Government to purchase the line, but it is not solely on those grounds that I am unable to entertain this proposal. If the result should justify the anticipation of those who regard this extension as a remunerative work, no company could enter on the undertaking, unless it were granted running powers over the Government lines, and apart from the objections which have always been felt to the granting of such powers in this country, the special engineering difficulties of the Ceylon Railways would render the presence of an independent and possibly a hostile company a source of serious risk both to the property of the Government and the safety of the travelling public.

I have, &c.,
Kimberley.

The chief profit from a new traffic caught by the proposed extension (by a company say) would arise from carrying that same traffic on the existing Government lines of 130 miles. Would Government hand such profit over to the company which really made it available? If so, a city friend guarantees to raise the company. Let him try.

Paumben Canal.

With reference to the Company already registered to cut above, there is still silence as to its whereabouts. However, a French Engineer has written pointing out many discrepancies between Captain Taylor's report of the visit to Paumben and what actually took place. Pointing out that the charts showing the passage were not old and refuting the idea of building of a break-water between the monument and the island as impossible, as the monument is on the island mentioned. There is no doubt great anxiety felt on the part both of Colombo and Madras, as it is feared that in the event of the canal being finished, a Railway would be pushed on to Jaffna from Matale, or more probably Polgahawalla or Rambukkan, and also in India from the Cape to join existing narrow gauge to Madras. When Colombo and Madras would cease to exist as ports of calls or coaling stations.

But how so Colombo? as it is on record that the Admiralty are urging the Government here to construct a dry dock when they will abandon the splendid Harbour of Trincomalie.

Machinery for tea estates and the necessary materials for erection of tea factories of all sorts and sizes from one sufficient to serve a 50-acre garden up to one of prodigious dimensions and three stories high are in great demand and a great deal is actually lying idle simply from want of labor trained sufficiently to erect, some of the local firms having more orders than they possibly can execute.

In connection with our Survey Department, Colonel Clarke, the Surveyor-General and Acting General Manager of Railways, has initiated a practical apprenticeship, a class formed none too soon, as hitherto it was thought only sufficient for training, to attend at one of the cheif surveyor offices as a volunteer till the candidate could pass the local examination for admission as a surveyor, and what that meant will be guessed at, when I say that on one occasion in 1878, I happened to be in the office when one of the chiefs came up to one of the examiners and expressed surprise to see him still examining the papers, as the list of successful candidates had appeared in the hall half an hour previously. However, something practical has been attempted at last under Mr. J. G. O'Dowd, one of the old stock, I believe, originally drafted here from the Ordnance Survey of England. He has tried a class of nine, commencing with them near Colombo, from here he took them all off to Kegalla, from whence he transferred to the jungles of the North Central Province thus showing them the worst duties before them. Examination reduced the number to six and now another has collapsed through fear or sickliness, as it is put, so that five out of the nine have been all that Mr. O'Dowd has handed over to the District Surveyor. Mr. O'Dowd has now a class of four Europeans (local born) who having passed the exam. he is to test and train. They are now in irrigation work, being known as the Yodi Ela Survey party and are engaged in finding out the extent of land capable of being irrigated therefrom. Colonel Clarke seems to be just what the Survey Department wanted, a thorough manager, one who leads without driving, and one who also looks after the welfare of his subs. Leave (sick) is now as easily procurable by one who has no influence, as by him who has. An officer is not now kept in a malarious district until he can gain favor with his chief, but he now goes forth knowing full well that he will be thought of and changed after a given time whether he complains or no. Jubilee Day is fixed for Tuesday at last, but there are to be no works of any magnitude.

BURMA.

(From our own Correspondent.)

The wonderful strides that have recently been made by paper manufacturers in utilizing paper compositions is indeed surprising. We read of barrels being made from pasteboards, and even paper tiles : but a recent introduction of paper pipes, lately imported by a local German firm for mill use, adds another to the list of modern inventions manufactured from this useful and cheap material. The pipes imported, besides claiming to be waterproof in the inner side by being coated with an enamel, have also the properties of composition to withstand the attacks of white-ants, and being fireproof, &c., are so durably made, that they will resist an internal pressure of 2,000lbs. although only half an inch thick. This novel experiment is being watched with interest, and should the new substitute be found to succeed we have no doubt that later on, paper pipes will supersede the costlier iron pipes used in drainage and water-works, &c.

The difficulty of obtaining local labor and materials for road-making in the Chindwin district has induced the local Government to advertise on somewhat favorable terms, and an opportunity now offers to contractors and engineers with capital. The climate is said to be good and living cheap. The following are the rates :—

Rs.	3	0	0 p %	c. feet	for blasting.
,,	1	0	0 p %	do.	for hard soil & soft rock cutting.
,,	0	12	0 p %	do.	for ordinary earthwork.
,,	8	0	0 p %	do.	for dry stone walling.
,,	0	12	0		for all sorts of joinery.
,,	0	6	0 p	lb.	for all kinds of iron work.

The road to be constructed is all along the Chindwin river and will run over the hills to Tumoo up to the Kubo Valley.

In view to further improving the Rangoon Port, it has been decided by the Port Trust, to construct four more iron jetties—plans and estimates of cost, aggregating Rs. 1,14,765, have been sent in to the Chief Commissioner for sanction.

The difficulty between the energetic projectors of the Rangoon Steam Tramway (Messrs. Darwood and Macgregor) and the Municipal Commissioners has at last been settled. At the opening of the new extension of the Tramway from the Strand to the Kemendine Road, on which line there was so much opposition shewn in connection with a bridge, which was to be constructed to suit the imagination of that august body, the work carried out by Mr. Bateman, the Chief Engineer of the Rangoon Steam Tramway, appears to have pleased them so much, that in drinking a bumper to the success of the Steam Tramway, permission was granted by the Commissioners to extend the line to the end of Kemendine Road.

It is now admitted all round, that the available carrying power is quite inadequate to meet present demands along the line of the Irrawaddy. Although we have the large fleet of steamers of the Irrawaddy Flotilla Co, Ld., regularly plying, barely allowing the commanders 12 hours' rest at the respective ports of embarkation and debarkation still the demand for carriage is the cry. All the large steamers are more or less chartered by Government for military purposes, and the consequence is that little or no space is available for commerce, which between Upper and Lower Burma is wonderfully increasing. The quantity of cereals alone exported from Rangoon to Upper Burma is enormous. To meet this pressing and profitable want the local workshops of the Company with a large staff are working incessantly to construct and fit out extra steamers. The last addition to their fleet was launched on the 28th June last—the paddle steamer *Canton*—she is built entirely of steel inlaid with teak, her length is 250 feet by 35 feet beam, her registered gross tonnage is 674 tons. Her engines are of 250 H.-P. fitted with quadruple expansion driving gear, the latest invention of Messrs. W. Denny and Bros. There are several larger and smaller steamers on the stock now being fitted up.

The Oriental Telephone Company have been induced by their profitable undertakings in Rangoon to extend their business to Mandalay, and for this purpose the Engineer and Superintendent of the Company have left for that place with a large quantity of stores. Great credit is due to Mr. Gibbons, the local representative, who notwithstanding the opposition and loss sustained when the Company first started four years ago, has now connected all the chief centres of business in this town, for which the Company are now receiving very profitable returns.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, July 2, 1887.

Upper Burma Notification.

With reference to *Gazette of India* Notification No. 192, dated the 6th June 1887, Mr. J. T. Simpson, Executive Engineer, 2nd grade, on transfer from India, reported his arrival at Mandalay on the forenoon of the 24th instant and is posted to the Shwebo division.

Lower Burma Notifications.

Mr. W. R. Gilbert, Executive Engineer, 3rd grade, is granted an extension of one day to the privilege leave granted him in *Burma Gazette*, Public Works Department Notification No. 78, dated the 4th June 1887.

With reference to *Burma Gazette* Notification No. 79, dated the 4th June 1887, Mr. C. F. McLeod, Assistant Engineer, 2nd grade, was appointed to officiate as Executive Engineer, Tharrawaddy division, for 14 days, namely, from the 7th to the 20 June 1887, both days inclusive, during the absence on privilege leave of Mr. W. R. Gilbert, Executive Engineer.

India, July 9, 1887.

The services of Mr. G. V. Martyn, Executive Engineer, 2nd grade, sub. *pro tem.*, State Railways, are on return from furlough placed at the disposal of the Director-General of Railways.

The undermentioned officers, lately employed on the Godhra-Rutlam Railway Survey, are posted as follows :

To Establishment under Director-General of Railways, Mr. E. G. J. McCudden, Executive Engineer, 2nd grade, sub. *pro tem.*, Mr. W. Slane, Assistant Engineer, 2nd grade.

Messrs. F. Lang and J. E. Dallas, Assistant Engineers, 1st grade, State Railways, are promoted to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st August 1886.

That portion of Public Works Department Notification, dated 22nd April 1887, relating to the transfer of Mr. W. H. King, Executive Engineer, 2nd grade, from Beluchistan to Burma, is cancelled.

The following temporary transfers are ordered :

Mr. E. J. Rumsby, Executive Engineer, 3rd grade, from Burma to Central Provinces.

Mr. W. G. Newton, Executive Engineer, 3rd grade, from the Central Provinces to Burma.

Mr. R. R. Dease, Executive Engineer, 4th grade, lately employed on the Godhra-Rutlam Railway Survey, is retransferred to the North-Western Provinces and Oudh.

Military Works Department.

The undermentioned officers are appointed to the Military Works Department as Assistant Engineers, 2nd grade, temporary, with effect from the dates specified :—

Lieutenant J. A. Gibbon, R.E., 8th January 1887.
„ O. H. Stoehr, R.E., 11th February 1887.
„ C. R. Stevens, R.E., 11th February 1887.
„ R. J. Mackenzie, R.E., 7th March 1887.
„ A. C. deL. Joly, R.E., 16th March 1887.
„ F. M. Medlicott, R.E., 19th March 1887.
„ T. B. Moore, R.E., 19th March 1887.
„ P. H. duP. Casgrain, R.E., 26th March 1887.
„ A. L. Schreiber, R.E., 29th March 1887.
„ H. C. Nanton, R.E., 29th April 1887.
„ A. L. Swainson, R.E., 3rd May 1887.

Director-General of Railways.

Lieutenant-Colonel H. J. Nuthall, S.C., Executive Engineer, 1st grade, is granted special leave for six months, with the usual subsidiary leave, with effect from such date as he may avail himself of the same.

North-Western Railway.

Mr. C. S. Rennick, Assistant Engineer, 1st grade, successfully passed the Departmental Standard Examination on 1st June.

Madras, July 5, 1887.

The following postings are ordered :—

Mr. J. W. Rundall, Superintending Engineer, First Class, to the charge of the II. Circle. To join on return from furlough.

Mr. W. Hughes, B.A., Executive Engineer, 2nd grade, to the VI. Circle, for charge of the Madura Division. To join on return from furlough.

Mr. J. Traill, Executive Engineer, 3rd grade, to the II. Circle, for charge of the Kistna Western Division. To join on return from leave.

Mr. A. B. Todd, Executive Engineer, 4th grade, sub. *pro tem.*, to the II. Circle, Kistna Eastern Division. To join on return from furlough.

Mr. S. D. Pears, Executive Engineer, 4th grade, temporary rank, to be Assistant to the Chief Engineer for Irrigation for tank restoration work.

The following transfers are ordered at the public expense :—

Mr. S. D. Pears, Executive Engineer, 4th grade, temporary rank, from the Kistna Western Division, to the Office of the Chief Engineer for Irrigation.

Mr. J. Grimes, Executive Engineer, 2nd grade, from the Madura Division, to charge of the Trichinopoly Division.

Punjab, July 7, 1887.

Mr. L. F. Robertson, Assistant Engineer, 2nd grade, attached to the Bannu Bridge Division, is granted leave for three calendar months to study the native language, with effect from the 20th June 1887, or such subsequent date as he may avail himself of the same.

Mr. L. F. Robertson, Assistant Engineer, 2nd grade, passed on the 15th April 1887, the Departmental Examination prescribed in Public Works Department Code.

N.-W. P. and Oudh, July 9, 1887.

Railway Branch.

Mr. W. G. Wood, Assistant Engineer, 1st grade, Lucknow, Sitapur, and Seramau Railway, is appointed to officiate as Executive Engineer in charge of that Division, *vice* Mr. Talbot on privilege leave.

Assam, July 2, 1887.

Mr. E. J. Mitchell, Assistant Engineer, 2nd grade, who was granted privilege leave for three months, reported his departure from Manipur district on the forenoon of the 27th June 1887.

Mysore, July 2, 1887.

Mr. B. S. Venkatachariyar, Assistant Engineer, attached to the Shimoga Division, is granted privilege leave for 10 days with effect from the 18th instant.

The following transfer is ordered in the interests of the public service :—

Mr. B. Subba Rao, Apprentice Engineer, from the Palace to the Kolar Division. To join at once.

The following transfer is ordered in the interests of the public service :—

Mr. K. Krishnaiengar, Apprentice Engineer, from the Palace to the Chitaldroog Division.—To join at once.

Mr. C. A. Mahadeva Sastri, Assistant Engineer, whose services are to be replaced at the disposal of this Department by the Southern Mahratta Railway Company with effect from 1st July 1887, is posted to the Hassan Division from that date.

Mr. F. J. McLaughlin, Executive Engineer, is posted to the Ashtagram Channel Division. The privilege leave granted him in Notification of 18th May 1887 is cancelled from the forenoon of the 16th instant.

Central Provinces, July 9, 1887.

With reference to Notification, dated the 1st June 1887, Mr. M. Leslie, Executive Engineer, reported his arrival at the Secretariat on the forenoon of the 21st idem.

With reference to Notifications, dated the 1st June 1887, Messrs. W. G. Newton and M. Leslie, Executive Engineers, made over and assumed charge respectively of the duties of Assistant Secretary to the Chief Commissioner, Public Works Department, Central Provinces, on the forenoon of the 28th idem.

With reference to Notification, dated the 24th June 1887, Rao Sahib Dhondo Sakharam Sathye, Assistant Engineer, assumed charge of the Hoshangabad Division on the forenoon of the 28th idem.

Bengal July 13, 1887.

Establishment—General.

Mr. C. P. Warde, Assistant Engineer, is transferred from the Balasore to the Hazaribagh Division.

Establishment—Irrigation.

Rai Krith Chunder Chowdry Sahib, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Northern Drainage and Embankment Division.

The 12 months' furlough granted to Mr. A. Monies, Executive Engineer, in Notification of the 22nd of June 1886, has been commuted by Her Majesty's Secretary of State for India into 15 months' leave on medical certificate.

Assam, July 9, 1887.

Mr. D. J. Clancey, Assistant Engineer, 2nd grade, who was transferred to the Cachar district in Orders, dated the 8th June 1887, reported his arrival at Silchar on the forenoon of the 18th June 1887.

Mr. G. W. Winckler, Executive Engineer, 3rd grade, attached to the Kamrup district, now absent on 34 days' privilege leave, sanctioned in Orders, dated the 7th June 1887, is temporarily transferred to Dibrugarh to officiate as District Engineer of the Lakhimpur district, *vice* Rai Durga Das Das, Bahadur, proceeding on three months' privilege leave.

Assam Public Works Department Notification, dated the 13th June 1887, transferring Mr. H. Kench, Executive Engineer, 4th grade (temporary rank) from the Khasi and Jaintia Hills division to the Lakhimpur district, and appointing him to officiate as District Engineer of that district, is hereby cancelled.

Bombay, June 30, 1887.

H. E. the Governor-in-Council is pleased to order the following appointments and transfers :—

Major W. H. Haydon, R.E., is to be Executive Engineer in charge of Karachi Defences, and to make over charge of the duties of Executive Engineer, Lower and Central Sind, to the Executive Engineer, Karachi Collectorate Canals, as a temporary measure.

Lieutenant W. W. Baker, R.E., is transferred from the Central Division to Karachi as Assistant to Major Haydon.

Lieutenant-Colonel. E. D'O. Twemlow, R.E., to act as Executive Engineer, Bombay Defences, during Colonel Merriman's absence.

Major E. C. Hart. R.E., to act as Executive Engineer, Poona and Kirkee District, *vice* Colonel Twemlow.

Mr. E. Pinhey to act as Executive Engineer Belgaum and Kolhpur, *vice* Major Hart.

Mr. T. Summers to act as Executive Engineer, Ratnagiri, *vice* Mr. Pinhey.

H. E. the Governor in Council is pleased to appoint Mr. A. Davidson, Assoc. M., Inst. C. E., on return from privilege leave, to act as Executive Engineer, for Irrigation, Khandesh.

H. E. the Governor in Council is pleased to make the following promotion in the Engineering Establishment :—Mr. W. L. S. L. Cameron to be sub. *pro tem.*, Executive Engineer, 4th grade, from 3rd May 1887.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 4th July 1887.

123 of '86.—Alfred Blackie, of Sidebrook Manor, Wadhurst, in the County of Sussex, England, Gentleman.—*For improvements in the preparation of emulsions of vegetable, animal and mineral oils, of solid paraffins, waxes and fatty substances and of liquids which are insoluble or but partially or slightly soluble in water.*

209 of '86.—Edward Lennon Cantwell, Civil Engineer of the Town of Calcutta.—*For an improved machine for husking paddy and cleaning rice, wheat and other descriptions of grain.*

15 of '87.—John Brown Evans, of Mabus, District of Aberdeen, Cape of Good Hope, South Africa, Farmer, at present temporarily residing in the City of London, England.—*For improvements in apparatus and appliances for straining and fixing fencing and other wires.*

85 of '87.—Christian C. Kauffman, Flour Dealer, residing at 64, Magazine Street, New Orleans, in the parish of Orleans and State of Louisiana, United States of America.—*For process and apparatus for treating ramie, jute and other fibres.*

104 of '87.—Robert John Shaw, Draper, of Nos. 24 and 26, Dover Road, Falkestone, in the County of Kent, England.—*For improvements in meatsafes, which improvements are partly applicable to existing meatsafes.*

105 of '87.—William Orr, of 45, West Nile Street, Glasgow, in the County of Lanark, North Britain, Merchant.—*For improvements in metal fencing, the said improvements being also applicable to other purposes.*

EAST INDIAN RAILWAY.

Teak squares required.

TENDERS will be received at the office of the Controller of Stores, East Indian Railway, Fairlie Place, Calcutta, up to noon of the 30th July 1887, for the delivery, free of all charges, at the East Indian Railway Carriage and Wagon Works at Howrah, of about five hundred tons of teak squares.

Tenders must be submitted in forms and covers to be obtained at the office of the Controller of Stores. Tenders submitted in any other way will not be considered.

Tenders will be received for any portion of the above quantity, not less than 100 tons.

The Agent does not bind himself to accept the lowest or any tender.

D. W. CAMPBELL,

Acting Agent.

Calcutta, 8th July 1887.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "Star Press," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India ...	Rs. 12 ...	Rs. 7 ...	Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—Street & Co., 30, *Cornhill, E.C.*

NEW YORK.—The Scientific Publishing Co., 27, *Park Place.*

ROME.—Loescher & Co.

STRAITS SETTLEMENTS.—"The Straits Times," *Singapore.*

CHINA and JAPAN.—Lane, Crawford & Co., *Hong-Kong, Shanghai,* and *Yokohama.*

JAVA.—G. Kolff & Co., *Batavia.*

AUSTRALIA.—Gordon & Gotch, *Melbourne, Sydney,* and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.
An allowance is made for continuous insertions.

Owing to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, JULY 23, 1887.

THE SEEBPORE ENGINEERING COLLEGE.

When the Engineering College at Dehree was transferred to Seebpore on an enlarged scale, great expectations were entertained as to the want it would supply and the good work it would accomplish in sending out an efficient set of men as engineers and mechanics. Ten years have scarcely elapsed since these changes were made, and the experiment is already being looked upon as a failure. Judging from an advertisement which appears in some of the Calcutta papers, there seems to be a number of "unemployed men qualified as Assistant Engineers, Foremen Mechanics, Overseers, Sub-Overseers and Draftsmen" on the hands of the Principal of the Seebpore Engineering College, whom he would like to dispose of to "Engineers, District Officers and others."

This indicates one of two things,—either the men turned out by Seebpore College are not of the proper stamp, or that they are not wanted at all. We are not prepared to offer our opinion as to the market value of these men We should expect that with the efficient staff of professors and teachers and the means and appliances available, thoroughly efficient men would be turned out. We have heard nothing against them as a class, but our impression is, they have hardly had a fair trial yet. But, it may be asked, why is not a trial given them? Why should so many of them be among the "*unemployed*"? We take it that the demand falls short of the supply. Cooper's Hill, Roorkee, Poona, and Madras fill up their respective shares of the "preserves," and other men imported by Government as well as by Railways, Factories and Mills block the way otherwise. It does appear to us that, as the hardship is not alone confined to Seebpore, some sort of understanding may be arrived at between employers and employées, not only in this but in other departments to utilize labor available in the market, with advantage to both. The employer has in these cases been accustomed hitherto to look to England as the *only* source of supply, and he does not, perhaps, realize the fact that efficient work can be done by men trained here, without the risk and the additional cost of importation.

This being the case we believe that some of the changes proposed to be made at the Seebpore College are at least premature if not a mistake. Among other things we notice that it is intended to establish Technical Institutions in connection with this College. Nothing could be more removed from the purposes of this College or would tend to lower its status and retard its efficiency than to establish in connection with it training classes for the simpler handicrafts and trades, or to attempt to do there the work of an ordinary training class for Telegraph Signallers. A Contributor in a previous number treated of the subject of Technical Education in connection with Mr. Spring's pamphlet on the subject, and we hardly need to repeat that any attempt made to start such a scheme on a large scale would be a waste of public money, and would be a huge failure.

But it is urged that some changes are necessary, because those for whom the College is intended do not avail themselves of its advantages as largely as was expected. We ask, Why? The first answer is given by the advertisement referred to above. Parents and young men say "*cui bono?*" The market is either glutted or young men trained here are not wanted at all. It cannot be expected that parents will invest their money and young men waste their best years in learning a profession which is not remunerative, or rather which is closed to them altogether. The remedy, to some extent, lies in the hands of Government. Let them in the first instance begin to employ those men by bestowing upon them such appointments in their gift as will infuse confidence in other employers and lead them to follow the example thus set them. But this tendency to overlook and undervalue local labor spreads downwards and is noticeable pre-eminently in the domiciled European community who, while they are the loudest to cry for redress at the hands of Government, are the slowest to recognize merit in those of their number who possess it.

The unpopularity of the College is also attributed to other causes. We have heard the boarding arrangements complained of. This it is hardly within our sphere to touch upon, but it does occur to us that it should not be difficult to arrange matters to the satisfaction of all parties concerned.

What is of more importance, however, is the general discipline and moral tone maintained in the place. With respect to this it is possible to *err* both by being too lax as well as by adopting the opposite course. We would not consider that there was even the semblance of discipline in a boarding school where the inmates may be absent from the premises without leave for a whole night, without any cognizance being taken of the fact. We would not by any means recommend the reins of Government to be drawn so firmly as to snap, but this would not imply that they should not be held at all. Those young men who enter the College from a sincere desire to benefit by so doing will not resent a little wholesome restraint put upon them in a judicious manner, and as for others, they were better out of the place altogether.

We would in the last place consider the objection raised by some that too much in point of scholastic training is required in the Engineering class, or that such an idea at least deters some from entering the College. Far be it from us to advocate a lowering of the educational standard, which should be as high as that of any other similar institution, but it should be generally known, that those who attain to this will receive at the hands of Government the same consideration, and be admitted to the same status as those from more favored institutions, and that others who are not able or do not desire to qualify for the highest standard may leave the College with certificates for having passed the examinations and fulfilled the requirements of the lower standards so as to entitle them to appointments suitable to their attainments. Whatever may be the changes that might be introduced, we would deprecate any attempt to diverge from the main objects which it was established to fulfil, to reduce its efficiency by burdening its present staff with work that does not come within their legitimate sphere, or by any means to lower its status as a first-class Engineering College.

HALF YEARLY REPORT OF THE E. I. R. CO.

We have been favoured with advance copy of the Report of the Directors of the E. I. Railway Company, for the half year ended 31st December 1886, together with statement of traffic for the whole year 1886.

The total length of the E. I. Railway proper was 1,515 miles, of which 469 miles are double, and 1,045½ miles are single. In addition to the above, State lines, aggregating 160 miles, including the Tarekeswar and the Cawnpore Kalpi section of the Indian Midland Railway, are worked by the Company. The expenditure on the maintenance and renewal of the Permanent Way and Works, during the period under notice, was 12·88*d.* per train mile, as compared with 12·85*d.* in the corresponding period of 1885, and the cost *per mile of line* per month was £24-17*s.*-1*d.*, as against £26-2*s.*-6¼*d.* during the corresponding period of the previous year. Three new locomotives and six tenders were issued during the half year, at a net cost to revenue of £10,690-11*s.*-3*d.* in replacement of condemned ones.

The number of passengers, exclusive of periodical ticket holders, carried during the half year ended 31st December 1886 was 5,812,802 as against 5,349,478 conveyed during the corresponding period of 1885. The entire number of passengers carried in the twelve months of 1886 was 12,132,495 as compared with 11,246,588 in 1885. The largest number of third class passengers 1,292,353 travelled over an average distance of from 11 to 20 miles, and the smallest number 30,771 over an average distance of 501 to 1,000 miles. From a return of the coaching traffic, we find that 480,047,800 passengers of all classes were carried one mile, and for the whole year 982,465,927 at an average of ·310*d.* and ·301*d.* respectively. The goods traffic for the half year represents 477,720,535 tons carried one mile, and for the whole year 1,051,092,178 tons at an average charge of ·659*d* and ·666*d* respectively, as against 487,104,205 tons and 1,040,181,334 tons, at an average charge of ·672*d.* and ·681*d* in the corresponding periods of 1885.

In the passenger traffic there was an increase in numbers of 463,324, and in receipts of £40,182-5*s.*-3*d.* This increase is attributed to the increasing number of tourists from England in first class passengers, and the war in Burma to the increase in second and third class passengers. In the goods traffic there was a decrease in weight carried of 16,409 tons, and in gross earnings of £52,413-13*s.*-7*d.* These results are due to the keen competition of foreign lines. Taking the whole year 1886, the passenger traffic shews an increase of 885,907 in numbers, and £63,395-15*s.*-1*d.* in receipts—the goods traffic an increase of 160,653 tons, and a decrease of £32,680-8*s.*-8*d.* in money.

As regards coal the Board of Directors of the E. I. R. Company regret to learn that the North-Western Railway, to whom a low rate for the carriage of coal was conceded on the understanding that they would take a large quantity of it, have again taken to burning wood on the line about Phillour, 227 miles from Ghazeeabad. It is gratifying to learn that the newly opened coal-field at Umeria despatched 4,593 tons of this commodity by the E. I. Railway during the half year of 1886.

There was an increase in the carriage of wheat of 2,076 tons, but a decrease in the receipts of £29,990, owing to a marked falling off in the long distance traffic. The exports from Calcutta were 199,995 tons as against 130,318 tons in 1885, while the export from Bombay during the same period increased by no more than 2,370 tons, which shews clearly that in spite of competition Calcutta still holds its own as an important wheat exporting centre.

During 1886 the outturn of steam coal from the Company's collieries was 177,108 tons as compared with 183,847 tons in 1885. The quantity consumed by the undertaking was 187,818 tons, at an average cost (including 4s. $4\frac{1}{2}$*d.* for carriage) of 8*s.* $10\frac{1}{4}$*d.* per ton.

The Company's share of the surplus profits, less income-tax of £39,798-1*s.*-11*d.*, is Rs. 5,38,162-14-9. This sum has produced, after payment of exchange, £37,745-18*s.* 2*d.* which, together with the balance brought forward from last half year, enable the Company to pay a dividend for the half year at the rate of £0-11*s.*-6*d.* per cent. on the Deferred Annuity Capital, in addition to the guaranteed interest of £2 per cent.

The Company's share of profit from the working of the State and Tarekeswar lines, &c., was £7,566-11*s.*-5*d.* for the half year under notice, which, added to £7,861-19*s.*-4*d.*, the profit relating to the previous half year, makes a total for the year 1886 of £15,428-10*s.*-8*d.* as compared with £14,005-18*s.*-4*d.* in the year 1885.

The approximate traffic returns for twenty-three weeks of the first half of 1887 amount to £2,066,731 as compared with £2,050,592 in the same period ended 30th June 1886.

ENGINEERING SCIENCE AND PRACTICE.

THE reign of Queen Victoria may be very appropriately designated an epoch of great Scientific and Engineering progress. A retrospective view through the vista of past ages, remarkable for ignorance, superstition, and doubt, reminds us that the civilization which sheds its benignant light on us today is the fruit of that never ceasing mental and physical energy since the birth of the human race which has succeeded in discovering the hidden forces of nature and making them subservient to the human will. To whom shall we appropriately ascribe the changes that have overtaken the social, physical, and political worlds? Space restricts us to a brief answer, as any attempt to furnish a full one would fill volumes. Mathematicians, Capitalists, Philosophers, and Scientists have done much to bring about or contribute to the amelioration of the human race, but pre-eminent amongst them has been the ENGINEER.

Looked at from the standpoint of the Military, the Civil, the Mechanical, the Naval, the Architectural, the Railway, and the Sanitary,—the Engineer appears the greatest philanthropist and the truest friend of mankind. It is through him that the necessaries of life and commodities of various kinds have declined in prices to an incredible extent during the last 50 years. He has been the principal means of ameliorating the condition of mankind wherever his influence has reached. To his assistance we must attribute the enjoyment of pure water, cheap food and clothing, and other conveniences and comforts of life. Thus we see that the science of Engineering—which lays under contribution so many other sciences—receives practical application at the hands of the Engineer. In alluding to the Engineering profession in his inaugural address, Mr. Nursey, the President of the Society of Engineers, very aptly describes us as being "matter of fact men who are never more happy than when, by a vigorous application of besom fact we succeed in sweeping away delusive fancy. Our profession," says he, "demands for its pabulum facts not fancies," and by way of practical illustration of his meaning he alludes to the theory of the proximate exhaustion of the British coalfields advanced by leading scientists which has been negatived by the fresh discoveries of coal at Home and abroad. Thus it is the investigations of the practical engineer at times—and that not unoften—place theories at variance with practice, and it is as often the combination of the two that tends to great achievements. While appreciating the labors of the Engineer we are not unmindful of those of the scientist, the natural philosopher, and the capitalist, who have each in his respective sphere or combined efforts helped to ease the labour of the Engineer and contribute to the progress of the world and the comfort and convenience of its teeming millions. By the labors of the scientist we have succeeded in concentrating in a small compass terrific forces derived from constituents harmless in themselves, we have brought to light the riches of the world, forced the condensed rays of the sun enveloped in rocky folds of the earth for millions of years to yield us light, heat and force, and compelled the earth to disclose its history of past and present life. We have investigated the stars and placed ourselves in chemical relationship with them, computed their distances, their orbits and time of revolutions and noted their other characteristics. The moon with her serrated border, is, science has declared, no longer *living.* We have further been enabled to discover in the water we drink, the common baccilli, the dreadful microcosm which spread death and desolation around. To conclude our brief treatment of a vast, interesting, and all absorbing subject, we can hardly escape the temptation of quoting the prophetic words of the poet whose genius gave the keynote of the vast progress which the world has made since his time:—

Bid Harbors open, Public Ways extend ;
Bid Temples, worthier of God, ascend ;
Bid the broad Arch the dangerous flood contain ;
The Mole projected, break the roaring Main,
Back to his bounds their subject Sea command,
And roll obedient rivers through the land.
These honors, Peace to happy Britain brings ;
These are imperial works, and worthy Kings.

Notes and Comments.

RANGOON DRAINAGE.—The Loan for the Rangoon Drainage Works has been offered and accepted, and the works will soon commence.

ENGINEERING TRADE IN AMERICA.—A Correspondent writes:—"This is a great year in America for Engineering work, especially 'Bridges.' All the shops are full of orders."

A WELL-DESERVED HONOUR.—Colonel Scott Moncreiff, C.S.I., R.E., has, on the occasion of Her Majesty's Jubilee, been appointed a Knight Commander of the Order of St. Michael and St. George for his services in connection with the Public Warks Department, Egypt.

ENCOURAGING NATIVE INDUSTRY.—The Director-General of Stores for India, Whitehall, is inviting Tenders to supply *Iron-work for Carriages and Wagons* and also for *Cast Iron Chairs* for Indian State Railways. We are at a loss to see the wisdom or necessity of meeting such requirements from Home, when the E. I. R. is able to supply its like wants locally with profit and advantage.

THE NEW BEERBHOOM COAL COMPANY.—The Report for the past half-year ended 30th April 1887 is eminently satisfactory—Rs. 59,506 standing at the credit of profit and loss. From this amount a payment of Rs. 6 per share or 12 per cent. dividend was made, and after transferring Rs. 6,000 to the reserve fund, Rs. 3,826 was carried forward for the next half-year.

THE INSTITUTION OF CIVIL ENGINEERS.—Rurki alumni will be pleased and proud to learn that the most distinguished student who has passed out of the College with the highest percentage of marks—Mr. W. Willcocks—has been awarded a Telford Medal and a Telford Premium for his Paper on "Irrigation Works in Lower Egypt." A Telford Premium has been awarded to Mr. John Kyle for his Paper on the "Colombo Harbour Works, Ceylon."

A NARROW GAUGE RAILWAY IN FORMOSA.—The Formosa authorities are constructing a railway on the 3 feet 6 inches gauge, Jardine, Matheson & Co., having taken a large part of the contract for the supply of rails, locomotives, etc. It was on the coast line of this island that the Plant of the uprooted Shanghai Wosung Railway—the first line ever constructed in China—was left to bleach for many years as a monument to Celestial enlightenment and progress.

MADRAS WATER-SUPPLY, 1885-86.—The preliminary works (construction of an off-take tower, &c., in the Red Hills lake) connected with the scheme for the improvement of the existing water-supply were completed at a total cost of Rs. 87,050, of which Rs. 36,739 was incurred in the year under review. The whole scheme is estimated to cost Rs. 13,68,850. Its execution will therefore have to be postponed until there is a substantial improvement in the financial position of the Municipality. The expenditure on the maintenance of the existing water-supply is shewn as Rs. 33,546.

THE COAL FUTURE OF NEW SOUTH WALES.—A report to the Department of State on the coal mines of New South Wales, states that the area covered by the seams is estimated at 25,950 square miles, extending from the interior to the water's edge. These deposits are said to be among the most extensive and valuable in the world and some of the highest authorities on minerals, both in England and Australia, are decided in the opinion that the New South Wales coal in many respects is superior to English coal. The exports of coal to San Francisco and other ports of the Pacific Coast of America have steadily increased during the last few years. A large quantity goes to China, and some of it finds its way to India.

THE NEW PRESIDENT OF THE INSTITUTE OF CIVIL ENGINEERS.—Mr. George B. Bruce has been elected President of the Institution of Civil Engineers. Mr. Bruce was educated under George and Robert Stephenson, was employed upon the Newcastle and Berwick Railway, and was resident engineer to the Border Bridge. He was subsequently employed upon the Alston Railway, and afterwards came to India, where he became Engineer-in-Chief of the South Indian Railway. Owing to failing health he was unable to complete his work there, but returned to England, becoming Consulting Engineer of the same Company, and also of some of the New Zealand railways, in addition to being engaged in general engineering work at home.

CART ROAD FROM SALEM TO YERCAUD.—The project for the construction of a road from the Hill Station of Yercaud to Salem, a large District Centre in the Madras Presidency, is to be postponed for the present. The total length of the Road is $12\frac{3}{4}$ miles, of which about $1\frac{1}{4}$ miles are about 1 in 17 to 1 in $17\frac{1}{2}$; $9\frac{3}{4}$ miles vary from 1 in 18 to 1 in 21; and the remainder, $1\frac{7}{8}$ miles, are at a still easier gradient. The width of the proposed road is 15 feet in the clear, and substantial parapet walls have been provided for, with metalling and gravelling throughout. The estimate amounts to Rs. 2,44,200, the largest items being revetments, blasting rock and parapet walls. This is at the rate of Rs. 18,784 a mile, a heavy rate necessitated by the sides being specially rocky and steep.

A DISTINCTION WITH A DIFFERENCE.—The *I. D. N.* asks:—Why have Major Gracey and General Browne drawn Rs. 500 and Rs. 400 a month special allowances for going to Burmah and Beluchistan, over and above the usual allowances? We always understood that the difference of pay between C. Es. and R. Es. was accounted for by the theory of military duties. It seems strange to see soldiers, who have to be asked if they will, for a consideration, take up frontier work which they might be ordered to do. We are far from saying that it is desirable that they should be so ordered, but to give them extra allowances for the same work as their Civil brother officers have to do, without those allowances, is fair neither to the Civilians nor to the public, and is another instance of the jobbery which a close ring can effect to the detriment of the national interests and their own reputation.

COLOMBO HARBOUR.—The Committee of the Colombo Chamber of Commerce, appointed to consider the best method of raising the additional revenue needed to complete the S. W. Arm of the Colombo Breakwater, have thought it desirable to extend the scope of their enquiry with a view to ascertaining if it would be possible, without taxing shipping too severely, to increase the Harbour revenue to such an extent as to admit of the completion of the Harbour, including the Northern Arm, according to the designs of Sir John Coode. There is a strong reason for coming to a decision upon and proceeding with the work at once. The Admiralty are disposed to aid in the construction of a Dock at Colombo. The eastern shore of the Colombo Harbour affords several suitable sites for the construction of a Graving Dock, but, wherever it may be placed, the Committee consider that it will be necessary to provide a Northern Arm or groin as a breakwater to protect the entrance to the Graving Dock. A Northern Arm would also have the effect of increasing the area protected by the Breakwater works during the prevalence of the south-west monsoon.

PETROLEUM FUEL *vs.* WOOD OR COAL.—The administration of the Tambov-Saratov Railway has made experimentsas to the relative cost of wood, coal, and Baku petroleum, with the following result:—One cord of wood is equal in value to 3,420 English pounds advoirdupois (95 poods) of coal, and 2,736 pounds (76 poods) of petroleum, whilst the cost of these quantities is 20·97 silver roubles for the wood, 20·90 for the coal, and 17·95 for the petroleum. Results still more favourable for petroleum have been made on the Orenburg, the Warsaw-Terespol, and the Dunaburg-Vitebsk Railroads. Besides these lines, the Transcaspian, the Transcaucasian, the Grjasi-Zarizyn, the Mornhansk-Sysran, and the Rjasan-Korlow Railways use petroleum for fuel. This is satisfactory as regards the future of our Frontier Railways. The trials of the oil from Khatun show favorably with these comparative figures.

MADRAS HARBOUR WORKS.—The Superintendent in his progress Report for April remarks on the rubble foundations that the quantity of stone required to form the rubble bases of the two piers will considerably exceed the amount estimated for. This is rather a serious matter, as the north pier base is not completed and yet 186,650 tons have been used in its formation against 182,260 estimated for the complete work. At the south pier 169,517 tons were estimated for the complete work, and 145,695 have been already used while much remains to be done. The only explanation which he can offer for this excess is that owing to the disturbed state of the sea near the ruined walls the rubble has been displaced more than was the case in the original work. But lest this should be considered an element of weakness he explains that the base of the finished walls is protected with blocks of 30 tons over the whole surface, and these prevent the sea scouring out the stone foundation.

THE TRAVANCORE RAILWAY.—We learn that the long talked of extension of the railway into Travancore is as yet an unsolved problem. The Travancore authorities still maintain that a northern route, by which the line will have its terminus at Quilon, will be much more advantageous to the country and people than the southern extension advocated by Mr. D. Logan, the Chief Engineer of the South Indian Railway. The advantages and disadvantages of the two routes have been discussed dry. It was pretty clear from the official papers placed at the disposal of the Press some time ago, that the engineering difficulties to be encountered in the northern extension are much more stupendous than those to be met in the southern line; but if the financial results to be expected show the balance of weight to be favourable to the former line, we think the matter may at once be brought to a settlement without wasting any more red tape.

AWARD OF GRATUITY AND HONORARIUM.—There is a tremendous altercation going on in the Hyderabad Municipality concerning the granting of a gratuity and honorarium to Mr. Lee, the Engineer and Secretary, on his retirement from municipal service. Mr. Lee has served the Hyderabad Municipality for twenty-four years, and during this long period he invariably gave the greatest satisfaction to his employers. Owing to ill-health he has been reluctantly compelled to retire from his onerous duties, and the general body of the Municipal Commissioners at one of their meetings resolved to grant him a gratuity of twelve months' pay. As, however, this gratuity was not considered to be a worthy token of the appreciation in which Mr. Lee's services were held by the Municipality, it was further determined to grant him an honorarium of Rs. 7,500. A difficulty has, however, arisen as to the legality or illegality of the dual award, and the mooted point is to be referred to the Legal Remembrancer, and a general wish is expressed that that legal luminary will decide the matter in favour of Mr. Lee.

PUBLIC SERVANTS AND PRIVATE PRACTICE.—A discussion ensued at the last meeting of the Calcutta Corporation on the recommendation of the Town Council "that no officer of the Corporation be allowed to undertake any private work or business unconnected with the Corporation." Dr. Macleod took exception to the wording of this recommendation. He pointed out that in 1880 a resolution was passed permitting the Engineer and other superior officers of the Corporation to take up private work with the sanction of the Chairman, who had afterwards to report the matter to the Commissioners. This was subsequently in 1884 rescinded, so far as the Engineer was concerned. Dr. Macleod pointed out the anomaly of the present recommendation, and impossibility of this rule being strictly enforced. He considered the recommendation of the Town Council in its present form was absolute, unfair, unusual, unnecessary, impolitic, and impossible. He therefore moved as an amendment that the resolution be so far amended as to fall in with the lines of the resolution of the Commissioners passed in 1880, *viz.*, permitting private work to be undertaken with the consent of the Chairman, who should report the matter to the Commissioners in meeting. The amendment was lost and the recommendation of the Town Council was carried by a narrow majority.

SANITATION IN INDIA.—Mr. Justice Cunningham writing to the *Times* advocates the creation of a branch of the Public Works Department whose special duty it shall be to assist Municipalities in important projects of drainage or water-supply and to test the soundness of projects. No such department at present exists, nor is there any class of sanitary engineers in India to whom Municipalities can look for assistance and guidance. The Government of India has in its employ some of the best hydraulic engineers in the world, but the services of these gentlemen are not available for advising upon Municipal undertakings. Much money, accordingly, is wasted through unskilfulness or ignorance, and many important reforms are postponed because there is no one who can advise authoritatively on the best way of setting about them. In connection with this subject, it is interesting to note that, just before the last mail left, a question on the matter of sanitation in India was asked in the House of Commons by Mr. Kenyon who enquired whether the attention of the Secretary of State had been called to the subject; and whether the Government were prepared to take any steps to carry out the objects indicated therein. Sir J. Gorst replied as follows:—The sanitary condition of towns and villages in India is constantly under consideration by the Government of India and the Secretary of State, and every effort has been, and will be, made to introduce from time to time such improvements as may be practicable.

Current News.

The services of Lieutenant-Colonel W. J. Engledue R.E., have been placed at the disposal of the Public Works Department.

Colonel Mallock, Deputy Director-General of Telegraphs, takes six months' leave to England from the 2nd August.

Instructions, we understand, have been issued for the commencement of the Kadri Extension and Villapuram-Paikal lines of railway.

Another new lode of silver-lead turned up a few days ago in Kot Kundi Kothi, in the Kulu district. Native sulphur is also known to exit very high in Chong Kothe.

A Traffic Manager and a Locomotive Superintendent have been appointed for the Indian Midland Railway, and they will join their appointments shortly.

The new East Indian Railway School in course of construction at Oak Grove, Mussoorie, is progressing, and will be a fine building when completed. It will cost about four lakhs of rupees.

The Reay Paper Mills at Mundwa, close to the G. I. P. Railway, will start regular work this month, the only cause of delay being the non-arrival of some water pipes ordered from Bombay.

Lieutenant-Colonel T. N. Wingate, R.E., has been appointed officiating Superintending Engineer of the Presidency and Oudh command during the absence, on leave, of Major W. L. Greenstreet.

The Government of India have sanctioned a revised project for the construction of No. 3 Battery at Manora, Karachi, at a cost of Rs. 2,52,485, in connection with the harbour defences of this port.

We understand that Captain Hext, R.N. has been offered, and has accepted, a further term of five years' service under the Indian Government in his present appointment, dating from March, 1888.

We are in a position to state that the Tirupati-Nellore section of the Cuddapah-Nellore State Railway will be opened on the 1st September for passenger traffic, and not on 1st proximo, as announced by some of our contemporaries.

Rumours have been floating about Calcutta for some weeks past of the probability of a Company being got up in England to run in opposition to the India General Steam Navigation Company for the river trade between Calcutta and Assam.

It is said that the late heavy rains have caused so much damage to the line of railway between Dharwar and Belgaum that, one of the trains proceeding from the former to the latter place could go no further than Londay, whence it had to return to Dharwar.

It was expected that the platelaying of the railway line from Choura to Jhansi would have been completed by the close of June, but the outbreak of cholera has, it is supposed, greatly retarded the progress, and a still further delay will ensue owing to the rains having set in.

The revenue survey of Mysore is almost completed, and the department will be abolished. It is reported that the Mysore Durbar wish to retain the services of Colonel Grant, Bombay Staff Corps, the Superintendent of the Revenue Survey, as Revenue Commissioner of Mysore.

Major Bissett, Agent of the B. B. and C. I. Railway, is a passenger to England by this week's mail steamer. We trust the result of his consultations with the Directors will be the carrying out of certain broad-gauge extensions of the line which have for sometime been under consideration.

The bridge of boats at Benares has, owing to the rise in the river, been removed, never again to be replaced, as the railway bridge is now open for foot passengers. In connection with the latter, it is stated that the Government intend constructing protective works at the bridge approaches.

We hear that serious damage has been done to the Head Works of the Western Jumna Canal by the late floods. One bridge has been entirely washed away. Details of damage are not yet to hand, but it is believed to be somewhat serious; and causes anxiety on account of the large crop depending on the supply from the Canal.

The arrangements for working the Kulu and Shigri Mines, now being carried out in London, are rapidly approching completion. Another new lode of silver-lead turned up a few days ago in the Kot Kundi Kothi. This makes about a dozen known lodes of lead. Native sulphur is also known to exist very high up in the Chong Kothe.

The *Sind Gazette* states that every item of supply, down to fuel and forage, for 100,000 men can now be placed by rail within eighty miles of Kandahar, and that an order for the despatch of 20,000 tons of coal to Quetta is now in course of being carried out, and great quantities of stores are being sent up to depôts on the Kandahar line.

The *I. D. N.* hears that the caisson on the Naihatti side of the Jubilee Bridge is shewing signs of sinking, and that the East Indian Railway authorities have, as a precautionary measure, issued orders to reduce the weights of the goods trains crossing during the day, and have for the present altogether suspended the running of goods trains across the bridge at night.

The Government of India has recommended to the Secretary of State that Major-General Sir A. Cunningham, K.C.I.E., C.S.I., R.E., late Director-General of the Archæological Survey of India, be granted a pension of £160 per annum in addition to the military pension he receives. General Cunningham was for fifteen years at the head of the Archæological Survey Department.

It is satisfactory to be able to record that the tonga and dak-gharri mail service between Simla and Umballa, that seems so much more liable than a railway to accidents by flood and field, work like clockwork, amid all the rain and storm which we have experienced of late. A railway to Simla will be an advantage in many ways, but it may be doubted if it will be more reliable than the present service.

The Madras Government has received a telegram stating that the Committee sitting in London to consider the question of the north-eastern entrance to the Madras harbour have recommended that the work should be continued at the south arm only upon the present design, which provides for the eastern entrance, and that work be stopped at the northern arm till a decision as to the entrance is arrived at.

It will be assuring to the many persons who have complained of the excessive and practically prohibitive charges made for the registration of inventions, that we hear on the very best authority that the Patent Bill, as published some time ago, will be greatly modified, and especially that there will be a considerable reduction in the fees, regarding which so much dissatisfaction has been expressed. These changes, however, are not expected to be announced till the return of Government to the Presidency.

The Madras Cement Works, which have been in existence for some few years, are, we hear, to be extended in their operations by extra plant being added. The requirements of the Cement works will receive the attention of Mr. J. Peddie, the Manager, during this gentleman's stay in England, whither he proceeded on six months' leave. Mr. Peddie has been connected with the Madras Cement Works ever since its establishment, and now goes home to enjoy a well earned holiday.

Work on the Indian Midland Railway is progressing rapidly. The embankments are now almost completed and the bridges and station-houses are advancing towards completion. The permanent-way has been laid for a distance of 33 miles between Bhopal and Bhilsa, and it is now used for furthering the works in progress. There will be twelve stations between Bhopal and Jhansi. The extension from Etwah to Saugor, a distance of 50 miles, is under survey. The telegraph line on all the sections is now in working order.

The Bombay Town Council considered the report of the Works Committee on the question of the detection and prevention of waste of water by adoption of Deacon's meter system, and the construction of pipe sewers and house connections in the Queen's Road District. The Council recommended the Corporation to sanction the extra establishment at an annual cost of Rs. 14,484 of which Rs. 10,000 would be required for the cost of establishment for the current year. The Council had not finished the consideration of the entire report when it adjourned.

Now that new buildings are in course of erection in Park Street for the Mathematical Instrument and Lithographic Offices of the Survey Department, we trust the present and possible future requirements of the department will be ascertained before the building is completed. The Post Office, the Presidency Offices, both of the Government of India and Bengal, and the Military Accounts Offices, were all found on completion to be unequal to the requirements of the departments for which they were specially built, and extra private buildings at a heavy cost to the State have to be rented in various parts of the town.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

ICE-MAKING MACHINES.

Sir,—I have much pleasure in sending you a few details which have come practically under my observation in reference to the working of West's Machine (Southwark Bridge Road, London).

Granting that the steam part of the machine is working in good order, we will follow on to the tail end of the piston rod on to which is coupled the ether pump rod. This rod has to be very carefully looked after, and great attention given to the packing gland of the ether pump. As the friction of Rod wears the packing so continually every 3 or 4 hours it is necessary to place a loaded key on to the packing nuts, and the weight on the key is so regulated as to tighten the nuts just sufficient so as not to be too tight. On this apparently minor detail depends, to a great extent, the success of a long run of the machine, for if the rod works in the packing gland in any way loose the result is a rise in the pressure on the condenser caused, of course, by the ether pump on its forward stroke to suck in air, which mixes with the ether in its volatile state, and when passed into the condenser, shews a rise in the gauge. I have worked the machines at 7 lbs. pressure in the condenser for over a month, and this is exceptionally a very good result, though it causes the machine to labor very much, and this means an expense of coal, and a stoppage to blow off the air that the pump has sucked in before blowing off, which is generally from a cock on the condenser. The ether is cooled by a flow of water which is continually being supplied to the tank in which the condenser is placed, the air then being blown off carries with it an amount of ether which is very expensive. Hence in all Ice industries great importance should be placed on the pump rod also on all flanged joints.

The process as regards the action of ether is correct, but no instructions are given as to the regulation of the liquid ether which flows from the condenser to the refrigerator to be vaporised. This is an important item, as too large a flow does not give a complete vaporisation, and consequently a quantity of ether is spent in the refrigerator, which has done no duty. The Ice tanks are also to be guarded by the way of having them well secured against draughts; all brine pipes, etc., should also be encased so as not to lose any cold by exposure to the atmosphere.

C. K. B.

Dr. SAISE ON COAL MINING IN STAFFORDSHIRE.

Sir,—It would appear from the pamphlet, which you briefly and appropriately noticed the other day, that the E. I. R. Collieries are *managed* on the "mutual adulation" principle. This is palpable from all the tracts that have emanated from this source, but more so from the pamphlet in question. For instance, I cannot see why Dr. Saise should have suggested that the Assistant Manager, who was at the time he wrote in India, should in his prospective leave go over the same ground as himself in the Old Country and acquire the same information that he apparently took so much time, care and trouble to evolve. This kind suggestion bears a dubious aspect in the face of the fact that the two senior subordinates or Mining Inspectors, in receipt of Rs. 500 odd per mensem each, were at Home at the same time as Dr. Saise, and that he might have initiated them into or given them the benefit of his valuable investigations—particularly as these acknowledged mining experts, who had been in the service of the Company for periods of 12 and 17 years, are to give practical effect to Dr. Saise's theoretical enquiries and obtain all the good expected to be derived therefrom. But the most surprising part of the pamphlet is the reticence on one point—*viz.*, that one of these senior subordinates or Mining Inspectors is *a Staffordshire man thoroughly conversant with Staffordshire Mining in all its aspects*, and one who has been tried and not found wanting in India! The other was specially engaged as a practical man thoroughly up in all the methods of coal mining in Yorkshire, and there is no sufficient cause why after so many years' good service and acquired knowledge and experience he should have to give way to strangers.

I can hardly see the necessity for bringing out fresh hands and increasing an already expensive establishment when the output of the collieries has under the recent ruling diminished by a half. It cannot be alleged that the knowledge of recent methods of the old hands is stale, for they have as often as Dr. Saise had opportunities for refreshing their information on furlough; I might say oftener, as these same old hands have come from colliery folk and are surrounded when at Home with colliery associations.

A few words more and I have done. The conviction that has grown upon me by taking the out-turn of the E. I. R. Coal workings, their concentrated position, and the enormous facilities and advantages they possess in connection with the largest Railway system in India, that the present establishment is disproportionately in excess of actual requirements and affords room for reduction.

Justitia.

[We have taken some trouble to test some of the statements in this letter and find as a matter of fact that the Manager, the two Mining Inspectors, and two European Contractors were absent from the Collieries at Home on leave at one and the same time; and that during this period the Senior Mechanical Engineer resigned his appointment. This certainly demands the attention of the Board of Directors.—Ed., *I.E.*]

LIGHT RAILWAYS IN BURMA.

Sir,—The important results of Railways in developing the resources of newly acquired countries has been so profitable that considerable attention has been given by Engineers for the past quarter of a century to inventing a cheap and economic line. This has led to the production of narrow gauge railway plant, that could be fitted up by even untrained men and easily removed to places when a more permanent form of railway is necessary. It is only a few years since that the projectors of narrow gauge railways experienced the obstinate opposition which is the almost certain consequence of those bold enough to suggest the possible expediency of departing from the beaten track. But energy and perseverance as usual won the day and now it cannot be denied by even the opponents of the narrow gauge system, that this cheap means of locomotion in thinly populated districts is the most profitable and is recognised as the most advantageous by eminent Railway Engineers. The narrow gauge when first started was about 40 inches and this was considered by its opponents as dangerously narrow; but it has since been proved that with suitable rolling stock that even narrower gauges can be efficiently worked at moderate speeds. The establishment of the possibility of safe running on a 2 feet gauge line has opened out a wide field for railway enterprise and has been the means of developing to the fullest extent the resources of our colonies.

A light railway to fulfil district requirements must be durable, elastic, cheap, easily laid down and taken up without needing skilled labor and consist of as few parts as possible. One of the systems that have been invented combining in the highest degree these desired qualities is a line now being laid down between Moulmein and Thatone by Mr. Geo. Dawson. The rails consist of two pieces only, the rail and the sleeper, which are respectively interchangeable, thus dispensing with chairs, bolts, fishplates, &c. It is more securely jointed than the ordinary method as there are no bolts or wedges to get loose. The laying down is very simple: the half sleepers at the outer clip are placed at the proper distance apart, and the rails are then placed in position; the half sleeper with the inner clip is thus inserted under the rails, at a sufficient distance to allow the clips to take in the flange of the rail; it is then put in its place with a mallet, thus ensuring an exact gauge and a firm grip of the rail. The jointing of the rails is equally easy, each rail has a fast joint plate with a stud fitting into the joining rail. The joining rail has the same; thus acting as two fishplates, which are kept in position by the sleeper. The sleepers can be made of any section suitable to the nature of the country—but under ordinary circumstances the best is that described, as it is easily ballasted and the ballast keeps the two half sleepers together. The price per mile for 18 inches gauge 10 lbs to the yard, is about Rs. 2,560, 12 lbs. Rs. 2,760, and 14 lbs. Rs. 2,970.

From the above it will be seen that a light railway is not so expensive as is supposed—the line now alluded to has paid its cost and the projector intends extending it.

T. H.

Literary Notices.

Stoney and Winter's Patent Switch Locks.

In a brochure of 13 pages with a number of carefully executed drawings, the authors and joint patentees describe in a lucid manner the method of locking railway switches by a contrivance known as the "Rocking Lever Switch Lock," which with the "Automatic Rocking Lever Switch Lock," possesses elements of safety and security not attainable by the ordinary method. The effectual locking of the points depends on the weight of the running train—which unlike the sleepy pointsman does its duty admirably and unfailingly. Under this system the possibility of danger arising from imperfect locking of the switches is impossible, unless from intentional and other causes. We find that a large number are in use on the Madras Railway and elsewhere, and we are only surprised, considering the small cost at which these can be laid, they are not more extensively adopted on other railways in the country. The first set laid in 1878 is still working and giving satisfaction.

The Government of India recognising the merits of the invention awarded an honorarium of Rs. 10,000 to Mr. Stoney for the use on State Railways of the switch locking apparatus.

The Association of Engineering Societies.

The Transactions and Proceedings for May and June, of the seven American Institutes that form the "Association" are now before us.

As these publications are issued *monthly*, there must of course be a smaller number of articles in each number than if it appeared at longer intervals. In the May number we find an elaborate article with a discussion on the great waterway to connect Lake Michigan with the Mississipi River. This paper should have considerable value and interest to Hydraulic Engineers. Another article on Traction Rope Railways in the same number is worthy of attention of those concerned with Street or Mine tramways under the cable system. The Contents of the June number call for no special notice, the articles referring to local practice, and of but little general importance.

IMPERIALISM AND FREE TRADE.*

A Review.

When Addison put into the mouth of one of the heroes in the *Spectator* the phrase 'much can be said on both sides,' he little thought that what he intended to represent as an idiosyncracy of his favourite character would have an almost universal application, not only in the world of politics, but in that of science as well. 'There are always two sides of a question' is a saying that has almost passed into an axiom, the truth of which is established in the application of the exact sciences to the ordinary concerns of life. And nowhere is this more visible than in the domains of Political Economy, which, if its advocates are to be believed, has its principles laid down on the sure and certain foundation of every day experience.

It is therefore a relief to turn from a well-beaten path to new channels, and examine some 'accepted' facts as looked at from an opposite point of view. One would hardly be prepared to find in the latter end of the present century a sceptic in regard to the principles of Free Trade; it is so hard to tear ones-self away from some of the most cherish-conviction's of the past to which we have ardently clung for close upon fifty years. But such is actually the case, and we must confess to having our preconceived ideas somewhat rudely shaken on rising from a perusal of Mr. Guilford L. Molesworth's "Imperialism and Free Trade." The reader finds himself carried along by the current of his thoughts, whether he wills it or not, and the warmest opponent of Mr. Molesworth will concede that a great many of the facts adduced by him are startling enough to justify a reopening of the question, whether the Free Trade of England, heavily handicapped as it is against protection of other countries, in the struggle for national existence, is, after all, such a boon as economists have pronounced it to be, and to have deserved the encomium so lavishly bestowed upon it by some of the greatest thinkers of the age. We will therefore enter into an examination of a few of the landmarks on this debated ground and see if 'Free Trade' has proved an unmixed blessing to the only country in the world to which its operations have been confined.

The first point to be considered is whether sufficient time has elapsed and if ample data have been collected to pronounce an opinion on its merits. We think both these conditions have been adequately fulfilled. Although Free Trade was introduced into England in 1846, it was twenty years ago that its effects told seriously upon our trade. Take for instance the wheat trade of india. The present yield is about 26,500,000 or about 9,500,000 in excess of the total imports of wheat into England, and it is capable of further expansion on a very large scale, as besides enormous tracts of cultivable waste land in other parts of India and Burma, it is estimated that the Punjab alone could produce 12,000,000 over and above what she supplies now. But of what use are these material resources of the land when instead of fostering her industries an embargo has been laid on them? If a slight tax were laid on American and Russian wheat, the prospects of India and Australia would look up, as the whole of the wheat import trade would be diverted to those countries; India would go on steadily increasing its cultivation, resulting in the cheapening of the commodity, as it would be produced at a lower rate. But such is the policy of the Government that all these advantages have to be abandoned in the face of a depreciated currency, only that the strict principles of Free Trade may not be deviated from. We shall quote another instance. India is burdened with a tax on rice which interferes seriously with its export as the tariff is sometimes as high as 14·2 per cent. on the value of the consignment. The natural consequences follow: the cultivators seeing no outlet for their production, divert their attention to growing the less remunerative crops of oilseeds for export, and when an unexpected famine occurs, there is no surplus of food which might be kept back from the exports. To remove the tax would not cause unnecessary drain. In this connection there is an interesting point which has been a veritable hard nut for economists to crack, and which nearly wrecked the reputation of Lord Northbrook as a financier. When the Behar famine of 1874 took the country by surprise, Sir George Campbell recommended that the export of rice should be stopped, and instead of procuring rice from Burma, it should be purchased here. The Viceroy put his veto on the proposal for two reasons, *firstly*, that it would interfere with the personal liberty of the exporters, and *secondly*, that if the countries supplied by India with rice were deprived of it they would look to some other market for the supply of this necessary of life. The result belied these anticipations. The price of the commodity immediately rose in Burma and rice of an inferior quality was purchased at regular famine prices. Now had Sir George Campbell's policy been followed out a great number of lives would have been saved and the people would have consumed the produce of their own country to which they were addicted from their birth. Now, to beat India in the rice market of the world is an impossibility, as nowhere else is it cultivated on such an extensive scale, and in the event of a failure in the supply for one short season it would not disturb the equilibrium of trade for a very good reason that the countries which had hitherto imparted it would have to fall back upon some other article of food as a makeshift. Take the case of America; during the Civil wars of 1861-65 there was a great demand for Indian cotton, and the impulse the trade received together with its disastrous results is a matter of history. But could Indian cotton manage to establish itself when the tide turned with the conclusion of the war? No. American cotton again led the way and has continued since to maintain its position in the teeth of the keenest competition.

Mr. Molesworth very properly observes, "In the present day it requires no small courage to propose anything in the shape of protection: but this is no time to shrink from a consideration of the truth; and the stern logic of facts tells so strongly against unlimited foreign competition, that it becomes necessary to analyse the results of its action in order to ascertain whether the claims that have been made in support of it are really tenable." Now, the great argument of the free traders is that protection being an artificial method of bolstering up an industry, it could not have a permanent existence in the economics of a country. But neither does the writer of the pamphlet say so, he merely advocates a temporary retention of it until the industry in question has taken root and flourishes without any factitious help. But then what have the advocates of free trade to say in defence of their pet hobby when there are facts to shew that while within the last forty-one years we have been steadily losing in spite of our boasted liberal policy, America and the other countries which have guarded their commerce by protection are infinitely in advance of us in material prosperity. If after a fair trial given for the past four decades the results are as we see, then the onus of proof of the decadence of English trade being due to causes other than free trade, lies with those who advocate its retention. Referring to this country Mr. Molesworth says:—"Everywhere in India may be seen evidence of native iron manufacture crushed out by unlimited foreign competition. Throughout the whole country may be found old slag heaps, testifying to the former prosperity of native iron industries, the splendid native iron being now superseded by cheap, worthless iron of foreign manufacture. Many attempts have been made to revive or start fresh iron industries: but they have one and all been crushed out for want of a little fostering protection. The latest attempt nearly succeeded, but the modest request for a little help was sternly refused, and the company broke down."

'Never prophecy till after the event,' that is a saying which the authors of a liberal policy ought to keep steadily before their eyes. Mr. Molesworth gives in parallel columns the prophetic utterances of politicals and their fulfilment, and any one who is not "beyond the reach of reason" can see at a glance how the prognostications have been falsified by events. It would be useless to multiply instances, scores of which might be found throughout the *brochure* under review, but we cannot help quoting a few out of a host of facts pointed out by the author with special reference to engineering matters, which we cannot help reproducing here: (1) English manufacturing industries are, for the most part, on the high road to ruin; (2) Iron industries are said to have lost £160,000,000 in four years; (3) The relative increase in the production of iron is greater in protectionist countries than in England; (4) Gloomy predictions are uttered about the immediate future of our iron trade, as few fresh orders are coming in, and stocks are consequently increasing in an alarming manner; (5) Ten years ago England supplied Germany with all its wire, but last year Germany sent into England 190,000 tons of manufactured iron, chiefly wire.

We have barely done justice to Mr. Molesworth's masterly essay, and want of space compels us to close this short and necessarily cursory review of one of the grandest problems of the present day, intimately connected with the well being and prosperity of England and India. We would strongly recommend our readers and the public to read, think and inwardly digest every point raised by that able writer in support of his position.

*Imperialism and Free Trade. By Guilford L. Molesworth, Consulting Engineer to the Government of India for State Railways. Reprinted from the *Calcutta Review* of October 1885.

New Books and Reprints.

ARCHITECTURE.

Architectural Studies. Parts 6 and 7. Folio, paper. New York ea. 5

ELECTRICITY.

Holmes (A. B.) Practical Electric Lighting. With 87 Illustrations. 3rd ed. Post 8vo, pp. 184. Spon. 3/6

Plante (Gaston) The Storage of Electrical Energy, and Researches in the effects created by Currents, combining Quantity with High Tension. With 89 Illusts. Translated from the French by Paul Bedford Elwell. 8vo, pp. 260. Whittaker ... 12/

ENGINEERING AND MECHANICS.

Baker (T.) A Rudimentary Treatise on Land Engineering and Surveying. 14th ed. Revised and corrected by J. R. Young. (Weale's Series.) 12mo, pp. 210. Crosby Lockwood 2/

Davies (D. C.) A Treatise on Slate and Slate Quarrying: Scientific, Practical and Commercial. 3rd ed. (Weale's Series.) 12mo, pp. 200. Crosby Lockwood 3/6

Dempsey (G. D.) On the Draining of Lands, Towns and Buildings. Revised, with large additions on Recent Practice in Drainage Engineering, by D. Kinnear Clark. Post 8vo, pp. 358. Crosby Lockwood 7/6

Fletcher (John Jas.) A Pocket Glossary of Technical Terms, English-French, French-English. With Tables suitable for the Architectural Engineering, Manufacturing and Nautical Professions. 64mo, roan. Crosby Lockwood 1/6

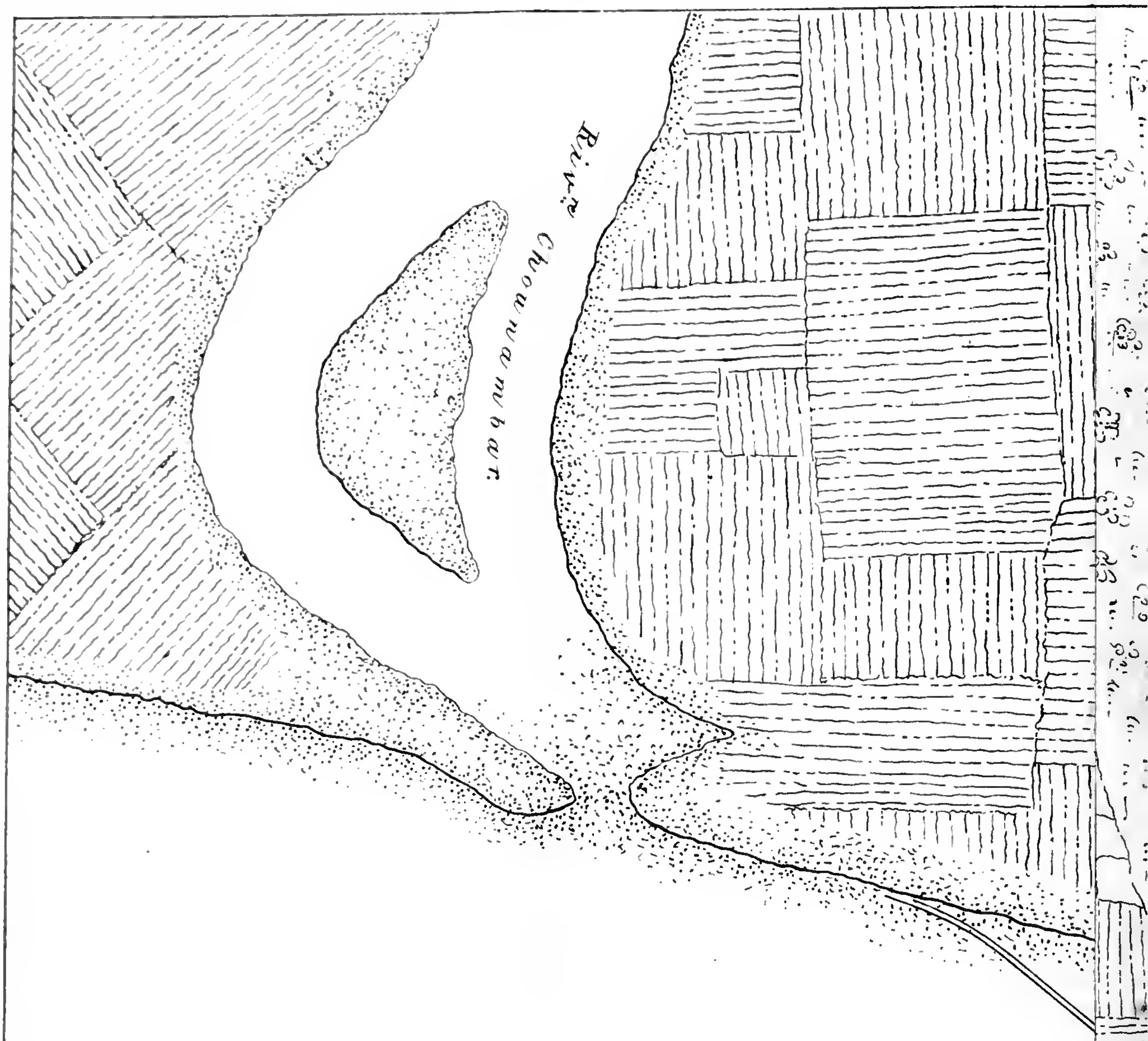
Hasluck (P. N.) The Watch Jobber's Handybook: A Practical Manual on Cleaning, Repairing and Adjusting; embracing information on the Tools, Materials, Appliances and Processes employed on Watchwork. With upwards of 100 illustrations. (Handybooks for Handicrafts.) Post 8vo, pp. 240. Crosby Lockwood 2/

Hutton. (Walter S.) The Practical Engineer's Handbook: Comprising a Treatise on Modern Engines and Boilers, Marine, Locomotive and Stationery, and containing a large collection of Rules and Practical Data relating to Recent Practice in Designing and Constructing all kinds of Engines, Boilers and other Engineering Work; the whole constituting a Comprehensive Key to the Board of Trade and other Examinations for Certificates of Competency in Modern Mechanical Engineering, with upwards of 570 Illusts. A Companion to the Work-manager's Handbook. 8vo, pp. 590. Crosby Lockwood 18/

Jamieson (A.) A Text-Book on Steam and Steam Engines. 2nd ed. With numerous Diagrams, 4 folding Plates, and Examination Questions. Post 8vo, pp. 410. Griffin 7/6

Reynolds (Michael) The Engineman's Pocket Companion. 2nd ed. Revised. 15mo, pp. 314. Crosby Lockwood ... 3/6

Vose (G. L.) Bridge Disasters in America: The Cause and Remedy. 18mo, pp. 89. Boston 2/6



I

PONDICHERRY HARBOR PROJECT

General Plan of the Mouth of the Ariancoupam with the surrounding region and the position of the Town of Pondicherry.

The proposed Harbor is outlined in thick black.

General Articles.

PONDICHERRY HARBOUR PROJECT.

By A. Pierres deClosets, C.E.,

II.

The Roadstead of Pondicherry.

The present roadstead of Pondicherry is entirely open and exposed to the winds of the N.-E., E., and S. E.

The bottom of this roadstead is a continuation of the alluvial earth constituting the basin of the Gingee River better known as the Ariancoupam. This alluvium covers the tertial earth found near Pondicherry and Cuddalore; we have no information as to the depth to which this earth is found below the level of the sea about a mile out, but it is supposed to be to about 100 metres.

The bottom of the roadstead is composed of sand, more or less mixed with clay, but on the beach no clay is found in it, and it is rather coarse without cohesion and easily disturbed by the waves. Under these sands, judging from soundings taken at Pondicherry at a short distance from the shore, there will be found sandy clay, black clay, then, still deeper, sands and lignitic gravel, then clay and sand continuing probably to the tertiary stage.

The average slope of the bottom of the road towards the open sea, is about $0^{m} \cdot 0068$, thence is produced a bar, the breakers of which being more or less high according to the state of the winds and sea. This bar in fair weather forms at about 100 metres from the shore, in bad weather it forms further out, and in cyclones, it has been known to commence at about 6 fathoms, that is about one mile from the coast and there to stir up the sands at the bottom. This effect, opposed to the theory admitted in Europe which gives from 4 to 6 metres as the depth at which the waves cease to disturb the bottom, should be taken into consideration in the establishment of a Harbour at Pondicherry, with regard to the constructions to be made at sea.

It has been observed on the roadstead of Madras which resembles that of Pondicherry that blocks of Laterite, varying from 5 to 100 kilogs had been dislodged and carried away to a depth of 40 feet, $12^{m} \cdot 16$ by the groundswell during a cyclone. As to the force exercised by the waves at a depth equal to their own height, it has been known to exceed 9 tons the square metre on the coast.

Situation of the Proposed Harbour.

The town of Pondicherry, being situated to the North of the mouth of the Ariancoupam, the only convenient place for a harbour as close as possible is naturally the interior of the opening. The Engineers that have studied the subject have always, as I observed above, indicated this place as the most favorable in every respect.

The necessary space providing for the future importance of the Harbour, would be that which at present is under the waters of the river itself, to a distance of about 500 metres below the Ariancoupam bridge, by adding to the whole of the perimeter a zone of 100 metres in width, and the space compressed between the jetties and the shore in which the entrance channel will be excavated. The former will form the interior harbour and the latter the outer one. It would be necessary to occupy the ground now known as the Cocoanut Isle.

Another reason for the choice of the mouth of the Ariancoupam, is the facility possessed by this river at the time of the floods, of being able to provide a current strong enough to clear away the entrance of the channel by carrying off the sand which may have collected there.

Thus current, moreover, might be strengthened by diverting the waters of the Chounambar, another branch of the Gingee, which would add to the intensity of the current and would render it sufficient with the help of dredging machines to keep the entrance of the Harbour in good condition without using locks, etc.

Loading and Unloading of Vessels on the present Roadstead.

At the present day, on the roadstead of Pondicherry, which is an open roadstead, the loading and unloading of vessels takes place either on the Pier or on the beach by means of chelingues. The chelingues are loaded at the Pier by means of cranes, while still afloat, but at the mercy of the waves. At the beach they are stranded during the loading and unloading and they have to cross the bar on their journeys to and fro to the ships and it therefore frequently happens that the waves swamp them and damage the contents. At the Pier, the chelingues are not so liable to this inconvenience, although it often happens in a rough sea, that the bales of goods they carry are damaged. Such a condition of things causes loss of time and property, above all during the N. E. monsoons, when the sea is rough and the surf too high for communication between the vessel and the shore. Besides these inconveniences, the vessels also find difficulty in shipping their cargo from or landing it alongside in chelingues. They are much exposed during the N. E. monsoon and when a cyclone is expected their only course, to avoid being run aground, is to cast off moorings and stand out to sea, and if there is any delay in getting under sail, their loss is certain. It is therefore necessary to change this state of things, in establishing a port in which the vessels will be completely sheltered and will have every facility for carrying out their operations without loss of time or capital.

General plan of the Proposed Harbour.

The proposed harbour will include:—

1. Two jetties starting from the shore, converging towards each other sunk to a depth of about 6 fathoms and reaching about 1,000 metres from the shore; between the heads of these jetties there will be an opening of from 200 to 300 metres as a passage for vessels entering or leaving the harbour
2. A channel or way from these jetties to the interior harbour properly so called. This channel will be excavated to a depth of 10 metres and will be 300 or 400 metres wide, which will allow sufficient space for the movement of the vessels.
3. An interior harbour inside the mouth of the river, excavated to the depth of 8 or 9 metres, in all that region now covered by the waters to about 500 metres below the Ariancoupum bridge. This excavation will allow of 4 basins with regular sides to the quays of which the vessels will be moored in order to land or ship their cargo, all being in perfect safety in bad weather.
4. Quays of masonry bordering the circumference of the basins, the walls of the said quays being provided with 4 by 4 metres of outworks in teak to protect the vessels from rubbing up against the masonry. The quays will, in addition, be furnished with cranes, and other apparatus to accelerate and facilitate the shipping of the vessels; the extent of the ground occupied by the quays, reserved round the basins, will be about 100 metres, which will allow of sufficient space for traffic, the building of warehouses, and the laying down of a railway, narrow gauge.
5. Warehouses, built on the quays and parallel to their sides; these will be of iron and will form separate blocks; they will be 12 metres high by 20. They must be built in a line about 10 metres from the sides of the quays; the total length of the different blocks being 4,000 metres and the total area covered by them 80,000 sq. metres. The space between the warehouses and the sides of the quays will allow of the vessels transmitting their cargo direct to the warehouses and *vice versa*.
6. A series of masonry buildings appropriated to carrying on the business of the Port. These will consist of Port offices, of Custom houses and commercial houses. A portion could also be reserved for seamen's hotels, hospital, etc., and the offices connected with the commercial buildings would communicate by means of a telephone or telegraph wire.
7. One or two dry, and careening docks with yards and sheds for all necessary repairs to steamers or ships.

8. Fountains on the quays for the public or for supplying the vessels.

9. A system of Electric lighting for a lighthouse, Harbour lights and for the quays.

Such would be the plan of the proposed Harbour, with a railing enclosing the grant of land.

The convergence of the jetties towards each other at an exterior angle of about 160° would have the effect of turning aside the littoral current without opposing a direct resistance to it. The current will follow the direction of each jetty at the same time carrying away the sand which it will not allow to settle. It may be feared that on reaching the open space which it will have to pass through between the heads of the jetties, that the direction of the current on changing might turn into the Harbour carrying the sand with it; but it must be observed that this, should it occur, would only take place during the floods and particularly at the time of the N. E. monsoon, and that the North jetty, prolonged by the curve it takes, will impart a direction tending to throw the current out beyond the head of the South jetty; and that should a sandbank be formed in this place, it could be but a slight one and easily removed by a dredger and, above all, by the waters of the river when they overflow at the time of the floods.

Moreover, what leads us to presume that the sand will not collect at the entrance, is that the Madras Harbour, which is subject to the same conditions, with this exception, that the jetties are perpendicular to the littoral current and have an outer wall, no sandbank has formed at the entrance and yet the current passing through carries sand with it, as the colour of the water clearly shows.

The portion of the sea enclosed between the jetties and the shore on either side of the channel could be utilised for the construction of reservoirs with locks, which could be opened at low water to clean the passage.

(To be continued.)

PRESERVATION OF METALLED ROADS.

This is an interesting and important subject and requires the attention of the Engineer. The practice of maintainting macadamized roads both of kunker and stone after construction or renewal has been to store a sufficient quantity of metal in each mile for a year's use, and to draw upon this store from time to time to patch up holes in the metalled road, but no means have been devised yet for lengthening the life of the metalled portion over and beyond the 5 or 6 years between renewals.

The following phenomenon was observed on a 12″ kunker road subject to very heavy traffic from December to June annually. To prevent the edges of the metalling from breaking up, a bund or ridge of earth 12″ × 12″ usually of clods from 3″ to 6″ was laid along both edges. The wheels travelling over these ridges of earth carried the greater part of the earth on to the metalled portion and in a short time the whole surface of the metalled road was covered over with a skin of earth from ½″ to 1″ in thickness. This road used to be under careful supervision and the Ex-Engineer in charge had an opportunity of personally observing that *little* or *no petty* repair was needed from December to June, although the wearing power of the road during this period was severely tried. From this it was apparent that if the surface of the metalled road was kept covered with a skin of sand, clay or mooram, it would be protected from the direct grinding action of wheeled traffic. But to ascertain beyond all doubt that such was the case in this instance the Ex-Engineer had the thickness of metal of all the miles gauged at each furlong post. The result shewed that the thickness of metal was surprisingly great. In some miles it was as much as 12″ and 14,″ in most miles it was 10 inches and in comparatively few miles it was 7 inches. It was ascertained from the road chart that the 7-inch miles had *not been renewed for the last* 10 *years!* The surface of all these miles was smooth.

This then was proof conclusive that the skin of earth accidentally placed over the metalling acted as a preserver or life lengthener, of the metalled part of this road.

Now considering that large sums of money are annually allotted for maintenance and renewals of metalled roads, something should be done towards effecting economy when the most simple and effective means are at hand. The primary duty of the Engineer is to preserve by the most economical means all structures that are placed under his fostering care. Each road should be dealt with specially according to local circumstances. For instance take the following roads in the N.-W. P. and Oudh:—

Road to Allahabad from Faizabad *viâ* Sultanpur and Partabgurh. There is a fair amount of traffic on this road and the surface should be kept covered with ½ inch of earth from the side trenches.

Road from Lucknow to Seetapur. The traffic used to be heavy on this road, but it will decrease considerably as the Railway has now been opened. This road should be treated in the same way as No. 1.

The Grand Trunk road from Delhi, Aligurh, Etah, Bhongong, Goorsahaiganj and Cawnpur. There is still heavy traffic on portions of this road. The heavily travelled over portion should receive a coat of 1″ of earth and the rest ½ inch.

Road from Fatihpur to Banda, Mahoba and Nowgong. There is a fair amount of traffic along this line. Whenever sand or mooram is found close to the road it should be used in preference to earth and ½ inch put over the road. Where black or cotton soil is only obtainable it should be sparingly used and ¼ inch put over the road.

It will be found that as soon as the rains commence the clay and mooram will be quickly washed off the road. Black or cotton soil as it is called is very tenacious hence it will be necessary to remove it just before the rains are due. Roads within station limits and for 3 or 4 miles outside should not be treated in the manner advocated for obvious reasons.

R.

CALCUTTA PORT IMPROVEMENTS.

Kidderpore Docks.

V.

History of previous proposals.

The Port Commissioners of Calcutta were represented on the Diamond Harbour Committee by their Chairman, Mr. H. J. Reynolds, C.S., their Vice-Chairman and Engineer, Mr. William Duff Bruce, being then on leave in England. But on seeing a copy of the series of questions which the Committee prepared and requested the Port Commissioners, among other public bodies and individuals, to answer, Mr. Bruce addressed a letter to the Commissioners in which he pointed out they were in the best position to answer two of them.

First.—"(Q. No 10) Having in view the probable increase of traffic on the Calcutta side of the river on the completion of the railway bridge over the Hooghly, do you think that the space now at the disposal of the Port Commissioners will be sufficient for wharfage and general accommodation."

Second.—"(Q. No. 11) If not, can you suggest any means of supplying the deficiency otherwise than by constructing the proposed Docks?"

Mr. Bruce answered the *first* of these two questions in the negative, but said that the present accommodation could be considerably increased. He would, on the completion of the new railway bridge, remove the floating bridge to the north of the Nimtola Burning Ghât and lay down a large number of new moorings immediately abreast of the town and the East Indian Railway Company's premises in Howrah, and thus save many vessels from the great inconveniece they were then put to by having to moor in Kidderpore and Garden Reach. He would then erect a jetty to the north of No. 1, another to the south of No. 8, and the whole frontage of the E. I. R. Co.'s premises in Howrah, would be available for jetties for the loading of coal or other exports brought down by the railway for direct shipment. And he would extend the the boat wharf southward opposite the Eden Gardens. That was all he thought could be done to extend the accommodation on the Calcutta bank of the river, abreast of the town, and it would not be sufficient for future wants; no wharfage could be provided for salt ships or for coasting vessels, and there was practically no frontage available for further increased accommodation except at Garden Reach, which was inconveniently situated for communication with the business quarters of Calcutta.

In answer to the *second* question, Mr. Bruce thought that Docks at Diamond Harbour would prove as great a failure as they would at Port Canning, on the Mutlah River. All experience had shewn that it was most difficult to move a great established centre of trade, and he thought that even with the help of a railway Docks at Diamond Harbour would not work, unless the merchants had offices there. The question then arose, Mr. Bruce said, how proper accommodation for ships could best be provided in Calcutta itself, for jetties or docks in Howrah would never answer when the Railway bridge was built and the railway ran into Calcutta. The space available for jetties or wharves being so limited, as he had shewn, docks seemed the only alternative, and the site which seemed to offer the greatest advantages, and which had been reported on most favorably, was Chitpur. Mr. Bruce could not agree in the opinion that by adopting Diamond Harbour as a site for docks, the worst shoals or the greatest dangers in navigating the Hughli would be avoided. He said:—

"The answers of the Pilots to the first nine questions (of the Committee) will, I hope, have convinced the Committee that the most changeable shoals in the Hooghly, and those most likely to interrupt traffic, lie between Diamond Harbour and the sea. Between Calcutta and Diamond Harbour, the Hooghly is now practically in the same state as it was a hundred years ago. Changes take place annually in the James and Mary sands, but they are well understood, and the pilots can guard against them. Below Diamond Harbour, in the Rangafulla channels, the case is very different. These channels are constantly changing, and in 1879-80, the Bellary channel—the only channel by which vessels could cross these (the Rangafulla) sands—was rather worse than the James and Mary shoal."—"The Committee that sat in 1854, in their report, divided the Hooghly channels into three classes; 1st—the stationary, 2nd—the fluctuating, and 3rd—the deteriorating; and then go on to say—'the portion of the river between Calcutta and Culpee may be considered to embrace all the channels of the first class' 'The channels between Culpee and Kedgeree constitute the second or fluctuating class, and their changes are constant and rapid both in character and position.' 'Below Kedgeree' the report goes as to say, 'the preponderance of evidence decides that they have deteriorated.'"

In 1796 the Rungafulla outer channel became so bad that the Master Attendant recommended that none of the Company's ships should be brought above Kedgeree; and Mr. Bruce said it would be a serious matter if such an interruption of traffic should occur now. The use of steam had improved matters, and traffic might not again be so completely interrupted, but Mr. Bruce thought it a significant fact that pilots were now prohibited from taking any vessels drawing more than 21 feet either up or down the river without a tug.

"Bearing all these facts in mind," Mr. Bruce said, "it appears to me that the first question to be decided when considering the question of improvements on the large scale now proposed is whether all such improvements are to be left entirely at the mercy of the changing channels of the Hooghly, or whether it would not be advisable to have a second string to our bow and to connect Calcutta by a ship canal with the Mutlah. I am decidedly of opinion that the latter is the proper and wisest course to adopt. If docks are to be constructed to meet the great increase in trade which it is anticipated that the construction of the new railway bridge will bring into Calcutta, such docks should be in a position to communicate either with the Mutlah or the Hooghly. Docks at Diamond Harbour are just as likely to be cut off from communication with the sea as is the Port of Calcutta, and this fact alone is to my mind a sufficient reason against their construction, even were it probable that they would be used by vessels with cargoes for Calcutta, which I feel confident they would not, so long as such vessels, even at some risk to themselves, can get up to Calcutta."

Mr. Bruce therefore suggested (1) to dredge a ship canal of the same section as the Suez Canal from the Mutlah to Sealdah; (2) to excavate a large dock on the east side of the railway; and (3) to connect that dock with the Hooghly by a cut joining the river to the north of the entrance to the boat canal at Chitpore. The canal would leave the Mutlah at a point about five miles below Port Canning (see Plate I. accompanying these articles). The scheme involved the transfer to the Port Commissioners of the portion of the Calcutta canal system from the entrance lock at Dhappa to Chitpore, which would then form a portion of the Port, and be placed in free communication with the proposed dock. The proposed site for the dock would be in the most convenient position for railway traffic and within easy distance of the merchants' offices, while the construction of the canal to the Mutlah would make Calcutta for ever independent of the freaks of the Hooghly.

Mr. Bruce was not then able to estimate the cost of constructing the docks, but it would not exceed that of docks at Diamond Harbour, and the accessory buildings and fittings would be fewer, and those that were accessory would be cheaper. He estimated the cost of dredging the canal at about £750,000, and the annual charge for interest and repairs would be $4\frac{1}{2}$ lakhs which would be covered in great part by the saving in pilotage by using the Mutlah route. As the trade of Calcutta was fast becoming a steam trade, there was little use in considering whether the necessity of towage would be an objection to the canal. The construction of Docks would tend very much to increase the number of steamers as compared with that of sailing vessels. Salt would come out to the Docks in steamers. Docks in Calcutta would be adjuncts and helps to the improvements already provided for the port, and not in opposition to them as they would be at Diamond Harbour.

The Committee thought Mr. Bruce's Mutlah Canal scheme deserved careful consideration, for it or some modification of it, appeared capable of providing trading facilities equal to any which might be expected from Docks at Diamond Harbour.

But in considering it they, as well as Mr. Bruce, were at a disadvantage in being at a distance from each other, and they were obliged to make many assumptions as to particulars. Besides the works mentioned by Mr. Bruce, it would, they said, be necessary to construct a lock between the dock and the Hooghly; two opening bridges for railways, and two for main roads to cross the canal; ferries at suitable places all along the canal; to close the River Palee and other water-courses in the line of the canal; and to make a lock at the Mutlah. They accepted Mr. Bruce's estimate of £750,000, or 90 lakhs, for the excavation of the canal as being approximately correct; but they thought that altogether the canal, with the works it would involve, and the dock would probably cost, exclusive of land, 237 lakhs of rupees. But Mr. Bruce's proposal was for a canal to pass vessels drawing not more than 25 feet of water, whereas already vessels drawing 26 feet had come up to Calcutta; and they therefore thought that allowing also for silting, the depth of both canal and dock should not be less than 28 feet. And they thought that at least the lock at the Mutlah should be in duplicate. These additions would make the probable cost 284 lakhs. And 45 lakhs worth of land, not including space for spoil banks, would have to be added, bringing up the assumed total cost of the whole scheme to 329 lakhs. And apart from the cost, there were local and other objections to Mr. Bruce's scheme, which the Committee thought should have weight:—(1) the removal of the floating bridge further up the Hooghly; (2) the partial severance of the roads and railways towards the north of the city, at present its most important outlet; (3) Mr. Levinge, one of the Committee, was of opinion that the reclamation of the Salt Lakes, which must eventally be carried out, would by diminishing the reservoir for the ebbtide cause the deterioration of the channels of the Mutlah; and, as a minor matter (4) it had been found very difficult to close a bend of the Palee River cut out by the Calcutta and South-Eastern Railway bridge. But some of these objections might be overcome by placing the Hooghly entrance at Garden Reach. The professional members also thought that the canal should be a high level one, to be filled only with water pumped through settling tanks from the Hooghly.

After thus considering and criticising Mr. Bruce's scheme, the Committee proceeded to apply the facts, opinions, and calculations embodied in the first part of their report (but which we have not space here to notice) to the consideration of the eight specific questions on which they had been directed to report, and which we enumerated in our last article, and they did so under the three following heads:—

1.—Whether it was desirable that wet docks should be constructed in the Hooghly.

2.—Whether Diamond Harbour was the best locality for such docks.

3.—Whether docks at Diamond Harbour would be financially successful.

The first question was answered in the affirmative. In considering the second question, the Committee found that docks at Diamond Harbour would have three principal advantages: vessels using them would escape the intricate and dangerous navigation of the upper reaches: they would cover the dock dues by savings in time, coal, pilotage and towage; and the docks would cost less than at Calcutta. The Committee argued if the dangers of the Hooghly were considered sufficiently formidable to warrant the construction of a canal from the Mutlah, both that and all the other disadvantages attending docks at Calcutta with only a Hooghly entrance would be intensified, for two strings to the bow would entail double expense for pilotage, towage, buoys, and lights, and the net revenue would be correspondingly reduced. The object of every dock scheme was not to monopolise the trade of the port, but merely to supplement the existing conveniences and appliances by means which some ships might use if they liked, and they thought this object would be best secured by placing the docks sufficiently low down the Hooghly to make the shortening of the voyage a tangible saving. But the Mutlah Canal to be financially successful must do much more than that. It must monopolise the trade and ruin the existing property of the Port Trust, though the Committee did not think it would do so. This risk was entirely avoided by the Diamond Harbour scheme. But the Committee also considered the objections to Diamond Harbour as a dock site felt among the mercantile community, who urged that they would have to keep up double establishments and rent a double set of warehouses; and that matters of importance would either have to be left to subordinates unfit to deal with them, or be delayed for the decision of a principal in Calcutta. The example of Port Canning was held up as a warning. The Committee did not, however, accept these arguments as conclusive against the Diamond Harbour site, and thought that the course of business would accommodate itself at Calcutta as elsewhere to altered circumstances and they had already indicated how this would probably be arranged for. "The failure of Port Canning merely shews that trade will not move into new channels without sufficient inducement to do so. It affords no argument against the success of a scheme which offers substantial advantages. The location of the railway terminus at Diamond Harbour indicates that place as the natural position of the docks. But independently of this consideration there is much to recommend the locality for the purpose. At the same time there are considerations on the other side which should not be overlooked." These were stated to be unhealthiness of locality, bad water, treacherous subsoil, strong tides, and a lee shore during the South-West monsoon. But the Committee combatted these objections, and were "not disposed to think that they need interfere with the selection of Diamand Harbour as a site for the docks." If the nautical objections were considered valid as against the precise spot chosen for the docks (Diamond Harbour Creek), Mr. Wawn had pointed out another, at Roychuck, 4½ miles higher up the river, to which a very profitable river-side railway could be constructed (? from Calcutta) and connected to the Diamond Harbour Railway, thus affording a double means of access to the docks.

In answering the third question, whether docks at Diamond Harbour would be financially successful, the Committee referred to the figures already given in their report, which they said justified the conclusion that, if the docks could be constructed and maintained at a cost representing an annual expenditure of seven and a half lakhs of rupees, the outlay would be recouped by the receipts from 468 vessels, at an average of Rs. 1,600 each. The saving to vessels, at this rate of payment, which was equivalent to 14½ annas per register ton, would afford a substantial inducement to them to use the docks. The Committee were therefore of opinion that, unless these their calculations could be shewn to be wrong, there could be no doubt of the financial success of the undertaking; and they adduced some further arguments in support of them which we have no space to notice.

The Committee adopted the site preferred by Mr. Wawn for the docks, which left the Diamond Harbour Creek untouched and available as a tidal basin for small craft, and as the outlet for the drainage of the country; and they adopted his design and estimate for the works, which amounted to 140 lakhs, but added to that amount 10 lakhs for establishment during construction, and they made their own estimate of the cost of providing the dock with warehouses, five miles of rails and sidings, and 40 steam or hydraulic cranes which came to Rs. 28,52,500. From these a separate revenue would be derived. The cost of land was not estimated.

But these affirmative answers to the three questions to which the Committee had reduced the eight originally put by the Bengal Government were not made unanimously, or without serious qualification, for Mr. Keswick, one of the mercantile members, signed the report "subject to reservations in my memorandum of dissent," and Mr. Morrison, the other mercantile member appears to have been joined by Mr. Wawn, the special Engineer member, in signing it—"subject to material reservations, as expressed in my 'dissent.'" Perhaps, though, as this latter dissent is everywhere expressed in the first person, and there is nothing that we can find in Mr. Wawn's own writings to lead to the belief that he disapproved of constructing the docks for which he chose a site and prepared designs, and of which he estimated the cost, he did not dissent, but merely signed the report in a wrong place. Mr. Keswick dissented from some of the views of his colleagues because, first, he agreed with Mr. Bruce that there was room in the port of Calcutta for "much further expansion of improvements," and because his own enquiries led him to believe that land might be acquired from Garden Reach downwards sufficient to double the accommodation of the port and provide sufficient warehouse and jetty room. *Second*, Mr. Keswick most ably argued that "one of two things will happen—Diamond Harbour will be a failure, or Calcutta will be much injured. If the Port Commissioners, after the adoption of the Diamond Harbour scheme, if adopted, wish to raise another loan, I think they will probably find the views of the public unmistakeably expressed." Mr. Keswick, for both reasons, proposed that steps should first be taken to ascertain what further accommodation in the way of jetties and warehouses could really be provided within the limits of the port, and what further land could be acquired at and below Garden Reach, suitable for jetties and wet docks, and what the probable cost would be.

Mr. Morrison's minute of dissent was short, but he had previously put in a long letter dealing more fully with the subject, which is printed with the other papers. He agreed generally with Mr. Keswick, but thought the canal to the Mutlah an essential part of a scheme for docks at

Calcutta, and he decidedly objected to the docks being placed at Diamond Harbour. His dissent and letter, which will be found in the Blue Book, are well worth perusal; as are also the replies to the Committee's questions received from many other quarters.

Mr. Robert Steel, an original member of the Committee, on his return to India, recorded his opinions in a note, written at the request of Colonel Trevor, in which he expressed his preference for Mr. Bruce's Dock and Mutlah Canal scheme, even of it cost twice as much as docks at Diamond Harbour. But he thought both schemes premature, until the floating bridge had been shunted up the river and Mr. Bruce's plans for extending the existing accommodation carried out. He would go the length of sweeping away Fort William, if necessary, to make room for the port, as Sir William Mansfield had suggested when he was Commander-in-Chief. This consensus of mercantile opinion induced Colonel Trevor, as the adviser of Government, in February 1882 to recommend that the Port Commissioners should be asked to submit a full and detailed report and estimate, shewing exactly what could be done to increase the accommodation within the limits of the port, what it would cost, and how far it would meet all the altered circumstances of the traffic when all the railways should come to be centred in Calcutta. But he still, as he had done as a member of the Committee, spoke up for the Diamond Harbour dock scheme, believing that docks would after all be necessary and that constructing them at Diamond Harbour would be the best way to make Calcutta a cheaper port. Colonel Trevor also advised that the scheme for the canal to the Mutlah should be investigated and a correct estimate framed of its cost. And he proposed that the Committee's report should be published.

The Lieutenant-Governor after discussing the *pros* and *cons* in an able minute approved of the publication of the Diamond Harbour Committee's Report and the relative papers, and directed that the Port Commissioners should be asked to institute the enquiry proposed by Colonel Trevor, excluding, however, for the present, the Mutlah Canal scheme from its scope. But in forwarding the papers to the Supreme Government an offer was made to undertake a survey for the canal. The Government of India entirely concurred with the Lieutenant-Governor as to the necessity for further enquiry, and sympathised with the mercantile view of the question. They also approved of the proposal to hold the question of a central goods station for Calcutta in abeyance until the question of the dock site should be settled. The Port Commissioners were requested by the local Government to make the enquiry in communication with the Chamber of Commerce.

BURDWAN—ITS SANITARY CONDITION.

The town of Burdwan is situated on the E. I. R. 67 miles from Calcutta and contains a population of 34,000 inhabitants. It is a place famous in Mahommedan history, being the scene of the war between Jehangir and Sher Afkan and of the sojourn of the very beautiful Noor Jehan.

Here are relics of old Beersingha, and the unbelieving Hindu who disbelieves the love adventures of Biddya and Soondra may yet have the Biddyapoota pointed out to him.

In ancient days the town rejoiced in the poetical appellation of Koosumapur or the City of Flora, and Bharutchunder sang of it:

Burdwan Maha sthan
Chow dekatar poospho ban.

It must then indeed have been a pleasant place, but now the glory of Burdwan has departed. Of late years, it had the reputation of being one of the most pestiferous and unhealthy towns of Bengal. Officials have considered it a penal settlement, and after 24 hours' residence have been inclined to apply to Government for a transfer. But happily Burdwan is now losing its bad name, as the construction of the Water-works, which were opened by Sir Rivers Thompson in 1885, has done much to improve the health of the town, for two-thirds of the population benefit by the pure water. Since then, the Municipal Commissioners seem so well satisfied with what has already been accomplished, that they appear to think further improvement unnecessary.

We now wish to lay before our readers, how the sanitary condition of Burdwan might be furthur materially improved.

We will deal first with the condition of the tanks, we can safely say there are not more than six tanks in the town fit for the purposes for which they are used, of which the largest are the Kristoshair and Sham Sagur, constructed by a former Rajah of Burdwan. The other tanks can be termed nothing better than "cesspools," divided into public and private ones, of which the latter are the most injurious. The Sanitary Commissioner of Bengal in his Inspection Report states:—'No Municipal or other tanks have been set apart for drinking, those that were so treated before the opening of the waterworks having since become available for bathing, and other domestic purposes. The private tanks are very numerous and with a few exceptions generally filthy. Most of them receive surface drainage and are polluted in several ways. They are resorted to for miscellaneous purposes.

"The very large number of tanks, holes, &c., all acting chiefly as cesspools is the greatest blot on the sanitary condition of the town. I observed attempts in some places to fill them up with street sweepings, but this is a slow and not very pleasant process: the Commissioners should therefore try to devise other means to lessen the great evil, and this can in many instances be done, by connecting tanks with one another by an open channel, the lowest one having communication with the river Banka, or some other discharge outlet.

"Some of the better tanks might also be re-excavated and the earth taken out used to fill in the smaller holes, which are very numerous, and, from impurity, dangerous to health. Now that filtered water is being supplied to the whole of the northern part of the town, tanks are much less necessary than formerly and should be gradually obliterated.

"I cannot foresee the time when Burdwan is likely to be a healthy town, unless this great sanitary evil is grappled with and gradually removed"

We fully endorse the above remarks and think the Commissioners should pull themselves together, and accomplish what little they can year by year, with whatever funds they can spare, as it is a matter of time and patience, remembering, that if this generation will not much benefit, the next will. We would begin by appointing a Conservancy Tank Overseer on say Rs. 50 per mensem. No matter how bad the finances may be the Municipality should consider this a permanent institution.

After eliminating most of the tanks, which are only fit to be filled up, certain tanks should be set apart for drinking water, when the hydrants are not conveniently situated, and others for Dhobies washing clothes, and one or two special ones for washing horses and other animals. These tanks should each be kept religiously for only the one purpose for which it was intended. Other tanks, if they were of a fairly good size might be used for bathing, but they should be made public ones as much as possible so as to be open to inspection. The majority of private tanks should be condemned, and no householder should be allowed to possess one, who did not maintain it in a clean state, and permitted it to be inspected periodically. The Overseer, if he displayed proper energy, would constantly inspect the public tanks and by the vigorous prosecution of all delinquents would endeavour to reform the loathsome habits of the low castes in the adjacent *bustees* to the tanks. There should be proper rules laid down for the maintenance of tanks. We think no house or dwelling should be allowed to exist quite near a tank, but a clear and public space of at least 100 feet broad should be kept around each tank, and this space to be kept clear of jungle; and trees which encourage undergrowth, such as bamboo, plantain and palms, which are a fruitful source of malaria, should be cut down, but healthy trees such as mangoe and peepul should be preserved. Every hut or group of huts in a *bustee*, should be provided with a latrine. By keeping the sides of tanks clear of jungle, the chances of their being defiled would be reduced to a minimum. What with the frequent inspections of the Overseer and the publicity of the place, tanks might be kept comparatively free from pollution. Regarding private tanks, by which we mean those reservoirs of drainage and filth adjoining a Baboo's house, which are enclosed by four high walls, excluded from air as much as possible, and are invariably very small, very filthy, and contain but little water the greater part of the year, we would discourage them as much as possible. We most indignantly protest against the selfishness and inhumanity of a man, who, because he has land and is wealthy, keeps a permanent hotbed of disease near his house, which is a source of danger and death to perhaps a whole village. It is these loathsome "dobos" which contaminate the air, and produce malaria during the rainy months. In these enlightened days we think that respectable gentry and *purda nushins* might abandon the ways of their forefathers and live differently. Some gentry in Burdwan have lately constructed masonry vats or baths in their compounds, where there are house connections, which are replenished with the filtered water daily: we think this a healthy plan, and hail the day when it is universally adopted, and every one understands what a curse a filthy tank may be, near his dwelling. Regarding the filling up of condemned tanks: we think the practice of shooting rubbish and street garbage into those in very populated parts, is objectionable, and should be discontinued. We believe the municipality has an ample quantity of earth at hand, in the high embankments round the Kristoshair and Sham Sagur Tanks, and as the Raj Estate is now under the Court of Wards, if the matter were represented to Government, how beneficial to the town the utilization of this earth might be, it might be obtained and used for the filling in of tanks in parts of the town at comparatively small cost, by the laying down of a portable tramway, say 12lbs. rails of 24" gauge with iron hopper wagons to the sides of the tanks, that could traverse the narrowest lanes in the bazar, earth being shot into the tank with ease from the wagons.

The wagons might be drawn by the Municipal bullocks, or even drawn by coolies. As soon as the filling up of a tank was complete, the rails might be taken up and laid down elsewhere. One mile of fully-equipped tramway would cost Rs. 4,000 or upwards according to the amount of rolling stock. The lengths of the embankment are considerable, if they are one mile long altogether, we compute roughly that they contain from 15 to 20 lacs of cubic feet of earth, which would suffice for filling in a tank of 150,000 s.ft. to 200,000 s.ft. area, to a depth of somewhat under 10' (owing to settlement of the new earth) or say a tank from 380' to 450' square, at a cost of from Rs. 4,000 to Rs. 6,000. The land made available by the removal of the bunds, could be made into gardens and rendered park-like in harmony with the rest of the Raj property, and no one would regret the disappearance of the useless and unsightly mounds of earth.

E. A. S.

(To be continued.)

THE following, from an exchange, is a contribution to science which ought to be better known to Engineers than, according to the best of our information and belief, it is:

"Would it be supposed that one line of rails on a track is more worn than the other! Such is the case, however. Engineers say that when the track runs north and south, or generally in that direction, the westerly rails are worn out sooner than the easterly set, and that they stretch, or "creep," as they technically express it. The only explanation given of this curious inequality is the supposed greater weight which is constantly thrown on the westerly rail by passing trains owing to the revolution of the earth on its axis from the east to west. In other words, the earth's movement tends to tilt the train upon its westerly wheels."

THE MAIN DRAINAGE OF THE HOUSES OF PARLIAMENT, WESTMINSTER.

By ISAAC SHONE, C.E.

IV.

(39). THE minimum and maximum quantities of sewage, and sewage and rainfall together, it is now difficult to estimate; but as one of Kaiser's Patent Counters, which is shown on Plate 3, is attached to each Ejector, a practically accurate record can be kept of the quantities that will be received and ejected from time to time.

(40). By the aid of these excellent Counters, therefore the Ejectors actually become sewage-meters, giving accurately the quantity of sewage in dry weather, and of sewage and rainfall combined during periods of wet weather.

(41). From observations already made since the Ejectors have been at work, it is clear that one Gas-Engine Air-Compressor and one Ejector will deal with more than the whole of the largest quantity of sewage flowing from the Houses of Parliament at any one minute of time, even though that sewage should be supplemented by an amount of water equal to one inch and more of rain falling upon the entire area of the Palace and grounds in 24 hours.

(42). When one Engine and one Ejector are insufficient, during periods of extraordinarily excessive rainfall, there is a float within the sewage manhole, adjacent to the Ejector Chamber, which will rise and fall with the sewage and rainfall, and which will actuate one of Mr. Julius Sax's Automatic Electrical Tidal Water Gauges (shewn on Plate 3).

(43). This apparatus is fixed within the Ejector Chamber, and a duplicate of it is also fixed in the Gas-Engine Room, both being very effectively operated simultaneously by the float.

These instruments have faces resembling ordinary clocks, and the hands on them denote the exact level, in inches, of the water in the sewage manhole, from which the Ejectors are supplied.

(44). The moment one engine is overcome the electrical apparatus rings a bell within the Ejector Chamber, and in the Gas-Engine Room, at one and the same instant, and then the Attendant will set a second Gas-Engine to work; but if the sewage continues to rise in the sewage manhole, notwithstanding the setting to work of a second engine, the electrical apparatus will continue to indicate such increased height, and the Attendant will then put a third, and, if necessary, the fourth Gas-Engine to work.

(45). Each engine can be set to work and stopped in about a minute.

(46). Besides having the means of ascertaining the quantity dealt with from day to day, and of seeing how the sewage and rainfall flows to the Ejector Station, there is also fixed, in the Ejector Chamber, a semi-mercurial and water-pressure gauge—designed specially for the purpose—by which the exact height of the sewage in the Metropolitan low level sewer can at all times be determined.

(47). This gauge is shewn on Plate 3, Fig. 5.

(48). This pamphlet would be incomplete without some further special reference to the relative values of the old and the new main sewers as *sewage carriers*.

(49). The velocity of the flow of the sewage shown on the invert of the sewer of 1839, as per Fig. 23, Plate 1, would be about 1.11 feet per second, and this volume of sewage would only occupy about the $\frac{1}{32}$ and part of the entire sectional area of the sewer.

(50). Whereas, by the alteration made in the inclination of the sewer in 1848, at the suggestion of Mr. Phil-

Plate III.

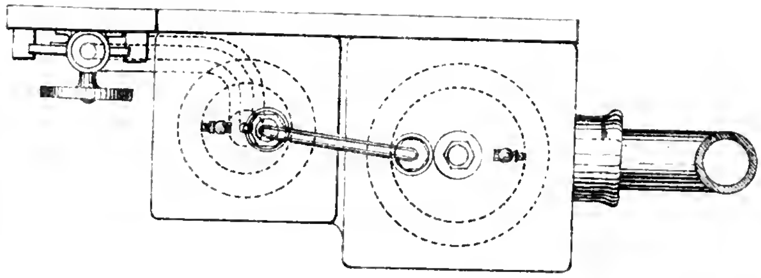


Fig: V^{a}

Fig: V^{g}

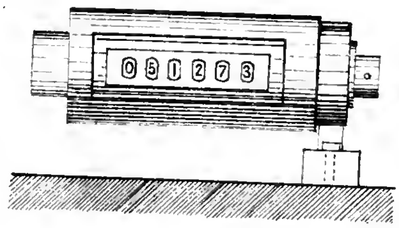
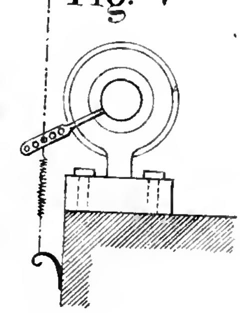


Fig: V^{h}



A. Kaiser's Patent Counter.

Fig: V^{e}

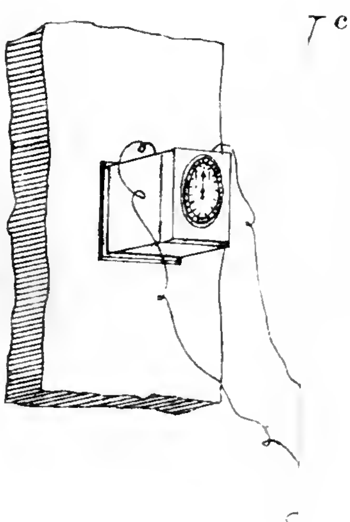
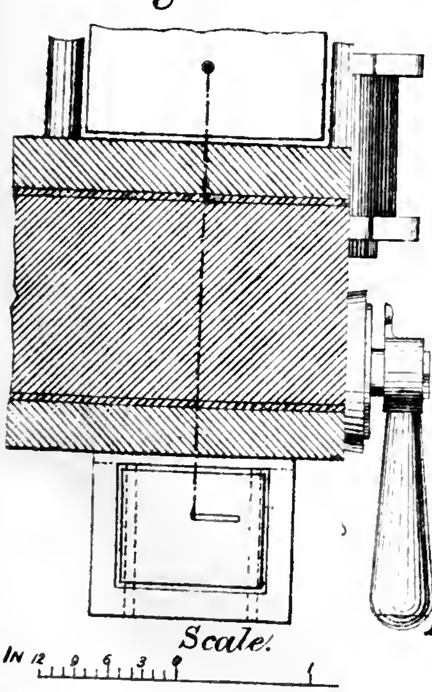


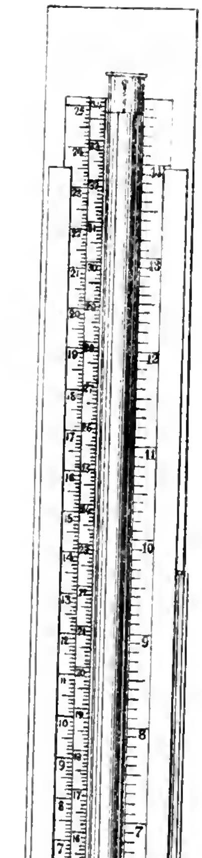
Fig: V^{d}

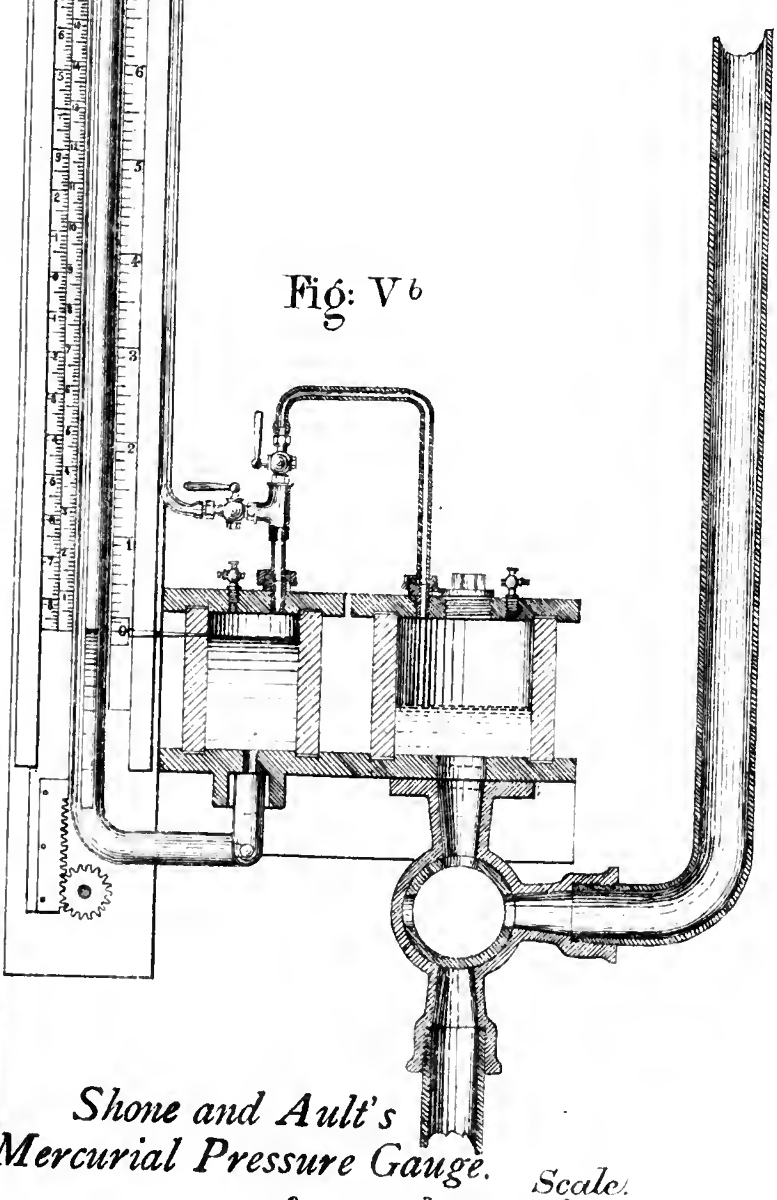


Scale.

IN 12 9 6 3 0 1

Fig: V^{b}





Shone and Ault's Mercurial Pressure Gauge.

Scale.

0 3 6 9 12 IN.

The "STAR" Press, 19 Lall Bazar Street, Calcutta

lips, the velocity of the same volume of sewage, carried in the new twelve-inch iron pipe, laid on the invert of the improved 1848 sewer, as per Fig. 24, Plate 1, would be 2·8 feet per second, and the waterway area of the latter sewer would be equal to the $\frac{1}{54}$th part of the whole.

(51). The former (49) is, to all intents and purposes, a non-self-cleansing velocity, whilst the latter (50), even though the pipe be only submerged to the extent indicated by Fig. 24, Plate 1, would be adequate to render it permanently self-cleansing.

(52). This alteration, consequently, had more than the hydraulic effect of doubling the *efficiency* of the sewer as a *sanitary sewage carrier.*

(To be continued.)

THE CHENAB CANAL.

THE Chenab Canal, into which water was admitted for the first time on the 9th instant, has for its object the irrigation of a portion of the high land between the Ravi and Chenab Rivers, which is known as the Rechna Doab.

The deserted sites of towns and villages which are to be found all over this tract show that it must have been in former times well cultivated and populous: the soil is still of excellent quality, but owing to the scanty rainfall, and to the depth of spring level below the surface, the future of the Doab comprising the lower part of the Gujranwalla District and the Jhang District is now little better than a desert. In years of favourable rainfall grass grows freely, and affords grazing for large herds of cattle, but there is practically no cultivation.

For many years past this tract has been marked down as most suitable to canal irrigation, and in 1875-76 a rough project was prepared for a perennial canal from the Chenab River to irrigate it. The cost of this scheme (345 lakhs of rupees) was, however, so large that the Government of India hesitated to undertake it, and in 1882 further investigations were instituted which resulted in a less ambitious and costly project.

The canal as now designed will carry 1800 cubic feet per second during the *kharief,* and an average of 500 cubic feet per second in the *rubbi.* It will command an area of 880 square miles, and will irrigate annually an area of about 230 square miles. Its head is at Garhi Gola, about 15 miles below the Alexandra Railway Bridge at Wazirabad, and when completed it will consist of 20 miles of main line and about 120 miles of branch lines, besides several hundred miles of distributaries. The cost was originally estimated at 32 lakhs of rupees, but the ultimate cost will be considerably higher. Ground was first broken in July 1883, or just 4 years before the date of opening.

The excavation of the upper portion of the main line has given employment to a large number of prisoners, who were lodged in two temporary Jails near Chenawan: free labor is very scarce in the tract of country through which the canal runs, and the progress of the work was materially aided by the prison labor.

The initial cost of the canal has been kept as low as possible so as to avoid large accumulations of interest and to secure speedy returns, for this reason no permanent weir or headworks have been provided in the first instance, but they will probably be added before long, and by increasing the supply during the *rabbi* would double the area annually irrigated. The system is also capable of being largely extended hereafter, as the lowest discharge of the Chenab is over 4000 cubic feet per second and the area under command is more than could be irrigated by that volume, so that the Chenab Canal, notwithstanding its unpretentious start, has every chance of developing into one of the largest systems of irrigation in the Province.

NOTES FROM HOME.

(From our own Correspondent.)

THE Birmingham Steam Tramways are trying the experiment of carrying goods of every description over their lines. This they have been enabled to do by means of a special wagon patented by Mr. Dickenson; and the experiment has, so far, proved quite a success. The company are enabled to carry goods at lower rates than the Railway Companies, and as there is the additional advantage of the line running close to the manufactories, the present prospects will lead to the idea being greatly developed.

Memorials have been presented to the Metropolitan Board of Works asking the Board to seek Parliamentary powers for the construction of a low level free bridge across the Thames from Shadwell to Rotherhithe. The corporation are at the present time building a bridge just below the Tower, and there is every probability that the Metropolitan Board will carry its scheme for the construction of a tunnel under the river to connect Greenwich and Woolwich. It is therefore probable that the Board will give good reasons for waiting to see the effect the Bridge and the Tunnel will have on the traffic.

Engineering endorses the recommendation of the Comissioners who report on the question of arterial drainage for Ireland, where they state that embanking rivers would be preferable to dredging, as it is considered that many a district might be improved in this simple fashion; which must remain as it is for years if it must wait until the inhabitants will undertake the double task of controlling the floods and creating a navigation.

The latest electrical novelty is a writing telephone; it hails from Munich and its inventor claims that the words of the speaker are duly written down by the apparatus as they are spoken.

The new deep water Dock at Southampton is making good progress. This dock is to be an open or tidal dock and the water area is to be 18 acres. There will be a depth of 26 feet of water at ordinary Spring Tides. The approaches of the dock are to be dredged to the same level as the Dock itself so as to give every facility to the largest vessel afloat for arrival and departure at any state of the tide.

Engineer of this week gives an illustrated account of the recent collision between the *Celtic* and *Britanic* steamships of the White Star Line, from which it is made plain that, but for the good work done by the watertight compartments, a frightful loss of life would have been the record of this accident from which there was not one life lost by drowning, and the vessels will soon be restored to their work again.

The steam-ship *Umbria* continues to retain her place as the fastest of our ocean-going ships. She lately arrived at Sandy Hook in six days and 3 hours after leaving Queenstown this being the quickest recorded passage.

The first passenger train is to cross the Tay bridge to-day, and is to contain the Directors of the North British Railway who go from Edinburgh to Dundee.

Your readers who are interested in Steel Works will find a paper read at the recent meeting of the Iron and Steel Institute descriptive of the Terni Steel Works, &c., with illustrations in the last issue of *Engineering.*

New York is to have an underground in addition to its overhead Railway, for, in view of the ever increasing Railway traffic, and to meet the demands for further facilities for local travelling in that city, the New York Central Railway Co., has determined to construct an underground railway about 3 miles and a half in length from the Grand Central Depot in Forty-second Street to Brooklyn Bridge. It is calculated that the Railway will be completed and opened for the public traffic in about 16 months' time. There will be four lines two of which will be employed for through travelling. It appears that this Company holds a charter which allows them the right to extend their lines in almost any direction and to any distance at any moment.

The Association of Municipal Engineers held a meeting last week at Kidderminster when the Borough Surveyor, Mr. Comber, read a paper on the sanitary works of Kidderminster in which special reference was made to the late typhoid epidemic, a discussion followed the paper and the members visited the Sewage Pumping Station, the Waterworks, the Infectious Hospital and several places of interest in the Town.

The Society of Engineers last week paid a visit to the Steam Road Roller Works of Messrs. Aveling and Porter at Rochester. After an inspection of the foundry, forge and boiler houses and fitting shops several engines were put through their facings before the visitors, very fine runs being specially made by a 6 H. P. agricultural engine and an 8 horse-power traction engine.

The Albert Medal of the Society of Arts presented annually for distinguished merit in promoting arts, manufactures and commerce has been accepted by the Queen who represents the personal embodiment of the Nation. The Howard Quinquennial prize of the Institution of Civil Engineers has been awarded to John Percy, M.D. F.R.S., in recognition of his researches on the use and properties of iron.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Bengal, July 20, 1887.

Establishment—General.

Rai Krishna Chunder Bandopadhya, *Sahib*, Assistant Engineer, is promoted to Executive Engineer, 4th grade, temporary rank, with effect from the 31st of May 1887.

Mr. J. W. Johnson, Inspector of Local Works in the Dacca Division, has been granted by Her Majesty's Secretary of State for India an extension of furlough up to the 31st of October 1887, in addition to the furlough sanctioned in Notification, dated the 16th of January 1886.

That portion of Notification, dated the 7th of June 1887, placing the services of Mr. W. P. Milne, Executive Engineer, 4th grade, sub *pro tem*, at the disposal of the Government of the India, is cancelled. Mr. Milne is posted to the Chittagong Division.

India, July 16, 1887.

Mr. H. Humfress, Assistant Engineer, 2nd grade, Central Provinces, is transferred temporarily to Beluchistan.

Major S. L. Jacob, R.E. Executive Engineer, 1st grade, Punjab, is appointed to officiate as Superintending Engineer, 3rd class, during the absence on privilege leave of Major J. W. Ottley, R.E. or until further orders.

Mr. C. F. Tufnell, Executive Engineer, 4th grade, temporary rank, Punjab, temporarily employed in the Simla Imperial Circle, is retransferred to the Punjab on expiry of the privilege leave granted him, with effect from the 1st July 1887.

Mr. H. A. S. Fenner, Superintending Engineer, 3rd class, temporary rank, is promoted Superintending Engineer, 3rd class, special, with effect from the 28th March 1887.

This cancels Public Works Notification, dated 14th June 1887.

With reference to Public Works Department Notification No. 229, dated 27th August 1885, Mr. L. R. Fraser, Assistant Engineer, 1st grade, is retransferred to Bengal.

Military Works Department.

The following appointment is made: Lieutenant H. L. C. H. Stafford, R.E. to be an Assistant Engineer, 1st grade, permanent.

Director-General of Railways.

With reference to Public Works Department Notification, dated 5th July 1887. Mr. E. G. J. MacCudden, Executive Engineer, 2nd grade, sub. *pro tem* is posted to the North-Western Railway.

With reference to Public Works Department Notification, dated 5th July 1887, Mr. W. Slane, Assistant Engineer, 2nd grade, is posted to the Sind-Pishin State Railway.

Mr. J. A. A. Wallace, Assistant Engineer, 2nd grade, is on return from furlough posted to the Sind-Pishin State Railway.

With reference to Public Works Department Notification, dated 2nd July 1887, Mr. G. V. Martyn, Executive Engineer, 2nd grade. sub. *pro tem.*, is posted to the North-Western Railway.

Mr. C. S Killick, Assistant Engineer, 2nd grade, granted three months' language leave with effect from the 15th August 1887, or such subsequent date as he may be permitted to avail himself of it.

Madras, July 12, 1887.

The following reversion is ordered :—

Mr. F. W Ashpitel, Executive Engineer, temporary rank, 4th grade, to be Assistant Engineer, 1st grade, with effect from 16th June 1887.

The following intimation, received from the Secretary of State, is published :—

Mr. J. Traill, Executive Engineer, Madras, third grade, P. W. D., permitted to return within period of leave.

Burma, July 9, 1887.

Upper Burma.

With reference to *Gazette of India* Notification, dated the 6th June 1887, Mr. J. A. Price. Executive Engineer, 3rd grade, on transfer from India, reported his arrival at Mandalay on the forenoon of this date, and is posted to the charge of the Myingyan division.

Lower Burma.

The services of Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, Toungoo division, are temporarily placed at the disposal of the Superintending Engineer, Upper Burma.

Mr. H. O. Walling, Assistant Engineer, 1st grade, on transfer from India, reported his arrival at Rangoon on the forenoon of the 5th July 1887. His services are placed at the disposal of the Superintending Engineer, Upper Burma

With reference to *Gazette of India*, Public Works Department Notification dated the 6th June 1887, Mr. A. T. Dodsworth, Executive Engineer, 4th grade, sub. *pro tem.*, reported his arrival at Rangoon on the forenoon of the 5th July 1887, and is appointed temporarily to the charge of the Toungoo division.

Burma State Railway.

Mr. E. F. Gordon, Assistant Engineer, 1st grade, is temporarily transferred from the 1st division, Toungoo-Mandalay extension to the office of the Engineer-in-Chief, which he joined on the afternoon of the 20th June 1887.

N.-W. P. and Oudh, July 16, 1887.

Buildings and Roads Branch.

Colonel E. Swetenham, S.C., Superintending Engineer, is transferred temporarily from the 3rd Circle, Public Works, to the charge of the first Circle, Public Works, during the absence of Mr. W. D. Brockman, on privilege leave for 3 months, or until further orders.

Irrigation Branch.

Mr. S. Athim, Assistant Engineer, 1st grade, is appointed to officiate as Executive Engineer, of the Bulandshahr Division, Ganges Canal, during the absence of Mr. W. P. Vonder Hörst, Executive Engineer, on privilege leave.

Muhammad Sadip Khan Bahadur, Honorary Assistant Engineer and Deputy Magistrate, Anupshahr Division, Ganges Canal, is granted one month and 15 days' leave on medical certificate, with effect from the 1st July 1887, or subsequent date.

Mr. E. A. Carswell, Executive Engineer, 3rd grade. *sub pro tem.*, Anupshahr Division, Ganges Canal, is temporarily transferred to the 3rd Circle, Irrigation Works, and appointed to officiate as Executive Engineer of the Agra Canal during the absence of Captain J. Clibborn, S. C., Executive Engineer, on privilege leave, or until further orders.

Assam, July 9, 1887.

Mr. D. J. Clancey, Assistant Engineer, 2nd grade, who was transferred to the Cachar district in orders dated the 8th June 1887, reported his arrival at Silchar on the forenoon of the 18th June 1887.

Mr. G. W. Winckler, Executive Engineer, 3rd grade, attached to the Kámrúp district, now absent on 34 days' privilege leave, sanctioned in orders dated the 7th June 1887, is temporarily transferred to Dibrugarh to officiate as District Engineer of the Lakhimpur district, *vice* Rai Durga Das Das, Bahádur, proceeding on three months' privilege leave.

Assam Public Works Department Notification, dated the 13th June 1887, transferring Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, from the Khási and Jaintia Hills division to the Lakhimpur district, and appointing him to officiate as District Engineer of that district, is hereby cancelled.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

ADDISON.—At Hoshungabad, on 22nd June, 1887, suddenly, of heat-apoplexy, John Copley Addison, Captain, Royal Engineers, elder son of John Addison, J. P., Castle Hill, Maryport, Cumberland, in his 35th year.

INDIAN ENGINEERING.

SATURDAY, JULY 30, 1887.

THE UPPER BURMAH FOREST REGULATION.

ALTHOUGH no fatalists, we are reluctantly compelled to admit that an incubus seems to brood over all connections with the forests in Upper Burmah, whether in the time of the indigenous kings or under the present owners. In times gone by, they were a fruitful source of contention between the predecessors of *ex*-king Theebau, and those who thought they had a rightful claim to the produce by virtue of *sunuds* and mutual agreements. But for these forests and the complications arising between the late king and the Bombay and Burmah Trading Company there would not have been such a sudden change in the policy of the Government of India towards Upper Burmah, to be followed by annexation.

However, that may be, now that the country is settling down to peace and order, the old state of things could not long be permitted to continue, and we are glad to find from a recent number of the *Gazette of India*, that an enactment has just been passed regulating the right to forests, forest produce, and the duty leviable on timber in Upper Burmah.

The principle kept in view in the Bill was to make such arrangements as would enable the people to provide for their requirements in the matter of forest produce, either outside the reserved forests, or under certain restrictions within their boundaries. There was, besides, consideration shown to the custom of a tribe who carry on a shifting kind of cultivation by cutting and burning the forest, and is called the Toungya cultivation. For this purpose defined areas were assigned to them, where they may practise it without laying themselves open to penalty. The practical results of the proceedings mentioned above would be that the forests set apart and demarcated can be effectively protected and improved by degrees, so that in process of time a limited area will yield all the timber and other forest produce required for home consumption and export, while the remainder could be thrown open for the use of the people and the extention of cultivation. One effect of this will be to concentrate forest conservancy upon limited areas instead of attempting to enforce restrictions over the whole of the forests.

The *new* Regulation of the present year extends to the whole of Upper Burmah with the exception of the Shan States. We notice that it is in some respects retrospective, as regards the saving element in the clause relating to punishments in regard to any place which has been exempted from its operation; and in others it is prospective.

We will now proceed to examine some of the important provisions of the law, connected with the determination of proprietary right to any land proposed to constitute a reserved forest. The claims under this head are to be disposed of by a forest-settlement-officer, who shall ordinarily be a person other than a forest officer, although he may be assisted by the latter in the prescribed inquiry. This is a wholesome provision, for an obvious reason that an officer conducting such an enquiry should be independent of the department; at the same time that he is well versed on the subject of land tenure, a branch of legal lore with which forest officers, as such, are not presumably acquainted but with which their interests are intermixed. More so as these enquiries will be held on the spot and it would not be convenient or even possible at all times to procure professional assistance in such out of the way places.

Certain facilities have been placed within the reach of claimants in preferring their right to forest produce, pasturage, &c., which is certainly a boon and will be appreciated as such by the people, but in regard to appeals from the decision of the forest settlement officer, we think their interests have not been sufficiently safe-guarded, and a little latitude may be given them without prejudicing the title of Government, and the time for preferring the appeal might also be extended, for reasons given above. Section 14 of the Regulation says:—"Any person who has made a claim under this chapter may, within three months from the date of any order passed on such claim by the forest-settlement-officer ....present an appeal from such order to such officer of the Revenue Department, of rank not lower than that of a Deputy Commissioner, as the local Government may........appoint by name, or as holding an office, to hear appeals from such orders."

Now, referring to the next section but one we find, that the decision of the Deputy Commissioner or any other officer appointed by Government for the purpose shall be final. A question involving a declaration of right is a serious matter and the court of last resort in such cases should be similar to that which hears appeals in revenue and civil cases. But as a following section provides that the Local Government may within five years from the publication of any notification revise any arrangement made and may rescind or modify any order made under this head, it is to be hoped that the working of the Regulation will be carried out in a judicious and liberal spirit, so that a clashing of public with private interests may be avoided, and a general obedience to the law accorded by the people.

DIRECTORS' REPORTS OF INDIAN RAILWAYS.

I.

Oude and Rohilcund Railway.—At the forty-ninth ordinary general meeting of the shareholders of this Company the chairman in proposing the adoption of the report ending 31st December 1886 stated that the gross earnings of the half year exceeded those of the corresponding period in 1885 by £41,611 and the net earnings by £35,046. The increase in earnings is attributed to the additional—75 miles—mileage length opened for traffic during the year, between Moradabad and Saharanpur. They carried 236,733 more passengers than in the second half year of 1885. Trade had been extremly dull and there had been a falling off in the principal staple of traffic—wheat, of which only 67,626 Tons had been carried as compared with 77,124 Tons in 1885. The falling off appeared under the head of exports to Howrah. There had been noticeable increase in the traffic of seeds and grain with Bombay. The additional expenditure of £ 6,565 was almost wholly due to the supplementary mileage open for traffic, but notwithstanding this increase the percentage on the gross receipts had declined from 69·85 in 1885 to 61·91 in 1886. The Ballawalla bridge was opened for traffic in May last and through communication thereby established with the northern extension. The Benares bridge consisting of seven spans of 356 and nine of 110 feet was expected to be completed by September next. Great credit was due to Mr. Walton the Resident Engineer who had most successfully met and overcome all difficulties experienced during the progress of the work. The Company derived a small profit—£ 365—from the operation of the Lucknow-Sitapur and Seramow metre gauge Railway. The most important question which affected the interests of the shareholders was the approaching optional purchase by the State of the Railway in June 1888. The Board had addressed a communication to the Secretary of State for India for the extension of the purchase period to 1898 or ten years hence from June 1888. After entering into a short review of the history of the Company, he pointed out that the period allowed under the contract had not been sufficent for the remunerative development of the Railway, and that although the Government had every right to take it over on 1st June next year, yet the Board had pointed out to the Secretary of State, that there had been considerable deviation from the original contract on the part of the Government, and this coupled with other militating circumstances should succeed in inducing him to accede to the concession asked.

Madras Railway.—The report of the Directors of this company for the half year ended 31st December 1886 shewed the gross revenue in that period to be £371,200 and the expenditure £228,475 leaving a net balance of revenue £142,725 against £151,832 for the same period of 1885. The gross revenue had been £20,000 more than that for the corresponding half year in 1885, but the expenditure being nearly £29,000 larger, the net revenue showed a diminution of a little over £9,000. The receipts per mile were more than last year by £23 and the highest on record. Reduction in the fare of 3rd class passengers induced a larger passenger traffic—the number carried being 500,000 in excess of the half year with which the comparison was instituted. The receipts from 2nd and 1st class passengers was unusually high in consequence of the Viceroy's visit to Madras. There was a decrease of £2 per mile in the expenses for maintenance and the Engineering departments but the abnormal charges to the revenue were three times as much as usual. The locomotive and other departments showed an over expenditure of £6,000 and £7,000. The working expenses were also higher owing to the higher cost of fuel. The most important engineering works in progress were the Calicut extension, the construction of the Penner bridge, estimated to cost 8 lakhs of rupees, and other minor bridges and the Palghat Branch. When the Penner bridge is completed the Chittravati bridge will be put in hand to be followed by the Papaghni—the former having 19 and the latter 13 openings of 140ft. each. Were it not for these various unfavourable circumstances a far more satisfactory result would have been attained.

Great Indian Peninsula Railway.—The Chairman before proposing for acceptance the Directors' report ended 31st December 1886 and declaring a diviend entered into an explanation of the results attained during the half year for which the meeting was held. He showed by the accounts that were in the hands of the shareholders that the disproportionate difference between up and down traffic—which was as 3 to 1 a year ago had grown smaller—a little more than 1½ to 1 during the half year under notice. Both the way and works were admirably maintained. The number of passengers carried had steadily increased to 8,140,000 from 6,000,000 in 1882 or an increase of 30 % in 5 years. On the expenditure side of the accounts the item of *Coal* had been a great drawback in the more profitable working of the line. The Umaria coal, declared to be as good as the English, was found to be 50 % inferior! The piece goods had suffered a decline not from competition on the part of other Railways but from falling off of the demand from religious prejudices on the part of the Hindus. The principal staples of traffic, cotton and wheat, had shown considerable improvement, in linseed another staple of traffic there had been a falling off which was more than made up by other seeds. After proposing the adoption of the Directors' report, a dividend of 4 shillings per cent on the ordinary stock, was declared payable out of the surplus profit, in addition to the guaranteed interest of £2-10 shillings per cent for the current year. Had it not been for the payment of 2 years' income tax from one year's receipts, the dividend would have amounted to 4s. 9d. instead of 4 shillings. There appeared every chance of prospects improving.

Indian Midland Railway.—The report of the Directors of this Company presented at the third ordinary general meeting of the shareholders held under the presidency of Colonel Holland was essentially the progress report of the Agent and Chief Engineer, Mr. Cregeen, under whose able and energetic superintendence the works of construction had made great advance. Mr. Cregeen reported that at one time the number of men employed on the works was 160,000.

Bengal-Nagpore Railway.—The first meeting of the shareholders of this Company only 16 weeks' old was formally held in compliance with the Act of Parliament, Mr. Samuel Hoare presiding. The total Capital £ 3,000,000 had bëen subscribed in England of which £2,549,000 had been paid to the 13th June leaving a balace to be paid up of £ 450,000. The chairman proposed the conversion of shares into stocks which was agreed to by a resolution passed to that effect before the termination of the meeting. Mr. Wynne had been appointed Agent and Chief Engineer and with an efficient staff is now engaged in examining the opening railway between Nagpur and Nandgaon with a view to its conversion from metre into broad gauge and its immediate extension to Raepur. In reply to a question the chairman confirmed the correctness of the impression that the Government gave them a guarantee of 4 per cent., whatever the traffic of the line might be, and if the receipts exceeded the guaranteed percentage the company would receive ¼ of the surplus.

A SOLUTION.

In connection with what is now commonly known as the "Sind-Pishin Railway Scandal" the following extracts from a Paper read before the "Royal Engineer Institute" at Chatham by Captain L. K. Scott Moncriff, R. E., supplies in a very naïve and artless way the solution of the case, which the authorities in India are so strenuously endeavouring to suppress:—

"The details I am about to describe are those that were new to me personally, and to almost *every officer in our Corps* who joined the line while I was there. Many of us had had experience in the construction of barracks and forts, in the laying out of military roads and building of road bridges, some of us knew a little about canal engineering, but with two or three exceptions, the Royal Engineer officers sent up to the works knew *nothing* practically, about the technicalities of railway engineering: did not know how to lay out curves or to set out bridges: did not know how to set out tunnels, and were quite ignorant on the subject of platelaying * * * * * I shall try and point out the practical lessons which I, in common with others, *learnt* on this great work.

"It is better to have some idea, even if it be only in theory of the work to be done, and not to have to learn it at the cost of disagreeable and humiliating failure, as well as of valuable time."—

* * * * *

"There were at first *no* directing officers of any railway experience except the Engineer in Chief himself" (?)

* * * * *

"Some writers in the Press, jealous of *The Corps* of Royal Engineers, have made invidious comparisons between the progress of the Bolan Railway, on which the Engineers are chiefly Civilians, and the Harnai line, on which *The Corps* has been so largely represented; * * * we have, on the contrary, while giving our Civilian brethren every credit for the work in the Bolan, good reason to be proud of the work done by *The Corps* on the Sibi-Pishin line. It has been entirely under the direction of one of the most distinguished officers of *The Corps*, of whom I think I may be permitted to say that there are few men who, in the face of such difficulties as we have had, could have carried on such an undertaking with so much success; and all the difficult works on the line, without exception, have been either partly or wholly under Royal Engineer officers * * * * and the only part that has been under Civilian Engineers is the easiest part of all, and the only part too, that enjoys a fairly temperate climate."

Comment is needless.

Notes and Comments.

LOCOMOTIVES FOR INDIA.—The well-known firm of local locomotive builders, *viz.*, Messrs. Neilson and Co., of Hydepark Locomotive Engine Works, have just received an order for the construction of 30 large and powerful engines for an Indian railway company.

E. I. R. COAL EXTENSIONS.—We learn that the Barakur Branch of the East Indian Railway is to be carried 10 miles over the river. Eleven lakhs is said to be sanctioned, and the work will start as soon as the borings now on the river find a solid bottom. They are now down to 130 feet.

ANOTHER WELL-EARNED REWARD.—Her Majesty the Queen has been pleased to approve of the honor of C. M. G. being conferred on Major McCallum, R.E., Colonial Engineer, Straits Settlements. Major McCallum has probably earned this honor by the energy and ability he displayed in the construction of the Singapore fortifications.

COOPER'S HILL.—A contemporary points out that according to the Home accounts for the year 1885-86, the Royal Indian Engineering College has very nearly become a self-supporting institution, which none of the local Engineering Colleges in India are, some of them showing shortcomings in "receipts" of a lakh or more rupees per annum.

KASHMIR RAILWAY ROUTES.—The Allahabad paper writes:—So far as the preliminary surveys for a railway to Kashmir have yet been carried out, the result goes to shew that there are at least three practicable alternatives, all somewhat costly, though a good deal more is needed before anything like an approximate estimate can be formed of what the actual expenditure on any one would ultimately be.

THE UMBALLA KALKA LINE.—The *Bombay Gazette* informs us, it is not strictly true, that the B. B. and C. I. Company have offered to construct without guarantee a broad gauge line running from Delhi, *via* Kurnaul and Umballa, to Kalka, at the foot of the Simla hills. There may not be, so far as we know, many obstacles to this; but there is one which is sufficient, and it consists in the fact that such a line would not at present have direct broad gauge communication with the B. B. and C. I. system.

RAILWAYS IN PERSIA.—A concession is reported for the construction of the first Persian railway. The syndicate is made up of Belgians and the line is to run from Teheran to Shah-Abdul-Azim a distance of about 6 miles. The latter place is a celebrated point of pilgrimage. The same concession entitles the Belgians to the exclusive right of constructing a line from the Caspian Sea to the Persian Gulf. The company is the *Societé Anonyme Belge des Chemins de Fer Persans* of Brussels.

TO ENGLAND BY RAIL.—There can be no doubt that the quicker England can communicate with North-West India, the stronger will be her hold on that possession, and the less likely is it that any power would desire to contend for it. Hence proposals have been brought forward for the Euphrates Valley Railway and for a Trans-Arabian Line. We cannot, however, see how this great object can be achieved if the railway system of India be—as it assuredly will be—connected with that of Central Asia, *via* Kandahar and Herat, despite its commercial advantages.

PENANG IN 1886.—The Beach Street reclamation works came practically to a conclusion in December 1886, after having been in hand since October 1883. Twenty-five acres have been thereby reclaimed at an outlay of $520,000. The expenditure on works and buildings showed heavy increases on 1885. The new Government offices alone are estimated to cost $250,000. Under the head of roads, streets, and bridges, excess over last year's expenditure in this respect is also noticeable, mainly caused by opening up communications in hitherto not readily accessible districts. Expenditure on this system may fairly be deemed reproductive in the end.

MADRAS TOWN DRAINAGE.—The Black Town drainage scheme made considerable progress during the year; Rs. 1,46,307 were spent on it out of a budget grant of Rs. 1,57,770. The total expenditure on the work up to 31st March 1886 was Rs. 5,75,939. About 8,000 feet of sewer-work were completed during the year. Considerable difficulty was experienced in the work in consequence of the bad soil which was met with in parts, and the large quantity of water which had to be constantly pumped out. Surface draining made good progress, 8 miles of drains having been laid in the course of the year, and house-drainage was also satisfactorily carried on.

POTINGHI-KORAPUT ROAD IN JEYPORE HILL TRACTS.—The estimate for the Potinghi-Koraput road on the Vizagapatam-Raipur route amounts to Rs. 3,10,000 including bridges, or for 30 miles Rs. 10,340 a mile. There are four large iron girder bridges, of which the girders are being obtained through the India office, twelve masonry bridges, and sixty-four culverts. It will occupy the long time of 5 years in making including, and 3¾ years excluding, the iron bridges, with a proportionate increase of time if the estimate is inadequate. The proposed extension from Koraput to the Central Provinces frontier, a distance of 130 miles, will be exceedingly expensive and formidable to make, and will cost not less than Rs. 13,50,000

FACTORIES IN THE MADRAS PRESIDENCY.—There are 24 Factories in Southern India, half being situated in the Districts and half in the city of Madras. The Railway workshops are the largest employers of labor—the "Madras" at Perambur employing 2,727 hands and the "South Indian" at Negapatam 1,573. In Madras, we find the Gun Carriage Factory, Powder Mills, Harbour Works, P. W. Workshops, and the Arsenal, all coming under the Act; but it is a sad commentary on the Administration to find a Policeman, who knows as much about Prime movers as a coolie does of politics, discoursing wisely on "working pressure," "blow off valves," &c. Under such circumstances everything must, of course, be satisfactory and all "good!"

BARAKUR IRON WORKS.—These works are now very slack for want of orders. This is not to be wondered at considering the price charged for casting sleepers. They ought to be very much cheaper: also all the outturn of castings should be much cheaper. We hear that Tenders have been offered at Home and accepted at £4-1-0 per ton for Steel sleepers for the Bengal-Nagpur Railway, and there is no wonder that Mr. Wynne decided on the latter instead of the Barakur Iron sleepers. But orders are always limited at Barakur especially for such class of castings, which cannot be compared to English, either in quality or price. We understood that the Bengalis were to burn all their wooden ploughs, and take to the Barakur plough, but not one in a hundred will use them!

ROYAL TRANS-AFRICAN RAILWAY.—This railroad will begin in the seaport of Loanda, in the colonial province of Angola, and run across the Continent to the Indian Ocean. The first grand section of this enormous runk line, now contracted for and under construction terminates at Ambacca, a coffee district, about 300 kilometres inland. It is located with a maximum grade of 15 per cent. and curvatures of 191 metres radius. The gauge to be one metre. No great engineering difficulties are encountered in this first section, but plenty of raiding, man-eating savages. The working staff is as follows: Colonel D. E. Davenport, of London, is General Manager; K. P. Crandall, of Ithaca, N. Y., Chief Engineer, and Geo. A. Schele, of Birmingham Ala., Chief Assistant Engineer.

THE PANAMA CANAL.—News from Panama, dated 16th May, states that water has been struck in one of the heavy cuts far above the final level of the canal, and it states that the water has washed the mountain side into the canal, filling the cut that had cost a very large amount to excavate. This, if true, is one of the feared and almost anticipated "accidents" to the Panama Canal. Whether it is serious enough to cause the abandonment of the work at this time is unlikely, but some such excuse will in all probability be used to account for the stoppage of the work by the French Company, which many well informed engineers deem inevitable, and to account to the unfortunate investors for the disappearance of the countless sums which have been and are being squandered in that disastrous enterprise.

GOLD IN SUMATRA.—The opening up of fresh sources of supply of the yellow metal cannot fail to be hailed with satisfaction by the commercial world. There is every prospect of something of the kind turning up in Sumatra. That island is now coming prominently into notice in Holland and France as a promising gold-field. So encouraging indeed does the outlook in this respect turn out to be, that the importance of Sumatra as a factor in monetary questions begins to secure recognition. A French scientific journal of high authority has drawn attention to the large quantities of gold stored up underground on the West Coast of Sumatra. In the olden time, very far back indeed, the island of Sumatra was known to be a gold region, and has been supposed to be the Biblical land of Ophir. From time to time scientists have drawn up reports on the mineral wealth of the island.

RAILWAYS IN TONKIN.—The technical Commission appointed to report on the proposed railway in Tonkin has just commenced its sittings in Paris. The first line will connect Hanoi with the Seven Pagodas, having a length of 60 to 66 kilometres on a level ground. From there it will bifurcate, going in one direction either to Haiphong alone or to Quangyen *viâ* Haiphong, and in the other direction towards Annam *viâ* Namdinh or Ninh-binh, thus putting the two countries in direct communication. The consideration of the north and western system of railways presents more difficulties. The Laokai line, the real economical and commercial line of Tonkin, passes through a district, quite different from the alluvial lands and as yet very little known. The last section of the Tonkin system would be a line from Hanoi to Langson, which would be purely for strategical purposes.

LAUNCH OF A PENINSULAR AND ORIENTAL STEAMER.—The *Victoria* the first of the magnificent additions to the Peninsular and Oriental Company's already large fleet, was launched from Messrs. Caird & Co's yard at Greenock on 9th May. Her dimensions are :—Length, 483 feet; breadth, 52 feet; and depth, 37 feet. She will register nearly 7,000 tons, and her triple-expansion engines are expected to devolope 7,000 effective horse-power, which should drive her 17½ knots at full speed. In addition to the *Victoria*, the Peninsular and Oriental Company are also building at Greenock the *Britannia*, of nearly 7,000 tons, and at Messrs. Harland & Wolff's yard at Belfast the *Oceana* and *Arcadia*, of the same dimensions as the *Victoria*, and these four steamers are being constructed for the India, China, and Australian mail services of the Company. The estimated cost of these four new vessels is something like a million sterling.

THE LUCKNOW WATER-SUPPLY.—We learn that the early initiation of the Artesian Well project is likely to be fulfilled. We understand that arrangements have been concluded with the "Pierce Well Excavator Company," of New York, for the supply of first-class drilling apparatus, all of the latest and most improved type and construction, including an engine of 15-horse power and piping for a well 2,000 feet deep, the cost being about 8,000 dollars. It is hoped that this very complete Artesian apparatus, everything in complete order ready for immediate setting-up and working, will leave New York not later than the end of September, and it should reach Lucknow by the middle of November. With it will come a thoroughly experienced Artesian Engineer under covenant; but this we think is a mistake, as such "covenanted" hands have not done much so far as they have been tried in India, and the coal-fields could produce "experts" far more capable and efficient for work of this class in the country.

THE COAL PROSPECTS OF VICTORIA.—For a long time past opinion as to the probability of discovering payable coal-fields in Victoria has been very much divided—one party scouting any such idea, and supporting their contention with illustrations of the past coal "failures" of the colony; and the other, not at all disheartened by non-success, quietly working, and hoping for more promising prospects. Of late, matters have been brightened by reported discoveries from time to time of fresh coal seams in various parts of Gippsland, which have quickly been taken in hand by various companies and syndicates. At no more opportune time could the coal question be "warmed up," for, with the partial falling-off in the gold-fields, speculators, who have hitherto confined their attention to quartz, have naturally turned towards Gippsland, while the Government last year recognised the necessity of action by placing £3,000 on the Estimates towards prospecting for coal, and the money was unanimously voted by Parliament.

PRINCE'S DOCK EXTENSION, BOMBAY.—The water area of the new Dock works is a little over twenty-four acres. In general shape it is rectangular, and its main dimensions are 1,866 feet from north to south by 1,000 from east to west. From the west side three spacious jetties are thrown out, measuring 400 by 230 feet. By this means the new dock possesses a greater quayage than that of the Prince's Dock, the walls measuring not less than nine thousand feet. At the north-east corner of the Dock a passage has been made ready for connecting the two docks, measuring 202 feet in length by 64 feet wide and 35 feet deep. The work was begun in January 1885. So great progress, however, has been made that although the contract time does not expire till October of next year, it is expected that Messrs. Kirby and Co., the contractors, will have finished their work in another six months. The Dock was designed by Mr. G. E. Ormiston, Chief Engineer to the Port Trust. It is confidently anticipated that March or April will see the extension open, and that it will be available for the trade of that season.

Current News.

CAPTAIN W. T. SHONE, R.E., Field Engineer, Upper Burma Field Force, has been invalided to England.

THE weavers are on strike, and 4,000 hand-machines in and around Belgaum are stopped. About 10,000 persons are out of work.

IT is an open secret that the increased activity in the matter of the defences of India is in no small measure due to the personal action of the Viceroy.

THE Chief Engineer of the East Indian Railway reports that there is no truth in the statement that a caisson of the Jubilee Bridge at Hughli has sunk.

WE learn that the Ahlone ice-works, Rangoon, have been purchased for a lakh of rupees by Kyouk-Myoung-Atwin-woon, the Tinedah Mingyee's son-in-law.

THE extension of the Bombay, Baroda, and Central India Railway from Godhra to Rutlam will be undertaken next working season. It is estimated to cost 158 lakhs.

SOME nine or ten junior officers of Royal Engineers are to be summoned to Simla to assist in preparing designs of the various defence works which the Government now looks to carrying out.

MR. ALBERT TISSANDIER, Architect to the French Government, is now on an artistic and scientific mission to India, and is visiting some of the principal places of interest in this country, such as Benares, Agra, Delhi, &c.

LANDSLIPS occur with alarming frequency at Simla. The most serious accident of the kind is the collapse of the tunnel on the road to Mashobra, traffic through which will be completely suspended for some time.

APROPOS of the diversity of knowledge of the Royal Engineer which we referred to in a late issue, we see that a Colonel E. F. St Lloyd, R.E., has received a certificate from the Board of Trade as master for fore and aft craft.

IT is said that the question of the extension of the Quetta Railway to Chaman is likely to be raised in the House of Commons, by those who accuse the Government of India of contemplating a forward movement on Candahar.

THE damage done to the head works of the Western Jumna Canal is not quite so serious as was at first anticipated. It is believed that the damage can be repaired without seriously interrupting the supply of canal water for irrigation purposes.

CAPTAIN J. G. LUTYENS, R.E., and Lieutenant E. A. Edgell, R.E. employed as Field Engineers in Upper Burma, being no longer required there, have been ordered to return to India and report their arrival at Calcutta to the Inspector-General, Military Works.

IT is said that, on the retirement of the Hon. T. C. Hope, the Honorable General Chesney, R.E., will succeed him as Public Works Minister, and that Major-General O. R. Newmarch is likely to be appointed Military Member of Council in General Chesney's place.

WE hear that there is a probability of a Burmese Sapper and Miner company being raised. The British officers and non-commissioned officers, also the native officers and non-commissioned officers will be supplied from India, while the men will be natives of Burma.

THE following Royal Engineer Officers in Upper Burma have been appointed Field Engineers:—Captain R. O. Floyd and Lieutenants W. F. Tilley, G. M. Duff, E. A. Edgell, G. D. Close., C. C. Percival, Lieutenant A. J. Huleatt, R. F. Sorbie, and E Stokes-Roberts.

SPECIAL provision for the projected defence works in India, both at the ports and in the interior, will probably be made in next year's Budget. It is of no use to have additional garrison batteries unless the guns and fortifications in which to mount them are forthcoming.

THE P. S. *Mogoung* was lately successfully launched from the Irrawaddy Flotilla Company's Dock yard at Dalla. The vessel is intended for the express mail service between Mandalay and Bhamo, and will be fitted throughout with electric light, and all other modern improvements.

THE Karachi Chamber of Commerce have submitted to the Viceroy, and the Governor of Bombay, a memorial urging the construction of the Hyderabad-Pachpadra line, many times referred to in these columns, and pointing out the postal, military and commercial necessity for the line.

WE understand that the arrangement under which the South Indian Railway Company are to work the Nellore-Tirupati section of the Caddapah-Nellore line is, practically, that the State pays for the actual working expenses, and that the surplus profits, if any, will be divided in the proportion of 1 to 3.

COLONEL A. WALKER, R. A., Inspector-General of Ordnance, Bengal, is about to proceed to England on three months' privilege leave, and while in England will visit the Royal manufacturing establishments in order to acquire information regarding the many changes now taking place in war material.

THE Madras Harbour Trust Board has resolved to widen the pier deck three feet on either side. The traffic on the pier is so great, that the deck is frequently very crowded, and considerable delay is thus caused. To obviate this inconvenience it was originally proposed to make some substantial improvement to the pier, and to widen it at the gangways and at the T end; but this proposal has not met with the approval of the Board, who consider it too expensive.

THE thanks of the Jamalpore public are due to the authorities of the East Indian Railway Company for the good work they have done in the matter of water-supply. The reservoirs which have been for some time in the course of construction have been completed, and will, we believe, be opened in a few days. It is expected that Sir Steuart Bayley will be present at the ceremony, which is to be carried out in a very effective manner.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

WORKING THE "BROKEN MINE."

SIR,—I would be obliged to you for inserting this letter in your next issue of INDIAN ENGINEERING, respecting the best method of working the *pillars out* in a mine rising 1 in 10.

The coal which is to the rise of the main levels is in pillars 12' × 15' and the thickness of seam 4'-6." The seam of coal is of a hard nature. The roof of a hard and coarse grained sandstone some 70 feet in thickness; within it there is a seam of coal and carbonaceous shale some 6 feet from the 4'-6" seam and about 4'-0" thick. The thill or floor is very hard fireclay. The bords in the whole work are 3 yards wide.

Would some of your readers give me the benefit of their experience in working a similar seam elsewhere? I wish the coal to be all got.

COLLIERY MANAGER.

THE SEEBPORE ENGINEERING COLLEGE.

SIR,—As some passages in your article on the Seebpore College which appears in INDIAN ENGINEERING of the 23rd instant, may mislead the public, I trust you will publish this letter.

The list you refer to, advertised in the daily papers by order of Government, contains but few names—in fact at present I do not know of a dozen ex-students who are unemployed.

The increasing number of names on the books indicates that the unpopularity of the college is over estimated. Notwithstanding the necessarily strict regulations in force for the maintenance of discipline in a large boarding establishment, and the restrictions with regard to leave, no student being allowed to absent himself without the Principal's written permission, there are more students in the college today than there ever were before since its opening, a little over seven years ago.

S. T. DOWNING,
Principal.

27th July.

THE SHONE SEWERAGE SYSTEM—A VINDICATION.

SIR,—We have read the report on a "Sewerage scheme for Karachi City and its Suburbs," by the Municipal Engineer, Mr. J. Strachan, M. Inst. C.E., contained in your impressions of the 7th and 14th May last, and have pleasure in saying that with a large number of the conclusions arrived at by Mr. Strachan, we heartily concur. There are, however, some statements in the report that we cannot allow to pass unchallenged.

In paragraph 6, Mr. Strachan enters upon the question of the "manner of disposal of sewage," and names four systems for consideration, *viz*:—

1st. Treatment with chemicals;

2nd. Pneumatic systems (Liernur's and Shone's);

3rd. The tidal outfall; and

4th. The application of sewage to land by means of irrigation.

We offer no remarks on the relative merits of the systems for *disposal of sewage* enumerated, except to say that we think Mr. Strachan has wisely chosen the method of irrigation. We wish, however, to say that the Shone system is not set forth as a means of *disposal* of sewage, but as a means of delivering sewage *rapidly* to an outfall, whether for treatment by the 1st, 3rd or 4th methods named.

We are not aware whether Captain Liernur claims specially that his Pneumatic system is one for *disposal* as well as *collection*, but we have no doubt that gentleman will be able to *chaperon* his own interests in the system, if he feels it desirable.

We now pass on to paragragh 8 of Mr. Strachan's report, and must emphatically traverse all the conclusions arrived at in reference to the Shone system. The remark at the beginning of the paragraph that "The Pneumatic system as carried out by......... Shone has few advocates in England" is a comparative one, and we say in reply, that besides the works carried out by Mr. Shone and his firm as Engineers, sewerage works have been carried out and have been adopted by the authorities, from plans and designs of the following Engineers :—Messrs. Geo. A. Wallis, C.E. (agent to the Duke of Devonshire); E. Pritchard, C.E., (of Birmingham and London); F. C. Stileman, C.E. (Member of the Council of the Inst. C.E.); Messrs Gotto and Beesley, C.E. (London); J. C. Mellis C.E. (London); T. Longdin, C.E. (Borough Engineer, Warrington); W. B. G. Bennett, C.E. (Borough Engineer, Southampton); J. Inglis, C.E. (Plymouth); R. E. W. Berrington, C.E. (Borough Engineer, Wolverhampton); Arden Hardwicke, C.E. (Borough Engineer, Walsall), O. Deacon Clark, C.E. (Engineer to the Municipality of Rangoon); besides Russian, Colonial, and American Engineers.

A Select Committee of the House of Commons, after careful examination and enquiry, unanimously decided to have the system applied to the main drainage of the Houses of Parliament, as recommended by Mr. John Phillips, C.E.

The System has been established at Eastbourne (since 1881)' Warrington, Fenton, Mexborough, Beaumaris, Henley-on-Thames, Southampton, Compton Gifford near Plymouth, Darlaston, Wednesbury, Campos (Brazil), Sacramento (California), several places in London, including the Houses of Parliament, Ashford (Middlesex), etc.

Tenders are accepted for works at Lowestoft and Heston and Isleworth.

We will not trouble you with the names of advocates of the system, but they are certainly not "few."

The last clause in paragraph 8 reads thus :—"With reference to Shone's sytem, it may be briefly described as being in every way similar to Liernur's, with this exception that the sewage is forced through the pipes by compressed air, instead of being drawn through by suction. All the reasons brought against Liernur's system are applicable, to the same degree, against Shone's system."

The reasons brought against Liernur's are *not* applicable against the Shone system, inasmuch as the two systems operate with air not only in different ways, but are also in no way similar in object or design. Taking the reasons against the Liernur and Shone systems, as given by Mr. Strachan in paragraph 8, we answer to the 1st :—That the Shone system deals with the *whole* sewage, whether pail contents, slops, or water-carried sewage, and rainfall as well, if desired.—To the 2nd, the sewerage of a town is *not* more costly on the Shone system than the ordinary schemes. To the 3rd, it is extremely simple and not likely to get out of order. To the 4th, the same closet arrangements as are used with the ordinary systems of sewerage are applicable for the Shone system. No *special* arrangements are required at the houses or other connections in applying the Shone system.

It would lengthen this communication beyond the bounds of your endurance, to give a detailed description of the Shone Hydro-pneumatic sewerage system. Suffice it to say that it is designed chiefly to enable engineers to *command* gradients to their sewers *in all cases*, that will be suitable to the quantity they have to deal with, and irrespective of the natural inclination of the surface. Many are the contributory advantages, such as avoiding excessive depths in laying sewers, the doing away with large sized sewers, the absence of storage and stagnation, rapidity of transmission from town to outfall, etc.

We conclude by saying that we write this in no captious spirit or antagonism to Mr. Strachan, but simply to endeavour to correct the false impressions which the publication of his report is calculated to spread in the minds of those who read it without being acquainted with the system which we have the satisfaction of advocating.

SHONE & AULT.

4, WESTMINSTER CHAMBERS,
LONDON, S.W.
June 23, 1887.

Literary Notices.

ASIATIC SOCIETY OF BENGAL.

IN the April number of the Proceedings Mr. H. F. Blanford offers some remarks on the subject, of the variation of rainfall of the Carnatic and N.-W. Himalayas with the sun-spot period. The purport of these remarks is that he considers it no longer doubtful that a cyclical variation of a very marked kind regulates the rainfall of the Carnatic on the one hand, and the winter rainfall of the North-Western Himalaya on the other, and that in some degree similar or opposite oscillations are traceable in the rainfall of other provinces. But he has been quite unable to detect such an oscillation in the rainfall of India as a whole.

ENGINEERS' CLUB OF PHILADELPHIA.

THE Proceedings for the second quarter (No. 2) of the current year contain a valuable article by A. H. Howland on "Stand Pipes"—their materials, workmanship, and design. The article is both practical and suggestive. W. E. Hall's article on "Controlling Expansion in Locomotives" is both novel and instructive. It is rather strange that more attention has not been given in Locomotive practice to this matter. H. R. Cornelius describes the U. S. Government Pumping Machinery used to remove the water from a Dry Dock in the Naval Yard of Mare Island, California. The pumps are of the "Centrifugal" type, and are the largest of their kind and of the greatest capacity in the world. The other articles call for no special notice, but they nevertheless combine to make a very readable volume of Engineering Papers.

New Books and Reprints.

GEOLOGY, MINERALOGY, MINING.

HOPTON (W.) Conversation on Mines, &c. 8th ed. Post 8vo, pp. 324. A. Heywood (Manchester). Simpkin 3/6

MINERAL Resources of the United States, 1885. Division of Mining Statistics and Technology. U. S. Geological Survey. Demy 8vo, pp. vii—576 ... ... 40 cents.

MORGANS (W.) The Solution of Colliery Explosions. Part 1: The Foe Entrenched. 12mo, sd., pp. 100. Arrowsmith (Bristol). Simpkin...1/

PHILIPS (J. Arthur) Elements of Metallurgy: A Practical Treatise on the Art of Extracting Metals from their Ores. New ed., revised and enlarged by the Author and H. Benerman. With numerous Illusts. and Two Folding Plates. Roy. 8vo, pp. 860. Griffin 36/

RUSSELL (Israel Cook) Geological History of Lake Lahontan, a Quaternary Lake of North-Western Nevada. Illust. with 45 Plates and a Folding Map. (Monographs of the U. S. Geological Survey.) Vol. 9. 4to, pp. xiv—288. Washington 81.75

MATHEMATICS.

HEATH (R. S.) A Treatise on Geometrical Optics. 8vo, pp. 366. Cambridge Warehouse... ... ... 12/6

HOARE (Charles) Mensuration Made Easy; or, the Decimal System for the Million. 17th ed. 12mo, sd., pp. 84. E. Wilson... ... 1/

LAYNG (A. E.) Euclid's Elements of Geometry. Book 1. With Notes, Examples and Exercises. (Blackie's Elementary Text-Books). Post 8vo, pp. 96. Blackie 1/

ROACH (Rev. T.) Elementary Trigonometry. Post 8vo, pp. 270. Frowde 4/6

WINTER (S. H.) Elementry Geometrical Drawing. Part 1. 13th ed. Revised and greatly enlarged. Post 8vo, pp. 234. Longmans ...5/

TRADE, COMMERCE AND MANUFACTURE.

CHARTERHOUSE (The) Photographic Art Journal: Designed to give Information on Modern Progress in Photography to Professional and Amateur Photographers. No. 1. 4to, sd., pp. 16. Whittingham... 3d.

FAULKNER (Robert) A Little Gossip about Printing. Oblong 4to, sd., pp. 20. Faulkner (Manchester). Simpkin. ... ... 6d.

HALLET (Holt S., C.E.) Burmah: Our Gate to the Markets of Western and Central China; treating with the Proposed Connection of Burmah with China by Railway. 8vo, sd., pp. 20. H. S. King and Son.6d.

JAY (J.) The Fisheries Dispute. 8vo, paper. New York... ... 1/6

MAITLAND (F.) Building-Estates: A Rudimentary Treatise on the Development, Sale, Purchase and General Management of Building-Land, &c. (Weale's Series.) 2nd ed., revised. 12mo, pp. 118. Crosby Lockwood. 2/

NORMAN (John Henry) Single Grain System for Determining the Par Value of all Moneys of Account, and Gold and Silver Coins between all Countries, &c. Post 8vo, sd., pp. 12. Waterlow and Sons ... 1d.

REDWOOD (B.) Petroleum: Its Production and Use. 18mo, bds. New York 2/6

SMITH (W. Nelson) Coins, Moneys, Weights and Measures of the World, with their English, French and American Equivalents. Post 8vo, sd., pp. 60. Wyman. 1/

WATT (A.) Electro-Deposition: A Practical Treatise on the Electrolysis of Gold, Silver, Copper, Nickel, and other Metals and Alloys. 2nd ed., revised and corrected. Post 8vo, pp. 584. Crosby Lockwood 9/

General Articles.

ARTESIAN BORING IN THE SUNDERBUNDS.

By Frank J. Agabeg, M. E., Superintending Engineer, Port Canning and Land Improvement Co.

The marshy and unhealthy country to the South-East of Calcutta known as the Sunderbunds has been formed, as most of your readers are aware, from the washings of Upper Hindustan, brought down in pre-historic times by pre-historic rivers and streams, which used to empty themselves into the sea at present known as the Bay of Bengal, and, geologically speaking, is only of recent formation. It is thickly over-grown with jungle and is intersected by innumerable small nullas and khals of salt water, all of which have their connection with the sea in one way or another. In some places the land is so low that it is only with the aid of bunds and dams that the large tracts which have been reclaimed and under cultivation are prevented from being submerged during the flood tides, and the utmost care has to be taken in keeping them in order.

The soil generally is fertile and yields good crops of rice yearly, but the greatest drawback that the inhabitants find is the want of fresh water. At times the villagers have to walk miles before they can get a drop either for drinking or culinary purposes, and what water they do get is not of the very best kind and far from wholesome. During the hot weather most of the fresh water tanks are dry, and should there be a little water left it turns quite brackish.

The Port Canning and Land Improvement Co., Ld., the largest Zemindary company in Bengal, have an estate of over 100,000 acres in these parts. This Company, who take a lively interest in the welfare of their tenants, have from time to time gone to a great deal of expense in excavating tanks on different parts of their holdings for their benefit, but with all this still the want of good water is badly felt. I may mention here that in digging a tank in this district you can only go to a certain depth, say 8 or 9 feet; for if you go too deep you come upon clays impregnated with salt and which allow the brackish water of the innumerable khals to percolate through it.

Mr. Cowasjee Eduljee, the Company's Agent at Canning, having heard of the good results obtained from artesian wells in Europe and elsewhere, proposed to his Directors at Bombay that they should try an experimental well in some part of their estate which might lead to favorable results. The Directors after consideration agreed to the proposal and the necessary plant was sent for from England.

Many who heard of what the Company intended doing were of opinion that the result would be a failure, as the probabilities were that any water met with in the alluvium below would be nothing more than the percolation from the sea. The only information that I could get in regard to the geological formation of the country was that the alluvium was supposed to extend to a depth of 700 feet; therefore, the country being flat and the geological section not known, it was quite unnecessary to select any particular spot for the well. But for convenience sake the site chosen was in the compound of the Agent's residence at Canning and about 200 yards from the Mutla river—*vide* Plate I.

It was agreed that the diameter of the Boring for the first 100 feet should be 5 inches; then reduced to 4 inches below; and tubed from top to bottom with wrought iron tubes 10 feet long flush joints both inside and outside, screwed into each other—*Fig.* 1, Plate II. The depth was to be 250 feet, and as this was not very great, steam power was not required. The work was started by sinking a pit 12 feet deep 7'-6" inside diameter, and lined with brickwork. Into this was fixed the necessary tackle for lowering down the tubes—*Fig.* 2, Plate II. On top of the pit was erected a wooden platform on which the men worked the rods. By this arrangement both operations of boring and forcing down the tubes could be proceeded with simultaneously.

The method carried out for forcing the tubes was as follows:—In the well A—*Fig.* 2, Plate II.—at about 4'-6" from the bottom, were fixed horizontally two rail girders, *b*, *b*, set into the brickwork and bolted down; on these girders with their heads downward were clamped two screw jacks, *c*, *c*, capable of exerting together a power of about 18 tons. The tube was inserted into the hole and passed between the two girders, *b*, *b*, and on it was fixed a driving clamp made of flat iron, 6" × ¾" × 1'-10." The pressure brought to bear on the clamps *d* by the screw jacks drove the pipe down, and as the pipe got to within one foot of the bottom another one was screwed on, the clamps raised, and the same operation performed as before.

The rods were worked up and down by tillers attached at a convenient height. At first 8 men were employed in the work, but as the boring progressed, extra 3 were taken on. At 100 feet the tillers were dispensed with as the rods became rather heavy to lift and another method used. This was, by attaching to the top rod a rope carried over a pulley in the sheer legs and coiled with three turns round the drum of a crab winch, the end of the rope being held by a man. The handles of the winch were turned and the rope held taut till the rods were raised a sufficient height when the rope was slackened and slipped, whereupon the rods fell and struck the required blow. In this work the chisel was discarded altogether, the clays being so soft that an ordinary shell pump tipped with steel was used, which did the work of cutting and digging at the same time.

(To be continued.)

THE STEAM ENGINE AND ITS HISTORY.

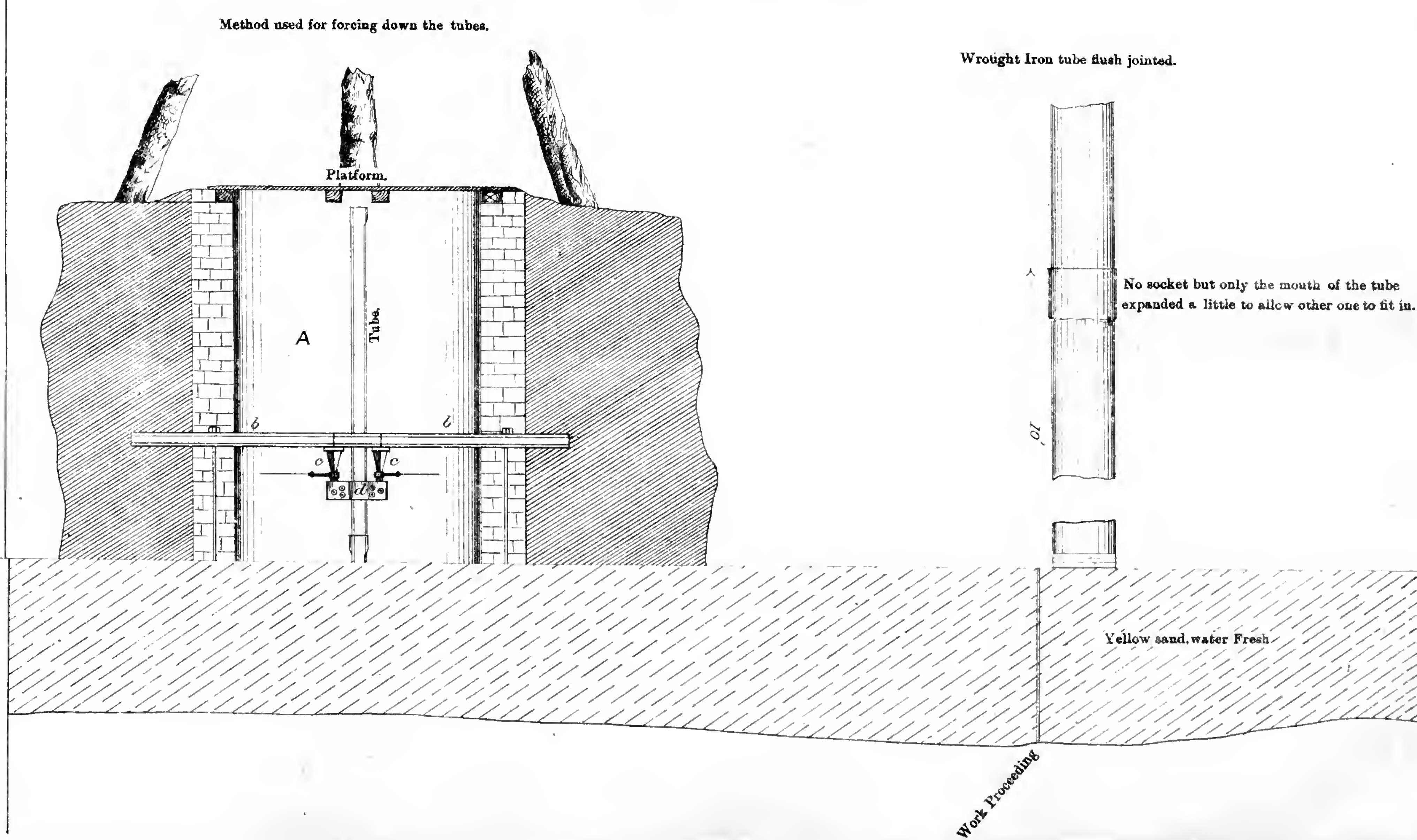
IV.

After the *Comet* came the *Clydé*, the *Elizabeth*, and the *Glasgow*, which were larger boats and of greater speed. In 1818 The *Rob Roy* crossed from Clyde to Belfast. In 1825 the *Enterprise* of 500 tons burthen and 120-H. P. made the passage round the Cape of Good Hope to India. Captain Johnston obtained £ 10,000 for making the first steam passage to India. Before this the *Savannah* fitted with an engine and paddles crossed from Savannah, Georgia, to Liverpool in 31 days. She was the first ship using steam power that crossed the Atlantic. When she entered the Channel off the coast of Ireland the smoke from her funnel brought down upon her a gun brig, detached from the Channel Squadron, under the impression that she was a ship on fire. In 1830 the value of steam for ocean navigation began to be fully recognised. The Peninsular and Oriental Company started in 1835, their first steam vessel being the *William Fawcet*, a wooden paddle boat 74 long, 60 H.-P., and 206 tons burthen; 10 years later the Cunard Line was established with the *Britannia*, 207 ft. long, 34'-4" beam, 22'-6" depth of hold, 423 H.-P., and 1,156 tons burthen, built of wood and propelled by paddles. In 1850 the Collins Line started in opposition to the Cunard. In the same year followed the Inman Line with the *City of Glasgow*, which was an iron plated ship. In 1856 came the Allan and Anchor; in 1863 the Guion; and in 1870 the White Star Line with the *Oceanic* 3,707 tons. In 1878 The Orient Line with the *Lusitania* 3,832 tons and shortly after the *Orient* 5,386 tons, and so on, each Company competing with the other to see who could produce the largest as well as the fastest boat subordinate to the practical conditions and commercial requirements of the times.

Paddle wheels have done good service and they will do a great deal more service. For certain purposes no better means of water locomotive could be devised; nevertheless, they are attended with certain draw-backs and disadvantages. They are unwieldy, and they are peculiarly exposed to the force of storms. They are continually varying their rate of immersion, inasmuch as every expenditure of coal lightens the ship and causes the floats of her paddle wheels to be raised out of the

PLATE II

PORT CANNING BORING.



The "STAR" Press, 19 Lall Bazar Street Calcutta

water. Worse than all, they interfere greatly with the sailing powers of a vessel. The earlist application of steam to the purposes of naval locomotion was by the intervention of one or more paddle wheels, and these were placed in every conceivable position in the rear, side, or between two vessels, whichever was supposed to give the best results; but this mode of propulsion was not destined to last for any length of time. Useful though the paddle wheel may prove to be in shallow rivers or creeks, it was found to be of very little practical service in ocean navigation, and shipbuilders were not satisfied with the results of its employment in deep waters, and looked forward to the introduction of something more reliable. Robert Wilson in 1832, after several years of study and practice, took out a patent and was granted the Society of Arts' medal for his models and description of propelling vessels by a "stern screw." This gave rise to the notion of adopting something after the principle of the Archemedian screw, called after the great Mathematician who first taught its use, 267 B. C. It originally signified a long hollow spiral mounted on an axis and was employed by the ancient Egyptians for the purpose of irrigation. Mr. Francis Pellet Smith, a farmer of Hendon, directed his attention to the subject and to his early experiments and unflagging perseverance the ultimate triumph of the propelling screw is referrable, though it has been said that his patent was simply a copy from the working models of three famous mechanics of Irvine in Scotland named Steedman, McCririck and Dick.

The types of propellers at present in use are principally the Griffiths and Mangin (French). The various types of Marine Engines in use are the Vertical or inverted cylinder the Direct acting, the Horizontal, the Oscillating—the two latter for paddle steamers—the Double and Triple Expansion, and the latest—the "Tandem Engine."

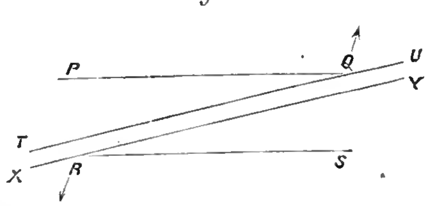
J. N. CONNELLY.

THE JHILMILI WINDOW.

By A. EWBANK.

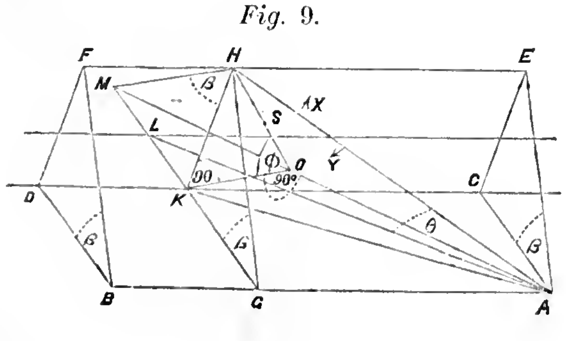
IV.

Fig. 11.



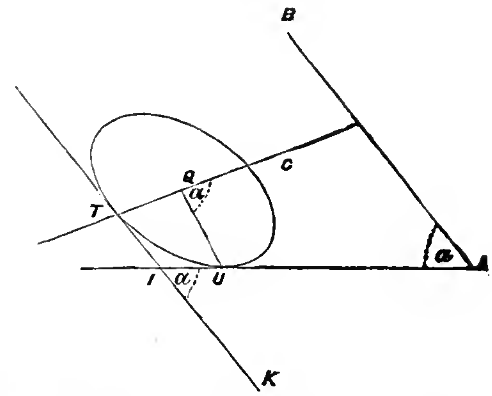
Now, suppose the extra volume V_2 to be an infinitesimal cylindrical shell of air initially coaxial with the tunnel. Then an imperceptible action first takes place at Q. A minute rise of the bar results. Immediately contact at R follows and the *jam* takes place. When the *jam* is fully established the bar is under the influence of an upward (vertical or sloping) force at Q and a downward at R. The bar is free to move up or down and therefore if it does not move either way these forces must be equal. That is, the force at R must increase until it equals the force (also increasing though not so quickly) at Q. Ultimately, therefore, we have two equal opposite forces usually called a couple.

Fig. 9.



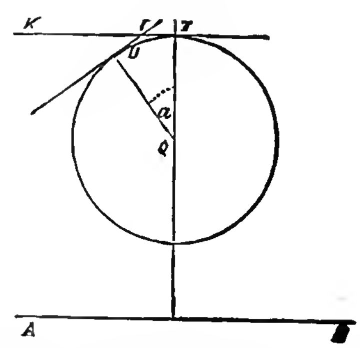
If we suppose the extra volume V_2 to be infinitesimal (or next door to zero) the couple comes into action before the line A L of *fig.* 9 has had time appreciably to change its position. Suppose the points Q R of *fig.* 11 to be just inside the tunnel, *i.e.*, not on the edge, in this case the forces of the couple are strictly vertical, and the plane containing both forces is the vertical plane through the

Fig. 7.



tangent line I U of *fig.* 7. Now, two such forces acting in a body can only induce one kind of motion. The motion must be a rotation and the axis of rotation must be normal to the plane of the couple. In this case the bar, if it moves under the couple, must rotate about a horizontal line perpendicular to I U or parallel to the radius Q U

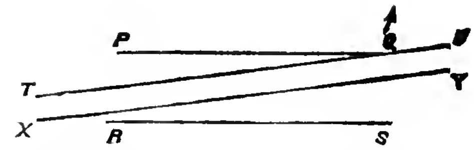
Fig. 6.



of *fig.* 6 or *fig.* 7. This motion the bar connections disallow, so both bars and leaves must remain at rest.

If it be considered that Q shall be taken actually on the edge of the tunnel, then, supposing the bodies smooth, we may consider this direction of the force at Q to be at right angles to the line T U, and similarly for the force at R. In this case we may resolve the forces at Q, R at right angles to P Q and parallel to P Q. We have already considered the former, so we have only a new couple of forces, say along Q P and R S. These forces are also in the vertical plane through A L, though the forces themselves are horizontal. They can only induce rotation about a line normal to their plane. Thus, as before the bar remains unmoved. This result does not require us to consider the force at Q to be exactly perpendicular to T U. Therefore, we need not suppose the ring material to be smooth. We only assume that the forces at Q and K are in the plane P Q S of *fig.* 11, that is, in the plane of motion of the elementary ring arc.

Fig. 10.



We have lastly to study the case where the extra volume V_2 is not negligible compared with V_1. In this case the action at Q, *fig.* 10, commences some appreciable time before the action at R. The bar is lifted appreciably. Finally, however, a jam occurs. The line A L of *fig.* 9 has at the moment when the jam is established reached the position A H. It now tends to move in a plane through A H perpendicular to the position of the leaf lamina B A H. The required plane of motion is the plane A H M O and we will now study the position of this plane with respect to the initial or horizontal plane A B L.

The planes F B D, H G K, A C E of *fig.* 9 are vertical and at right angles to A B, the axis of motion. F D, H K and E C are vertical lines. D B, G K, A C are at right angles to A B. Thus in the line A L, L is the point which revolves into position H. Draw in the plane L G H the line H M at right angles to G H. Let H M meet G K L produced. Join A M and draw K O in the horizontal plane to meet A M at right angles. Then the slope of the plane A H M is given by the angle H O K, call this angle ϕ. H K being vertical gives H K O $= 90°$. G A L $=$ G A H $= \alpha$. Let the length G A $= b$. $\therefore$ G H $= b \tan \alpha$. $\therefore$ G K $= b \tan \alpha \operatorname{Cos} \beta$. H K $= b \tan \alpha \operatorname{Sin} \beta$; K M $=$ K H $\tan \beta = b \tan \alpha \operatorname{Sin} \beta, \tan \beta$.

$\therefore$ G M $= b \tan \alpha (\operatorname{Cos}\beta + \operatorname{Sin}\beta \tan\beta) = b \tan \alpha.$
$\dfrac{\operatorname{Cos}^2 \beta + \operatorname{Sin}^2 \beta}{\operatorname{Cos} \beta} = b \tan \alpha \operatorname{Sec} \beta.$

$\therefore \tan \text{G M A} = \dfrac{\text{A G}}{\text{G M}} = \operatorname{Cot} \alpha \operatorname{Cos} \beta.$ Now Sin M $=$

$\tan \text{M} \operatorname{Cos} \text{M} = \dfrac{\tan \text{M}}{\operatorname{Sec} \text{M}} = \dfrac{\tan \text{M}}{\sqrt{1+\tan^2 \text{M}}}$; $\therefore$ Sin G M A $=$

$\dfrac{\operatorname{Cot} \alpha \operatorname{Cos} \beta}{\sqrt{1+\operatorname{Cot}^2 \alpha \operatorname{Cos}^2 \beta}}$ and K O $=$ K M Sin M $=$

$$\frac{b \tan \alpha \operatorname{Sin} \beta \tan \beta . \operatorname{Cot} \alpha \operatorname{Cos} \beta}{\sqrt{1+\operatorname{Cot}^2 \alpha \operatorname{Cos}^2 \beta}} = \frac{b \operatorname{Sin}^2 \beta}{\sqrt{1+\operatorname{Cot}^2 \alpha \operatorname{Cos}^2 \beta}},$$

and $\operatorname{Cot}\phi = \dfrac{\text{K O}}{\text{K H}} = \dfrac{\operatorname{Sin} \beta}{\tan \alpha \sqrt{1+\operatorname{Cot}^2 \alpha \operatorname{Cos}^2 \beta}}.$

Now $\operatorname{Cos} \phi = \operatorname{Cot} \phi \operatorname{Sin}\phi = \dfrac{\operatorname{Cot} \phi}{\operatorname{Cosec} \phi} = \dfrac{\operatorname{Cot} \phi}{\sqrt{1+\operatorname{Cot}^2 \phi}}$;

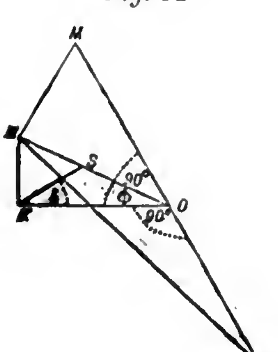
$$\therefore \operatorname{Cos} \phi = \frac{\operatorname{Sin} \beta}{\sqrt{\operatorname{Sin}^2 \beta + \tan^2 \alpha + \operatorname{Cos}^2 \beta}} = \frac{\operatorname{Sin} \beta}{\sqrt{1+\tan^2 \alpha}} =$$

$\operatorname{Sin} \beta \operatorname{Cos} \alpha.$

If $\alpha = 90°$, ϕ must $= 90°$, as is evident otherwise. If α is zero, $\operatorname{Cos} \phi = \operatorname{Sin} \beta$. The position of the plane A H M in this limiting case is obtained by making the plane A H B rotate through $90°$, that is, making the original plane A L B rotate through $\beta + 90°$.

When we suppose V_2 indefinitely small compared with V_1 there is a definiteness in the shape of the tunnel. Thus when the ring material in the tunnel is disturbed from its position in a given way, the points of contact between it and the tunnel and the direction of the forces of the couple are, so to say, definite——. But when we have around V_1 an extra volume V_2 for play of ring within tunnel, our forces become indefinite in their directions, for on the shape of the arbitrary extra volume the directions of the forces depends. But we shall assume that the ring material in the tunnel whose direction is the line A H just before it gets jammed, and which is moving in the plane M H A, does call into action two forces which lie *in* that plane. For thus the forces directly resist further motion. In *fig.* 9 a point near H moves faster than a point near A. Thus if X and Y are the equal forces at the end of the tunnel acting *on* the tunnel they are placed as shown in *fig.* 9. We shall not inquire into their exact directions. It is enough to know that their plane is A M H. This plane A M H is also shown in *fig.* 12. In either figure K S is a normal to the plane. Therefore, if K S make an angle δ with the horizon, $\operatorname{Sin} \delta = \operatorname{Cos} \phi = \operatorname{Sin} \beta \operatorname{Cos} \alpha$. S is on the line H O and δ is the angle S K O as shewn in *fig.* 12. The plane H K O is normal to the line M A.

Fig. 12.



Now, the forces X, Y acting on the tunnel *i.e.*, on the bar will tend to give it a clockwise rotation as seen from K. The axis of this rotation is parallel to K S. But a clockwise rotation about a line parallel to K S is equivalent to a rotation about a line parallel to K O and a rotation about a line parallel to K H. This is explained in works on statics which treat of the theory of the couple, or in works on Rigid Dynamics. Here we assume the theorem as known. We need not examine the rotation about the horizontal line parallel to K O for the bar connections disallow this rotation. We have, therefore, only to consider the rotation about a line parallel to K H. The vertical bar by rotating about a vertical axis remains vertical. Therefore, to this component of the X Y couple the bar may possibly yield. Let W represent the total leverage power of the X Y couple. Then the component leverage about a vertical line will be W Cos S K H $=$ W $\operatorname{Sin} \delta =$ W $\operatorname{Cos} \phi =$ W $\operatorname{Cos} \alpha \operatorname{Sin} \beta$. Thus the factor we have to consider is $\operatorname{Cos} \alpha \operatorname{Sin} \beta$. If $\alpha = 90°$, the leverage vanishes.

Thus we derive the theorem that if the leaves be made horizontal and the bar turned through a right angle the clamp must be perfectly effective even without friction and with excess volume V_2. That is, the leaves cannot by their weight or extra force applied cause the bar to revolve back into the meridian position. The leaves can sink somewhat—the bar rising—for amounts that depend the extra volume V_2. When the *jam* sets in it is thoroughly effective. If $\beta = 0$ or $V_2 = 0$ the effective leverage also vanishes for any acute angle α. This result we had already obtained.

(To be continued.)

THE MAIN DRAINAGE OF THE HOUSES OF PARLIAMENT, WESTMINSTER.

By Isaac Shone, c.e.

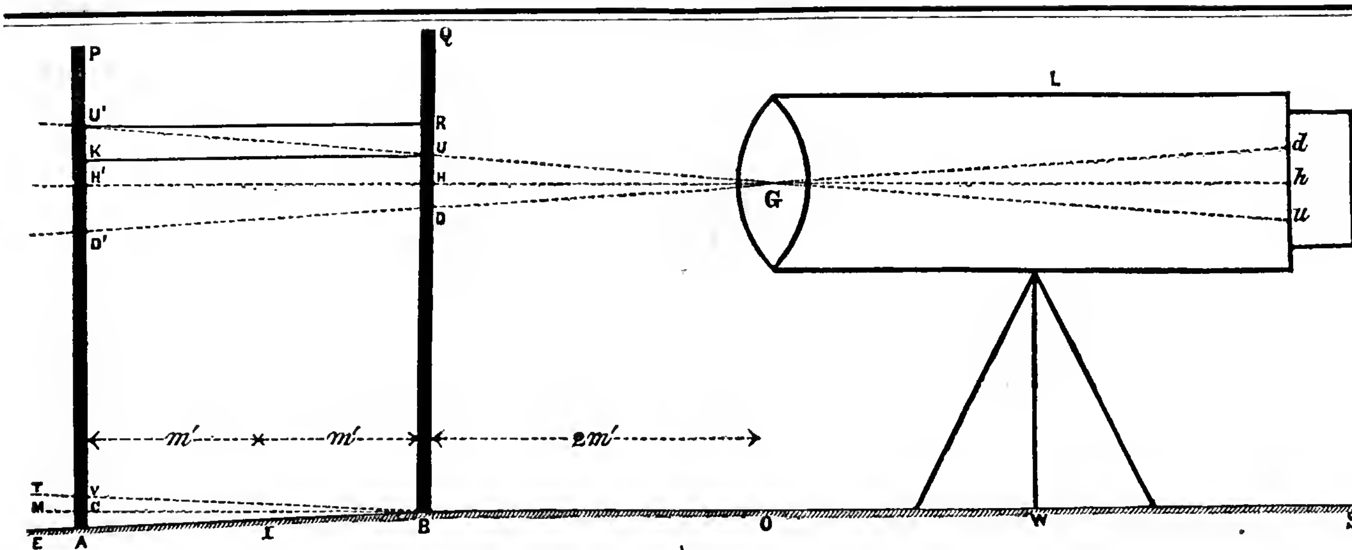
V.

(53). This way of estimating the efficiency of a sewer, however, is misleading to the uninitiated. If by mechanical alteration the efficiency of a steam engine, for example, is doubled, it means that the owner of the engine is spared one-half of the original annual fuel cost—which, if the improved engine be a powerful one, may represent the interest on a comparatively large sum of money.

(54). But the number of preventable fatal accidents consequent upon improvemets effected in the working of the extravagant engine, are neither increased nor diminished by the fifty per cent. reduction in fuel consumption.

(55). On the other hand, an unnecessarily large and costly sewer may fail, as the sewer in question failed, during its normal and abnormal working condition, to perform its functions as a sanitary sewage carrier; and, if so, who can estimate the number of cases of preventable sickness and death resulting directly and otherwise from the existence of such a sewer?

(57). Notwithstanding the enormously reduced size of the Palace main sewer, in all human probability the new twelve-inch main sewer will never be found more than half filled, at the outlet, during the greatest rainfall storms; neither will the Gas-Engine Air-Compressors or the Ejectors ever be required to dispose of anything



approaching the maximum quantities which they are unitedly capable of dealing with.

(58). Besides improving, hydraulically, the capacity of the main sewer to receive and discharge the minimum as well as the maximum quantity of sewage and rainfall, by substituting a twelve-inch sewer for the old one, it will be seen from the drawings that, the upper portion of the latter is converted into a convenient subway—which is well ventilated—along which workmen can pass to and fro, in comfort, for the purpose of inspecting the condition of the new main sewer and its numerous connections.

(59). In case of a complete break down, too, of the Gas-Engine Air-Compressors and Ejectors during periods of heavy rains, this subway would act the part of a reservoir, as it has done heretofore.

(60). But this is a contingency which the author thinks can never happen—except, of course, through carelessness—so long as the Houses of Parliament remain free from the influence of severe earthquake shocks.

(61). The ventilation of the new twelve-inch main sewer is effected by admitting fresh air into the subway which puts the basement of the Houses of Parliament into direct communication with the Ejector Chamber, and allowing it to proceed, firstly, along that subway into the Ejector Chamber; secondly, through the Ejector Chamber into an air-duct at the top of the eastern end thereof; and, thirdly, along this air-duct into the sewage manhole.

(62). The air is made to pass out of the sewage manhole partly into the main twelve-inch sewer and partly through the rectangular air opening, which communicates with the subway above the main sewer.

(63). That portion of the air which passes into the twelve-inch sewer proceeds direct to the furnace at the base of the Victoria Tower; but, before diverging from the line of the main sewer, it is joined by the air current which travels from the head of the sewer. Both currents, therefore, go together—from the point of divergence in the new twelve-inch main sewer—into and out of the Victoria Tower, along with the volumes of vitiated atmosphere proceeding from the Palace.

(64). That portion of the air which passes through the rectangular opening in the sewage manhole into the old sewer subway travels along that subway for a short distance only, when it makes a detour to the right, along with the air that is admitted at the head of the old sewer subway (to ventilate it), and proceeds along an air-duct direct to the furnace at the base of the Clock Tower.

(65). The air that ventilates the smaller nine-inch sewer is drawn from the upper end of that sewer to the Clock Tower furnace.

(*To be continued.*)

TO COLLIMATE A DUMPY LEVEL.

Having seen the article under the above heading, by J. C. M., in your Journal of the 21st May 1887 (page 305), I was induced to go through it and see if there was anything worth learning. But unfortunately I found that there were not only several mistakes in figures in the last paragraph of the article, but the method itself is wrong or rather impracticable, though the principle on which it is based is right. For it is said there that we must increase the reading on the distant staff by exactly ·006 by moving the diaphragm down. How can a staff be read to the third place of decimals while it is only graduated to the second place of decimals? The mistakes in figures above referred to are (1) in the line preceding the last paragraph of the article where '$y=\frac{11}{10}\times$·066' should be $y=\frac{11}{10}\times$·06=·066, and (2) in the 2nd line of the last paragraph ·006 should be ·066.

2. I also read the criticism by "A. M." in the issue of the 11th ultimo (page 356) on the same article. But strange it is that this critic does not say a word on the defects of the method. A sheet of water suited to the purpose is not always available.

3. The following is my method of Collimating a Dumpy Level, which is based on the same principle as the one published, and which I consider to be practicable. I hope it will be approved by you and will find room in your valuable journal.

4 (a). On a tolerably even piece of ground, select a straight line E A I B O W S (see the annexed figure), and measure on it, the straight line AI=IB=m ft, and BO=AI+IB=2 m ft. Place two levelling staves P and Q accurately graduated, the one on the point A and the other on B. Set up the instrument (whose adjustment for bubble tube is complete) exactly over the point I by means of a plummet or otherwise. Read the two staves and note the difference, if any, between the two readings. (It is, of course, absolutely necessary to make temporary adjustments every time the instrument is shifted and set up anew, and to focus, remove parallax, and take care to see that the bubble is in the centre of its run, everytime a staff is read).

(b.) The difference between the two readings is the true difference of level between the points B and A, notwithstanding the instrumental error with reference to collimation, as it is eliminated by placing the instrument exactly midway between the staves. Now remove the instrument to W, and set it up so that its object glass G is exactly over the point O by plummet or otherwise as before. First read the nearer staff (at B) and add to, or subtract from, this reading, the difference of level noted between the points B and A, according as the point B is higher or lower than A, and call the sum or difference N. If the difference of level between the points B and A be *nil*, N will, of course, be merely the reading on the nearer staff at B without any addition or subtraction. Then read the farther staff (at A) and if this reading be exactly N, the adjustment is complete. But if there be a difference n, then *decrease* or *increase*, the reading on the farther staff by exactly 2 n, or on the nearer staff by exactly n, by moving the diaphragm *up* or *down*, according as the reading on the further staff is *greater* or *less* than N, or in other words according as the line of collimation points *up* or *down*. Then the adjustment is complete.

N. B.—I. The ground at the points B and A must be hard, for if it is too soft or sandy and if the staves should down by their own weight, while being read, the result may perhaps be unsatisfactory.

II. The minimum and maximum value of m will respectively be such, that the staves will admit of being focussed when the instrument is set up at I, and a clear sight of the distant staff (at A) can be had when the instrument is set up at W. In practice m = 50ft. will answer the purpose best.

(c.) As a particular example take m = 50ft.; then A I = I B = 50ft. and AO = 200ft. Suppose the instrument is set up at I, the reading on the staff at B is 4·25, and the reading on the staff at A is 5·75. Then the difference is 1·50 shewing that B is higher than A. Again suppose the instrument is shifted and set up at W, and the reading on the nearer staff is 4·94. Then N will be 4·94 + 1·50 = 6·44, because B is higher than A. Next suppose the reading on the further staff is 5·60, shewing the line of collimation to point *down*. Now n will be 6·44 − 5·60 = 0·84. In this case we must increase the reading on the further staff by exactly 2 × 0·84 = 1·68, or exactly 0·84 on the nearer staff, by moving the diaphragm *down*.

(d.) *Proof*:—Let L be the level, with its object glass exactly over the point O, and $2m$ ft. from the nearer staff and $4m$ ft. from the further staff. Suppose the line of collimation points up as u G U U^1 before adjustment, and is brought horizontal as h G H H^1 after adjustment; and also suppose the point B higher than A. Draw the horizontal lines U K, U^1R, and B C M. Now B U is the reading on the nearer staff at B, and A C the difference of level between the points B and A; ∴ B U + AC = N = AK. Again A U^1 is the reading on the further staff at A; ∴ $AU^1 - N = KU^1 = UR = n$. By similar triangles, H^1 U^1 : H U = H^1G : H G = $4m$: $2m$ = 2 : 1; ∴ H^1 U^1 = 2 H U. But H^1U^1 = H R; ∴ H R = 2 H U; ∴ H U = U R = n, and $H^1U^1 = 2n$.

If the point B be in the same level as (as in B C M), or higher (as in B V T) than, A, a similar reasoning will hold good, as also in the case where the line of collimation points down as dGDD^1.

P. L. R.

ACCIDENT ON THE LUCKNOW-SITAPUR AND SERAMOW RAILWAY.

Abridged from the Official Report

By Mr. F. B. Hebbert, Officiating Deputy Consulting Engineer.

I.

On the evening of Saturday, 30th April, after the arrival of the down train from Lakhimpur at Bakshi-ka-Talab, between 7 P.M. and 7-30 P.M. the Station Master discovered that there were no passenger carriages or brakes on the train and sometime afterwards a messenger arrived to report that the missing vehicles with contents had been overthrown and left behind during the dust storm which was then blowing.

The following general facts were elicited :—

The train left Itaunja Station 'all well' and up to time. Soon afterwards it encountered a storm of wind and dust followed by rain. When this storm was at its height the rear part of the train was overturned and parted from the front portion about 2½ miles north of Bakshi-ka-Talab, the in Station and four miles from Itaunja the out Station. The engine driver did not discover what had happened until he reached Bakshi-ka-Talab with 16 loaded waggons only.

The scene of the disaster I examined myself, and satisfied myself as to the exact position in which each vehicle was found after the catastrophe.

The accident occurred at 14¾ miles from Charbagh station, Lucknow, at chainage 2153·60 from Sitapur. The line at this point is nearly level (1 in 6,000), on the straight and fully ballasted. The height of rails above the berm averages 5′. On the west of road distant about 50 yards and separated by borrow pits is the metalled road to Sitapur running between an avenue of fine trees chiefly mangoes and neem. There are no borrow pits on the east side where the vehicles fell. There is a level crossing about 250 yards north of the spot where the rear brake was found, and a curve commences at about 100 yards south or on the Lucknow side of the place where the foremost waggons were derailed.

The rough sketch Fig 1, shews the position of carriages as found after the accident.

The damage to the vehicles was not so great as might have been expected. They suffered, some more and some less, chiefly from injuries to the couplings and footboards and also to sunshades and lamps.

Opposite every carriage which was capsized there is a mark caused by the edge of the roof on the left side striking the ground and this mark is on the berm within a few inches of the toe of the bank and parallel with the position of vehicles when found. From this, combined with the fact of the ballast being undisturbed, it is evident that each vehicle was upset immediately on or when leaving the track.

There are also marks shewing where the lamps broke and the oil was spilt shewing that each carriage, except those otherwise described, made a complete revolution and then again collapsed on to the left side. This happened to 11 of the derailed carraiages.

The brakes of the brake vans were found by me to be slack and no one appears to have meddled with them since accident.

The Sitapur road runs parallel with the Railway, the whole way from Mariaon Station, and I noticed that about every two miles the avenue had suffered from some small local cyclonic effect similarly to that part of it near the accident though not to such a great extent. At the site of accident the nearest line of trees is distant 37 yards from the railroad. From the position of the torn branches it could be seen that the direction of the wind was almost due west being slightly from north of west, while the direction of line is from slightly west of north, so that the direction of wind was from the Sitapur road towards line at an angle of about 80° with line bearing slightly in the direction of train motion. I would here remark that if an external force acting at right angles drove a vehicle off the line, it would travel owing to its previous impulse pretty nearly in the direction of the wind and the marks on the ground shew that the vehicles did revolve in that direction. The avenue along the Sitapur road consists of fine spreading trees, but they are not big enough and are too far off to break the force of the wind blowing against a train.

The permanent-way on either side of the accident was in capital order and quite fitted for a speed of 30 miles an hour though the time table only allowed for a speed of 20 miles an hour on this part of the line.

The vehicles were in consecutive order corresponding to their order as shewn in the guard's report. None of the vehicles were marked with their tare weights.

I could find no signs on the wheels of the overturned vehicles of any undue grinding on the flange of near wheels though this must have taken place owing to the direction of the storm.

I have arrived at the following conclusions:—The train left Itaunja up to time proceeding for a short way at 20 miles an hour then slackened to 15 miles an hour, and either just before or just after the accident slowed down to 10 miles or a little less, arriving at Bakshi-ka-Talab at about 7-28. This would correspond with the

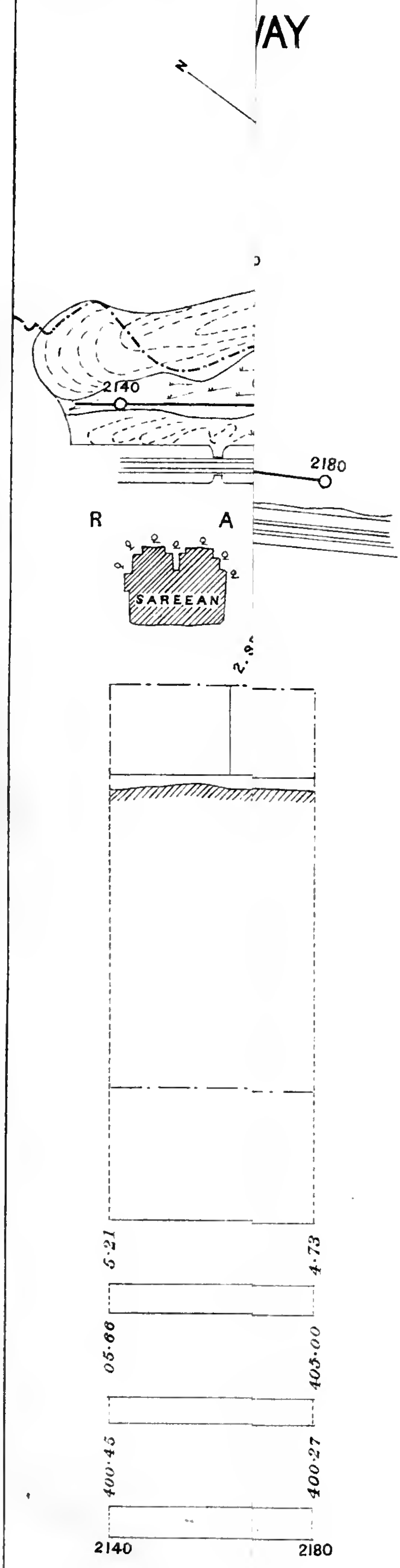


Fig: 1.

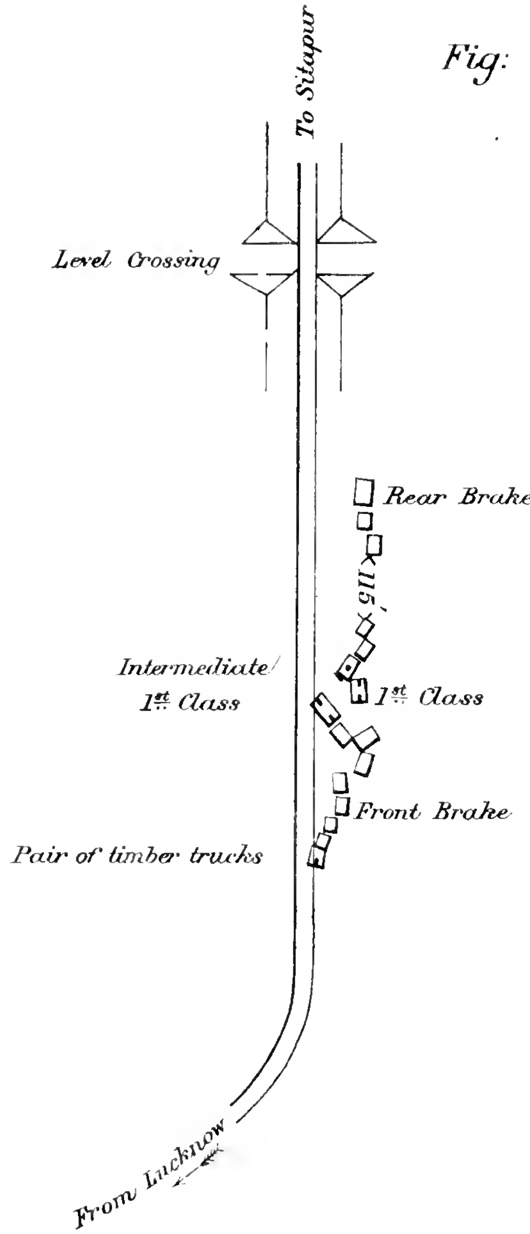


Fig: 2.

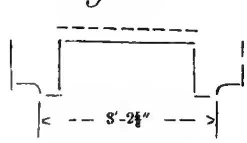
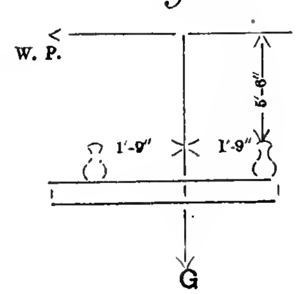


Fig: 3.



The "Star" Press, 19 Loll Bazar Street, Calcutta

various times testified to by the witnesses. If the driver checked speed somewhat sharply, in the latter instance, it may have had something to do with the accident.

The facts point to the probability that the train was struck by two distinct gusts of wind the first of which overturned the brake van and two nearest passenger carriages, and when the rest of the train had travelled a little more than a chain the second gust overturned the remainder of the passenger carriages and front brake which dragged off the track the 4 nearest goods vehicles.

From an inspection of the four supports to the rear brake I am led to believe that the false roof had been partly or wholly torn of the vehicle before the accident. I think it not unlikely that the roof was only partially torn off before the accident and being blown up acted as a sail giving the necessary leverage for overturning the brake and connecting carriages. It would then be very probable that the light passenger carriages beyond, vibrating under the shock caused by the forcible detachment of the rear vehicles and caught by a second powerful gust, should reel over on to their sides.

The brake van would I think be less likely to be upset by any force of wind than a passenger carriage and yet it was undoubtedly the first to leave the track. The upper roof of the brake van is not protected by sunshades and this vehicle was the only one which had its roof torn off. Moreover the overturning would have had no tendency to tear off the upper roof, but rather to jam it down on to the lower one. It is therefore clear to my mind that the upper roof was partially separated before the accident. If we suppose the two supports on the off-side to have given away and the roof to be standing up on the rear side with the wind blowing against it we can see that there would have been a powerful force acting to overturn it. Whether the passenger vehicles would have upset or not had the brake remained firm is a matter of opinion, but I think the probabilities of their doing so would have been decreased. The upper roof of brake van could not have been detached if it had been in good order.

I do not think the overturning was aided in any way by slight defects of permanent-way or by obstructions on the line. The thin flat bricks used for top dressing were not blown about or disordered in any way along the line.

I do not think the pressure of the wind could have caused the wheels to first mount the rails and then upset the carriages without causing injuries to the permanent-way, and these did not occur.

II.

In my previous report I purposely refrained from entering into the question of the stability of the carriages as being one that would require working out and take time.

I will now enter into the question of the stability of the vehicles.

The actual gauge of rails as tested by me was $3'\text{-}3\frac{7}{16}''$ and the gauge of wheels of the rear brake van was $3'\text{-}2\frac{5}{8}''$ so that the play was only $\frac{13}{16}''$ which seems small—see Fig. 2.

The tare weight of van is said to be 4 tons, 8 cwt., so that with guard and postal employée, the total weight must have been quite $4\frac{1}{2}$ tons.

The brake van tires were in very good order as were all the tires. I examined them carefully at the time and they seemed to shew no signs of wear.

It is reckoned that the area of side exposed to wind pressure was 117 s. ft., and if convexity of roof be taken into consideration it would be 126 s. ft. Practically the wind was blowing against an area 18′ long by 6′-6″ or 7′ according as rise of roof is included or not. I consider 117 s. ft. as area on which pressure may fairly be considered to have acted and the total pressure may be considered as concentrated and acting along a horizontal plane at a height $(2'\text{-}6'' + 3') = 5'\text{-}6''$ from rail level. This I will call the centre of pressure. Allowing for thickness of rail, gravity would act vertically at a distance $\left(\frac{3'\text{-}3\frac{3}{8}''}{2} + \frac{2\frac{5}{8}}{2}\right) = 1'\text{-}9''$ within rail track—see Fig. 3

Then if x be the required pressure per square foot for overturning vehicle when stationary;

$$117x > \left(\frac{4\frac{1}{2}\text{ tons} \times 1\frac{3}{4}}{5\frac{1}{2}}\right)$$

$$117x > \tfrac{63}{44}\text{ tons.}$$

$$x > \left(\frac{63 \times 2240}{117 \times 44}\right)\text{ lbs.}$$

$$x > 27\tfrac{1}{2}\text{ lbs. (about) say 28 lbs.}$$

Or, to put it into another shape.

Let P = pressure against vehicle.

Let h = height at which pressure acts. Then moment overturning vehicle will be Ph.

If W = weight of vehicle and d = horizontal distance of line of gravity from fulcrum, then

Wd = moment of stability of vehicle. If Ph > Wd then the vehicle will overturn.

Then $P = 117x$ as above

and $h = 5'\text{-}6''$

If $5\frac{1}{2}' \times 117x > 90\text{ cwt.} \times \frac{7}{4}'$

$$\text{then } x > \frac{70 \times 112}{13 \times 22}\text{ lbs.}$$

that is if $x > 27{\cdot}4$ lbs. per superficial foot the vehicle would overturn.

The least pressure required to overturn the brake van when standing still it has thus been shewn would be about 28 lbs. per s. foot. This pressure would be produced by a wind blowing at right angles to the plane of the side of vehicle if it had a velocity $= v$, where $v^2 = \frac{28}{{\cdot}00492}$; that is the velocity of required wind would be 75 miles an hour.

The question is complicated by the play of springs, the speed of the train and its oscillation. The continued pressure of the wind must have driven the vehicle down on to its leeward springs. The effect of this cannot be ascertained but I propose to assume that the combined oscillation and play of springs and of wheels shifted the centre of gravity to within 1′-6″ of the centre line of the leeward rail when the train was going at 15 miles an hour.

Then as above the required pressure x would be $> 23{\cdot}5$ or, say, $x = 24$.

When the vehicle was in motion with an oscillatory side motion sufficient to displace the centre of gravity 3″ as assumed, the velocity of required wind is found from the formula $v^2 = \frac{24}{{\cdot}00492}$; that is $v = 70$ miles an hour.

Assuming then that the train at the time of the accident was going at 15 miles an hour, causing a displacement of centre of gravity of vehicle amounting to 3,″ the pressure required to upset vehicle would have been produced by a wind with a velocity of 70 miles an hour blowing at right angles to its direction.

The resistance of the vehicle weighing $4\frac{1}{2}$ tons and proceeding at a speed of 15 miles an hour would be about 42 lbs., but this force is comparatively insignificant and moreover being purely impulsive would not affect the rotatory motion produced by a side wind.

I have dealt only with the stability of the brake van as having been the vehicle to first leave the rails and as the one least likely to have been exposed to shocks at the time.

NOTES FROM HOME.

(From our own Correspondent.)

The Report of the Judges appointed by the organizing Committee of the Imperial Institute upon the plans and designs that have been submitted has just been published. It states that of the six designs submitted; none could be adopted without alteration, for while each possesses some special merit no one appears to be superior to the others in all particulars. In the opinion of the judges the design of Mr. Collcutt is superior to those of his competitors in the leading features taken collectively, at the same time they are of opinion that the tower and some other points in Mr. Collcutt's plan would be susceptible of advantageous modification and Mr. Collcutt is recommended as the architect of the Imperial Institute.

Anxiety was felt by many as to the safety of some of the stands that were put up from which to see the Jubilee procession of the 21st for it was very evident that some of these structures were left to the care of the "practical" builder or the jobbing carpenter who evidently put trust in the ability of a railing or balustrade to resist horizontal thrust or a cement cornice to carry heavy loads. The authorities, however, exercised a wise supervision and required all to be licensed and the event has now passed off without any accident of the kind feared.

The Institution of Civil Engineers adopted a novel application of the electric light for the purposes of illumination. Five hundred incandescent lamps arranged two in series each of ten candle-power and aggregating 18,550 watts were employed in forming the following legend "1837-1887 Her most Gracious Majesty the Queen" and in surrounding the panel at the top of the building containing the name of the Institution. The current was provided by a Victoria dynamo driven by a 24 horse-power portable engine.

It is stated, says *Engineer*, that the prospects of the French Railway Jubilee Exhibition have been seriously compromised by the failure announced in Paris of M. Gabriel Levy who is one of the chief promoters of the enterprise. The exhibition is nominally open, and a series of fetes have been arranged but the want of support, says another paper, by the French companies and the scandal now created are very serious difficulties to meet.

It was generally thought here that the Metropolitan Sewage question was settled, the contract was entered into for the erection of Sewage works at the southern outfall at a cost of £400,000 and a sludge ship has just been completed costing £16,000. A cheaper plan has, however, now been proposed and reported upon, and this has had the natural effect of paralysing the chemical operations now going on at the outfalls, and occurring in this sultry season it is feared may have serious consequences.

The Water Committee of the Sheffield Corporation and the Directors of the Sheffield Water Company have at last come to an arrangement by which the water works will be transferred to the corporation. The transfer will take place on the 1st of January next, and the holders of preferential and ordinary shares are to receive annuities, the former at the rate of 4 and 5 per cent, and the latter at the rate of 2 per cent. per £100 share, capital for 1888 and 1889 rising $\frac{1}{4}$ per cent. every 2 years until 1894 and thence forward the amount will be 4 per cent.

The Board of Trade inspection of the Tay Bridge which lasted three days was concluded on Saturday last. The concluding tests were mainly to ascertain the vibrations of girders while a train was passing over them slowly and at high speed.

The inspection gave every satisfaction and the inspecting officers telegraphed that they saw no reason why the bridge should not at once be opened for traffic.

At the last meeting of the Meteorological Society Mr. F. J. Waring read a paper on the "Amount and distribution of monsoon rainfall in Ceylon generally with remarks upon the rainfall in Dimbula" The author referred to the peculiar physical characteristics of the island and gave details of the rainfall at twenty-five stations and remarked upon the effect and influence of the mountain zone and of the gaps therein upon the rainfall within the zone and upon the district outside of it.

The current half year's Railway receipts are expected to equal and in some cases exceed those of the corresponding half of last year. Very substantial increases are recorded on some lines and though the expences may have similarly increased, it is expected that in all cases the dividend will be maintained, but in most of them some slight increase would appear to be the most probable result of the working of the half year.

A most interesting matter to all connected with the construction and management of harbors has been brought to light at Aberdeen. The dock, opened two years since, was formed of Portland cement concrete, and a few months ago it was observed that the concrete entrance walls which are not lined with granite had become swollen and that the surface had begun to shew cracks. The concrete was analysed, and from the analysis it is stated that the action of the sea water on the Portland cement itself caused an expansion and softening of the cement in consequence of the deposit of magnesia from the sea water, and also led to the formation of carbonate of lime by the union of the carbonic acid contained in the sea water with the lime in the cement.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

THE recent earthquakes in the South of Europe raised apprehensions of danger amongst Colliery managers, which have been verified by more than ordinary issues of gas. Unfortunately, these issues have been accompanied by serious explosions at Blantyre in Scotland at Bryn in England and near Gelsenkirchen in Westphalia.

The question of the connection between seismic movements and issues of gas is being examined in both England and France. The experiments have now been continued for some time, but will no doubt require longer and more earnest investigation.

There appears to be some room for economy in the consumption of coal upon steamers, when the fact is considered that the Cunard Company consume nearly 1,000 tons daily or 356,000 tons yearly.

The Dortmund Mining Association have appointed a special committee to negotiate with the leading bankers in Germany for the formation of a syndicate to undertake the sole agency for the sale of Rhenish-Westphalian coal in Germany. It is reported that the firms of Bleichröder and Rothschild and the Berlin Discount Company have promised their support to the scheme and are prepared to form a company with a capital of about $1\frac{1}{4}$ millions of pounds. The intention of the promoters is to obtain an immediate and permanent advance in the price of coals of about 1*s.* per ton. The scheme is being watched with great interest in this country.

Many attempts have been made to apply small fireless locomotive engines to the work of haulage in mines. A very useful arrangement is shewn at the Newcastle-upon-Tyne Exhibition. It is the invention of Messrs. Lishman and Young of Fence Houses, and is worked by compressed air stored in a tank attached to the locomotive. It appears to perform its work very efficiently and is a credit to the Grange Iron Co., who are the sole makers and owners of the patent rights.

Considerable attention is being accorded to the question of the most perfect lock for fastening miners' safety lamps. A statement has been made by M. L. Janet, a Mining Inspector under the French Government, who found that at Douche Colliery, with the old screw lock, only one per cent. of the lamps were relighted at the lamp station, whilst under a more perfect system of locking, the number of extinguished lamps increased to more than eight per cent. There is strong evidence, therefore, that the use of the screw lock enabled the miners to relight their lamps in spite of the severe penalties attached to the dangerous practice. The matter is worthy of the attention of inventors, as a simple, effective and unpickable lock would be quickly appreciated by lamp manufacturers and mine managers.

The question of the success of legal enactments is being actively debated in connection with the new Mines Bill. It is pointed out that the death rate is the same now as it was 10 years ago, and that there has been no appreciable decrease in the numbers of non-fatal accidents. There is another important view of the question, that the imposition of severe liabilities upon mine owners and managers may prevent the introduction of many useful appliances intended to render human life more secure. It is not intended to depreciate the valuable precautions contained in the new bill or to protest against the enlarged powers of the Mining Inspectors in respect of the safety of the mines but to ask whether something should not be left to individual management and not to embrace employers and employed in a network of restrictions.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, July 16, 1887.

Upper Burma.

With reference to *Burma Gazette* Notification dated the 24th June 1887, Mr. J. T. Simpson, Executive Engineer, 2nd grade, assumed charge of the Shwebo division on the afternoon of the 24th June 1887.

Mr. E. J. Rumsby, Executive Engineer, 3rd grade, Mandalay division, held charge of the Shwebo division in addition to his own duties from the 17th May to the 24th June 1887 inclusive.

Assam, July 16, 1887.

Mr. D. J. Clancey, Assistant Engineer, 2nd grade, made over charge of his duties as Manager of the Cherra-Companyganj State Railway at Cherra Punji on the forenoon of the 14th June 1887, on transfer to Cachar.

Rai Bholanath Dass, Bahadur, Executive Engineer, 1st grade, who was granted privilege leave for two months and twenty-five days in Orders dated 8th June 1887, made over charge of his duties to Mr. D. J. Clancey Assistant Engineer, 2nd grade, on the afternoon of the 30th June 1887, on which date he availed himself of the same.

Rai Sahib Brij Mohan Lall, B.A., Assistant Engineer, 1st grade, who was granted privilege leave for three months in Orders dated 6th June 1887, availed himself of the same on the forenoon of the 28th June 1887.

Assam, July 23, 1887.

Rai Durga Das Das, Bahadur, District Engineer, Lakhimpur district, who was granted privilege leave for three months, availed himself of the same from the forenoon of the 19th July 1887.

Punjab, July 21, 1887.

His Honor the Lieutenant-Governor is pleased to sanction the following reversions and promotions in the Amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the date specified against each :—

Mr. J. J. Mullaly, Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, *vice* Mr. Higham promoted to Superintending Engineer, 3rd class, permanent, with effect from 1st January 1887.

Mr. F. W. Chanter, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, *vice* Mr. Higham promoted to Superintending Engineer, 3rd class, permanent, with effect from 1st January 1887.

Mr. A. Hicks, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, temporary rank, *vice* Mr. Higham promoted to Superintending Engineer, 3rd class, permanent, with effect from 1st January 1887.

Mr. J. E. Hilton, Executive Engineer, 1st grade, sub. *pro tem.*, to be Executive Engineer, 1st grade, permanent, *vice* Mr. Higham promoted to Superintending Engineer, 3rd class, permanent, with effect from 1st January 1887.

Mr. J. M. Taylor, Assistant Engineer, 1st grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, permanent, to fill an existing vacancy, with effect from 1st January 1887.

Capt. J. W. Thurburn, R.E., Executive Engineer, 2nd grade, sub *pro tem.*, to be Executive Engineer, 2nd grade, permanent, to fill an existing vacancy caused by permanent transfer of Mr. Greer to the Punjab, with effect from 11th January 1887.

Lala Balmokand, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent, to fill an existing vacancy caused by permanent transfer of Mr. Greer to the Punjab, with effect from 11th January 1887.

Mr. W. J. Greer, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent, to fill an existing vacancy caused by permanent transfer of Mr. Greer to the Punjab, with effect from 11th January 1887.

Mr. J. J. Mullaly, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 2nd grade, sub. *pro tem.*, *vice* Captain Thurburn, R. E., promoted permanently, with effect from 11th January 1887.

Mr. F. W. Chanter, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, *vice* Lala Balmokand promoted permanently, with effect from 11th January 1887.

Mr. A. E. Orr, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, sub. *pro tem.*, to fill an existing vacancy, with effect from 1st March 1887.

Mr. S. F. Cox, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, permanent, *vice* Mr. Stevens, retired, with effect from 19th March 1887.

Mr. A. B. Phelan, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, *vice* Mr. Fenner, promoted to be Superintending Engineer, 3rd class, permanent, with effect from 28th March 1887.

Mr. J. J. Mulally, Executive Engineer, 2nd grade, to be Executive Engineer, 2nd grade, permanent, *vice* Mr. Fenner, promoted to Superintending Engineer, 3rd class, permanent, with effect from 28th March 1887.

Mr. P. S. McGowan, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent, *vice* Mr. Fenner, promoted to Superintending Engineer, 3rd class, permanent, with effect from 28th March 1887.

This cancels that portion of Public Works Department, Notification dated 29th March 1887, which refers to the reversion of Mr. A. Hicks from 11th January 1887.

His Honor the Lieutenant-Governor is pleased to sanction the following temporary promotions and reversions in the Amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the date specified against each :—

Mr. W. J. A. Bird, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Hicks, promoted to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 29th November 1886.

Mr. W. J. A. Bird, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, *vice* Mr. Hicks, reverted to temporary rank, with effect from 1st January 1887.

Mr. A. Grant, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Hicks, proceeded on furlough, with effect from 2nd March 1887.

Mr. W. J. A. Bird, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Parkes, proceeded on furlough, with effect from 14th March 1887.

Mr. W. J. A. Bird, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, *vice* Mr. Stevens, retired, with effect from 19th March 1887.

Mr. A. Grant, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, *vice* Mr. Fenner, promoted to Superintending Engineer, 3rd class, permanent, with effect from 28th March 1887.

Mr. A. Grant, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Hatten, proceeded on furlough, with effect from 15th April 1887.

Mr. W. J. A. Bird, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Brodie, proceeded on furlough with effect from 17th April 1887.

Bakshi Ram Singh, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade. *vice* Mr. Harris, proceeded on furlough, with effect from 5th May 1887.

Mr. C. E. V. Goument, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Bayley, proceeded on furlough, with effect from 10th May 1887.

Mr. F. Farley, Executive Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Morris, proceeded on furlough, with effect from 15th May 1887.

Mr. F. Farley, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, *vice* Mr. Bellasis, returned from furlough, with effect from 18th May 1887.

This cancels Punjab Government, Public Works Department, Notification dated 10th June 1887.

Mr. J. K. E. Verschoyle, Assistant Engineer, 1st grade, from the Superintending Engineer's Office, Bari Doab Circle, which he left on the forenoon of the 20th June 1887, to the Swat River Canal Division, of which he took over charge on the forenoon of the 21st June 1887. The transfer was made in the interests of the public service.

Mr. J. K. E. Verschoyle, Assistant Engineer, 1st grade, from the Swat River Canal Division, which he left on the forenoon of the 4th July 1887, to the Office of Superintending Engineer, Bari Doab Circle, which he joined on the forenoon of the 6th July 1887. The transfer was made in the interests of the public service.

Madras, July 19, 1887.

Mr. J. W. Brassington, Executive Engineer, 2nd grade, is confirmed in the appointment of Consulting Architect to Government.

N.-W. P. and Oudh, July 23, 1887.

Buildings and Roads Branch.

With reference to Government of India, Public Works Department, Notification dated the 6th July, 1887, retransferring Mr. R. P. Dease, Executive Engineer, 4th grade, to the North-Western Provinces and Oudh, that officer is posted to the 1st Circle of Provincial Works in these Provinces.

Mr. W. E. T. Bennett, Assistant Engineer, 1st grade, is appointed to officiate as Executive Engineer, Benares Division, Provincial Works, during the absence of Mr. W. E. Parry, Executive Engineer, on privilege leave for two months and twenty-six days, or until further orders.

With reference to Notification dated 23rd May 1887, posting him to the 2nd Circle, Public Works, Brijpat Rae Rai Sahib, Assistant Engineer, 1st grade, was employed on special duty in the Rohilkhand Division, from the afternoon of the 21st June to the forenoon of the 11th July 1887, when he assumed temporary charge of the duties of District Engineer, Bareilly, from Mr. R. D. M. Lang, Assistant Engineer, 1st grade.

In continuation of Notification dated 6th June, Mr. E. Hodges, Executive Engineer, 2nd grade, on return from privilege leave resumed charge of the Allahabad Provincial Division from Mr. G. J. Joseph, Executive Engineer, 3rd grade, on the forenoon of the 14th July 1887.

Irrigation Branch.

Mr. H. J. Strickland, Assistant Engineer, 1st grade, Etawah Division, Lower Ganges Canal, passed the Departmental Examination in Hindustani on the 30th June 1887.

Mr. J. A. Cones, Temporary Executive Engineer, 4th grade, is appointed to officiate as Executive Engineer of the Aligarh Division Ganges Canal, during the absence on privilege leave of Mr. A. H. Barron, Executive Engineer, or until further orders.

Central Provinces, July 23, 1887.

Mr. G. M. Harriott, Executive Engineer, 4th grade, temporary, is transferred from the Eastern to the Hoshangabad Division, as a temporary arrangement.

With reference to Notification dated the 15th current, Mr. G. M. Harriott, Executive Engineer, was relieved of his duties in the Eastern Division on the forenoon of the 9th idem.

Mr. W. G. Newton, Executive Engineer, 3rd grade, was attached to the Chief Engineer's office, Centeral Provinces, on special duty, from the 28th June to the 5th July 1887, both days inclusive.

With reference to Government of India, Public Works Department. Notification dated the 6th July 1887, the transfer of Mr. Mr. W. G. Newton, Executive Engineer, to the Eastern Division, as notificed in Central Provinces Notification, dated the 1st June 1887, is hereby cancelled. Mr. W. G. Newton, Executive Engineer was relieved of his duties in the Chief Engineer's office, Central Provinces, on the forenoon of the 6th July 1887.

With reference to Notification dated the 15th current, Mr. G. M. Harriott, Executive Engineer, assumed executive charge of the Hoshangabad Division from Rao Sahib D. S. Sathye, Assistant Engineer, on the afternoon of the 16th idem.

India, July 23, 1887.

Mr. F. H. W. Morse, Executive Engineer, 3rd grade, State Railways, is on return from furlough transferred temporarily to Burma for employment on Provincial Works.

The transfer of Mr. W. P. Milne, Executive Engineer, 4th grade, sub. *pro tem.*, from Bengal to Burma Provincial Establishment, published in Public Works Department Notification dated 6th June 1887, is cancelled.

Lieutenant-Colonel William John Engledue, R.E., is reappointed to the Public Works Department as an Executive Engineer, 1st grade, in the Railway Branch, and attached to the Office of the Consulting Engineer to the Government of India for Guaranteed Railways, Calcutta.

Baluchistan.

Captain E. Glennie, R.E., Executive Enineer, Military Works Department, is, with the concurrence of the Inspector-General of Military Works, appointed to officiate as Executive Engineer of the Pishin Irrigation Division, in addition to his own duties, during the absence on leave of Mr. R. G. Kennedy, Executive Engineer, or until further orders.

Owing to the abolition of the 4th Division, Frontier Road, Mr. H. H. Green, Assistant Engineer, is transferred to the 2nd Division, Frontier Road.

Mr. H. H. Green, Assistant Engineer, held charge of the late 4th Division. from the 14th to the 31st May 1887.

Mr. H. H. Green, Assistant Engineer, 2nd Division, Frontier Road, is granted privilege leave for three months, with effect from the 1st August 1887, or such subsequent date as he may avail himself of it.

Central India.

Mr. R. H. Tickell, Assistant Engineer, 1st grade, passed the Departmental Standard Examination as laid down in Public Works Code.

Bengal, July 30, 1887.

Establishment—Irrigation.

Mr. G. A. G. Shawe, Executive Engineer, Cossye Division, is appointed to be Executive Engineer of the Circular and Eastern Canals Division in the place of Mr. A. E. Behrmann from the date on which the latter officer retires. Mr. Shawe will continue in charge of the Cossye Division until further orders.

Mr. O. C. Lees, Executive Engineer, 4th grade, temporary rank, is transferred from the Balasore to the Circular and Eastern Canals Division, and is appointed to hold charge of the latter Division, as a temporary arrangement on the retirement of Mr. Behrmann.

Mr. J. R. Swinden, Executive Engineer, is granted privilege leave for three months, with effect from the 2nd of August next.

Mr. G. J. R. Leeson, Executive Engineer, is transferred in the interests of the public service from the office of the Superintending Engineer, South-Western Circle to the Balasore Division.

Establishment—General.

Mr. E. J. Martin, Superintending Engineer, Class. I. has been granted by Her Majesty's Secretary of State for India, a further extension of furlough for three months on medical certificate.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 11th July, 1887.

230 of '86.—William Oliver, of Albert House, Canonbury, London, England, Engineer.—*For an improved method of administering Faradic of Galvanic electricity combined with an advertising apparatus.*

32 of '87.—Andrew Howatson, of 7, Lavender Hill, Surrey, England, Civil Engineer.—*For improved methods of arranging plates or appliances in vessels used for separating solid impurities from water or other liquids.*

64 of '87.—James Whittall, of 9, Fenchurch Avenue in the City of London, and Kingdom of England, Merchant.—*For an improved solution or electrolyte for primary electric batteries.*

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50	Rs. 30	Rs. 18	Rs. 10	Rs. 6.

Double these rates for outside front.

An allowance is made for continuous insertions.

OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

IVES.—At Peshawur, on the 24th July, I. E. Ives, Executive Engineer, P. W. D., of cholera.

GREIG.—At Hyde Park Mansion, on the 4th July, Major-General Irwin Montgomery Greig, R.E., (Bo.) Retired, aged 53.

INDIAN ENGINEERING.

SATURDAY, AUGUST 6, 1887.

WANTED—A RATIONAL SYSTEM OF PUBLIC WORKS.

WE have always in these columns discussed the anomalous elements which constitute the P. W. D. in this country; and have denounced the system which while distributing its loaves and fishes among those, who have no business in the Department, in the absence of cogent reasons for their presence in such large numbers, studiously neglects the claims of those who have borne the heat and burden of the day. Of course it was not to be expected that any inborn sentiment in the Government would lead to a change in a system condemned by those who have a right to be heard on the subject. We were also right in our surmise that agitation, persistently but temperately carried on, would naturally bear fruit. Over and over has it been brought to the notice of the authorities that their importation of a foreign element into the service not only blocked the promotion of deserving men, but their supersession was a decided encroachment on their preserves, which was certain to be resented at some time or another. The grievances complained of were that the case of the Royal Engineer Officers, who performed similar duties as their civil brethren, were not only governed by more generous rules, but that they drew larger pay, obtained higher pension, and in the matter of leave and furlough were on a more favourable scale. This denial of equal privileges to Civil Engineers, could not but be productive of much heart-burning and sullen discontent. But these are a twice told tale, and what is more to our purpose is the recent order of the Government of India recalling to their legitimate sphere of duty, about a dozen young Lieutenants of the Royal Engineer Corps, thus setting free those appointments to be distributed among Civil Engineers. We are sincerely glad to observe that repeated representations have brought about such desirable results; and the recent ruling against the employment of young R. E. Officers in the Accounts Branch of the P. W. D., given elsewhere, would appear to confirm this view of the question. We have invariably maintained that the free indiscriminate appointment of Military men to the Public Works Department was a suicidal policy, inasmuch as they were quite out of place in this, one of the most important branches of the Indian Administration. Subsequent events have conclusively proved that we were not singular in our opinion and that their condemnation is pronounced by one of their own body.

The subject of consolidating the several branches of the P. W. D. and the question of permitting the Military to exchange into the corps of Civil Engineers, are greatly exercising the American Press at this moment, and an admirable letter by General W. F. Smith of the U. S.

Army, contributed to the former is being widely reproduced in the Journals. As he very well observes that when the Federal Government was formed under the constitution the administrative bureaus were small in number and simple in character; just as in India where with the increase of responsibilities new varieties of duties have arisen, a vast and cumbrous machinery has been gradually erected; but instead of being under one head, each bureau—that which answers to 'department' in this country—acts independently of the other, and the consequences are that continual mal-administration follows, which would never have occurred if all the branches were united under one executive head to whom everybody would be responsible. General Smith exultingly points to the case of France, where the administrative ability is higher and the systems more thoroughly elaborated, and perhaps more perfectly carried on, than with any of the great nations of the world. For be it observed that the Ministerial Department of Public Works has outlived the various changes which the Government has itself undergone during the present century. There must be a great deal in the system to recommend itself to the other powers in Europe and to America. There is no pitchforking of the young officers of the Engineer corps and of the Navy into the Corps of Civil Engineers, but those who elect to exchange must do so permanently and will be treated on terms of equality with the members of the latter service. But the system of recruiting is one of the strongest and most commendable features of the scheme. The French do not acknowledge a variety of schools and places of instruction from which to pick the young men. They have no such institutions as Cooper's Hill, Chatham, Roorkee or Seebpore, each having a different curriculum and a different style of teaching. They recognise one finishing school from which they fill the ranks of the Corps of Civil Engineers. They have a uniform standard for admission, and the selections for the government school are made from those who attain to that standard. The studies are both theoretical and practical and directly answer the purpose in hand, that is educating and training up pupils for the proper discharge of any class of duties which they may be required to perform under the Department of Public Works. Besides the students educated at public expense, the institutions receive others who pay a tuition fee, and acquire an education second to none of its class in the world. The latter have no ambition to enter government service, but have to qualify themselves for private enterprise—a class of men sadly wanting among the alumni of Indian Colleges. Such a system cannot but foster an *esprit de corps*, which impresses each member with zeal in the discharge of his duties, and breeds a feeling that the general reputation of the entire body rests in a great measure on the success of each individual. Sentiments such as these contribute to raise the morals of a service, and it would be well for the Indian Government to direct its attention to this subject when the reconstitution of the Public Works Department is next seriously discussed in its Councils.

DIRECTORS' REPORTS OF INDIAN RAILWAYS.
II.

H. H. Nizam's Guaranteed State Railway.—Sir R. J. Meade presiding at the ordinary general meeting of this Company, said that the Singarini coal-field had not been reached until the 4th of June in consequence of the great difficulties which had been experienced in getting labor for the works and cholera which dispersed those that were on the works. The country between Warungal and the coal-fields was sparsely populated and unhealthy. The expenditure—additional—up to the time the account was made up on the Secunderabad Warungal section raised the cost of that section to £4,780 per mile. The expenditure on the Warungal-Domakul section and the mineral track to the coal-fields and other small items amounted to £29,155, and the balance at credit of the capital account on that day was £596,456, which it was hoped by the Directors would suffice to complete those sections. The company was greatly benefitted by the low exchange in their remittance to India.

West India Portuguese Guaranteed Railway.—At the yearly meeting of this Company the presidential chair was occupied by Major-General J. S. Trevor, R. E., C.S.I. The accounts shewed the expenditure of past year to be £364,041 and the total expenditure on Harbour, Railway and other works, from the beginning £1,216,694, shewing as against total receipts—capital and revenue—of £1,399,173, a credit balance of £182,480. The traffic of the line had been satisfactory especially in passengers. On this line there are 12 tunnels, one viaduct 135 feet high, and an embankment 125 feet high, besides cuttings through granite and gneiss 60 and 70 feet in depth. The Braganza Ghât, named after the Royal family of Portugal, runs up an incline of about 14 miles in length at an uniform grade of 1 in 40. Of this distance 3½ miles belong to the Southern Mahratta system. "The work," said the Chairman, "is one of the toughest jobs that has ever been carried out in India." To enable the company to get on for sometime until the development of traffic placed them in better position, it was proposed to raise the additional loan of £50,000 to complete the loan of £550,000 the contraction of which had been authorised by the Directors in 1885.

The Bombay Baroda and Central India Railway Company.—The report of the Directors of this Company for the half year under notice discloses the following result. The total capital expenditure to the close of 31st December 1886, was £8,257,014 irrespective of stores and material on hand or in transit to India, valued £249,543. The gross revenue figured £515,836 against £517,328 and the expenses £242,492 against £241,760. The working of the Rajputana-Malwa Railway shewed a falling off in the gross receipts to the extent of Rs. 190,441 as compared with the closing half year of 1885. The result of the combined system indicated a favorable balance—Rs. 4,15,516—which with the amount previously retained in India—Rs. 38,882—did not, however, equal the income of the half year under comparison. Paying for all things and taking into consideration the unexpended balance previously held over the directors were enabled to recommend the distribution of £32,087 out of £33,236 *plus* Rs. 25,516 in India available for dividends—in payment of a dividend in July next of 8s. 6*d.* per £100 consolidated stock making with the guaranteed interest a total expenditure for the half year on the capital stock of £2-18-6 per cent., the proprietors receiving £7 2s. per cent. on their stock holdings for 1886 against £6-15-6 for 1885.

South Mahratta Railway.—We find from the Directors' Report of this Railway that the receipts for the half year closing with 31st December 1886, amounted to £72,693 against £42,650, and the expenditure £53,613 against £38,675, in each case showing a considerable increase as compared with the December half of 1885. There was also an increase in the number of passengers carried, and the percentage of expenses amounted to 58·06 against 82·38 shewing a saving of 24·32. The length of line open to traffic was 476½ miles on the Southern Mahratta Railway and 139¾ on the Mysore State Railway. Since December 1886 there have been made several additions and others are in progress. It is hoped that when the various additions, extensions and constructions have been linked with those in working order there will be considerable increase in the traffic and better results possible. There would be no participation in the profits of the half year as the share (¼) of profits to which the company was entitled was not sufficient for division.

Bengal and North Western Railway.—At the meeting—held under the presidency of Lieutenant-General C. H. Dickens C.S.I.—of the shareholders of this Company the following particulars were given from the Directors' report, ending 31st December 1886. The accounts shewed a gross revenue of £61,822, an expenditure of £39,900 and a profit of £21,922. The rates of working expenses were 64·54 per cent. against 64 per cent. in the corresponding half of 1885. Both in passenger and goods traffic there was considerable increase. The total length of miles open, including the Uska Branch opened in December 1886, was 375 miles. The important engineering work, the completion of the Gundâk bridge constructed by the Government of India, connecting this with Tirhoot System of Railways had now become *a fait accompli.* Dullness of trade had restrained the expansion of traffic, but notwithstanding that fact the earnings had increased 44 per cent. and the traffic by 16 per cent., which was not so bad as they would have supposed. The expected earnings for the half year ending 30th June are estimated at 5½ lacs of rupees. The report on the whole is satisfactory and the future hopeful.

IRRIGATION WORKS IN UPPER BURMA.

It has been recently and correctly observed that the Madras Engineers have long borne a reputation as experts in the restoration of old native irrigation works, as well as for their aptitude in designing original irrigation projects; and the long experience they have had in this branch of Engineering and the past general success of their undertakings, point to the Madras Public Works Department as the proper source from which difficulties on this head should be met. It was the Southern Presidency that gave the Upper Provinces and Bengal such men as Rundall, O'Connell, Haig, Stoddard, and others; and it was the success of the Madras Irrigation systems that led to the establishment of those of Northern India and elsewhere. Madras *Native* Irrigation Engineering was quite different to anything of its kind in Europe or other parts of the world; and when Western science and skill as represented by the Addiscombe Engineers in the "Company's" service was brought to bear upon its improvement, the result has been without a parallel in the history of reproductive undertakings.

It is therefore not surprising to find the Government of India indenting on Madras for an Irrigation Engineer for the maturation of a proper scheme for the restoration of the Irrigation Works of Upper Burma. We had occasion to refer to this matter in our issue of 28th May, and there pointed out the circumstances under which Mr. J. D. Grant undertook the task.

We have now been favored with a copy of the Report by Mr. Grant, as Special Irrigation Engineer, on the Irrigation of the Kyauksé district of Upper Burma. This district covers an area of 900 square miles, in which the physical characteristics of the country favor irrigation and to which the natives appear to be fully alive. In describing the existing system of works, Mr. Grant only deals, in the first instance, with such works as are necessary to *maintain* the irrigation of the district, pending improvement and extension; and as the original works are of the simplest description, he suggests nothing that is new to the country, so that with a little supervision the workmen who now repair the dams and channels could carry them out perfectly.

In the second part of his Report Mr. Grant deals with the future aspects of the question before him. He says that to form an opinion of any value on the best means of improving and developing the Irrigation of the Kyauksé district, it is essential that much information which cannot now be obtained should be collected, and that there should be no doubt of its accuracy. Experience has abundantly proved that there can be no more fatal error than to attempt to design hydraulic works of any magnitude on imperfect or doubtful data, for in such works an apparently slight error may produce consequences so far reaching that to correct it would virtually mean recasting the entire scheme. Too much caution cannot therefore be exercised in dealing with works such as those in this district, which with but trifling repairs can be made to do their work well enough for some years.

There can be no doubt that there is room for great improvement and extension of irrigation, and that in all probability properly designed works would bring in a large return, but in order to lay them out trustworthy information is necessary. The suggestions given on this head are pertinent and practical, and are in every way worthy of the attention of Government as the outcome of much thought and trouble from an Engineer capable of directing the operations of extensive irrigation works and the initiation of new projects beneficial to the community and remunerative to the State.

Notes and Comments.

SEEBPORE JUTE MANUFACTURING COMPANY.—The report of the Directors of this Company for the past half-year discloses a profit on the working of Rs. 48,517.

NATIVE ENGINEERS IN BURMA.—The transfer of Sirdar Bahadur Bhugut Sing, an Executive Engineer, to Burma appears a mistake, as Burmans have no respect for a Native of India, and this being so such an officer is useless, as he cannot push on with work that is to be done by Burmans, while they work well under a European.

P. W. D UPPER SUBORDINATE ESTABLISHMENT, BURMA.—Thirty-one promotions have been made in the Upper Subordinate Establishment, of which three are temporary, the rest being permanent. Casualties have already commenced amongst the Military: Sergeant Russell died and two Overseers are about to be remanded to Military duty.

ECONOMY IN THE PUBLIC WORKS DEPARTMENT.—The Government scheme for amalgamating the Provincial Public Works with the Local has partially taken place in the North-West Provinces and Oudh, and the scheme, it is said, is (as was expected) working satisfactorily, because the District Engineers are now under Government Executive Engineers, that is, Divisional Engineers, an arrangement long wished for.

THE BOMBAY P. W. D. SECRETARYSHIP.—The scandal which we announced in our issue of the 16th July as under contemplation has at last been perpetrated. A Government Resolution has lately been passed appointing the lucky 2nd grade Executive Engineer, who was acting as Secretary, to be a Chief Engineer, 1st class, *sub. pro tem.* This is promotion with a vengeance—from pay of Rs. 800 per month to Rs. 2,500!

SUCCESSFUL INDIAN CANDIDATES AT THE EXAMINATION FOR MINING ENGINEERS.—We are glad to see the names of two gentlemen well known to the mining profession in this country among the list of passed candidates of those who presented themselves at the recent examination for Mining Engineers at Home. Mr. Thomas Forster, who has been elected a Fellow of the Geological Society, and Mr. R. E. Highby have both successfully competed for certificates of competency and stood second and third in the order of merit. They are both shortly expected out.

TOUNGHOO-MANDALAY RAILWAY.—We glean that a considerable portion of the earthwork is already completed; brick-making and other necessary operations are being rapidly pushed forward, and large orders have been placed at home for iron work for the big bridges. But labor is not over-abundant, nor is the Burman coolie a particularly reliable workman. Nevertheless, though we do not join in the sanguine expectations of the Chief Commissioner that the through line will be open by March 1889, there is a reasonable probability that the next few years will see the completion of this great work, one of the most important civilising agencies of modern times.

COAL IN SUMATRA.—The inland coalfields lying along the Ombilien river form part of extensive deposits of very good coal extending from the equator to the first degree of south latitude. The readily accessible portions of the coal measures contain, at the lowest estimate, upwards of 104 millions of tons of that fuel. Chemical analysis shews that the Ombilien coal contains a heavy percentage of carbon with very little sulphur and only a small quantity of ashes. The problem which has puzzled intending concessionaries for years, is how to secure ready means of access to these vast coal deposits and bring their hidden treasure to market at a profit. The Government have taken the matter up and its scheme provides for a railway to the mountains bordering the mines, communication with which will be kept up by wire tramways.

THE CALCUTTA SWIMMING BATH.—The building, which is under construction, measures 150 feet long by 51 feet wide; the entrance which faces the Strand Road will be paved with ornamental tiles. The bath itself will be 100 feet long by 34 feet wide, having at one end a depth of 4 feet, sloping down at the other to a depth of 9 feet 6 inches. At the entrance, on the right-hand side, will be the office and committee-room, together with the store-room and durwan's lodge; while on the opposite side will be the waiting-room, the lavatory, and other necessary accommodation. There are to be twenty-five dressing-rooms in a line with the lavatory on the north of the building. On the west side of the main building, or at the entrance to the bath, will be a ten-feet promenade, while the space on the opposite or east side of the building, 22 feet by 46 feet, will be utilised as a gymnasium.

HYDERABAD (DECCAN) P. W. D. CHANGES.—Mr. J. H. Glass, who has been officiating for nearly two years as Secretary to Resident, P. W. D., is proceeding on 12 months' furlough to Europe from the 1st proximo. Major H. C. Fox, R.E., who has hitherto been doing duty at the R. E. Depôt at Chatham, having elected for continuous service in India, left the above Depôt and is expected to relieve Mr. M. P. Coode, Executive Engineer, Secunderabad Division, who intends going on furlough. The Inspector-General of Military Works having intimated that the services of Lieutenant E. Houston, R.E., Assistant Engineer, attached to the Secunderabad Division, will shortly be required on the Frontier Defence Works, it is rumoured that Mr. C. Palmer, Assistant Engineer from the Central Provinces, will be transferred to Hyderabad to take up Lieutenant Houston's place.

MADRAS P. W. D. BUDGET ESTIMATE, 1887-88.—The resolution of the Government of India passing orders on the Estimates of the Madras Presidency for the current official year shew that the total allotment for "Irrigation" is Rs. 36,51,000, of which Rs. 10,00,000 is for Major Works (Imperial) and Rs. 26,51,000 for Minor Works and Navigation (Provincial). Under "Buildings and Roads" the grant for "Military Works"—carried out by the General Agency of the Department, there being no Special Branch—is Rs. 5,50,000, while that for "Civil Works" (Imperial) is only about Rs. 34,000. The "Provincial" expenditure, however, on this head is set down at Rs. 17,-93,000 and the "Local" at Rs. 41,10,000—making an aggregate for "Civil Works" of Rs. 59,37,000 for the Presidency, exclusive of "Military Works." A sum of Rs. 50,000 has been entered on account of the "Nilgiri Railway."

ROADS *VERSUS* RAILWAYS.—It has been rightly argued that the railway is a profitable investment of capital, while the road is an unproductive expenditure of money—at least the indirect benefits it yields are no adequate return for its cost, and it is absurd to think of getting them at this cost when the railway can be made to yield them much more efficiently at no cost at all. Very few long roads are being made in India now-a-days on account of the expense of their upkeep, and railways, besides being the policy of the hour, open up a new tract of country much more rapidly. A railway also is much easier constructed in a difficult country possessing absolutely no resources. The rails are laid in sections, and contractors' trains bring up materials for the inner and incompleted sections with the utmost cheapness and rapidity. On the other hand, the road drags a lengthening chain.

ALIPORE COAL AND BURRAKUR COMPANIES.—The report of the Managing Agents of the Alipore Company for the half-year ended 31st May shews that the quantity of coal sold and delivered amounted to 23,200 tons, as against 22,000 tons for the same period of last year. The revenue account shews a credit balance of Rs. 29,984, and after writing off Rs. 19,967 for interest, wear and tear, &c., the net profit was Rs. 10,017. The report of the Managing Agents of the Burrakur Company for the year ended 31st May shews that 46,593 tons of coal and coke were sold and delivered, against 54,047 tons during the previous year. The revenue account shews a credit balance of Rs. 39,103. An *ad-interim* dividend of 5 per cent. has been already paid and it is now proposed to pay a final dividend of 10 per cent., making 15 per cent. for the year, and to carry Rs. 5,330 forward. The dividend last year was 15 per cent.

THE PROPOSED AGRA WATER-WORKS.—On the advice of Mr. Hughes, M.I.C.E., Superintending Engineer, the Municipality have resolved to make a vigorous effort to finally deal with the question of a water-supply for the town of Agra. They propose, therefore, to maintain the source of supply now in every-day use from the Jumna, and to place it more conveniently within the reach of all, and to purify it by the best system of special filtration that can be devised. During the rains and cold weather months special filtration will not be necessary, and it is proposed to adhere to the system of settlement and sand filtration in use in Calcutta. The distribution of water to the town is to be effected through the twelve miles of piping, furnished with stand-posts on three patterns—the ordinary stand-post with two or four taps—stand-posts with roof and cattle troughs for bazaars and crowded localities—and stand-posts for filling *mussuks* on bullocks, for the supply of remote parts of the town, not included in the system of piping now proposed.

P. W. D. C.E.'s HIGHER PENSIONS.—We understand the Government of India in the D. P. W. have called on all local Governments and Administrations to submit the views of selected officers as to the application of the rule granting additional pensions over and above the ordinary retiring pensions, to those Civil Engineers who have filled the high and responsible offices of Chief and Superintending Engineer for three years. At present the permanent officer alone is allowed to count service towards the qualifying period even though he may be on leave for two out of the three years, and the officer in temporary rank of Chief or Superintending Engineer is debarred the privilege of qualifying for the additional reward for good service. The question put is, whether it is desirable to alter the rule, and let service whether in temporary or permanent rank count. In this case time spent on leave by the permanent officer would not count. As the rule professedly grants the additional pension as reward for good service in a high and responsible position, it appears to us there can be but one answer to the question.

EMPLOYMENT OF YOUNG R. Es. IN THE ACCOUNTS BRANCH; P. W. D.—The Government of India has had under consideration the question of the appointment of Officers of Royal Engineers to the Accounts Branch of the Public Works Department. It is observed that at present young officers after receiving an expensive scientific education, mainly at the cost of the State, are allowed to enter the Accounts Branch, where they spend a considerable portion of their service while in the junior grades in doing merely mechanical work. This, it is considered, is a misapplication of their previous training, and, moreover, their services could be utilised to more advantage on military works for which their training has fitted them; and for which indeed they have been brought on to the Indian Establishment. Hence it has been decided that in future the transfer of young Royal Engineer Officers to the Accounts Branch of the Public Works Department, either direct from military duty, or from the Engineer Branch of the Military or Public Works Department, except under very special circumstances, will not be permitted.

TENURE OF OFFICE BY UNDER-SECRETARIES, P. W. D., INDIA.—There are three Under-Secretaries, attached, respectively, to the General, the Railway, and the Civil Works Branches of the Public Works Department Secretariat. The Under-Secretary in the General Branch is not necessarily an Engineer, and there are special reasons in connection with the work done by him which make a tenure of some length desirable. This is not the case with the two other Under-Secretaries who must have technical knowledge which renders it desirable, in the interests of the officers themselves and of the public service, that the tenure of their appointments should be limited. On these considerations the Governor-General in Council is pleased to decide that the tenure of the appointment of Under-Secretaries in the Railway and Civil Works Branches shall be limited to four years' continuous service, whether permanent or officiating. It is further ruled that no leave, other than privilege leave or leave on medical certificate, shall be granted to the incumbents of the same two posts, except on the most urgent grounds; when special leave only will be granted under sections 61—63 of the Civil Leave Code.

AN INIQUITOUS ORDER.—We informed our readers some little time ago of the pretty little bribe of Rs. 500 per mensem in addition to salary given to Major Gracey, R.E., to induce him to take up the appointment of Superintending Engineer and Secretary, D. P. W. at Mandalay. We have now further to intimate that the Government of India discounted this liberality to a Royal Engineer by mulcting a Civil Engineer of his harldy earned allowance. Mr. H. C. Richard, Superintendent of Works, who has controlled Public Works in Upper Burma during the most trying period, from our occupation in December 1885 to the date of Major Gracey's joining in April 1887, is to be deprived of the usual allowance of Rs. 100 per mensem in addition to salary. Such is the Government of India order. When the whole country was in a ferment Mr. Richard, C. E., received 950+100 for controlling Public Works; when the country is settling down Major Gracey, R.E., is to receive 1,250+500, for similar duties, and Mr. Richard is to be deprived of his allowance of 100 per mensem. Fortunately the Chief Commissioner, Mr. Crosthwaite, is not the stamp of man to fold his hands and say *jo hookum* to such an iniquitous order. Mr. Richard's friends may therefore hope that the order will be cancelled.

Current News.

THERE are now altogether 905 officers in the Corps of Royal Engineers on the active list.

THE Bombay Town Council has paid Rs. 80,000 as the Municipal contribution towards the Victoria Technical Institute.

THE result of the crushing of ore at the Mysore Gold Mines, for the month of June, was 822 ounces of gold from 792 tons of ore.

THERE will be an International Railway Conference at Milan next month, at which Colonel Luard will represent the Government of India

THE question of granting a gratuity and honorarium to Mr. Lee, the Hyderabad Municipal Engineer and Secretary, is still exercising the minds of the rate-payers of that city.

MR. JOHN PENDER, the Chairman of the Oudh and Rohilkhand Railway Company, will probably visit India next cold season, to attend the ceremony of opening the new railway bridge at Benares.

THE Senior Captains of Royal Engineers owing to the number of Majors having fallen below the establishment, are getting their majorities well under the 20 years; the last of those lately promoted having got his majority in 18½ years.

THE Bombay Town Council have resolved to recommend the Corporation to sanction the immediate carrying out of street pipe sewers with gully branches and street syphons and sullage pipes and trapped receptacles for drainage purposes, at a total cost of Rs. 11,14,929.

IT is said that in the Punjab out of 23 millions of acres of irrigated land, more than 8 millions are watered by wells, while Government canals, which naturally come second, irrigate a little less than 7 millions. Nearly 4½ millions are irrigated by means of tanks, and 2 millions from other sources, exclusive of private canals which water 930 thousand acres only.

THE bridge of boats at Benares has been removed never more to be laid out. The railway bridge is now open for foot-passengers to cross over. In connection with the latter, it is said that Government contemplate posting artillery on the approaches to the bridge at each end, and that a sum of Rs. 40,000 has been sanctioned for the construction of the necessary works for the purpose.

A DISCUSSION has been going on for some time regarding a proposal by the South Indian Railway Company to extend their system into Travancore territory, but the Government has now informed the railway company that it cannot hold out any hope of State aid for some years to come. Still the local Government is prepared to recommend that the construction of the proposed line in British territory should be undertaken concurrently with that in the Travancore territory but that this must be done by private enterprise without State aid.

COLONEL K. A. JOPP, R.E., having returned to Madras from leave, has assumed charge of the duties of Senior Deputy Consulting Engineer for Railways. There will now be four officers, instead of three (the full complement in the office of the Consulting Engineer for Railways)— Colonel Smith, R.E., Colonel Jopp, R.E., Major Sidney Smith, R.E., and Mr. Knapp; but this abnormal state of things, it is said, is due to the fact that Major Sidney Smith shortly proceeds on leave; and it would, therefore, be inconvenient, in the brief *interim*, to retransfer Mr. Knapp elsewhere.

THERE have been heavy floods in parts of the southern and eastern divisions of the Central Provinces. Two bridges on the Warora-Chanda road have been damaged, and traffic has been interrupted. At Hinganghat the greater part of the old town has been under water. No lives were lost; but much injury to property was sustained. This may be an advantage in inducing the people to move to the higher and healthier site of the new town, when no other means of persuasion would be effectual. On the Nagpur-Chattisgarh Railway several hundred feet of embankment were swept away about four miles on the Nagpur side of Amgaon.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

SEEBPORE ENGINEERING COLLEGE.

SIR,—It appears from the Principal of Seebpore Engineering College's letter in your issue of 30th July, that he is laboring under an erroneous impression both as regards the popularity of the College as well as the whereabouts of its "unemployed ex-students." He can scarcely have forgotten the time when no less than 150 boys used to enter the College every year, and the 1st year class had in consequence to be divided into three sections of 50 boys in each for convenience of lectures. Now I believe the College can hardly boast of more than a couple of dozen admissions to the Engineer classes every year. If number of admissions into a College is any test of its popularity, it must be confessed that the Seebpore College is looked upon with much greater disfavor by the parents and guardians of our young men than it used to be not many years ago, although much better inducements are now held out in the shape of 10 scholarships to those who join according to their order of merit in the University Examinations.

As regards the "List of unemployed Assistant Engineers, Overseers and Foreman Mechanics, &c.," kept in the College, the "unemployed ex-students" have no faith in it, and therefore do not care to send in their names to be registered. Engineers, Contractors and District Officers for whose information the List is advertised, very seldom, if ever, write to the Principal for any subordinates that they may want, under the impression that men direct from College, though possessing a ton of theory have not got an ounce of practice, and hence are useless.

August 2, 1887. AN UNEMPLOYED EX-STUDENT.

DISCHARGE FROM CATCHMENT BASINS.

SIR,—In your issue of the 16th July 1887, page 48-49, on the above subject "R." quotes Dickens's fomula as $D=825M^{\frac{3}{4}}$. As far as I am aware, 825 is an empirical co-efficient which varies inversely as the areas of basins, and is also affected by the length of the basin, inclination, nature of soil, previous humidity of soil, and the bareness or otherwise of vegetation. It is thus evident that any formula to be of practical use should in this case solely depend upon observation.

2. Putting "C" (co-efficient), instead of 825, the formula would be $D=CM^{\frac{3}{4}}$, and C has been quoted as 140, 150, and 460 for catchment areas of 97,050, 27,700, and 1,750 square miles, respectively, in Southern India. On these data, I would say that C=825 would be suited to an area of say 100 square miles, and for smaller areas such as those instanced by "R.", C would be considerably more, and I should be justified in taking it at 1,500, especially when the area is so limited, and the rainfall has been so extraordinary as 5″ in 2 hours.

3. The Rurki Treatise takes C=825, when the average *annual* rainfall is from 24 to 50 inches.

4. I do not understand how "R." assumes 6 feet per second velocity, and when he gives the fall of the country he does not say for what length the fall is. Assuming 6 feet velocity, and assuming the culverts have cutwaters, the area required in case (1) would be $D=315=\cdot9\times A\times6$, which gives Area=58 square feet; and in case (2), $D=531=\cdot9\times6\times A$, ∴ Area=98 square feet. In case (2), "R." may say area is too much; well then take C less than 1,500, say 1,200, as catchment area is more, and calculate.

5. Other formulæ on this subject are :—

(2.) Ryves, $Q=C\,M^{\frac{2}{3}}$,

(3.) .... $Q=C\times27\,(M)^{\frac{1}{2}}$. where $C=8\cdot25$,

(4.) American, $Q=200\,(M)^{\frac{5}{6}}$.

(5). Burge, $Q=C\dfrac{M}{\sqrt[3]{L^2}}$, where L=length of basin.

(6). O'Connell, y (c. yds. per sec.)$=M\sqrt{x}$, where x=sq. miles, and M=co-efficient.

(7). Craig, $A=148\ \Sigma\left(B\log\dfrac{8L^2}{B}\right)$, into the meanings of the symbols of which it is too much to enter now.

MAISUR: *July* 23, 1887. A. G. ACHARLU.

[In a paper on Dickens's formula written by Mr. Heaford, Executive Engineer, Irrigation Works, Oude, attention is called to the effect which the declivity of the river bed, and the heaviness of the rainfall have on the value of the co-efficient, and the following valuable table derived from measurements of discharge is given :—

	Area.	Discharge.
Jumwaree	65 Sq. Miles.	200 $M^{\frac{3}{4}}$
Lonee	120 ,,	127 ,,
Sye at Bunee	240 ,,	106 ,,
Jumwaree and Suraen	326 ,,	148 ,,
Sye at Roy Bareilly	960 ,,	96 ,,
Goomtee at Lucknow	3,361 ,,	64 ,,
Ganges at Cawnpore	34,000 ,,	92 ,,

—ED., *I. E.*]

Literary Notices.

DIFFERENTIAL AND INTEGRAL CALCULUS

By A. G. Greenhill, M.A., (Macmillan & Co.)

A Review.

The author of the book under review states in his preface—"I have endeavoured to make this book suitable not only for the mathematical student, but also for men like engineers and electricians who require the subject for practical applications, to whom even a slight knowledge of the Calculus is becoming more and more indispensable." It is chiefly from the latter point of view that I propose to criticise the work.

Whether as a text-book for the tripos candidate or an addition to the mathematical library of the practical engineer, the book will be found disappointing; to the former on account of its incompleteness, to the latter from a want of simplicity of style and method.

What I may call the mathematical literature of Engineering ought to be distinctly conservative in its tendency in order to be most useful to the ordinary engineer, ought in fact to be clear, simple and (as far as possible) practical. The author tells us in his preface that "the chief novelties in the present work consist, first, in carrying on the subjects of the Differential and Integral Calculus together......; secondly, in the use of the *hyperbolic* functions in conjunction with the ordinary circular trigonometrical functions, in order to preserve an exact analogy, which is not apparent when only the exponential and logarithmic functions are employed" (It may be noted here that $\sin h\, x$, $\cos h\, x$ are such that $\sqrt{-1} \sin h\, x = \sin \sqrt{-1}\, x$ and $\cos h\, x = \cos \sqrt{-1}\, x$; $\cos h^2\, x - \sin h^2\, x = 1$; whence the term *hyperbolic* functions as distinguished from the circular functions whose property is $\cos^2 x + \sin^2 x = 1$).

I have quoted the second novelty *in extenso* because it forms, as a matter of fact, the predominant feature of the book. To exemplify the prominence given to the hyperbolic functions, I may mention that of the 94 examples in the chapter on differentiation, 40 are devoted to these fuctions, the rest including the usual algebraical, transcendental and circular functions: this prominence is continued throughout. There can be little doubt that the hyperbolic functions are destined to play an important part in the elementary mathematics of the future, but until they begin to be somewhat extensively used in *engineering* works (which I venture to predict will not be for a considerable time), it seems rather a waste of the practical engineer's time to devote himself to the study of a book in which they are so intimately interwoven with the circular functions that it will be found difficult to proceed without their aid. It would be much easier to eliminate the unnecessary information from the older and excellent works of Williamson or Todhunter than from their most recent rival, if indeed rival it can be called.

I must be distinctly understood as referring to the *practical* engineer, who has not much leisure to devote to new and somewhat fanciful studies, but who requires the Calculus merely as an indispensable aid to his *engineering* work. To any one having the leisure and inclination, the book will be found to contain a very lucid and comprehensive exposition of the theory of hyperbolic functions; starting from the definitions and explaining their geometrical interpretation, leading up through all the elementary forms, exhibiting a complete analogy between them and the circular functions (even including the inverse forms, $\sin h^{-1} x$, etc.) and carrying on the analogy throughout the whole range of the Calculus so far as it is expounded in the volume. I must confess, however, that I have failed to discover anything which is much simplified by their application.

But this very amplification of a particular hobby of the author naturally takes up considerable space, and "in order to keep the size of the book within reasonable limits" this space is acquired at the expense of the more useful branches of the subject. The consequence is that simplicity is sacrificed to brevity, necessary explanation is frequently curtailed or altogether omitted, and the work gives one the impression of being altogether too crowded

An admirably simple proof of the theory of Amsler's. planimeter is given, but the planimeter to be reliable requires the most delicate handling and must also be kept in most perfect order. In India it is peculiarly liable to get out of order, and I fear that this most beautiful and wonderful mathematical conception must be classed among the fanciful theoretical creations which have really no practical value.

I fancy most engineers would prefer to rely upon the very old but practical artifice of cutting the area out of cardboard and weighing it against known areas of the same cardboard.

The articles on the epi—and hypo—cycloids and on exact mechanical parallel motion are decidedly good, but both might be extended with advantage. Indeed I may say that it is to the mathematical student alone, that the work will be of much value. If not exactly suited for a *text*-book, it forms a very excellent companion (as it were) to Williamson's or Todhunter's books and is replete with new methods of solution. Regarded merely as a treatise on the hyperbolic functions it ought to be found in the library of every mathematician.

On the whole, then, it is principally from a Trigonometrical point of view that the book will be welcomed, and I must not omit to mention a very simple figure from which the author deduces geometrically not only the expansions for $\sin(A+B)$, etc., but also the values of $\sin A + \sin B$ in terms of the sum and difference of half the angles and the other like formulæ. Indeed the author seems so wedded to Trigonometry that he goes so far as to give the tables exhibiting each of the circular functions in terms of each of the others.

J. H. Gilliland.

Excavating and Under-cutting machines for Sinking wells and cylinders.

We have received from the author and patentee a copy of his pamphlet on these appliances which though same in principle as his "Helical Excavator" they differ from the latter in constructive details and methods of operation. The impression its perusal has left on our mind is that to enlargen the sphere of usefulness and application of the machine a great effort on the part of the patentee is necessary, if not imperative. No one—including even the profession—unacquainted with its mechnical arrangement and details will realise the efficiency and economical performance of the machine unless he is shewn by experimental exhibition of its operating powers that the machine will do what the patent guarantees it will perform. Several of these machines are, we are informed, in use in Ceylon and in this country, where they have given satisfaction, but it is apparent from its restricted application that it is not generally known. We would advise the patentee to engage the services of an intelligent mechanic to travel over the country and exhibit the machine in actual operation more particularly at bridge building sites, where wells are often resorted to for good foundation and in the agricultural districts of the country where wells form the chief sources of irrigation.

In absence of skilled labor and difficulties local and otherwise the "Excavator" "Enlarger" and "Under-cutter" should find ready application.

Handbook of Patent Law. *By J. K. Fahie and Son.* Dublin : John Falconer.

This is a new edition of a well known treatise on the nature and mode of procedure of the formalities complied with for obtaining Patents, not only in the United Kingdom, but in the principal Colonies and Foreign countries. It embraces, within a convenient form, all the information inventors may require as to the expense, the rights, the privileges, and the obligations of Letters Patent and Copyrights; and the "Hints to Inventors" will doubtless be of assistance in impressing on the minds of those interested in patent matters the desirability of entrusting their business to competent and skilful hands.

General Articles.

PONDICHERRY HARBOUR PROJECT.

By A. Pierres deClosets, C.E.

III.

Details of Construction.

The harbour will be commenced by the building of the two jetties which will be carried out either by means of blocks of concrete sunk one on the other in such a way as to preserve intact the intended outline or by one block only. To this end there will be raised on the shore and at the starting point of each jetty a platform provided with rails for the working of the cranes, which must lift the blocks to load them on the trucks, and for the engines used in the transports; these platforms should be long enough to allow of the blocks being stored on them during their exposure to the air before use.

In front of these platforms, and communicating with them by a railway will be placed the machines and workshops for the manufacture of the concrete, and mortars of hydraulic lime. The largest size of the blocks manufactured will be 2m × 2m × 4 or 16 cubic metres. Weighing 34 tons. Belgian Portland cement will be used for making the blocks, adding the necessary sand for the mortar, and gravel from the hills, or pieces of laterite from the same place.

It would be necessary first to connect the quarries with the S. I. R. station of Villenour and then the station of Pondicherry with the concrete workshops, by branch lines or to lay down a line which would put the quarries and workshops in direct communication.

The blocks, having been moulded on the platforms would remain there for two or three months before use. For sinking them, there must be a strong moveable crane on each jetty or a railway which will be laid down gradually in proportion to the advancement of the works. The blocks having been heaped up anyhow, this way of enrockment will allow of their settling down, and taking a fixed position. It is probable that the total subsidence of the jetties, that is the depth to which the base will be buried in the sands of the bottom, will be more or less deep, it may be reckoned at about 2 metres.

In sliding down the blocks care must be taken that they should fall as nearly as possible in the exact spot they are to occupy in order to preserve the proper outline of the jetty. This outline will act as a Breakwater on the side towards the open.

The base of the jetties will be to the depth of 6 fathoms, and 30 metres across; its height not more than 15 metres including the portion in the sand; it will be divided into 3 portions on the sea wall.

1. A horizontal platform 8 metres in width.
2. A first embankment of 2 to 1.
3. A second embankment of 1 to 1.

Should it be feared that cyclones would disarrange the blocks, or change their position, the jetties could be constructed of one block only but there is no cause for apprehension as regards jetties of blocks weighing 36 tons. It should be noticed that in a cyclone, the force of the waves on a surface of Om. 204 square millimetres varies from 1 to 3 tons.

The walls of the quays will be of concrete, the portion below water, which will be built after a preliminary dredging, will be shaped on the spot by means of moveable moulds, and the upper portion above water, of bricks with hydraulic mortar, and with an outer coating of the same.

After the building of the jetties or during their construction, the clearing out of the channel must be attended to. For this work, dredgers will be used, each capable of excavating 1,500 tons from the cutting in a day, in the course of 10 hours' work. These dredgers, will have tenders with steam valves attached to them; in allowing 10 years for the completion of the works, it will be necessary to employ 6 dredgers and 18 tenders.

The total surface of the cutting to be made will be 1,910,500 square metres, divided as follows:—

In the channel ...	... ...	293,600 m. 2
In the interior harbour	... ...	1,616,900 do.
	Total ...	1,910,500
And the Cube of the earth to be raised will be in the channel to a depth of 10 metres at low water ...	...	2,936,000 *m.* 3
In the interior Harbour including the grounds above sea level to 8*m.* deep		12,935,200 *m.* 3
	Total ...	15,871,200 *m.* 3

The damp and somewhat clayey sand of the coast weighs on. average 1,708 kilogs. the cubic metre—say 1 ton 708 kilogs.

By using dredgers of 1,500 tons power per day, the annual product of each dredger, for 300 working days will be 4,50,000 tons or in cubic metres 2,63,466, and allowing a period of 10 years to complete the excavation of the port, 6 or 7 dredgers would have to be used. It would not be necessary to finish the cutting before admitting vessels into the harbour; for this could be done, as soon as the channel and a port of the interior harbour were ready.

The construction of the quays, of the warehouses, &c., &c., could be done as the dredging allowed of it, and the work of building could be carried on without interfering with the business of the port.

(To be continued).

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

During a service of some years I have kept myself, or have obtained from my assistants, notes of details of labor and materials employed on different descriptions of work. Judging from their usefulness to myself I conclude they will prove useful to your readers generally, and particularly to young Engineers, if you think them worth publishing. I begin the series with details for "Boulder Masonry in Foundations." Columns 3 to 6 would differ for different localities even in the same Province, and are therefore left blank.

Boulder Masonry in Foundations.

Items per 100 c. ft. of work. (1)	No. or quantity. (2)	Rate. (3)	Per. (4)	Amount. (5)	Total of labor and material. (6)
Labor—					
Masons No. ...	1				
Do. ,, ...	$1\frac{1}{3}$				
Coolies ,, ...	$3\frac{1}{3}$				
Do. ,, ...	$1\frac{1}{3}$				
Do. ,, ...	$1\frac{1}{2}$				
Bhisty ,, ...	$\frac{3}{4}$				
Grinding Mortar c. ft. ...	40				
Sundries ...	... ..				
Materials—					
Boulders & Quarry chips c ft. ...	80				
Stone lime slacked in powder c ft. ...	$19\frac{1}{4}$				
Sand, dry ...	$19\frac{1}{4}$				
Surki, dry ...	$19\frac{1}{4}$				
Sundries	......				
Petty establishment	. ..				
Total ...	...	...	...	...	...

Note.—About 58 c. ft. of dry material produces 40 c. ft of ground mortar ready for use.

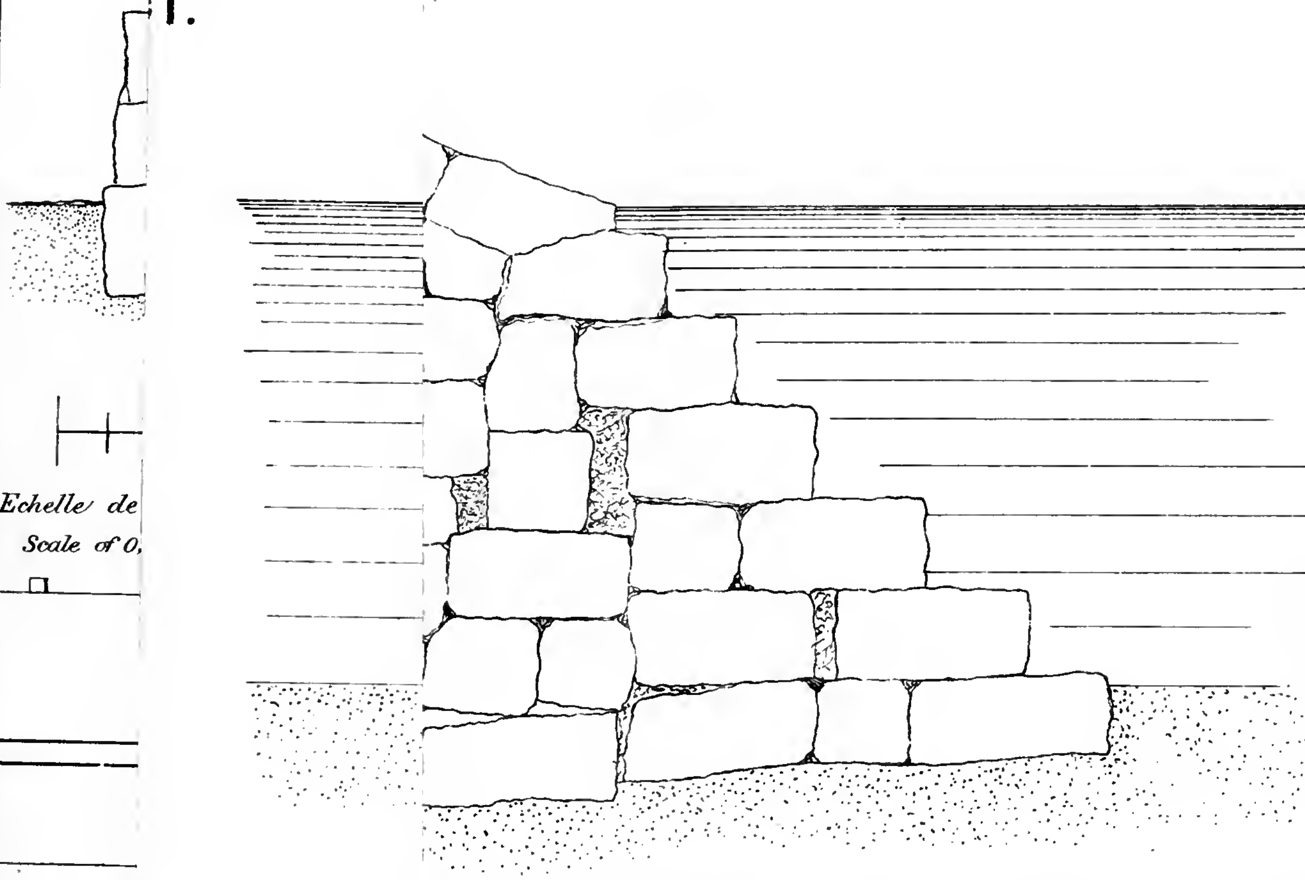
Specification.—The boulders to be sound trap packed close on a bed of mortar, all crevices being carefully filled with mortar and quarry chips. No boulder to be of smaller size than 6" cube, and the proportion of these to the larger boulders not to exceed 10 or 12 per cent. At every 18 inches the masonry to be brought up level.

X.

NG.

Co... ...y at 6 fathoms.)

T.



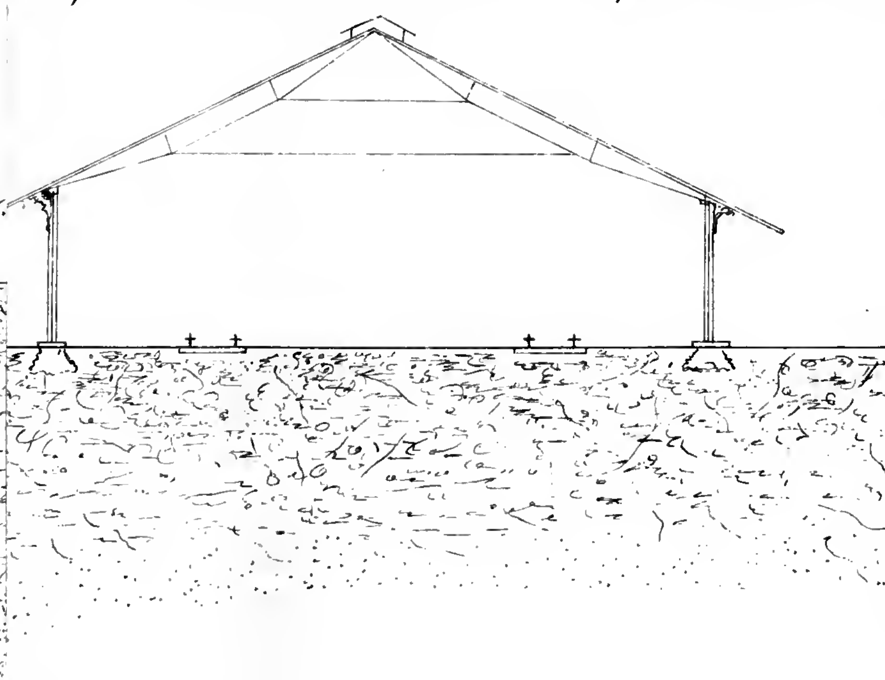
Echelle de

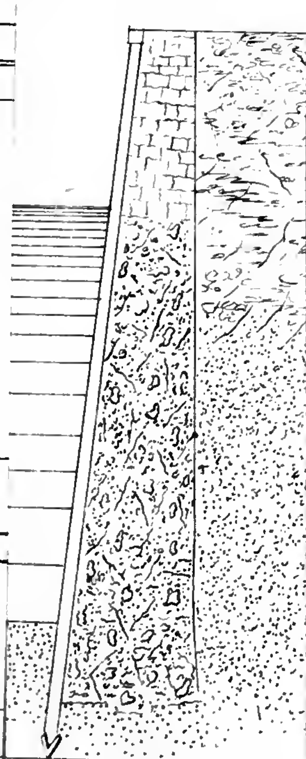
Scale of 0,

...du quai et d'un Magasin. (Section of a quay & a Warehouse.)

2

...e des Murs de Quai.(...





...de $0,043^{m/ \; mm/}$. pour 10 metres pour fig. 4, 5.

...of $0,^{m/}043^{m/m/}$. the 10 metre for fig. 4, 5.

10 m 20 m

The "STAR" Press, 19 Lall Bazar Street, Calcutta

ON FINDING THE NORMALS TO CURVES.

THE problem of finding the correct slope for the beds of voussoirs in arches sometimes presents difficulties when the arches are large and the curves not circular. The following investigation affords a solution :—

If $y = \Phi(x)$ be the equation to a plane curve, then from the Differential Calculus we have for the equation to the tangent at the point whose co-ordinates are x', y'

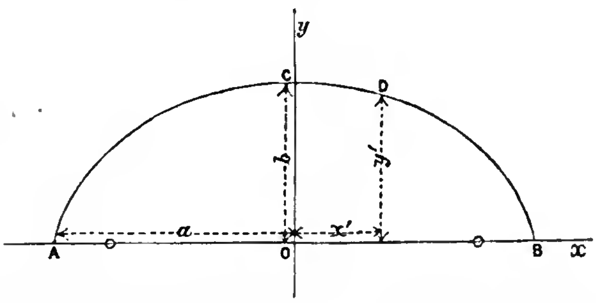
$$y-y'=\frac{dy'}{dx'}(x-x') \quad \ldots \quad (1)$$

and for the normal

$$y-y'=-\frac{1}{\frac{dy'}{dx'}}(x-x') \quad \ldots \quad (2)$$

supposing the axes rectangular.

Application to the Ellipse.



Let A C B be an elliptical arch. Take O, the centre of the ellipse for the origin of co-ordinates: A O B the major axis for the axis of x; and O C, perpendicular to it for the axis of y. Then

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

is the equation to the curve; a and b being the semi-axes major and minor respectively.

Suppose we require to find the normal at the point D, whose co-ordinates are x', y'.

We have from the above equation

$$y'^2 = b^2 - \frac{b^2}{a^2}x'^2$$

Therefore $$y' = \left\{b^2 - \frac{b^2}{a^2}x'^2\right\}^{\frac{1}{2}}$$

Differentiate this with respect to x'.

$$\frac{dy'}{dx'}=\tfrac{1}{2}\left\{b^2-\frac{b^2}{a^2}x'^2\right\}^{-\frac{1}{2}}\left\{-\frac{2b^2}{a^2}x'\right\}$$

$$=-\frac{\frac{b^2}{a^2}x'}{\left\{b^2-\frac{b^2}{a^2}x'^2\right\}^{\frac{1}{2}}}=-\frac{\frac{b^2}{a^2}x'}{y'}=-\frac{b^2x'}{a^2y'}$$

Substituting this value of $\frac{dy'}{dx'}$ in equation (2) we get as the equation to the normal at the point D

$$y-y'=\frac{a^2}{b^2}\cdot\frac{y'}{x'}(x-x') \quad \ldots\ldots \quad \ldots\ldots (3)$$

It will be observed from the above that if $y'=0$, y also $=0$: that is, that at the springing the normal is horizontal. Also, if $x'=0$, x also $=0$: that is, that at the crown the normal is perpendicular.

Let $a = 30$, $b = 20$, $x' = 10$:

then from the equation to the curve $y' = 19$ nearly. Substituting these values in equation (3) we have

$$y-19=\frac{900}{400}\cdot\frac{19}{10}(x-10)$$

$$\therefore y=\frac{171}{40}x-23{\cdot}75.$$

The quantity—23·75 corresponds to the intercept C in the ordinary equation to the straight line, namely

$$y=mx+C$$

and being negative shews that the normal at the point under consideration cuts the axis of y *below* the axis of x. If the dimensions were in feet it would shew that the normal cuts the axis of y 23ft.9in. below the springing line of the arch.

For the mere *slope* of the normal (that is the bed of the voussoir) the intercept is thrown out.

We have then $y=\frac{171}{40}x$; that is, the ratio of the base to the perpendicular is 40 : 171 or 1 : 4·275.

The above method applies to any curve ; and therefore may be used for circular arches : but the circle is so simple a curve, being of uniform curvature throughout, that the slope of the head of a voussior at any point of a circular arch may at once be found from the equation to the circle. Thus—

The equation to the circle, taking the centre as the origin of co-ordinates is

$$x^2+y^2-r^2=0$$

where r is the radius.

From the above $$y=\sqrt{r^2-x^2} \quad \ldots\ldots (4)$$

And r being known, the value of x for any particular value of y (and *vice versa*) can always be calculated ; and the slope of the normal is the ratio of the one to the other.

Suppose a segmental arch of 60ft. span and 12ft. rise. The radius of such an arch is 43·5ft.—from the well known property of circles that if two chords in them intersect the rectangle under the segments of the one is equal to the rectangle under the segments of the other. If it be required to find the slope of the bed of a voussoir 20ft. from the centre, or axis of y, we have

$$y=\sqrt{43{\cdot}5^2-20^2}=38{\cdot}63$$

Therefore 20 base : 38·63 perpendicular is the slope of the normal at the proposed point.

R. W. THOMPSON, C.E.

MADRAS ; *July* 20, 1887.

BURDWAN—ITS SANITARY CONDITION.

II.

WE will now pass on to the conservancy of the river Banka. This is a stream which traverses the town from east to west, and passes under the iron girder bridge on the Railway, about one mile east of the Railway station. The stream runs near Joojooty on the river Damoodah, 12 miles from Burdwan, at which point it is connected by a short channel, protected by a masonry sluice which provides the supply of river-water from the Damoodah for the waterworks and is conveyed by the natural channel of the river Banka to Kunchunnuggur ; one mile to the east of Burdwan, where a fine annicut has been constructed by the Irrigation Department, that bunds up the water for the supply of the Eden Canal, which takes off these. The waterworks are constructed immediately above the reservoir and the Municipality has the advantage of the use of the annicut above the head sluice and weir for the supply of the mains ; therefore what water is *not* drawn away to the Eden Canal and the waterworks passes as spill over the masonry weir, down the river Banka and through the town. As this is chiefly the Damoodah river-water for the greater portion of the year during the dry months, and though unfiltered and occasionally mixed with drainage must be fairly wholesome, it is largely used by the inhabitants on the south bank as the filtered water supply only serves the town on the north bank of the river Banka. Now, though this water is largely used by the inhabitants who do not get hydrant water, for both drinking and bathing along a length of about 2 miles, the Municipality takes no steps to prevent pollution of the stream. We recommend a small conservancy establishment, and arrangements made similar to those proposed for the improvement of tanks. We are of opinion if this were done, that there is no immediate urgency for the extension of the water supply to the south bank of the river and, that until it is done, that this polluted stream will continue to be the most fruitful source of disease, and nucleus for malaria in Burdwan. We should begin by clearing the banks of trees and opening out a broad metalled road, above flood level, along both banks as far as the *bustees* extend, the banks being railed off, and ghauts allowed at fixed intervals, bathing &c. at casual spots being prohibited. The Municipal Commissioners have grossly neglected their duty in the way that they have allowed private individuals to make gardens and even build houses on public land, which is or should be under the charge of the Municipality. This land should be reclaimed, together with the chur land by deepening and widening parts of the channel.

The "churs" are now nuisance grounds and covered with jungle chiefly, which get flushed during freshets in the river, and then when the water subsides causes rotting vegetation, which during the fierce burst of sunshine in the rains gives forth the most poisonous gases and is accountable for much of the sickness of Burdwan. All the houses, including those of the European residents, along the banks, are notoriously unhealthy, especially during the cold season when the flood water has subsided and the chur land is rank with jungle. On a still evening, the damp and fœted smell, which is perceptible as far as the Law Courts, is most overpowering. There is a masonry weir at the lower end of the town, near the Railway bridge, which does not seem properly managed, by the irregular way in which it is worked, unnecessary raising and lowering of the water goes on. The water should be kept at such a level as to avoid flushing the chur lands, and there should always be a minimum depth of two feet during the dry season by deepening out the bed. The channel might be widened out, and the chur land done away with as much as possible by raising it and forming islands above flood level or terraces along the banks. This new land if kept clean, might be leased out as a grazing ground. Such a scheme would greatly improve the appearance of the town. As regards the cost, to excavate a channel with 40ft base say 5ft. deep for one mile, it should not exceed Rs. 6,000. This earth would not only be ample for a broad road on each bank, but also a fine grassy terrace below it.

We shall now proceed to consider the drainage of the town. The river Banka is the chief natural drain, and should take all the surface drainage over the area lying between the river and the river Damoodah embankment. Undoubtedly it had formerly branch channels which fed it, but they have long been entirely obliterated or turned into paddy fields though there are still one or two channels barely traceable near Kunchunnuggur. These old watercourses should be reclaimed and kept open.

If levels were taken, it would probably be found that the greater part of the Municipal area, could be drained into the river Banka, and the drainage of the remainder might be diverted northwards through the paddy fields to the Goura Nuddee, a small stream which crosses the Cuttwa road on the 1st mile. At present drainage is obstructed by private individuals having constructed tanks, bunds, &c., on the sides of the river Banka. This should be prohibited and all drainage outlets kept under Municipal control.

The Sanitary Commissioner reports regarding the arrangements for drainage "that they are on the whole very defective and unsatisfactory. Drainage from the town in its natural state may be towards the Banka river and drains have been constructed to carry off the water to it, but drainage generally is only into the nearest tank or hole, which has no outlet in too many instances. The main drains are mere deep ditches and are totally wanting in proper levels............An efficient system of drainage is an absolute necessity for the town and without it Burdwan can never be a healthy place."

As an instance of the apathy of the Commissioners we are informed that they would not sanction the outlay of Rs. 100 some years ago, to have a few levels taken and a drainage scheme prepared.

As this is the Jubilee year when every Municipality in India is ready to provide funds for some praiseworthy object in honour of Her Most Gracious Majesty the Queen Empress, we deem this a favourable opportunity to put forth our views and hope some steps will be taken to ameliorate the condition of the poor and suffering of Burdwan.

We are informed that the Municipality propose devoting Rs. 4,000 to the construction of a Town-Hall, and that the Distict Board will contribute the same sum. We can only say that we sincerely hope they will not undertake such extravagance, but will see their way to expending the money in some such direction as we have pointed out.

THE LUCIGEN.

THROUGH the courtesy of the Engineers connected with Messrs. Bulloch Brothers and Co., Rangoon, where a series of experiments have been successfully conducted with this new lamp, I have been enabled to give two sketches of the same. This new system of lighting appears specially designed for large open spaces, such as mills, dockyards and also for use on sea-going vessels. It is only a recent invention (jointly introduced by Mr. Jas. Lyle and Mr. J. B. Hannay). The "Lucigen" was originally introduced at the Forth of Tay Bridge Works in December 1885, where its superiority over electric are lights was fully recognised. But it was more widely known after the last Exhibition and has since established its advantages over all other known lamps. It has been introduced into most of the large engineering, manufacturing and ship-building yards in England, and is also used by the Royal Arsenal at Woolwich.

The apparatus simply consists of an iron reservoir having a vertical pipe leading to the burner; the reservoir is stocked with a sufficient quantity of refuse of chemical and oil works, and this is forced by means of compressed air, under a pressure of about 12lbs. per square inch, up the vertical pipe to the burner; by this means the oil is sub-divided into a minute spray and when lighted it burns as a large solid flame, and all the particles are thoroughly consumed without having either smell or smoke.

The lamp experimented on is only a small size Lucigen, and gives a light equal to about 200 candles with a consumption of about 1 bottle of the hydrocarbon oil per hour. but it is intended to use a larger lamp, which will give a light equal to 2,500 candles with a consumption of 2 gallons of oil per hour, and will provide ample light for the whole yard having a radius of 500 feet from the light as a centre. It is also claimed for the "Lucigen" that it is entirely free from the defects incidental to electric and other lights where the maximum of intensity is obtained in the minimum area of effluence, with the resultant dark shadows and strains to the optic nerves. It diffuses a glowing rather than intense light over the space illuminated.

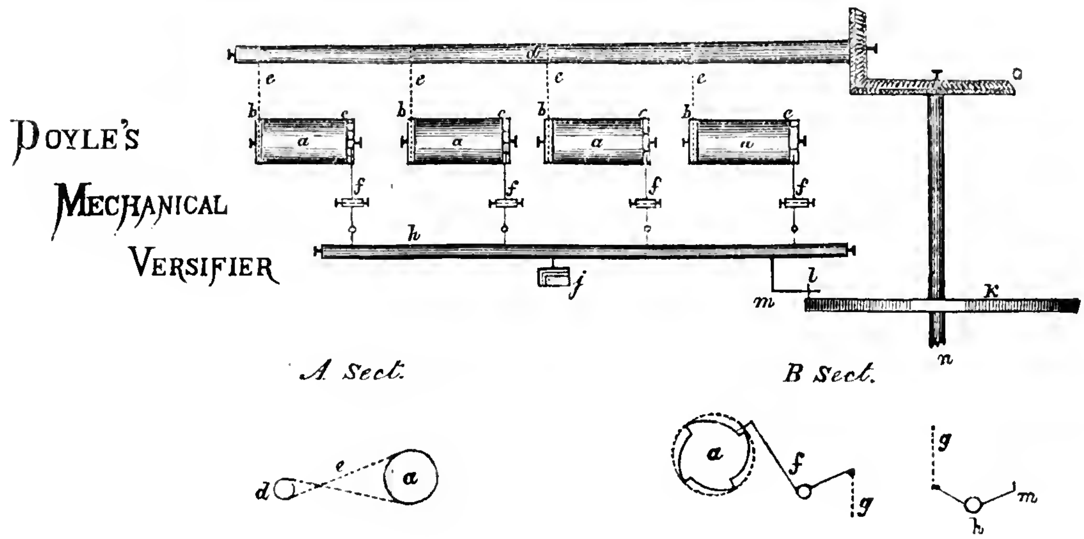
There are modifications of the lamp in which the flame is caused to issue at an angle, so as to prevent shadows being cast below. Small bracket lamps of the same description can also be used for lighting spacious halls; in which case a central oil tank is the supplying source, all the air and oil being conveyed by separate pipes to the various burners. When dry steam is available it may be substituted for compressed air and a special appliance has been manufactured by the inventors, in which the heat of the lamps is sufficient to produce steam for its own use.

The Lucigen also has these necessary advantages besides being portable; the wind or rain never affects it. It is manufactured by the Hannay's Patents' Co. Ld., Glasgow.

H. T.

A MECHANICAL VERSIFIER.

By the Revd. James Doyle, Catholic Irish Mission, Madras.



A certain unequal number of selected words, or groups of words, are inscribed longitudinally on each of a suitable number of cylinders (*a*, *a*), which are grooved at one end (*b*, *b*), and indented at the other (*c*, *c*); the number of notches on each individual cylinder, corresponding with the number of words, or groups of words, and the position of the indentations being determined by the position of the words or groups of words, inscribed on that particular cylinder. These cylinders are mounted by pivots on standards, and are all connected with a roller (*d*), also mounted by pivots on standards,—by endless bands (*e*, *e*) passing over the grooved end of the cylinder and the roller (as *per* section A). A number of cranks (*f*, *f*) corresponding with the number of cylinders used, and having a spatula at one end and a loop at the other (see section B), are likewise mounted by pivots on standards, and in such a position, that the spatula of each crank may work freely into the indentations on a corresponding cylinder (consult section B). These cranks all connected by their looped ends, and by just a sufficient length of cord (*g* in section B) with one other crank (*h*) mounted as the other cranks, but on a lower level, and weighted (*j*), so as to incline in a direction, opposite to that of the first cranks. A wheel (*k*) with a projection (*l*) in its inner plane and near the ring, is mounted in such a position, that in the course of its revolutions, the projection may tilt up the crank *h* by acting on its arm *m*. The motive power operates at the extremity *n* of the axle of the wheel *k*; a bevelled wheel (O) at the other extremity of this axle, communicates motion to the roller (*d*).

The action of the machine may be thus described :—

When the machine is set going, *actual* motion is given to the roller *d*, but only *possible* motion to the cylinders *a*, *a*, in consequence of the action of the cranks *f*, *f*, on them. When, however, the crank *h* is tilted up by the action of *l* on *m*, the result is a strain on the cords *g*, and this has the effect of drawing out the spatulas of the cranks from the indentations of *c*, *c*, (consult section B), and setting the cylinders *a*, *a* free to revolve; but so soon as the crank *h* is released from the tilting influence of *l*, it reverts to its original position: this releases the strain on the cords *g* and the spatulas of the cranks *f*, *f* fall back and on their respective cylinders and slipping into the next indentation prevent the cylinders from revolving till the wheel *k* completes another revolution. Now, as has been intimated, there are fewer indentations on some of the cylinders than on others, and consequently some of these cylinders, will come to a state of rest sooner than others, and consequently also some cylinders will complete their revolutions more quickly than others, and exhibit certain portions of their surface uppermost and in a state of quiescence, more frequently than others: it is this last fact that is utilized for the composition of verses mechanically, and in this wise :

You compose, or select a verse, embodying the sentiment you wish to express, say: *God save the Queen*; and you next divide it into sections, as you find convenient, thus for example, we might make four sections of this verse:

I.	II.	III.	IV.
God :	*save :*	*the :*	*Queen.*

You next select a number of synonyms, or at least interchangeable words, or groups of words, having the same, or an interchangeable number of feet, for each of these sections—*ex. gr.*:

I.	II.	III.	IV.
God	Save	the	Queen
Heaven	Aid	Our	
Mighty Father	Guard		
Jehovah			
Angels			

The above table also illustrates the arrangement of the sections and of their synonyms on the cylinders, and the positions of the indentations. It will further be remarked that the numbers of words or wordy groups, are not only unequal in every case, but are further prime numbers—a result one should always try to secure.

Suppose now the above table to be mounted on the cylinders of this machine, and the indentations duly wrought, let also the first verse read, God save the Queen, and let the machine be set in motion. At the first tilt of the crank *h*,—cylinder I. will revolve $\frac{1}{5}$ and come to a stop; II. will move $\frac{1}{3}$; III. will revolve through $\frac{1}{2}$ of its girth; and IV. will complete a full revolution, since it has only one notch by which it can be gripped, and they will each exhibit a word, forming the following verse:—

I.	II.	III.	IV.
Heaven :	*aid :*	*our :*	*Queen.*

At the next tilting the following verse will appear:

Mighty Father guard the Queen,

and so on through 30 variations. But of course by increasing the synonyms in each section, and by just a few, the number of variations could be rendered almost fabulous.

The machine is inclosed in a case with slits at the top, through which only the words inscribed on the cylinders are visible, that is, as they rise to the top, and whilst cylinders themselves are held stationary.

Place's Gardens: J. D.
July 1887.

CALCUTTA PORT IMPROVEMENTS.

KIDDERPORE DOCKS.

VI.

Report of Joint Committee of Port Commissioners and Chamber of Commerce of 1883.

THE conclusions arrived at by the majority of the Committee appointed in December 1881, namely, that increased accommodation for the shipping frequenting Calcutta should be provided by constructing docks at Diamond Harbor, not having weight enough to ensure their acceptance by Government, in the face of the unanimous opposition of the mercantile community of Calcutta, the further consideration of the subject was taken up by the Port Commissioners, who, as was mentioned at the close of our last article, were in February 1883, called upon by the Lieutenant-Governor of Bengal to institute an enquiry and submit a report, in communication with the Chamber of Commerce, as to the measures which it was possible to take for the extension of the existing accommodation of the Port, and the cost at which any changes they might recommend could be carried out. The Port Commissioners appointed Mr. H. A. Cockerell, C.S., C.S.I., their Officiating Chairman, Mr. D. Scott, C.E., their Officiating Vice-Chairman,* Mr. Franklin Prestage, C.E., the Agent of the Eastern Bengal Railway Company, Mr. W. P. Alexander, of Messrs. Mackinnon, Mackenzie & Co., and Mr. Keswick to represent them on the Joint Committee, and the Chamber of Commerce, on their part, nominated their President, Mr. R. Miller, of Messrs. Hoare, Miller and Co., Mr. H. B. H. Turner, of Messrs. Turner, Morrision and Co., and Mr. James Stevenson, of Messrs. Graham and Co. On Mr. Miller afterwards going to England Mr. Lorraine King, of Messrs. Vale, King and Co., was nominated in his place.

The Joint Commitee,—looking to the very complete evidence taken by the Diamond Harbor Committee, as recorded in the appendices to their report, and to the practical knowledge of the requirements of the commerce of the Port possessed by several of the members,—considered it unnecessary to examine witnesses. As suggested by the Government of India, due consideration was given to the various projects which had previously been brought forward for providing docking accommodation for the shipping of the Port. But, to begin with, the Committee, in their report, drew attention to the special characteristics of the trade of the Port of Calcutta, and gave statistics of the nature and extent of its shipping business. With a view to ascertaining the accommodation required for vessels and the best facilities which could be given for discharging and loading them, they classified the vessels which entered the port during the year 1882-83 as follows, and found that the jetties accommodated all the general import cargo vessels, other than those from China and the Coast Ports; and that the number of vessels so berthed at the jetties during the year was 199.

	No.	Tonnage, net.
Vessels bringing general cargo from ports of the United Kingdom and Europe ...	199	375,947
Vessels from China, the Straits, and Coast Ports ...	332	356,155
Do. from the United Kingdoro, bringing Railway material and iron	33	47,886
Vessels bringing horses, and in some cases a few articles of import	11	14,765
Vessels bringing Petroleum	27	37,179
Do. Coals	40	57,540
Do. Salt	174	234,171
Do. Ballast	335	386,841
TOTAL	...1,151	1,510,344

There had been a progressive increase in the tonnage of the Port during the past four years, the figures being as follow:—

Year.	Number.	Gross tonnage.	Net tonnage.
1878-79	967	1,430,789	1,115,392
1879-80	896	1,415,979	1,103,013
1880-81	984	1,579,868	1,220,546
1881-82	1,074	1,808,905	1,377,399
1882-83	1,151	1,982,187	1,510,344

*Mr. Scott was relieved by Mr. Wm. Duff Bruce, C.E., the permanent Vice-Chairman, when he returned from furlough.

As regards the amount of imports the information available was defective, but—supplementing the Custom House returns by those compiled from the jetty reports—the total for 1882-83 was 1,040,513 tons. The information regarding exports was, for all the large staples, full and accurate, and the totals for the five years above mentioned were—

Years.	Tons.
1878-79	1,247,298
1879-80	1,165,870
1880-81	1,485,777
1881-82	1,673,639
1882-83	1,798,536

The downward traffic of the East Indian Railway had increased greatly, as was shewn by the totals for the preceding year and the two *lustras* preceding it, which were—

RECEIVED AT HOWRAH.

	COALS.	OTHER GOODS.
	Tons	Tons.
1871—1875	1,316,289	1,105,221
Average per year	263,257	221,044
1876—1880	1,758,744	2,973,748
Average per year	351,748	594,749
For year ending 31st March 1883 ...	502,763	815,047

During the year 1882-83 the total tonnage of the goods received by rail at Howrah amounted to 1,317,810 tons, and of this quantity 746,408 tons were of the class of goods exported by sea from Calcutta. The quantity of goods brought down to Sealdah by the Eastern Bengal Railway during the same period amounted to about 400,000 tons, of which 341,693 tons were of the class of goods exported. The following are the totals of a table given by the Committee, shewing the quantities of goods shipped, brought down by the two Railways, and by boats and steamers on the rivers and canals :—

Quantity Shipped.	Quantity brought down by East Indian Railway.	Quantity brought down by Eastern Bengal Railway.	Quantity brought through Canals and Nuddea Rivers by boats.	Quantity brought by river Steamers and Flats.
Tons.	Tons.	Tons.	Tons.	Tons.
TOTAL..1,798,536	746,428	341,693	1,012,885	110,515

Up to the time of the Committee's deliberations the operations of the Port Commissioners had been almost entirely restricted to import cargo brought from ports of the United Kingdom and the European continent, which as already mentioned during the year 1882-83 amounted to 375,947 tons, brought in 199 vessels. And for the convenience of this trade the Commissioners were constructing large warehouses within the jetty inclosure by the use of which the charge for removing goods from the jetties to warehouses in town would be avoided. The jetties had been so continuously occupied by the discharge of vessels bringing general imports that neither the salt ships nor the bulk of the vessels employed in the export trade had been able to find accommodation at them. They all had to unload and load in the stream by means of cargo boats or lighters; and it was for these vessels—673 in number during 1882-83—that the Committee had considered the necessity for accommodation.

In deciding on the facilities to be recommended the Committee had to consider the existing practice in dealing with the chief export staples.

"One of the advantages claimed for the Diamond Harbor Dock scheme, as stated in paragraph 49 of the Committee's report, was that goods from up-country could be taken alongside vessels and placed direct into the ship's hold from the railway wagon. The mercantile members, in recording their dissent from the report, took the opportunity of pointing out that the peculiar circumstances of the Indian trade practically prohibited such direct shipment. In the case of grain, wheat, seeds, and most country produce, the Calcutta merchant and exporter has to exercise a most vigilant supervision over the cargo purchased up-country and sent down to him."—"It is therefore an absolute necessity to the Calcutta shipper to examine, weigh, and, where necessary, sort and re-bag his cargo before sending it on board."—"For this reason the Committee thought the accommodation to be provided should be as close to Calcutta as possible, and sufficiently large to meet the requirements of the trade, and give every facility for the examination, sampling, and sorting of large grain and seed cargoes."

The Committee found that twenty-one additional jetties could be erected on the Calcutta side of the river, within the limits of the Port, without causing inconvenience, and another twenty on the Howrah side, below the Botanical Gardens, which could be connected by a direct line with the East Indian Railway, and they estimated the cost of doing so at Rs. 2,05,00,000.

Allowing 14 days to each vessel, the additional jetties would accommodate 1,066 vessels annually. Those at Garden Reach would have to be provided with railway accommodation by an extension of the Port Commissioners' Railway from Chandpaul Ghât along the river bank. But, judging by past experience, such detached tee-headed jetties would not be efficient, and their heads would all have to be united to form a continuous wharf as had long ago been done with the original jetties.

"Such a wharf was absolutely necessary for the import trade, but it costs almost as much to provide accommodation in this shape as it would take to give the same extent of accommodation in docks, while vessels lying at jetties would have neither the security nor the conveniences that could be afforded in a suitably arranged wet dock. It was therefore considered that if any extension of the existing jetty accommodation should be provided for the import trade, it should be limited to two jetties to the south of No. 8 jetty, at a cost of 11½ lakhs."

The Committee, however, strongly advised that, unless there should be delay in giving effect to the proposals they submitted for docks, no more jetties should be provided, and that, in that event only two to the south of No 8 should be erected.

The Committee considered the projects, of date prior to 1882, which had been before the Diamond Harbour Committee and also the following:—

(1.) The proposal of Lieutenant Stiffe, Port Officer, regarding docks at Akra.

(2.) The proposal of Messrs. Denham and Bayne, resuscitating a scheme of the late Mr. Power for docks at Akra.

(3.) The proposals submitted to the Committee by Mr. Bruce for the construction of docks at Kidderpore and jetties at Howrah for the export trade.

(4). The proposal of Mr. F. Prestage for docks at Howrah with canal leading from Garden Reach to the docks.

Lieutenant Stiffe's project contained no information, and no details of any description, but he put the cost of his docks at 300 lakhs of rupees. Messrs. Denham and Bayne (of the E. I. Railway) submitted drawings, and estimated the cost of their scheme at 122 lakhs only; but their docks were pronounced to be unsuitable for the class of vessels requiring accommodation, and they gave no details of the cost. Both of these proposals for docks at Akra were, however, found to be inadmissible owing to the site being then as it has been before, in 1863, pronounced by all the marine authorities to be absolutely prohibitory, owing to the difficulty of entrance to the proposed docks, and because there was no safe anchorage there or near it. The eddies there were said to be almost continuous and as bad as any in the river. Messrs. Denham and Bayne had suggested an alternative entrance from Garden Reach, with a canal two miles long leading to the docks, which would be preferable. But the Committee found that there was a general unanimity of opinion that, to meet the requirements of the import trade of the port, docks should be located on the Calcutta side of the river, and they saw no reason why the exports should not be accommodated in the same docks, when the East Indian Railway should be taken across by the bridge about to be built. Mr. Prestage's proposal for docks at Howrah was therefore also rejected, and the Committee resolved to recommend a site at Kidderpore immediately to the south of, and with an entrance through, the Government Dock Yard.

The works recommended to the Committee to be undertaken at Kidderpore, and which are now being carried out, will be described and illustrated in future articles.

NOTES FROM HOME.

(From our own Correspondent)

Among the Jubilee honors it is pleasing to note that baronetcies have been conferred on Mr. Richard Moon the Chairman of the London and North Western Railway Company, a gentleman who represents the most powerful and influential of our Railway Companies in the United Kingdom; and upon Sir William Armstrong who now becomes Lord Armstrong, whose scientific genius and skill have so greatly benefited his country.

Builder is enabled to place before its readers a large illustration of Mr. Colcutt's design for the Imperial Institute, to which I alluded in my last letter—and the general opinion is that the design of the main body of the building is a pleasing bit of architecture, but that the tower's bare appearance is out of keeping with the richness of the remainder. No doubt modifications will be made in this and other details, but in criticizing the work it has to be borne in mind that economy had to be taken into consideration in working out his design.

A very important metallurgical improvement has just been brought to a successful completion at experimental works at Lambeth in a new process for the production of sodium and through sodium of aluminium and magnesium which are dependent upon it. The process is the invention of W. Castner of New York and enables a great saving in the wear and tear of cylinders and furnaces. The effect of the new process will be to place a practically unlimited supply of sodium, aluminium and magnesium, as well as of metallic alloys dependant upon these substances, at the disposal of the manufacturers at one fourth their previous cost.

Under the title of the Aluminium Company Limited, a Company is being formed for producing cheap aluminium by the aid of the sodium process referred to. The proposed capital is £400,000 in 60,000 shares, and amongst the directors are the names of Sir H Roscoe, Sir Andrew Clark and Mr. William Anderson.

Papers on basic cinder as a manure were recently read in the Chemical Section of the Manchester Exhibition by Professors Wrightson and Munro. The points of special interest are its manurial value owing to its highly phosphatic composition, the extreme facility of its application, all that is required being a disentegrator to reduce it to an impalpable powder, and its abundance, one steel company turning out over 60,000 tons per annum. This may therefore he looked upon as a boon to agriculturists. The substance is to be applied at the rate of from half to one ton per acre.

A series of experiments recently made by a French metallurgist are stated to have proved that steel loses weight by rust about twice as rapidly as cast iron when exposed to moist air. Acidulated water was found to dissolve cast iron much more rapidly than steel. This would indicate that steel bridges are less affected by the acids contained in the smoke of locomotives than iron ones.

The Steam Boilers Bill is likely it appears to meet with strong opposition in the House. The object of the Bill is to empower the Board of Trade to annually inspect the boilers of steamers, and this is complained of as undue interference, seeing that the Engineer holds a Board of Trade certificate. A meeting at Lloyds has condemned the Bill and many protests have been sent up against the measure.

Rapid progress is being made with the construction of the Birmingham cable tramway. The line between the town and Hockley Brook will it is expected be in operation before the end of the month and the whole system will be completed before the end of the year. The depot at Hockley Brook is nearly completed and Messrs. Tangye have constructed the high pressure horizontal winding engine of about 250 horse power which will keep the endless steel rope in motion at an average rate of from 6 to 7 miles an hour. Another engine of equal horse power will work the route between Hockley and Handsworth. The steel rope having a diameter of 1½ inches will have a safe load strength of from 40 to 50 tons and will run over pulleys on a slot about 17 inches below the road level.

A new electric boat named the *Countess* lately built at the Royal Albert Dock is now fitting out to take part in the Jubilee Naval Review at Spithead. This craft is entirely a new departure in electric motion, as in addition to the 400 cells with which her main engines are worked she will be fitted with a donkey engine to be used as an auxilliary, its motive power being derived from the force accumulated by the vessel's passing through the water, and it is expected by her owners that a speed of 13 knots will be obtained. Should her trial prove successful other vessels of a similar type will be laid down and the principle is likely to be applied to torpedo vessels.

Dr. Frankland in reporting experiments in bacteriological research which he described before the Society of Chemical Industry stated the curious fact that, contrary to what might be expected, the organisms found in the water are most numerous in the winter months. This resulted probably from the rivers being fed more by spring water in summer than by surface and drainage water.

BURMA.

(From our own Correspondent.)

A NEW method of stamping and flanging plates, &c., for boilers, engines, &c., by hydraulic pressure, has been lately introduced at Dallah Workshops, belonging to the Irrawaddy Flotilla Company, Limited; it is certainly a great improvement on the old mode, when large plates had to be flanged by the slow and laborious process of hammering, incurring considerable labor and time. The hydraulic process chiefly consists of forcing a cast-iron or steel model of the form required into three matrices, the last one finishing the shape. This process also tends to the durability of the metal, as by the gradual mode of pressure it prevents the sudden distension of the fibre or grain of the metal which in many cases happens to the plates when beaten out by the heavy blows of large hammers; besides the hydraulic process turns out a plate with an even surface and a truer model, free from pucker, &c., which can hardly be attained by hammering.

Steel plates turned out under this new process are seen in their best form, as it does not require the constant heating and hammering, which is an undoubted objection to the stability of the work turned out, as constant heating produces scales, thereby reducing and eliminating the quality of the metal required. Almost all the plates for steamer requirements of the Company are now worked by the new process, and from experience it has been found to be the most durable as well as economic.

The local State Railways, with a view to safety and economy, are now introducing recent inventions. Jones' patent lock buffer has been tried and found successful, and now we have the Insein station, where the workshops of the State Railway are located, being filled up with Messrs. Laxby and Farmer's patent safety interlocking points and signals. The former has already been introduced and the latter is now being subjected to test, and will on approval be introduced along the whole line.

A French syndicate, through their Agents, Messrs. Fischer and Co. of Bombay, tendered to supply the electric light to all the wharves and jetties at this port, where an improvement in this direction is absolutely necessary during the shipping season, when frequent deaths and accidents are the rule. The Port Commissioners, however, for want of funds, declined the offer, but we are assured that the illuminations of the port will shortly be improved; by what means has not been decided on.

The public of Rangoon are greatly indebted to the untiring energy and zeal of our worthy City Engineer Mr. O. Deacon Clark, C.E., for the success which he attained in introducing the subject of the new drainage scheme for this town Messrs. Shone and Ault have been telegraphed to to send out all the necessary apparatus connected with the scheme in working order as early as practicable, in order to commence operations at an early date. The Bank of Bengal have accommodated the Municipality with a loan of 23 lacs to meet expenses.

In view of increasing the large commercial relations existing with Rangoon and Glasgow, the local Government are in communication with District Officers in Burma to commence collecting exhibits for the forthcoming International Exhibition of Industry, Science and Art, to be held in Glasgow in 1888.

No special officers have been selected for the purpose up to date, but we are pretty certain that either Mr. Tilly, who so ably conducted the work and represented Burma at the last Calcutta Exhibition, or Mr. Cabaniss, the late Assistant Director of Agriculture, will be chosen for this Province.

NOTES FROM MADRAS.

(From our own Correspondent.)

OUR Jubilee rejoicings are now quite over, and some people—notoriously those who took the most active part in them—even say they are glad of it. Scaffoldings have been abased, lanterns and *chirajs* have extinguished themselves, and bunting has ceased to flaunt. All that remains to be done is to pay the bill—a formality which the oil merchants and firework men are very anxious to have observed.

There is but little doing here just now either in the Engineering or Architectural line—no private building at all worth mentioning. The Harbor Trust Board are laying down an additional siding from the iron pier to relieve the congestion of traffic on that over-worked institution. This siding runs parallel to the existing mixed gauge (broad and narrow) line running along the beach, and two cranes are to be erected between them, so that goods can at once be transhipped from the pier trollies on to either the Madras Railway or South Indian Railway waggons. Also goods can be brought by rail right up to the pier and either at once transhipped into the pier trollies, or stored pending shipment. For this purpose iron sheds are to be erected along the new siding. The scheme reflects great credit on the Harbor Trust Board, for not only will it be a great convenience to the mercantile community, and yield themselves a well-deserved profit, but they will reduce the Madras cartman—to his proper dimensions. He will not be in so much request as heretofore, and the circumstance will not only make him as little uncivil as a cartman can be, but he will no longer scorn a reasonable reward for his services.

Of public buildings, our Town Hall, of which you had such a capital illustration in your issue of the 2nd instant, is fast approaching completion. The extension of the Civil Engineering College buildings is well forward, and would have been more so had Mr. Stephens been supplied with the roofing girders in time. And the Municipality have commenced a new façade to their offices. The building in Errabaloo Chetty Street has long been an eyesore to the æsthetic, but it promises now to be a thing of beauty, and consequently a joy for ever. Mr W. N. Pogson, Architect, has designed a sort of cage or mask, which amounts practically to a verandah, for it, such that its own father will not be able to recognise it again. I hope to be able to send you drawings shortly shewing the old face and the new. The most successful application of this system of improving buildings that I have seen carried out has been in Mr. Chisholm's mask to the old D. P. W. Workshops on the beach between the Fort and St. Thome. The old building was the most hideous thing that even the D P. W. ever perpetrated, but we now have what Mr. Ruskin might call a poem in brick and chunam. I mentioned Mr. A. Lee Pogson to you in my last letter. I may as well tell you at once—there being nothing to be gained by reticence—that Mr. N. R. Pogson, our Government Astronomer, is the father of both these Pogsons and many more.

I read with much interest your remarks, in your issue of the 9th instant, on a circular addressed to unemployed Civil Engineers in the country, by one of their number. I have not seen the document, so can offer no opinion upon it. I agree with you that "at the present moment Government is in a most difficult position." But I have no sympathy for them, for they have only themselves to thank for the awkward predicament they find themselves in, with about a hundred engineers on their hands for whom they have got no work to do. You say "If there were no dearth of men in India to carry on all outside works, why is it necessary for private railway companies and other concerns such as cotton mills, jute mills, workshops, &c., &c., to keep on recruiting Engineers from England? And yet it is well known that new men are continually being imported into this country."

New men certainly are continually being imported into this country as you say, but this is not due to there being any dearth of men in the country, but to the fact that the Directors of private companies very naturally send out their own relations and friends to every good appointment in their gift; and while human nature is what it is I do not see how this can be remedied.

There is, however, one abuse which can be remedied which calls loudly for reform, and that is the doing of private work by men who are in the service of Government, or in that of Guaranteed Railway Companies—which is practically the same thing. There is an order of the Government of India which prohibits—not the doing of private work by its officers—but the acceptance, without their consent, of fees for doing it. That is to say, the part of the transaction which must be done openly, they sanction, but the other part, the acceptance of the fee, which can be done privately, they prohibit. The man who cannot interpret this order aright is unworthy the honor of serving an astute Government. We had a case not long ago where an officer of the D. P. W. competed successfully with private Engineers for the work of designing water-works for one of our towns, and got leave from the Government to enable him to take the necessary surveys and sections. And the Locomotive Superintendent of one of our railways has erected pumps and laid down piping for the water-works of another. I have no doubt this officer will apply to Government before long for an assistant or an increase to his salary on the ground of being over-worked.

ROYAL JUBILEE EXHIBITION—MANCHESTER.

[*Expressly for* INDIAN ENGINEERING.]

IN entering the machinery section from the railway, one of the first exhibits that attracts attention is that of the Hadfield Steel Foundry Co., Sheffield; their display forming a splendid illustration of the vast number of uses to which steel castings can be applied. Over 30 tons of their castings are shewn, and from a careful inspection of them a good idea may be obtained of the immense strides made of late years in the manufacture of steel castings, and of the special adaptability of cast steel for different purposes. It is impossible in the space at our disposal to more than briefly indicate the principal articles shewn.

The most striking part of the exhibit is the arrangement of 8 cast steel hydraulic cylinder castings erected vertically, varying from 6 to 20 ft. in length, and with internal diameter of 6″ to 36.″

Most of the articles are polished up bright, giving a most effective appearance, as well as shewing their remarkable soundness. Owing to the many classes of work for which these steel castings are suitable it may be well to classify them.

For *Railways* are shewn engine wheel centres up to 8 ft. diameter either plain or cast with crank, bosses and balance weights, complete, motion plates, roof stay bars, horn blocks, axleboxes and slides, cross-heads, piston blocks, buffer boxes, cranks and crank pins, domes, tumbler shafts, points and crossings, manholes, light platelayers' trolley wheels and axles, &c. The quality of Messrs. Hadfield's steel is well shewn by one of the locomotive wheel centres which has been tested by dropping upon it no less than 15 times a weight of 21 cwt. from a height of 27 feet. This company are supplying cast steel wheel centres for 70 locomotives which are being constructed for the L. and Y. Railway. Specimens cut out of these wheel centres have given the high elongation of 30 per cent with a tensile strain of not more than 32 tons per sq. inch. Our readers may readily imagine the superiority of these wheels over those hitherto used welded up from wrought iron. In the latter there are more than 100 different welds in one wheel centre, whereas these are cast complete in one piece of homegeneous cast steel. The cast steel roof bars shewn are another speciality of this firm. Originally designed by Mr. T. W. Worsdell of the N.-E. Railway, they have rapidly grown in favor, and Messrs. Hadfield have now supplied more than 5,000 to Railway Companies and locomotive builders. "*Engineering*" says:—"The use of cast steel for these stays appeared to us decidedly a step in the right direction, as it enables the stays to be well proportioned to their work, and affords the opportunity of providing convenient attachments for any form of sling stays which it may be desired to adopt."

For *Tramways*:—Hadfield's Patent "Hecla" wheels, many thousands of which are running on the principal tramway lines in this and other countries. They are exclusively adopted on the Sydney steam tramways, running at high speeds and having to stand very severe usage. Also tramway points and crossings, of which many thousands have been used in constructing tramway lines in this country and elsewhere.

For *Shipbuilders*:—Cranks, levers, crossheads, propellor blades, nuts, couplings, &c.

For *Rolling Mills*:—Helical pinions, anvils, spindles, tups, &c.

Gearing:—Every description of spur, bevel, mitre, pinion, segment, worm, &c., with straight or helical teeth, machine-moulded by patent machinery or from full patterns. Twelve years ago this company supplied large gear wheels of special heavy pitch for driving purposes in the Lancashire Cotton and other mills, Sheffield and other iron and steel rolling mills, &c., and they were one of the first, if not the first, to supply machine-moulded steel gear wheels in rolling, cotton, and other mills and engineering works. More than ten thousand of their gear wheels are at work throughout the world. Sir Joseph Whitworth, years ago, ordered steel gear wheels (12 feet in diameter) from Hadfield's for his steel compressing plant—a high compliment to the quality and usefulness of their castings.

For *Hydraulic Engineers*:—Press cylinders of all kinds in the rough and finished ready for use, up to 22 ft. in length and 3′ 6″ in diameter, to stand various pressures; glands, pumps, press plates, doors, cheeks, rivetters, hobs, &c.

For *Dredgers*:—Hadfield's patent cast steel dredger bucket as used by the Admiralty and by dredging contractors in this country, Australia, Canada, Italy, &c., &c. These buckets have been recently fitted in Australia to the largest dredger ever built. Messrs. Hadfield also exhibit (by the kind permission of Mr. J. Garlick, C.E., Preston) two of the largest dredger buckets yet made in England, 100 of which they have just supplied for dredging the canal from Preston to the sea. These buckets are additionally interesting as giving one an idea of what will be required for dredging the Manchester ship canal. Under this head may be also mentioned, dredger backs, lips, links, tumblers, bars, pins, mouthpieces, gearing, &c., and it may be stated that Messrs. Hadfield have secured the sole right to manufacture Robert's patent bush for dredgers, by the use of which, it is claimed, wearing and breaking of the pins are avoided. This system has been tried in the Suez Canal dredging plant, and has given great satisfaction.

War Material:—Hadfield's patent cast steel shell for 6″ B.L. gun, fitted ready for firing; two 9·2 inch common shells (Hadfield's patent) as now being supplied to H. M. Government; gun carriage castings, &c. Messrs. Hadfield also shew two of their patent shells which have been fired at Shoeburyness, and, bearing in mind that they are castings pure and simple, the tests they have stood are very remarkable. A 6″ shell, after penetrating an 8″ "Brown" wrought iron armour plate, is practically uninjured, only "setting up" one-hundredth of an inch and it could be fired again from the same gun. The striking energy was 3,200 foot tons. Another shell, fired from a 9·2 inch B. L. gun, with 150 lbs. cocoa powder, penetrated 24¾″ of "Cammell" wrought iron armour plate and 2 feet of wood, and is also practically undamaged. Velocity 1,780 feet per second, striking energy 9,200 foot tons. Both these shells being exhibited our readers may see for themselves the correctness of these statements.

The *Collieries, Mines, Contractors*, &c.—Wheels and axles of various kinds, patent self-oiling wheels, barrow wheels, pedestals, rollers, pulleys, cage guides, points, crossings, stamp shoes and dies, tappets, cams, levers, &c., &c. Over 2,000,000 of Hadfield's cast steel wheels and axles (most of which are fitted by their patent fast method) are in daily use in this and other countries. Their registered designs of angle sheaves (for carrying ropes round curves) and self-oiling roller and frame, will repay examination, and are, we understand, meeting with great favor. A pair of wheels mounted on an axle are shewn, which, after falling down a shaft 1,770 feet deep, are only slightly bent, exemplifying the remarkable toughness of the material.

To a practical man, however, perhaps the most interesting item is the collection of test bars, which is probably the most complete ever exhibited, and represents both their cast and forged steel, of varying qualities, suitable for different purposes. It may be mentioned that the tests stood by the unhammered cast steel range from 28 tons tensile strain per sq. inch with 31% elongation; up to 65 tons with 6% elongation; whilst the forged steel bars vary from 28 tons with 41% elongation and 62% reduction of area up to harder kinds with 87 tons and 10% elongation; the series concluding with an extraordinary specimen with 125 tons per sq. inch tensile strain. These are not specimens got up merely for exhibition, but samples of the work turned out daily by this firm.

It must be borne in mind that in no case has an exhibit been manufactured by forging, though some of the castings have been drawn under the hammer shewing that it is possible to have a forging and casting combined in one piece. Several shavings from unhammered steel castings are shewn, one being 30 feet long in a single piece.

That Messrs. Hadfield's good work has been appreciated at previous exhibitions is evidenced by the case of medals on view, comprising *gold* ones from Paris, Melbourne and Madrid, silver ones and special diplomas from Sydney and Calcutta, and other awards gained at London, Wrexham, Cornwall, &c., in all cases the awards being the highest in their line.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Madras, July 26, 1887.

The following transfer is ordered:—

Mr. G. D. Wybrow, Executive Engineer, 1st grade, from charge of the II. Circle to the I. Circle, for charge of the Ganjam Division. To join at the public expense on relief by Mr. J. W. Rundall.

Burma, July 23, 1887.

Upper Burma.

With reference to *Burma Gazette* Notification dated the 27th May 1887, Bhagat Singh, Sirdar Bahadur, Executive Engineer, 3rd grade, made over, and Mr. J. C. Rees, Executive Engineer, 3rd grade, received, charge of the Meiktila Division on the forenoon of the 4th instant.

With reference to *Burma Gazette* Notification dated the 8th July 1887, Mr. H. O. Walling, Assistant Engineer, 1st grade, reported his arrival at Mandalay on the forenoon of the 15th instant, and is posted to the Mandalay Division, military works.

With reference to *Burma Gazette* Notification dated the 14th July 1887, Bhagat Singh, Sirdar Bahadur, Executive Engineer, 3rd grade, is transferred from the Meiktila Division to Mandalay, to be temporarily attached to the office of Superintendent of Works.

Bhagat Singh, Sirdar Bahadur, joined at Mandalay on the forenoon of the 14th instant.

Lower Burma.

With reference to *Burma Gazette* Public Works Department Notification, No. 89, dated the 8th July 1887, Captain M. Laugharne, R.E., Executive Engineer, made over, and Mr. A. T. Dodsworth, Executive Engineer, received, charge of the Toungoo Division on the afternoon of the 12th instant.

Burma State Railway.

Mr. E. T. Faulkner, Assistant Engineer, 1st grade, is granted two months' privilege leave, with effect from the afternoon of the 19th instant.

Mr. E. T. Faulkner, Assistant Engineer, made over, and Mr A. R. Lilley, Executive Engineer, Rangoon district, received charge of the Sittang district on the afternoon of the 19th instant

Punjab, July 28, 1887.

Irrigation Branch.

Mr. R. P. Russell, Assistant Engineer, 1st grade, Delhi Division, Western Jumna Canal, passed the Lower Standard Examination in Hindustani on the 4th April 1887.

N.-W. P. and Oudh, July 30, 1887.

Irrigation Branch.

Mr. H. G. Boyce, Executive Engineer, 4th grade, sub. *pro tem.*, is appointed to officiate as Executive Engineer of the Eastern Jumna Canal, during the absence of Mr. C. G. Palmer, Executive Engineer, on two months' privilege leave.

Central Provinces, July 30, 1887.

With reference to Government of India, Public Works Department Notification dated the 12th July 1887, Mr. H. Humfress, Assistant Engineer, 2nd grade, was relieved of his duties in the Chief Engineer's office, Central Provinces, on the afternoon of the 21st current, on transfer to Beluchistan.

India, July 30, 1887.

Mr. J. A. A. Wallace, Assistant Engineer, 2nd grade, State Railways, is permitted to resign his appointment in this Department, with effect from the 15th July 1887, the date of expiry of his furlough.

Captain W. V. Constable, R.E., Executive Engineer, 4th grade, sub. *pro tem.*, State Railways, Officiating Deputy Consulting Engineer for Railways, Bombay, is confirmed in that appointment, with effect from 26th November 1886.

Mr. H. W. Warden, Executive Engineer, 2nd grade, State Railways, Officiating Deputy Consulting Engineer for Railways, Bombay, is confirmed in that appointment, with effect from the date on which Captain Constable vacates his appointment.

The services of the undermentioned officers are placed at the disposal of the Agent and Chief Engineer, Bengal-Nagpur Railway Company, with effect from the dates specified :

Mr. P. T. S. Large, Executive Engineer, 1st grade, sub. *pro tem.*, State Railways, on return from privilege leave.

Mr. R. A. Way, Executive Engineer, 2nd grade, sub. *pro tem.*, State Railways, on return from privilege leave.

Mr. H. Luckstedt, Executive Engineer, 3rd grade, sub. *pro tem.*, State Railways (for the present only).

Captain W. V. Constable, R.E., Executive Engineer, 4th grade, sub. *pro tem.*, Officiating Deputy Consulting Engineer for Railways, Bombay, with effect from date of relief.

Mr. P. L. Rooper, Assistant Engineer, 1st grade, State Railways, with effect from the 1st April 1887.

Mr. J. N. A. Eaton, Assistant Engineer, 1st grade, State Railways, with effect from the 1st April 1887.

Mr. A. Rowland, Assistant Engineer, 1st grade, State Railways, with effect from the 1st April 1887.

Mr. L. G. Prickett, Assistant Engineer, 1st grade, State Railways, on return from leave.

With reference to Public Works Department Notification dated 1st July 1887, Mr. F. B. Walker, Engineer-in-Chief, Assam-Behar State Railway, is appointed to act as Engineer-in-Chief and Manager of the Tirhoot State Railway, in addition to his own duties, during the absence of Mr. H. Bell, or until further orders.

Mr. H. H. Gahan, Executive Engineer, 3rd grade, State Railways, is temporarily transfered to Bengal.

Military Works Department.

Lieutenant H. V. Biggs, R.E., passed the examination for promotion to Assistant Engineer, 1st grade, prescribed in Public Works Department Code, on the 12th July 1887.

Director-General of Railways.

Mr. W. J. Weightman, Assistant Engineer, 1st grade, is under Public Works Department Code, granted language leave for three months, with effect from the 1st August 1887, or such subsequent date as he may be permitted to avail himself of the same.

Bengal, August 3, 1887.

Establishment—Railway.

With reference to Government of India Public Works Department Notification of the 29th July 1887, Mr. H. H. Gahan, Executive Engineer, 3rd grade, is posted to the Assam-Behar State Railway.

Establishment—Irrigation.

Mr. R. O. Clayton, Executive Engineer, attached to the Balasore Division, is granted privilege leave for three months, with effect from the 2nd of August.

Assam, July 30, 1887.

The thirty-four days' privilege leave sanctioned to Mr. G. W. Winckler, Executive Engineer, 3rd grade, in Assam Public Works Department Notification dated the 7th June 1887, is hereby extended by two days. Mr Winckler reported his return from the privilege leave at Gauhati on the afternoon of the 11th instant.

Mr. E. T. Faulkner, Assistant Engineer, 1st grade, of the late Bengal-Assam State Railways, successfully passed at Shillong the Lower Standard examination in Hindustani prescribed in Public Works Department Code on the 10th May 1887.

Mr. G. W. Winckler, Executive Engineer, 3rd grade, who was temporarily transferred to Dibrugarh to officiate as District Engineer of the Lakhimpur district in orders dated the 8th July 1887, reported his arrival at Dibrugarh, and assumed charge as District Engineer on the forenoon of the 20th July 1887.

NOTICE.

Bengal-Nagpur Railway.

1st.—Sealed tenders for the supply of 30,000 cubic feet of Teakwood scantlings required for the construction of broad gauge Railway carriages in the workshop, Bengal-Nagpur Railway, will be received by the undersigned up to noon on 20th August 1887, and opened by him then and there in the presence of all parties who may choose to attend.

2nd.—The timber to be seasoned and sound, cut perfectly straight and square and to be free from knots, flaws or cracks. Sizes of scantlings may be obtained from Loco. and Carr. Supdt., Bengal-Nagpur Railway, Nagpur.

3rd.—Seals of tenderers (unable to write) will not be accepted; they should have their marks verified by witnesses.

4th.—Covers to be superscribed "Tender for Teakwood scantlings for B. N. Railway."

5th.—The tender may be in part or for the whole requirement, and the undersigned reserves to himself the right to accept tenders in whole or in part, but in the event of his accepting in part only, and the tenderer failing to take up the contract, the whole earnest deposit will be confiscated.

6th.—Tenders without earnest money of Rs. 1,000 will not be attended to.

7th.—The Agent reserves to himself the power of rejecting any tender without assigning a reason, and does not bind himself to accept the lowest or any tender.

T. R. WYNNE,

Agent and Chief Engineer,

B. N. RAILWAY.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong Shanghai*, and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.

An allowance is made for continuous insertions.

OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order. .

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, AUGUST 13, 1887.

SURVEY OF INDIA, 1885-86.

SURVEYS are an important factor in the economy of Indian administration. Ever since the advent of the British in Bengal, the demarcation of boundaries has unceasingly occupied the minds of the authorities. Primarily, it was a matter of sheer necessity, owing to the precarious nature of the tenure under which the early traders held factories and lands. Subsequently, when the country began to settle down by degrees, the need of delimitation grew more pressing, and for close upon two hundred years it has formed part and parcel of the Government machinery.

In addition to this, and in the cause of the advancement of Geography, Topography, and science in general, there have been extended applications of survey in all its branches, until at the present moment it embraces a number of departments relating to sea and land, that are rendering yeoman service to the country in more ways than one. We are therefore glad to notice a Resolution of the Government of India on the survey operations during 1885-86.

Want of space prevents our entering into the details of the work, we shall therefore give a *resumé* of the important results obtained :

HIMALAYA PARTY—Continued the operations of the previous years in the Topographical survey of the Hill States about Simla, and of the demarcation of the Nepal boundary in the Mechi river, twenty-four miles of which was demarcated, but the erection of pillars was left over to be taken up on completion of the entire line of boundary. The party also undertook to bring up the arrears of mapping connected with the Nepal boundary survey, the Sikkim Triangulation, and the Darjeeling Revisionary and Dahing Lands surveys.

AFGHANISTAN.—A good deal of substantial work was carried on during the year under review under the head of Geographical Survey and Reconnaissances. It was highly creditable to the officers of the Afghan Boundary Commission that the very large area of 120,000 square miles were surveyed in that country. The entire province of Herat, including the hitherto unknown Taimani and Firozkuhi country was mapped ; almost the entire province of Afghan Turkistan, with a large portion of the Hazara country in the vicinity of Bannian was reconnoitered or surveyed ; and on the return march of the Commission, all important passes of the Hindoo Koosh were surveyed.

UPPER BURMA.—In this country Captain Hobday, with a small party of surveyors, made a reconnaissance survey round Mandalay, and compiled the reconnaissance sketches executed by officers with the Burma field force. Captain Hobday and a surveyor joined two military expeditions, one to the Kuchin hills and the second to the south-east of Mandalay. They succeeded in extending triangulation southwards as far as latitude 21 and in surveying an area of 150 miles on the ½ inch scale.

MAPS ISSUED.—These numbered 210,288, valued at

Rs. 1,66,749. and the amount realised from their sales was Rs. 8,372. In this department a great deal of work was done for the Colonial and Indian Exhibition, among which were a map of the World, exhibiting the Export and Import Trade of India, and map of India to illustrate Security of Population, Emigration, External Trade, Land Settlements, and Revenue, Geology and Religions.

MATHEMATICAL INSTRUMENTS.—The total number of these instruments issued to other departments was 41,643, valued at Rs. 1,77,864. The serviceable stock increased during the year by 52,128 instruments, valued at Rs. 1,70,179. Of these, 13,453 were manufactured during the year at a cost of Rs. 21,454, and 3,103 instruments were repaired in the Mathematical Instrument depôts, at a cost of Rs. 21,378, their value after repairs being estimated at Rs. 76,039. The account of the Mathematical Instrument Office shows a net profit of Rs. 3,887.

In conclusion, the Resolution acknowledges the considerable advance made by surveys in the direction of improving their financial value to the State, by doing work of a positively remunerative character. This is notably so in the operation of the great Traverse Survey of the Central Provinces, which, by providing a frame work for the detailed plotting of villages by district establishments, will probably enable the revenue authorities to complete the assessment of about 40,000 square miles without losing a single year's revenue. A great burthen was imposed on this Department by the performance of this work, which it bore without any murmur, at a time when it was heavily handicapped, first by retrenching its establishments, and secondly by responding to the demands for a survey staff on the Boundary Commission, in Upper Burma, and in the North-West Frontier, thus throwing additional difficulties in its way. In no previous year has the Department done more to prove its financial value to the State than in the year under review. The Government of India has, therefore, conveyed its thanks to Colonel Thuillier, Colonel Barron, Major Sandeman, Colonel Steel, Mr. Scott and others.

While according praise to those deserving it, the Government expresses its regret at the death of Colonel G. C. De Prée, the Surveyor-General. This distinguished officer was connected with the Survey Department for nearly 33 out of 37 years, the entire period of his service, and had proceeded in February 1886 to Europe on furlough owing to ill health.

THE LATE MR. CLAYTON.—We regret to have to record the death, on Wednesday last, of Mr. Robert Ougler Clayton of the Bengal Irrigation Branch of the Public Works Department. Mr. Clayton (who was educated at Cooper's Hill) was a most promising young officer, and had endeared himself to all who knew him by his bright and genial disposition. He was quite a young officer in the P. W. D. having served a little less than 8 years, and he was only 29 years of age. For some years past he was employed on the Coast Canal Works, and latterly in charge of the Contai Subdivision, where he did excellent work, but it is certain that the feverish climate must have been the cause of his early death, which will be most sincerely and deeply deplored by his fellow-collegians, and his other friends in Bengal.

JEYPORE STATE GARNET WORKS.

WE have been favored with a copy of the annual report on the Garnet Works of Jeypore, closed to the 31st December 1886, from which we gather much that is interesting and instructive. Mr. Tellery tells us that in order to fully develope the trade in this article the Durbar found it necessary, in the interest of the State and without in any way discouraging private enterprise, to work its own quarries, thereby not only providing employment for its subjects, but increasing the revenues of the country. The accounts for the year under notice shew a net profit of Rs. 19,314-2-3, which speaks well of the management, considering that the works were started without funds. From a careful study and observation Mr. Tellery, the Manager, has been enabled to declare it as his opinion that indigenous lapidaries compare favorably with their European brethren in the work of splitting and cutting of precious and semi-precious stones of all descriptions as well as glass from the rough, but in *cutting* and *polishing* of stones for jewellery and industrial purposes they are far behind, so much so that almost every stone cut in India has to be sent to Europe before it can be used for jewellery. This shortcoming or imperfection had been due to bad tools and the conservative habits of the people, who are now shewing signs of emergence from the proverbial *groove* and improving under the instruction of Mr. Gorsuch, the English lapidary brought out by Mr. Tellery from London last year. Out of 60 boys then at work 35 have become perfect masters in the art of *cutting* and *polishing*.

Finding that there was not much demand in Europe for garnet, which Mr. Tellery endeavoured to introduce largely in the manufacture of jewellery there, and his exertions to induce the Indian jewellers to use their garnet more extensively in the manufacture of native jewellery, he resolved in the beginning of the year in connection with the Garnet Works to establish a jewellery factory, which though on a small scale has already succeeded well. The profit of the year from this source amounts to Rs. 2,441-2-6. The improved tools and machinery for the manufacture of jewellery have not been taken to kindly by the native jewellers, who prefer to use the rude ones of their own making, partly we believe from prejudice and partly from ignorance. It is however contemplated to bring out a European jeweller to instruct his native *confrères* in the use of the tools and machinery, but this cannot be done until the profits realised during the next year are large enough to encourage the investment.

Mr. Tellery has succeeded in discovering marketable mica at Kakoria close to the garnet quarries and has been informed of other possible or likely places, but there are difficulties in the way of undertaking of explorations, which can only be removed by State interference. We are informed of the prospect of a European company leasing the right of exploring for and working these mica quarries, but the terms were not settled.

We gather from the same report that there were employed daily during the year from 200 to 250 laborers, Sixty were under instruction in the lapidary-art. They are engaged for 5 years under agreement and are paid at the commencement at the rate of 1 rupee per mensem rising to Rs. 10 each at the end of the 5th year.

In the jewellery department there were engaged from 30 to 50 hands.

The working of the quarries was conducted by 25 men headed by an overseer.

On the whole, the result of the past year reflects the highest credit on the Manager, Mr. Tellery, to whose untiring energy and extensive resources based on an accurate and perfect knowledge, the work conducted under his able administration is mainly due. There has been much to discourage him, but in all and every case he has happily risen superior to the occasion, and were it not for the apathy displayed by the State throughout, he might have shewn a far better result.

We think the Durbar possesses an excellent officer in Mr. Tellery who should receive every encouragement at its hands and be guided by the sound practical advice which he is able to afford in the interest of the State, its people and finances from his long experience, observations and study.

THE NORTH WEST FRONTIER ROAD.

SOME of our readers may remember that early in 1885 the Government of India sanctioned an outlay of 30 lakhs for the improvement of the frontier road from Dera Ishmail Khan to Khushalgur *viâ* Bannu and Kohat. The road was to be a first-class military road suitable for wheeled traffic of all descriptions, and the new road was to be carried along the trace of the old road as far as possible. There were to be two large bridges, one of 15 spans of 100ft. each over the Kumaon close to Bannu and the other over the Jumbila 25 miles farther on of 9 spans of 100ft. each; the roughly estimated cost of the two being Rs. 8,25,000 (8¼ lakhs.)

Divisions were formed and officered, but instead of arranging some definite plan of action the Executive Engineers were told to go ahead and spend a certain sum by the end of the official year—5 lakhs, we believe.

The result was that the staff were so much taken up with starting and arranging for work in a desert that they could not give the time they should have done to making estimates and drawings of what had to be done. In most cases they laid out the general line of road, and did the easiest work first, *viz.*, earthwork and collection of metal; then by the time the work in the Kohat Division, 92½ miles, was fairly advanced and the estimates submitted, they proceeded to tackle the bridges. The sum required for this section alone, amounted to 22 lakhs as against an approximate estimate of 9 lakhs only. But inasmuch as the embankments were all more or less done and could not be undone, Government were committed to an expenditure which better supervision might have avoided and the financial estimates were cut down to something under 14 lakhs. The next section is the Bannu Division, 10 miles in length. Metal was collected and laid down in some 16 miles and collected only in a good many more. In the Dera Ishmail Khan Division the same thing occurred, and then came orders that no more metal was to be laid down, as the rough estimate had been largely exceeded.

As regards the two large bridges over the Kumaon and Jumbila, drawings and rough estimates for both brick arch and iron girders were completed and submitted to Government, but the Chief Engineer of the Province would not look at them for several months and passed no orders on them whatever; thus much valuable time was wasted. When, therefore, the whole of the estimates were collected and compiled, it was found that even with the omission of the uncollected metal and the non-completion of that collected, the road would cost 33½ lakhs, against a contemplated 30 lakhs.

The old road on the hard " putt" had been cut up and embanked, and was practically a new road, but in far worse condition than the old one. The dâks now run on the old road in some places, in others on the new, and in a great many places just where they can; but it is said that the new road is everywhere worse than the old.

The bridge over the Kumaon is progressing slowly as far as the piers go, but no orders are issued about the kind of girders to be used; two are proposed, *viz.*, metre gauge girders now lying at Karachi, not being required by the Railway, and specially designed road girders. The Jumbila Bridge is still in abeyance.

This then is the present state of the road after more than 2½ years' work, and as the whole affair is pretty near being a scandal we think that the public should be put in possession of some of the facts. As to the road being complete by the rains of 1888, it will at the present rate of progress not be ready by 1889.

DIRECTORS' REPORTS ON INDIAN RAILWAYS.
III.

South Indian Railway.—According to the Directors' Report for the half-year ending 31st December 1886, the gross receipts for that period amounted to £238,143 as against £216,384, shewing an increase of £21,759 as compared with the corresponding half of 1885. The expenditure was £174,351 against £146,712 in 1885, the increase being due to the unusually high cost under the head of maintenance—way and works and stations. The number of passengers carried was 3,262,056 against 3,091,647 in the corresponding half-year of 1885. There was an appreciable increase under the head of goods traffic, 149,847 tons being carried in excess of 1885. The percentage of expenses was 73·21 as against 67·80. The Directors had entered into negotiation with the Secretary of State for India for working by the Company of the Nellore-Tirupati Section of the Cuddapah-Nellore State Railway. This line is 86 miles in length and crosses the Madras Railway by an overbridge. It is on the metre gauge and the works were expected to be ready for opening in June last. It is proposed to construct the State Railways from Tirupati *viâ* Kudri to Dharmavaram and an extension from the Pakkal Junction of the Cuddapah-Nellore Railway to Villupuram. The cost of the two lines—166 and 135 miles respectively—is put down at £1,387,500 or £4,600 per mile.

Notes and Comments.

RANGOON DEFENCES.—Captain Boddy, R.E., is deputed to Rangoon in connection with the defences of that port.

THE PUBLIC WORKS MEMBER.—Sir Charles Elliott will succeed Sir Theodore Hope, as Member of Council in charge of the Public Works Department, when the latter retires in December.

INTERNATIONAL RAILWAY CONFERENCE AT MILAN.—There will be an International Railway Conference at Milan during September. Lieutenant-Colonel Luard, R.E., will be deputed to attend it on behalf of the Government of India.

A BURMAN ENGINEER, P. W. D.—Moung Hpo Thine, the first Burman that has passed the Assistant Engineer's test at Seebpur College, is likely to be appointed to the Public Works Department in Burma as an Engineer Apprentice.

FIRST EXAMINATION IN ENGINEERING, CALCUTTA UNIVERSITY.—We observe that eight candidates have passed this Examination—one in the First and seven in the Second Division. They are all natives from the Government Engineering College, Seebpur.

SUPERINTENDING ENGINEER, SONE CIRCLE, BENGAL.—Mr. C. W. Odling, Superintending Engineer of the Sone Circle, took over charge of his duties from Major McArthur some little time ago, and it is expected that the Lieutenant Governor will shortly inspect part of the Sone System.

TUTICORIN PORT.—The estimate for doubling the width of the inner portion of the Tuticorin pier is sanctioned. The Government accept the view expressed that owing to the shallowness of the water the further extension of the pier would yield no advantage commensurate with the outlay involved.

THE ASSAM CHIEF ENGINEERSHIP.—A Correspondent asks: When was Assam made into a Chief Engineership and why should the officiating appointment in Burma be given to Assam, while Burma, a more important province, is split up into two Superintending Engineerships—apparently to give the Assam Superintending Engineer an officiating step?

AN OFFICIAL PARADOX.—From the *Burma Gazette* we learn that Captain Laugharne, R.E., Executive Engineer, Tounghoo, is transferred to Upper Burma, and a few days after retransferred to Lower Burma, where he is attached to the Superintending Engineer's office, Rangoon, for a few days, and then 3 months' privilege leave is notified for him from 3rd August 1887.

AN EXPERIMENT.—Arrangements have been made in the Punjab by which the execution of all special repairs and original works in connection with jail buildings not costing more than Rs. 500 shall be undertaken by Superintendents of Jails. The object is to permit the employment of prison labor upon such works to the fullest extent, as Superintendents can more readily utilize the convicts under their control than can the officers of the Public Works Department.

CEYLON PUBLIC WORKS DEPARTMENT.—The following departmental changes and appointments have been sanctioned:—Mr. L. Creasy, to act as Provincial Engineer, Eastern Province; Mr. Hawkes, to be District Engineer, Kalutara; Mr. Fletcher, to be District Engineer, Matale; Mr. T. R. Ward, to be District Engineer, Anuradhapura; Mr. A. S. Burnett, late of the Contractors' Staff on the Colombo Water Works, has been appointed a District Engineer of the Public Works Department, on probation, for a year, and will be stationed at Kalmunai.

THE SEEBPORE COLLEGE.—There has been a storm in a tea-cup at Seebpore, owing to some stringent criticisms having been made by Mr. F. J. E. Spring on the method of education pursued in the College. We hear that Mr. Downing gave vent to a very powerful reply in answer to Mr. Spring's note, and that the latter gentleman has to a considerable extent, receded from his former position. However, this may be, there can be no doubt that the system now in vogue at Seebpore could be much improved, judging from the results of the Examinations for the last few years.

BELLARY-KISTNA RAILWAY.—In the Cumbum Division good progress has been made in earthwork, a number of minor bridges are approaching completion, while some of the major bridges are fairly well advanced. Mr. Harman, Executive Engineer, has been specially deputed for the purpose of measuring up of all works executed by Messrs. Derry and Co., whose connection with the B. K. S. Railway is fast coming to a close. This firm might have done a rare good business but for an unfortunate misunderstanding, for they not only had the capital, but the skill and other necessary essentials to carry on any undertaking.

THE PAHANG MINING COMPANY, LIMITED.—This Company has been formed for the purpose of taking over and working the tin mines and land at Quantan in the state of Pahang, Malay Peninsula, belonging to Mr. William Fraser. These mines have been worked for the last two years, and there are at present about 300 coolies employed at them. The tin is found in quartz of which there is a practically unlimited quantity, and the percentage of tin ore is, we are informed, very large indeed. The Company was registered on 27th April, and the capital is £200,000, of which the greater portion has already been subscribed privately.

MADRAS MUNICIPAL PUBLIC WORKS.—On public works Rs. 3,98,050 were spent out of an estimate of Rs. 4,27,380 in the year 1885-86, the outlay during the previous 15 months having been Rs. 4,27,710. Of the total outlay during the year, communications absorbed Rs. 1,40,348. The only new work of any importance undertaken under this head was the construction of a bridge at Cossapet, on which Rs. 2,417 were spent up to the end of the year. Nearly the whole of the balance was laid out on repairs, but notwithstanding this, the condition of several of the important roads was anything but satisfactory. The subject is, however, now under the consideration of a special committee, and it is hoped that some improvement will be effected. Thirty-three miles of road were re-formed at a cost of Rs. 89,650, and it would seem that a steam roller was used with much advantage in this connection.

THE TANSA WATER-SUPPLY OF BOMBAY.—Of the total length of water-way from the Tansa Lake to the reservoir to be constructed at a terminal point 48½ miles off, 28¾ miles will consist of tunnel and conduit, and 19¾ miles of siphon pipes. The only Engineering work of importance on the line of main is the bridge which will carry the pipe across the Bassein Creek, and this is now being erected. The piers and abutments consist of cast iron cylinders 5 feet in diameter, filled with concrete, and sunk to a foundation in the river bed, which, for some of the cylinders, was not reached until 60 feet below the low-water level. These cylinders support lattice girders, with rolled joists placed across so as to carry one line of pipes now, with ample space for a second to be added. In all there are three bridges across the creek, of respective lengths of 400 feet, 1,500 feet and 400 feet, the height being sufficient to allow of the barges, which use the navigation, passing under.

RAILWAY EXTENSION—N. W. SYSTEM.—The Bhakkur-Malakwul section of the Sind-Sagur Loop Line of the North-Western Railway was opened for all descriptions of traffic on the 1st instant. This line which forms one of the frontier protection railways leaves Mozaffarabad station on the Sind section of the North-Western Railway, and runs in a northerly direction to Lieah, Bhakkur, and Kundian, from which station it takes an easterly course past Khushab, and then follows the northern bank of the river Jhelum, until it reaches Hararunpur, at which point the line is carried over the river by the recently completed Jhelum Bridge, and is continued due east until it joins the Punjab section of the North-Western Railway at Lala Musa, a station between Jhelum and Wazirabad. Three branches of various lengths leave this loop line, running to Bhora, Khewra (for the salt fields) and to Kuraishi for Dehra Ghazi Khan, all of which are open for traffic.

MORE ANOMALIES.—*Apropos* of the "Inconvenient Question" on page 40 in our number of the 16th July, our attention has been called to the fact that Mr. Grant, a first grade Executive Engineer and a junior to Mr. Richard, Superintendent of Works, gets a special allowance of Rs. 300, and two of his Supervisors also get a proportionate special allowance. The Railway officers sent a special representation regarding this anomaly to the Director-General of Railways some months ago, but that distinguished functionary appears to have shelved these memorials as they involve "inconvenient questions." The circumstances under which Mr Grant undertook his present special work are given on page 318 of our issue of the 28th May. "R. E. after R. E. refused to go, though *they should have been ordered* to go"—irrelative of the extra emoluments they ordinarily receive in the Department "in virtue of their military obligations and liabilities," so much set forth !

INDIAN COAL FOR OCEAN STEAMERS.—The *Englishman* hears that the Peninsular and Oriental Steam Navigation Company has just concluded a contract with the Assam Railway and Trading Company for a monthly supply of from 800 to 1,000 tons of coal for the use of the former Company's steamers. We endorse the view of our contemporary, that this is a highly practical way of assisting to develop the resources of the country. It is to be hoped that other lines will follow so good an example, and thus not only lessen their working expenses, but hasten the growth of an important local industry, which only needs due encouragement to render them to a great degree independent of the costly English steam fuel which now runs away with so large a proportion of their profits. Indian coal is largely used by the B. I. S. N. Co., the China, Asiatic, and other steamers; but until the Agent of the E. I. R. can see that it will conduce to the interests of that concern to reduce the down-country freight on coal, the prospects are anything but hopeful for the Bengal field.

THE PUBLIC SERVICE COMMISSION AT MADRAS.—Mr. Claude Vincent, on examination for the Public Works Department, said that natives are unfit for the higher offices of the Public Works Department, judging from the manner they conduct their duties as overseers. He thought an increased admission of natives to the gazetted ranks of the Public Works Department is impossible, as the necessary class of men is unavailable. He said that natives often made excellent subordinates. Mr. Ellis, Sub-Engineer, said that Cooper's Hill was not necessary for India; it is not a proper recruiting ground for the engineering requirements of India. He said we had our Indian engineering colleges, therefore one or other was unnecessary, as there is no field for both. He suggested that Indian colleges should have the bulk of the appointments and Cooper's Hill a sixth of the number of appointments. He said that Indian colleges can train men of sufficient attainment, and instead of Indians going home to study at Cooper's Hill, Cooper's Hill men should come to India to study in the Indian colleges. We may add that Mr. Ellis' son was sent to Cooper's Hill—with what result we have not heard.

DANGERS OF THE HUGLI.—At the outset of the series of articles on Calcutta Port Improvements now appearing in INDIAN ENGINEERING, it was said that the utmost vigilance of skilled pilots was necessary to ensure a vessel reaching the Port safely. "At certain critical points, with a deeply laden vessel it is literally 'touch and go' should a ship ground there, and not scrape through, she may capsize, and the tide or stream may scour a hole round her that will engulph her in a few hours." The recent wreck on the "James and Mary" shoal of the steamer *Mahratta*, of only some 700 tons burden, and with a draft of probably only 10 or 11 feet, shews that this danger is not confined to deeply laden vessels, and that a small vessel may be overwhelmed by the rush of the flood tide even before much scouring can take place. As this wreck will be enquired into judicially, it would be out of place at present to say anything as to the cause of it, except that the advocates for placing the docks at Diamond Harbor, below the "James and Mary" shoal, will be able to quote this as another proof of their argument that the upper part of the river is the more dangerous.

BURRAKUR IRON WORKS.—The key-note of our recent remarks on these Works was that the expensive establishment and low outturn, could not compete against Home prices. We learn that the second furnace is not yet blown in, and is not likely, while they have such large stocks of pig iron. Some time ago, arrangements were made to collect the gas of the present working furnace, to be carried to the boiler furnaces, to heat the boilers for steam, to work the blowing engine. This is yet incomplete though it has cost many thousands of rupees. The object, we were told, was to save fuel so that they would be able to do without coal, as they could not get it at their own bid from the collieries, though we hear they can get the best of the mineral at less than Rs. 3-0-0 per ton delivered on the Works. Instead of the money being spent on patent gas heaters, if it had been applied in the purchase of some rolling mills on a small scale to work up small iron suitable for the requirements of the country, the works would by this time have been in a much better position. We don't think the Iron Works will ever be any good or pay to be taken up by any private company until mills are introduced, and this will require practical, experienced men who fully understand iron work generally, and particularly a good knowledge of what class of iron is wanted for the market.

Current News.

It is said that the Engineering College at Sibpur will be closed about the middle of the month, and the next sessions will commence early in November.

The office of the Survey Department at Dehra last year continued the work of solar photography, and no less than 115 large and 525 small pictures of the sun were taken.

Colonel Mallock, Deputy Director-General of Telegraphs, takes leave for six months, Mr. Brooke will officiate for him, and Mr. Luke acts for Mr. Brooke as Director of Construction.

We learn that Mr. Franklin Prestage has informed the Madras Government that he is prepared to form a company in England to undertake the construction and working of the Nilgiri Hills Railway on the "Adhesive System."

Colonel Conway Gordon proceeds shortly to Quetta and Pishin, inspecting the frontier railways and seeing for himself how work is progressing. This, we may add for the benefit of the alarmists, is not preparatory to war.

The *Statesman* learns privately from Simla that the Secretary of State has refused to sanction the continued maintenance of the office of Director-General of Railways, and desires the Government of India to reconsider the question.

The Government of India have sanctioned the construction of a railway from Junaghad to Jethulwa, a station on the Bhownugger-Gondal Railway line. The new line will extend over 67 miles, and will approximately cost 37 lakhs of rupees.

It is said that when technical schools are established experimentally next year, an agricultural class, under a passed student of the Royal College at Cirencester, will probably be opened in connection with the Civil Engineering College at Sibpur.

The recent break on the North-West Railway occurred midway between Gujrat and Lala Musa stations. The wash of the Bhimbar river had sapped the embankment, taken out the ballast and shifted the rails in places, over a distance of about half a mile.

The Toungoo-Mandalay Railway is reported to be making good progress, and the Engineers are sanguine that it will be finished within the time originally estimated : in fact in 1889 trains should run through from Mandalay to Rangoon, as we have already intimated.

Mr. Wynne, Engineer-in-Chief of the Bengal-Nagpur Railway, has proceeded to England mainly in order to expedite, as much as possible, the supply of rails and material for the new line. He hopes by the beginning of next hot weather to have the broad gauge working as far as Raipur.

As the system of frontier railways has been so far completed that the journey even to the Khwaja-Amran can be easily made, it is likely that the Viceroy will pay his deferred trip to the North-West frontier this next autumn ; but the plan for the annual tour has not yet been decided upon.

Local manufactures, we are glad to observe, are receiving that attention which they ought to from the authorities in this Presidency. The Government of India have just authorized the Superintendent of Army Clothing, Madras, to enter into a two years' contract with the Egerton Woollen Mills Company for the supply of the great coat cloth required for the Madras Infantry.

The Civil Members of the Public Works Department can have no reason to complain of promotion in Bombay, at least as far as the Secretariat is concerned. The lucky man who is shown in the last classified list as Secretary to Government and Chief Engineer, 1st class, sub. *pro tem.*, is Mr. W. C. Hughes, who appears as a substantive 2nd grade Executive Engineer of less than 19 years' service.

The question of sub-marine mining defence for our Indian ports has been under consideration at Simla, and a Committee of Royal Engineers has been assembled to consider the details of the executive necessary to efficiently conduct operations. One of the suggestions of the Committee is the establishment of sub-marine Volunteer companies at Calcutta, Bombay, Rangoon, Karachi, Madras, and Aden.

The Midland Railway Carriage and Wagon Company has secured an order for 325 wagons for one of the Indian lines. The wagons are made almost wholly of steel and iron, the proportion of wood employed being very trifling. Another company has an order for 300 wagons of a similar character for an Indian road. Carriages built that way will not be very attractive in the merry months of May and June.

The Delhi Water Works scheme is coming to a head—thanks, again, to Mr. O'Brien. The Local Government have sanctioned the raising of the necessary loan in the open market, and a Public Works Committee is shortly to assemble to pass the plans and estimates and to discuss the subject threadbare for the last time. This will be the *third* time that the scheme has been favored with a threadbare discussion.

The *Pioneer* doubts the accuracy of its London correspondent's information, recently telegraphed out, to the effect that the Government were themselves going to work the Burma Ruby Mines. The doubt is based on the certainty that if the Government attempt anything of the sort, they would assuredly make a mess of it. It is more likely that, at the instance of the Home authorities, no concessions will be granted till further information is obtained as to the value of the workings.

A correspondent says that it is little less than a grave public scandal that in a place like Cawnpore, pre-eminent above all things for its manufacturing industries—where probably not less than 10 millions of rupees have been invested in factories which are almost entirely owned by Europeans and managed and worked by Europeans, where at least 10,000 natives find constant and lucrative employment daily from one year's end to the other, that in such a place there is no representation on the Municipal Board of the vast interests involved.

Notwithstanding the suspension of other important public works in Bengal, the Rajapur drainage scheme is shortly to be carried out. The work will commence in the sub-division of Rajapur, in the district of Howrah. The scheme, when completed, will reclaim thousands of acres of low marshy lands, which are now lying waste in the sub-division, and will yield a large revenue to the zemindars who are owners of those lands. A canal, about 15 miles in length, is to be excavated, with a number of smaller channels connected with the main cut. The works will cost over 12 lakhs of rupees.

The Government telegraph line from Bombay to Bilaspur is to be continued along the line of the Bengal-Nagpur Railway, and we shall thus have an alternate through communication between the eastern and western capitals of India. By the use of copper wire, direct signalling between Calcutta and Bombay will no doubt be rendered possible, and with the largely increasing telegraphic traffic between the two places, this will be a great gain to the mercantile world. The Telegraph Department will put up on their posts such wires as the Railway Company require, the latter paying an annual rent for them.

The Engineering staff of the South Indian Railway have petitioned the Board of Directors in England, through their Chief Engineer in India, for a change of designation, as they aver that the present term "Assistant Engineer" is misleading as to their status and professional abilities and qualifications, inasmuch as the term implies one of short service, and possessing no professional experience. Most of the men are ripe in railway Engineering experience, and they request that officers in independent charge of a division or work, and working directly under the Chief Engineer, be designated "Resident Engineers."

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

INFORMATION SOUGHT.

Sir,—Would you or any of your readers oblige by giving me in your columns any information as to how I am to prevent rubber from becoming sticky or viscous?

I have used it for years and some give no trouble, while others, apparently, to me, being exactly the same, become sticky after being heated by steam and will not come off the steam joint at all, except by breaking or tearing in pieces, and this only after being in use, say, a week. Some after years of use can be taken off again and again, and be re-used by me for its original purpose.

A. B. C.

O. R. R. Mechanics' Institute,
Lucknow ; *August* 6, 1887.

IRRIGATION CHANNELS IN THE MYSORE PROVINCE

Sir,—The Government has lately ordered the handing over charge of channels to the Revenue Department during the irrigation season, and the retention of head-sluices in the P. W. D. This has necessitated one subordinate to serve two and even three taluqs or an additional establishment for each Amildar (Tahsildar). Further each P. W. Officer not in charge of channels has to employ some hands to regulate the head-sluices and carry out the urgent repairs during the irrigation season, should any accidents occur. Consequently, these extras amount to some loss to Government and is worthy of attention. Nor are the ryots benefitted, because the P. W. D. regulates the head-sluice and will not decrease or increase the water in channel, or undertake to do any urgent repairs without a reference from a competent revenue authority, in spite of any condition of channel. Further, in a canal of 50 or 60 miles, it may rain heavily in the middle of its length and the channel breach owing to surface drainage water, &c., as there will be no direct communication to the watchman at head-sluice to close at once as hitherto. All these together finally tell upon the ryots' crops.

2. Some experienced officers think that it is, therefore, better to appoint a Channel Superintendent and place him under the orders of the Deputy Commissioner during the irrigation season, and under the Executive Engineer during the working season, as well as on urgent works, and thus avoid all extra establishment otherwise required, by selecting one sub-deputy officer in each district as the P. W. Division will have spare hands on being relieved of channels.

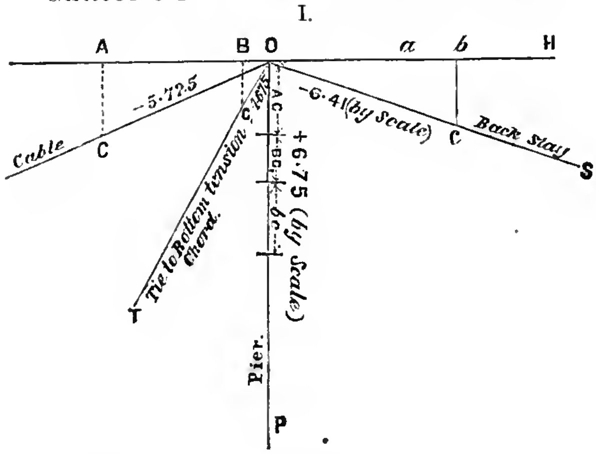
3. This is only calling back the old system in a slightly modified form and the subordinates will not feel a half-yearly change of superiors as would be, if the present orders should hold good.

4. This will also relieve the Amildars from being overburdened, as they already possess a multifarious set of business, and the uneasiness of mind they may hereafter encounter on account of the limited authority given to them for increasing or decreasing the water in channel when ryots complain.

AN EXPERIENCED HAND.

GARSON'S PATENT SUSPENSION BRIDGE.

I.



SIR,—Please refer to stress diagram, page 92, February 19, 1887; and "F. E. R.," page 177, April 2, 1887, to "*Secondly*, &c."

(1.) The mode of connection at O (see diagram), top of pier is not described by any of your Correspondents.

(2.) "F. E. R." takes tension on back-stay as—7·175 granted, and forgets the tension of tie to bottom chord O T.

(3.) Taking pull on cable O C, and on tie O T as −5·725 and −1·675, respectively, as per stress diagram, resolve these into their horizontal and vertical components, O A, O B, and A C, B C, respectively. Set off O A+O B=O *b* on O H (because there is equilibrium at O), and draw *b c* perpendicular to O H, cutting O S (direction of back-stay) in *c*. Then O *c* (by scale= −6·41) is the pull on back-stay.

(4.) Pressure on pier due to main cable is (*a*) A C, due to bottom chord tie (*b*) B C, and due to back-stay (*c*) *b c*=A C+B C+*b c*, which is set off on the pier line, and measures by scale +6·75.

Has "F E. R." to say anything against this treatment?

(5.) If angles A O C, A O T, and H O S are considered, their sines and cosines into the pulls will give exactly the same results.

(6.) About stress on pin joints:—"F. E. R.'s" method of taking the bearing surface for one link as diameter into thickness of link ($1\frac{1}{8}'' \times \frac{3}{8}''$)—instead of *semi-circumference* × thickness—is perfectly correct, and also his stress of 7·7 tons per square inch of bearing area. A. and J. Main and Co.'s reply—"*Thirdly*," see page 230, April 23, 1887, is no reply to this, for "F. E. R." considers the *stress* on the *bearing* area, whereas A. and J. Main and Co. consider the *shear* on *sectional* area?

(7.) Was the bridge tested by a *moving load* by the Darjeeling Road Cess Committee? If so, how?

MAISUR; *July* 27, 1887. A. G. ACHARLU.

II.

SIR,—On referring back to our communication published in your issue of 4th June last, as also to the original drawing and stress diagram published in yours of the 19th February concerning this special type of bridge, we would wish particularly to explain that the top-joint pins F and those next below them shewn as $1\frac{1}{8}$ inches diameter, have reference really to a lighter bridge as originally designed; and these were altered for the bridge actually constructed in accordance with the stress diagram, by making the said joint-pins $1\frac{1}{4}$ inches diameter.

We regret that this error in the original publication has not come to our notice sooner, as it has called forth some controversy which might otherwise have been avoided.

The remarks of your correspondent "F. E. R." (who is evidently thoroughly well versed in theoretical and applied mechanics) have however been well to the point and may have served some useful purpose in calling general attention to the weakness of a pin-joint improperly designed.

Under the improved conditions as above explained we have no doubt that "F. E. R." will be ready to accept the packing on the pin as shewn in our sketch of 4th June, which when the pin is sufficiently strong to resist bending moment allows a more even balance of the principal strains in the plane of the links; the strain on tie D. E. being not truly in the same plane.

In conclusion, we may remark that unless otherwise called for by special circumstances, we adopt the working strengths of 5 tons per square inch for iron and $6\frac{1}{2}$ tons for steel as fixed by the Board of Trade; and that every attention is given to secure best quality of materials and workmanship in all bridges, &c., constructed by us. A. AND J. MAIN AND CO.

CLYDESDALE IRON WORKS, POSSILPARK:
GLASGOW; *July* 21, 1887.

Literary Notices.

AIDS TO COMPUTATIONS. *By J. E. A. D'Cruz, B.C.E.*, Madras Revenue Survey.

THIS *brochure* is an exposition of the methods for operating and reducing adopted in the survey operations of Southern India, wherein the superfluous and defective are eliminated, and the scientific residuum turned to practical account. The object of the writer is evidently to lift the *modus operandi* of the Madras Survey practice to a higher plane as well as to enlarge its boundaries; and the suggestions made have the recommendation of brevity and utility, if not that of "much novelty." The room for improvement that exists in the Madras system of computations has been fully exposed if not entirely met.

THE GEOLOGICAL SOCIETY OF LONDON.

PART 2 vol XLIII., or the May issue of this well-known Quarterley achieves most of its interest from President Judd's Aniversary Address. In it he takes notice of the gaps made in the Society by the hand of death; among those who have passed away perhaps none will be missed more than JOHN ARTHUR PHILLIPS, the well-known author of that valuable treatise on the "Mining and Metallurgy of Gold and Silver" first issued 1867, and the important scientific work entitled "A Treatise on Ore Deposits" which was published as recently as 1884.

In reviewing the operations of the Society, the President observes that in a year when so much attention has been directed to our Colonial and Indian possessions, and when we have had the pleasure of greeting in our rooms some of our most active members, who are citizens of the Greater Britain beyond the seas, it is not surprising that communications bearing on the geology of these British "outliers" have been as numerous and valuable as they were welcome.

Among the "Papers" which follow the address and make up the volume, we find two on Palæontological subjects by Mr. R. Lydekker of the Indian Geological Survey. Captain Hutton contributes one on the eruption of Mount Tarawara which took place on the 10th June 1886, in which the results and products and causes of the phenomenon are fully and clearly discussed Mr. Whitaker's Notes on some deep Borings in Kent, throw light on that important and interesting subject—the underground geology of the London Basin.

STONEY'S IMPROVED SOORKEY SCREEN.

THIS is a pamphlet of 6 pages with illustrations descriptive of a soorkey screen which may be described as consisting of a supporting frame-work of timber, a screen of wire netting or perforated zinc suspended by four wires so adjusted on horizontal motion bars placed on the upper portion of the frame as to give the screen when in normal condition a *fall* towards the spout or where the screenings are discharged. By this arrangement of unequal length of the suspending rods a rocking or tilting motion is obtained, when the crank actuated by a lever or handle worked by manual labor communicates an oscillatory movement to the screen, which effectually sifts the material placed in it. The duty performed by one of these (a 6′×4′) is represented by 10 cubic yards of fine soorkey in 8 hours with the assistance of one coolie and 4 women at a cost of 10 annas. The value of one of these machines is placed at the low figure of Rs. 120, and the use of them would dispense with the necessity of a mortar mill often used for the reduction of the coarse and gritty brick dust and lime sold in the market. A simpler and more economical soorkey screen could not be found and the arrangement of the various parts is such that an ordinary village blacksmith can take them to pieces and put them together again.

All who have used and seen these screens at work testify to their efficiency and economy. We have no hesitation in saying that on large buildings and Railway Engineering works the screen would be found both useful and economical.

General Articles.

THE CENTRAL PRESS,
HASTINGS STREET, CALCUTTA.

WE give this week two illustrations of this building, which was designed by Mr. E. J. Martin, F.R.I.B.A., and erected in 1883-84. As will be seen from the plans it is a three-storied structure with a narrow quadrangle in the centre intended for the passage of carts bringing stores to the Press, which stores are raised to the different floors by means of cranes. The main block of the building occupied by the Press, and the floors and roof,—all of which consist of walled joists with jack arches covered with terrace,—are carried on a double row of cast iron columns, so as to give a maximum of space for the presses. Over 1,500 workmen can be accommodated, and the whole of the Government of India Press work is carried out here. The design has been slightly modified by the construction of a large main staircase in the eastern block, as it was found that the two small staircases, shewn in the ground floor plan, were too narrow and quite insufficient for the large number of men working in the building.

At the southern end of the building is a three-storied wing, which has been constructed for the purpose of providing quarters for the Superintendent of Printing to the Government of India. Owing to want of space, the out-offices belonging to the quarters have had to be constructed on the roof, as may be seen from the elevations; a rather novel arrangement in this country, but not so inconvenient as might be supposed at first sight.

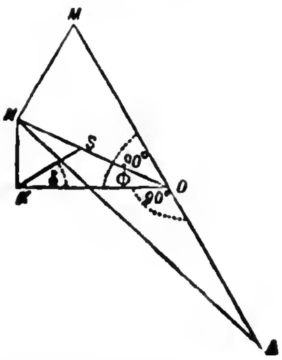
The work has been carried out in pointed red brick (rusticated on the ground floor) with buff-coloured terracotta ornamentation, and although no great architectural effect has been aimed at, the building both inside and outside has been admirably designed for the purpose for which it is now used. The elevation on the Hastings Street side (the north) is however a handsome one.

THE JHILMILI WINDOW.
BY A. EWBANK.

V.

(Concluded.)

Fig. 12.



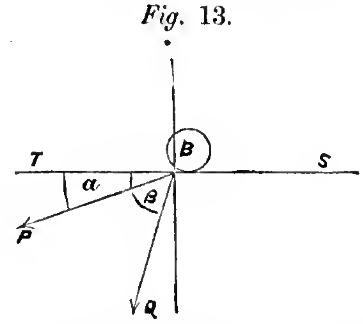
LET us now consider a to be some angle greater than zero and less than 90° and V_2 of apppreciable magnitude.

The X Y couple tends to cause a clockwise rotation about a line parallel to K S. By imagining this line to revolve about K and gradually reach the vertical line K H, and to carry the clockwise rotation with it, we see that the component rotation about the vertical looking *upwards* will be clockwise. Therefore, looking downwards it will be lefthanded or as seen from H the line A L will revolve through the *acute* angle a, *i.e.*, not through the supplement of a into coincidence with A B.

Thus recurring to *fig.* 6 the line I U will revolve through the acute angle a=K I U into coincidence with K. T. But this is the reverse of that rotation of the bar about vertical axis which carried the tunnel from T to U. Therefore, the effective component of the X Y leverage tends make the bar regain its meridian position. This may be verified on an ordinary window. Let the leaves be made horizontal and the bar then slightly rotated. Remove the hand from the bar, and, grasping a leaf or two leaves, force them to sink to the closed position. We shall see the bar first rise without rotation (owing to the V_2 volume being utilised) and then when the jam occurs and a couple comes into play we shall see the bar rotate back into the meridian. If the material of ring and tunnel were perfectly smooth this return of the bar would happen for a value of a as large as we please, provided it was not quite as large as 90°.

But with friction there is a limit to the magnitude of a. For although a certain component of the X Y couple is ineffective for geometrical reasons it still acts dynamically by producing pressure, and this produces increased friction. Hence for a certain value of a (say for example 40°) it might be impossible for the couple to produce motion even if the forces X Y were largely increased. Most readers of this paper will understand this point without further explanation. *Fig.* 13 is, however, given in illustration.

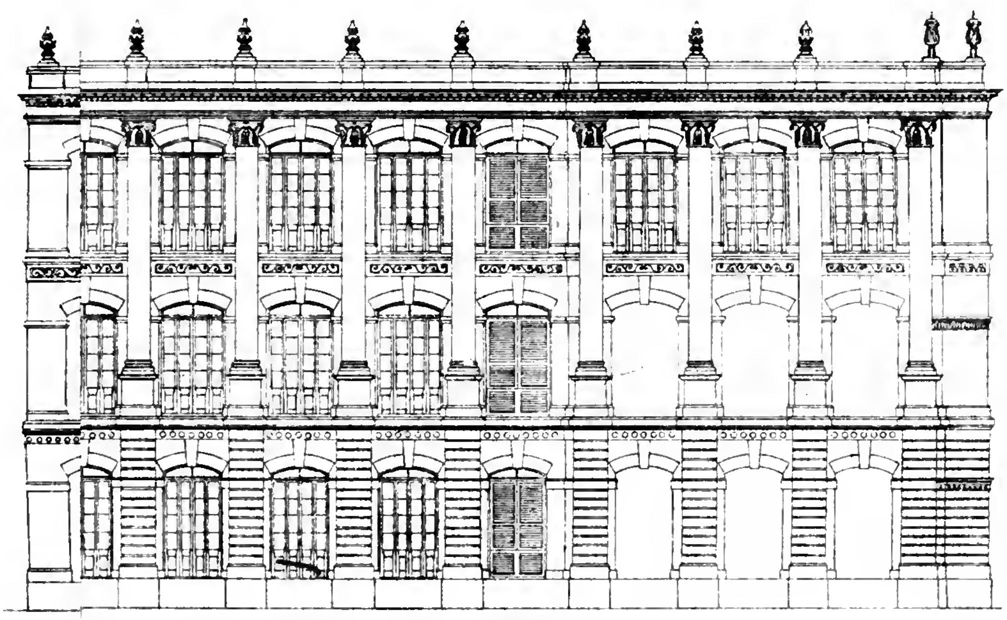
Fig. 13.

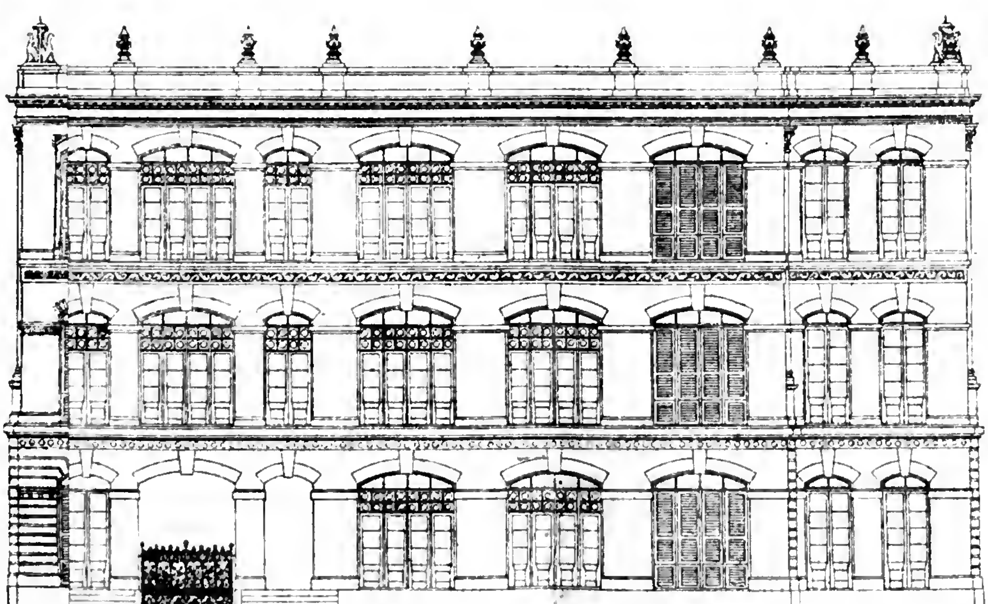


A body B rests on a rough horizontal surface. A small force P may be able to move the body while a large force Q may be unable. And yet Q may be so large that R Cos β > P Cos a. If β be large enough Q may be increased indefinitely without producing motion. This supposes that the body and surface are not *altered* by the great force Q. In our problem where friction remains proportional to normal pressure we postulate the absence of any change in the extra volume V_2 or in the shape of the ring or in the nature of the surfaces. In this case we have what we may call a critical acute angle χ. If a is < χ the bar can be made to rotate by acting in the leaves. If a be > χ the return of the bar to the meridian is not possible, be the weight of the leaves small or great.

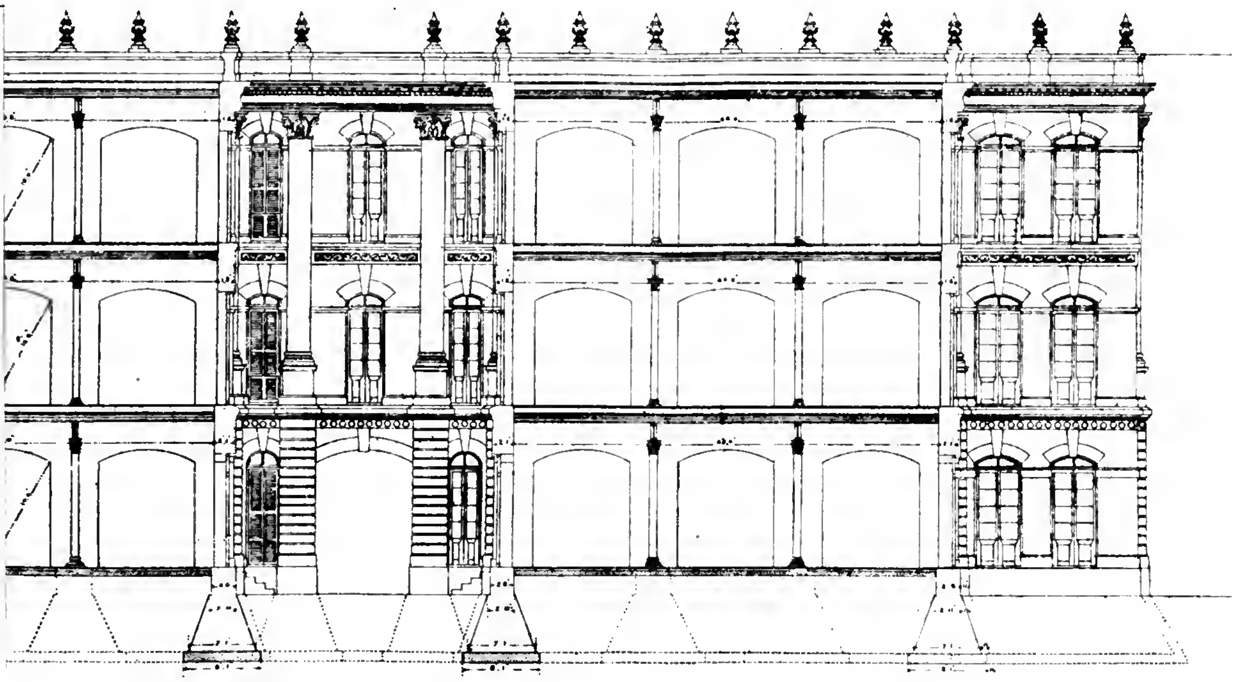
Some of our readers may possibly suppose that because we have reasoned on ideal bars and leaves our reasonings do not apply to the actual arrangements in our Indian doors or windows. This inference would not be sound. If two smooth bodies are so connected that certain relative motions are impossible these motions remain impossible when the bodies become rough. If certain other motions are possible for smooth bodies they remain possible for rougth bodies, provided the necessary extra forces are supplied. We said that a leaf is a lamina. This is strictly true. Our lamina is the central lamina of an ordinary leaf. Other laminæ are disposed on either side of the central one, but these extra laminæ have their motions entirely governed by the central one. It is to the central lamina that the ring and bearings are adjusted. The weight of the other laminæ may be supposed added to that of the central lamina. Similarly for the bar. There *is* a central lamina to which the tunnel arrangement is fixed and the other laminæ do not enter into the question. The length of the tunnel is independent of these other laminæ. We have amply provided for the thickness of the central bar lamina by giving an extra volume V_2. Thus the geometry and dynamics of this interesting contrivance have now been fully elucidated.

A. EWBANK.

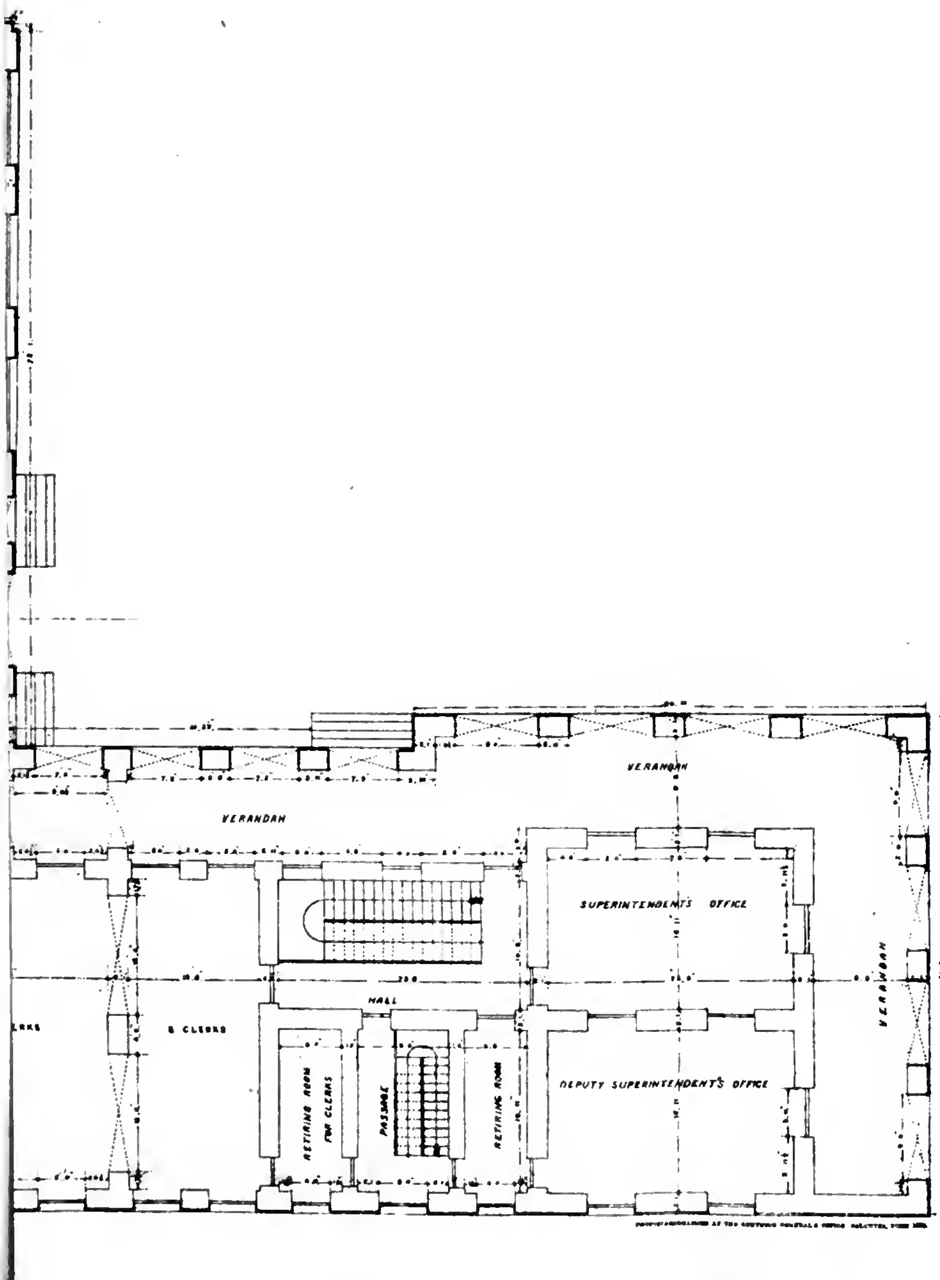




SOUTH ELEVATION



SECTION ON LINE A.B



ARTESIAN BORING IN THE SUNDERBUNDS.

By Frank J. Agabeg, M. E., Superintending Engineer, Port Canning and Land Improvement Co.

II.

The work proceeded rapidly to the depth of 55 feet when dark grey micaceous sand very watery (salt) was struck. In cutting the first 20 feet of this the silting was not of much consequence, but after this depth it became so great that sometimes it was impossible to progress even six inches after a hard day's work and it was only by forcing the tubes every time the blow was struck that any headway could be made. The silting at times used to be as much as 30 and 40 feet and one day it rose to 50 feet. The greatest care had to be taken in this sand to prevent the rods jambing so much so that if they were allowed to remain stationary for over three minutes it took 6 men at the crab winch to lift them again, this was owing to the sand closing over the pump below. When it was required to raise the tillers the rods had to be hoisted 5 and 6 feet and then the tillers adjusted.

This sand was passed through at 126 feet when the tool struck dark grey clay mixed with sand.

At 130 feet it struck green clay with streaks of salt in it.

At 135 feet mottled clay yellow and blue mixed with broken shingle.

At 138 feet blue clay.

At 140 feet yellow clay mixed with broken shingle. The clay here becomes sweet, and salt seems to disappear.

At 145 feet yellow clay with bands of blue and ochre. The water which used to stand at about 12 feet from ground level gradually begins to get lower showing that the top water had been jambed off by the tubing.

At 150 feet light grey clay, very stiff mottled with yellow.

At 156 feet yellow clay, very loamy. Water in hole loses about 90 % of its salt and stands 80 feet below ground level.

At 166 feet yellow earth.

At 173 feet yellow sand (micaceous). Water rises in the boring to within 8 feet of top and perfectly fresh.

From 173 feet to the present depth (*viz.*) 235 feet, the boring is still in this sand which is very watery (fresh) and rich in yellow mica; when washed it looks like gold dust, but unfortunately, as your readers are aware, " all is not gold that glitters."

The work is still progressing, and the deeper the boring goes the higher the water rises in the hole. The silting in this sand is very great, as much as 40 feet, at times. I have not been able up to the present, to get a satisfactory idea of the volume of water but hope to give the necessary information later on.

Although the proposed depth of the boring is only to be 250 feet, and notwithstanding the fact that we have come upon fresh water, still it would be advisable to go deeper down and strike a lower porus stratum, the water in which I am sanguine would have a greater hydrostatic pressure, and which we are bound to get. I have come to this conclusion from the section of alluvium already passed through, which up to the present has proved that it is composed of alternate layers of permeable and impermeable strata, and I have advised the Company accordingly.

The idea that the water in the alluvium below would be salt has exploded by the results obtained from this boring, and no one, I think, knowing anything about the laws that govern hydraulics would ever have expressed such an opinion.

It is very evident that any porus stratum which is fed by water from a higher level than the sea, would naturally eject a greater pressure than the sea water, and would remain fresh till it had passed out of the stratum and mingled with the waters of the same, as water follows the same laws underground as it does on the surface.

The benefits derived from fresh water in a country like India are incalculable, and it is worth all the time and expense in putting down wells. There may be a good many failures but I am sanguine the majority would be successful.

In all future borings, never mind by whom undertaken, a correct record of the section passed through in each well should be forwarded to the Superintendent of the Geological Department for reference; by doing this not only would we be able to get a thorough knowledge of the formation of different parts of the country, but the records would act as a guide for new operations.

Borings of any importance ought to be placed under the supervision of a really competent Engineer who must be well up in the work and understand the laws of hydraulics and know something about geology. No engineering operations require so much skill and ingenuity at times as boring work. A well placed in charge of a man of no resources may be lost and thousands of rupees wasted, while if the same had been under an Engineer who was never at a loss for an idea it would have been a success.

The tackle must be carefully examined daily and any suspicious looking places rectified at once for by the want of this care a whole year's labor and expense may be lost. How many wells have been abandoned through sheer carelessness!

In conclusion I beg to suggest that the advisability of pushing on boring work in India not only requires the consideration of Government but all Public Boards who are interested in the supply of water in the different towns. A good supply of wholesome water from wells in all parts of the country during the hot months would greatly lessen the annual mortality from cholera, *et hoc genus omne.*

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

II.

Rough Rubble Masonry in Foundations.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)
Labor.—			
Masons No. ...	1	Variable.	Do.
Do. „ ...	$1\frac{1}{2}$		
Do. „ ...	1		
Coolies „ ...	$3\frac{1}{2}$		
Do. „ ...	$1\frac{1}{3}$		
Do. „ ...	$1\frac{1}{8}$		
Bhisties „ ...	$\frac{3}{4}$		
Grinding Mortar, c. ft.	40		
Sundries	...		
Materials.—			
Rubble stone & quarry chips, c. ft. ...	80		
Lime, slaked, c. ft. ...	$19\frac{1}{4}$		
Sand, dry, c. ft. ...	$19\frac{1}{4}$		
Surky, „ „ ...	$19\frac{1}{4}$		
Sundries	......		
Petty Establishment ...	......		
Total ...	...	...	...

Brought over	...	...
Labor ...	...	...
Material ...	...	...
Petty Establishment	...	...
Total per 100 c. ft.	...	...

Specification.—The stones to be from $\frac{3}{4}$ to 1 c. ft. in size, no dimension being less than 6″. They are to be close packed in mortar, all crevices being filled with mortar and quarry chips. The masonry to be brought up to a level at every 18″ of height.

THE MAIN DRAINAGE OF THE HOUSES OF PARLIAMENT, WESTMINSTER.

By Isaac Shone, c.e.

VI.

[*Concluded.*]

(66). The consumption of cannel-coal gas when one engine is running and compressing air to about 10lbs. per square inch continuously for twenty-four hours, is about 2,000 cubic feet, which costs—reckoning gas at the price paid for it, *viz.*, 3*s.* 9*d.* per thousand—7*s.* 6*d.* per day; which is just $3\frac{3}{4}$*d.* per hour for the four horse-power engine, or less than 1*d.* per horse-power per hour.

(67). The Atkinson Gas-Engine Air-Compressor is extremely simple, effective, and strong; and it affords extraordinary facilities for keeping the air-pressure constant. It has no slide valve—which occasionally gives trouble and expense in other Gas Engines; and an explosion takes place in its cylinder at every revolution. The speed of the piston at the instant of explosion is comparatively great, so that a proportionately increased quantity of heat is thereby converted into useful work—more than is obtained from other Gas Engines—because, the comparatively slow motion of the pistons of the latter, at the moment of ignition, allows the heat, to a large extent, to be transmitted to the cooling water surrounding the cylinders.

(68). The air-compressing cylinder of the Atkinson Engine can be worked as single-acting or double-acting by means of a very ingenious "easing-gear" arrangement—which, by simply turning a handle, admits compressed air under the inlet valves, and thus renders them inactive; and that without any loss of compressed air. The same "easing-gear" adjusts the air-pressure in the air-receivers also.

(69). These engines require no other attention than that needed for lubricating, and occasionally to clean them; and as for the Ejectors—one of these has already been left to itself for a whole week, working night and day without anybody either lubricating or attending to it in any way.

(70). One of the Gas-Engine Air-Compressors and one of the Ejectors of the Palace, working continuously for twenty-four hours, day and night, could deal with the sewage of more than 20,000 people, reckoning the sewage discharges at twenty gallons per head per day—the lift to be twenty feet; and the total gas consumption, assuming the quality and price of the gas to be the same, would be no more nor less elsewhere than it is at the Houses of Parliament—*viz.*, 7*s.* 6*d.* per day of twenty-four hours.

(71). The works were divided into three contracts, the General contract (No. 1) being let to Messrs. John Mowlem & Co., of Westminster; and the Special contracts—(No. 2) embracing the supplying and fixing of the Pneumatic and Hydraulic Ejectors, to Messrs. Hughes & Lancaster, Chester; and (No. 3) for the supply and erection of the Gas-Engine Air-Compressors, to the British Gas-Engine and Engineering Company, Queen Victoria Street, London.

(72.) The Author is pleased to be able to add that the work, as a whole, has been well and substantially executed without accident, and without there being any practical increase in the cost, which, in round figures, is a little over £11,000,—the amount approximately estimated by the Engineer in the first instance, for the guidance of the Treasury and of the Commissioners of Her Majesty's Works and Public Buildings.

(73). In conclusion, it may be said that modern sanitary science had its origin in this country some fifty years ago; and, as this is the Jubilee Year of Her Majesty's beneficent reign,—during which so much, comparatively, has been done for the sanitary well-being of millions of Her Majesty's subjects—the present time would appear to be peculiarly appropriate, for demonstrating to the Legislators of the greatest Empire in the world, through the medium of their own Houses of Parliament, the superiority of the new over the old system, of draining houses and towns of their sewage proper, separately from the rainfall, or otherwise.

(74). Finally, the object of the Engineer, in making this Report is of a two-fold character—the one is to satisfy them that the money voted by Parliament, at the recommendation of Sir Henry Roscoe's Committee, for the purpose of executing the new drainage works, has been well spent; and the other is to try, through the instrumentality of the works themselves, to help forward the great and important cause of sanitary science.

PLANTING OF ROADSIDE TREES IN SIND.

A road with a good avenue of trees is a great desideratum in a hot country, and too much pains cannot be bestowed on attaining perfection in this desirable object.

Planting and maintenance of trees in a province like Sind, with a very scanty annual rainfall of 4 to 5 inches, require special treatment. The want of copious rainfall is fortunately overcome in a great measure by the periodical floods in the river Indus and the facility with which water is conveyed by canals and small trenches to many parts within 2 or 3 feet of the surface of ground.

The soil, however, being stiff clay, percolation and absorption of water so advantageous for the growth of plants, found in moorumy and sandy soils in other parts, are reduced to a minimum here. Unless, therefore, water is brought down almost to the very foot of even grown up trees every year, the trees will die for want of nourishment, especially as the subsoil is often dry up to 20 feet from surface, and below that depth sand with brackish water is met with.

The exception to the above rule is in the case of inferior trees native to the soil such as *Jahoo* or *Lai*, *Kandi* and *Khabad*, which grow in sweet as well as saltish ground and whose roots penetrate deep into the subsoil. These trees abound in parts formerly subject to inundation.

The plan adopted in planting and maintaining road-side trees in some towns and suburbs in Sind is as follows:—

Cuttings or plants from nurseries are at first planted on roadside as usual at the beginning of the flood season and provided with strong thorn or other high fencing to prevent injury from camels and goats. Watering is then continued twice or thrice a week for about three years. Deep side trenches are at the same time provided and filled with canal water and the process continued in the flood season from year to year even when the trees are grown up. This is necessary, as otherwise the trees will suffer and die either for want of water or from salt subsoil.

Mangoes and other trees in the compounds of bungalows are planted round large flat rectangular excavations about $2\frac{1}{2}$ feet deep. These pits are now and then flooded with canal water and thus afford, not only the required nourishment to the plants on their edges, but also yield grass for horses.

Trees which grow readily and attain large sizes are *Peeple*, *Wad*, *Talee*, *Siras*, *Nimb* and *Babul*. The last three supply timber for buildings and carriage wheels; while *Talee* is especially valued for the superior wood it yields for house-furniture. The cost of the *Talee* tree of full growth is often as much as Rs. 50 or 60.

A few flower trees such as *Kanchan*, *Gulmore* and *Amaldas* planted here and there among other trees give beauty to the road when they are in blossom in the spring.

G. R. T.

In America the flashing point of mineral oil is now determined by means of the induction spark. The oil is placed in an open vessel and heated by a water bath. A thermometer in the oil tells the temperature, and just over the surface of the oil are two electrodes connected to the secondary circuit of an induction coil. These are fixed at a distance apart, which allows the spark to pass. The oil when heated to the flashing point gives off inflammable gas, and the sparks passing between the electrodes set fire to it. The temperature at which this firing takes place is observed on the thermometer, and is the flashing point.

PONDICHERRY HARBOUR PROJECT.

By A. Pierres deClosets, C.E.

IV.

(Concluded.)

Estimate of Cost.

The principal expense is that of the Jetties; in allowing for their construction an enrockment of blocks of concrete sunk by cranes with a power of raising 50 tons, the cost price of one cubic metre of the jetty can be analysed as follows, reckoning the rupee at 2 francs.

1. Cost of the Mortar by the Cubic Metre.

Belgian Portland cement is to be had at 75 francs the ton landed at Pondicherry. The cubic metre of cement weighs from 1,250 to 1,300 kilogrammes. Including landing cost the price of the cubic metre will be ...	Rs.	50·05
The sand used in mixing will be that of the sea side; it will be mixed with cement by means of sea-water. The sand being on the spot, the cubic metre at cost price will be	,,	0·06
The mortar will be proportioned as follows by the cubic metre:—		
1 of cement ... ... price ...	,,	12·80
3 of sea-sand ... ... ,, ...	,,	0·18
Making ... ... ,, ...	,,	0·25
and the price of the cubic metre will be	,,	13·23

Concrete made with this mortar will be manufactured by means of kneading or softening machines worked by steam and mixed in the mortar with hill gravel or pieces of crushed laterite.

The mixing of the concrete and its cost by the cubic metre may be estimated at—		
$0^m{\cdot}33$ of mortar ... ... price ...	Rs.	4·30
$1^m{\cdot}66$ of broken stones ... ,, ...	,,	0·33
Making ... ... ,, ...	,,	0·25
The cost of the cubic metre of concrete ...	,,	4·88
In adding to this price—		
Moulding the blocks ₽ m^3	Rs.	0·22
For carriage do. do.	,,	0·06
Sinking do. do.	,,	0·05
Sundry expenses do.	,,	0·05
the price of the cubic metre of blocks in place in the jetty will be	Rs.	5·26
The average section of a jetty being 215 square metres and the length from the shore to the extremites 2,000 metres, the total cube will be 430,000 m^3		
Supposing for both 860,000,m^3 that, which is at 5·26 the metre will for the two jetties cost...	,,	45,23,600
The cost of the cutting by means of dredgers assisted by tenders is estimated as follows: annual cost of a dredger, workmen, combustibles and sundry expenses included ...	,,	15,408
Each dredger is assisted by three tenders, of which the annual cost, workmen, combustibles and sundry expenses included is ...	,,	39,654
The annual cost for the working of a dredger, that is for the excavation of 263,466 cubic metres, including tenders will be ...	,,	55,062
The cost by cubic metre of the earth excavated and carried out to sea will be ..	,,	0·208
And since the total amount of the cutting is 15,871,209 the total cost of the dredging will be	,,	33,01,600
The walls of the quay will be of concrete to the level of the water, in building them entirely of concrete the cost price of the metre found above can be taken and will amount to—		
1 Cubic metre of concrete	Rs.	5·00
Cost of moulds and sundries	,,	1·00
Outer layer of cement	,,	0·50
Price of the cubic metre ...	,,	6·50
The cross section of the quay walls being of 15 metres of surface including the foundation, and the total expanse being 11,600 metres, the entire cube 174,000m^3 will amount to	Rs.	11,31,000
For the protection of the quay walls there will be 4 by 4 metres of piling of $0^m{\cdot}304$ square and 5 metres ground depth, cost ...	,,	49
These pilings will be fixed to the quay walls by a splinter and two bolts, of which the cost will be	,,	2
Fastening and putting in position ...	,,	1
The head of the pile work will be provided with a covering of cast iron, cost ...	,,	6
Each piling placed in position for the protection of the walls will cost ...	,,	5·8
The number of outworks necessary for the protection of the quays being 2,900, the total cost will be	,,	168,200

The iron warehouses can be imported from Scotland where this kind of construction is to be had at the cheapest rates. The cost varies according to the current price of iron. Corrugated and galvanised sheet iron is used, and the warehouses raised on foundation walls. It would not be necessary to pave the floor with bricks, as it could be made of earth beaten down and mixed with sea-sand, the cost of the warehouses according to the estimates of the Scotch manufacturers is in detail: by the cross cutting of 3 linear metres:—

2 Posts of ribbed sheet iron	,,	40
4 Sand pits	,,	24
1 Truss	,,	80
10 Purlins	,,	30
4 Posts of fillings in	,,	40
500 Relays sheet iron for walls	,,	70
1,000 Relays sheet iron for roofing ...	,,	140
3 Metre ventilators	,,	5
Screws and rivets	,,	3
Foundation	,,	12
8 Bolts for posts	,,	4
Raising and setting in position	,,	80
Total cost by 3 metres cts. ...	Rs.	528
There will be 1,333 sections each 3 metres in length (10 English feet) and the total cost of the warehouses will amount to ...	Rs.	7,03,824
In the above estimate of articles sent from Scotland, freight, etc., etc., has been included. It is impossible to say beforehand the number of cranes, lifts, or other apparatus which it will be necessary to establish on the quays for the loading and unloading of vessels, but we can add for this to the estimate an item of ...	Rs.	1,20,000
For the cranes, fixed as well as moveable, with which the quays must be provided; the careenage dock with workshops, yards and machines, the cost will be ...	Rs.	8,00,000
Besides the cost of the above constructions we must add 10,000 metres of Railway for the business of the Port (6 to 7 miles) at 15,000 rupees by 1,609 lineal metres, say...	,,	1,05,000
Wagons, trucks, etc.	,,	40,000
2 cranes (Titan) for the building of the jetties, each at 30,000	,,	60,000
6 Dredging boats, each at 60,000... ...	,,	3,60,000
18 Tenders with screws for the working of the dredgers, each costing 40,000 ...	,,	7,20,000
2 Engines for the manufacture of the concrete, each at 15,000	,,	30,000
Kneading machines and sundry other implements for the manufacture of the concrete and the blocks	,,	10,000
4 Moveable cranes to assist in the making of blocks	,,	24,000
2 Locomotives for the transport of the blocks, at 16,000 each	,,	32,000
A tug for the harbour	,,	1,20,000

The different items for the building of the quays, besides that of the warehouse will be: For offices for the port and warehouses	Rs.	20,000
Commercial offices	,,	30,000
Custom houses	,,	10,000
Hospital for sailors	,,	25,000
Hotel ,, ,, ...	,,	25,000
Thannahs for the police	,,	10,000
A battery for salutes and signals, the cannon furnished by the Government ...	,,	8,000
Semaphore and signals	,,	9,000
Drainage of the quays, etc., etc.	,,	10,000
Telegraph	,,	2,000
Electric lighting, with steam engine dynamic-conducting wire and lamps	,,	20,000
Staff for carrying on the work for a period of 10 years	,,	5,00,000
6,000 Metres of enclosing railing with masonry base at 12·33 the metre, for 6,000 metres	,,	73,980
To deduct from the preceding sums the price realised by the sale of the machines, cranes, tools and different apparatus which will not be necessary after the construction is finished, of which the first value will be	,,	2,64,000
And which in calculating a depreciation of 5 per cent. a year will at the end of 10 years represent a value of	,,	1,32,020

Recapitulation of the sums constituting the total cost of the proposed Harbour for Pondicherry.

	Items.	Rupees
1	Jetties	45,23,600
2	Dredging	33,01,209
3	Quay walls	11,31,000
4	Protection of the quays (outworks) ...	1,68,200
5	Iron warehouses	7,03,824
6	Cranes and apparatus	1,20,000
7	Careening Dock	8,00,000
8	Railway and waggons	1,45,000
9	Titan cranes	60,000
10	Dredgers and tenders	3,60,000
11	Manufacture of concrete machines ...	96 000
12	Building of the offices, etc.	1,28,000
13	Semaphore and signals	9,000
14	Drainage	10,000
15	Telegraph	2,000
16	Lighting	20,000
17	Staff...	5,00,000
18	Railing and enclosing	73,980
19	Tug...	1,20,000
	Total ...	1,20,71,813

INUNDATION CANALS.

An Example of Remodelling.

The canal which is shewn in the rough map feeds from a side channel or creek of the river. This side channel is from 150 to 250 feet wide, is perennial, and has existed from time immemorial.

The main line A B D was at one time a branch of the river and the present branches were independent cuts from it. When it began to silt annual clearances were necessary and by successive clearances it gradually became canalized. The silting tendency was probably hastened by putting a *bund* across at D. From this arose the practice of two irrigators combining together to clear the main line and then separating each to clear their own branch. The irrigators naturally shewed the greater zeal in clearing out their own branch so as to draw off as much water as possible. The dotted lines at C will shew how old heads of branches were abandoned and new ones made higher up the main line. The main line being every one's business was neglected and great, useless, excavations were made on branches. At every bifurcation there were were huge spoil banks from 10 to 15ft. high and from 20 to 60 and 70ft. wide. From weight and want of slope a good deal of stuff slipped back again.

The great loop, like a man's ear, at D, was made purposely in the times when regulators were not dreamt of to check the superior draw of the most southerly channel.

Things came to such a pass about 10 years ago that Government had to take over the management.

The first step was to put the requisitions for labour on a definite footing and not leave it to the discretion of the irrigators—whether they complied with a requisition or not. On the other hand it was necessary that the irrigator should be guarded against unlimited demands. Regulations were framed whereby an irrigator could tell pretty closely the amount of labor he would have to supply from the area he irrigated. The next thing was to improve the supply in main line. So long as the main line was neglected any improvement of the branch was done at the expense of the others.

It was then necessary to have a sufficient command over the increased supply to be able to deliver it wherein actual working it was found to be most wanted. The cut F I traversed a tract that fared the worst of all when the main line worked badly. The branches it intersected had very small slopes; it was not possible to grade them higher than 1 in 10,000 whereas those running south could be graded as high as 1 in 5,000.

Having improved the means of supply on the line F I the complaints became louder in the fringes of imperfect irrigation now showed by the cut G J.

The cuts F I and G J were not made in one season but in sections. Circumstances at the time determined which sections were taken in hand and the branch that the section started from was specially improved in that clearance.

The principle steadily adhered to was not to stint labor on the main line clearance but to cut down all the rest to the barest maintenance and any surplus used up on cuts F I and G J.

Outside or to the west of the flood embankment the floods sweep across the country uncontrolled. In floods the channels are naturally more or less knocked about and those running from west to east are liable to be more or less choked up. To reduce this chance of damage to the lowest limits the channel E H D is being made. Another advantage obtained by taking off more and more of the supply through the channel B E is that the draw in the branch A B is greatly increased. For 6 years the reach A B has been cleared to the same bed width, *viz.* 40 feet, yet the supply has augmented the silting year by year.

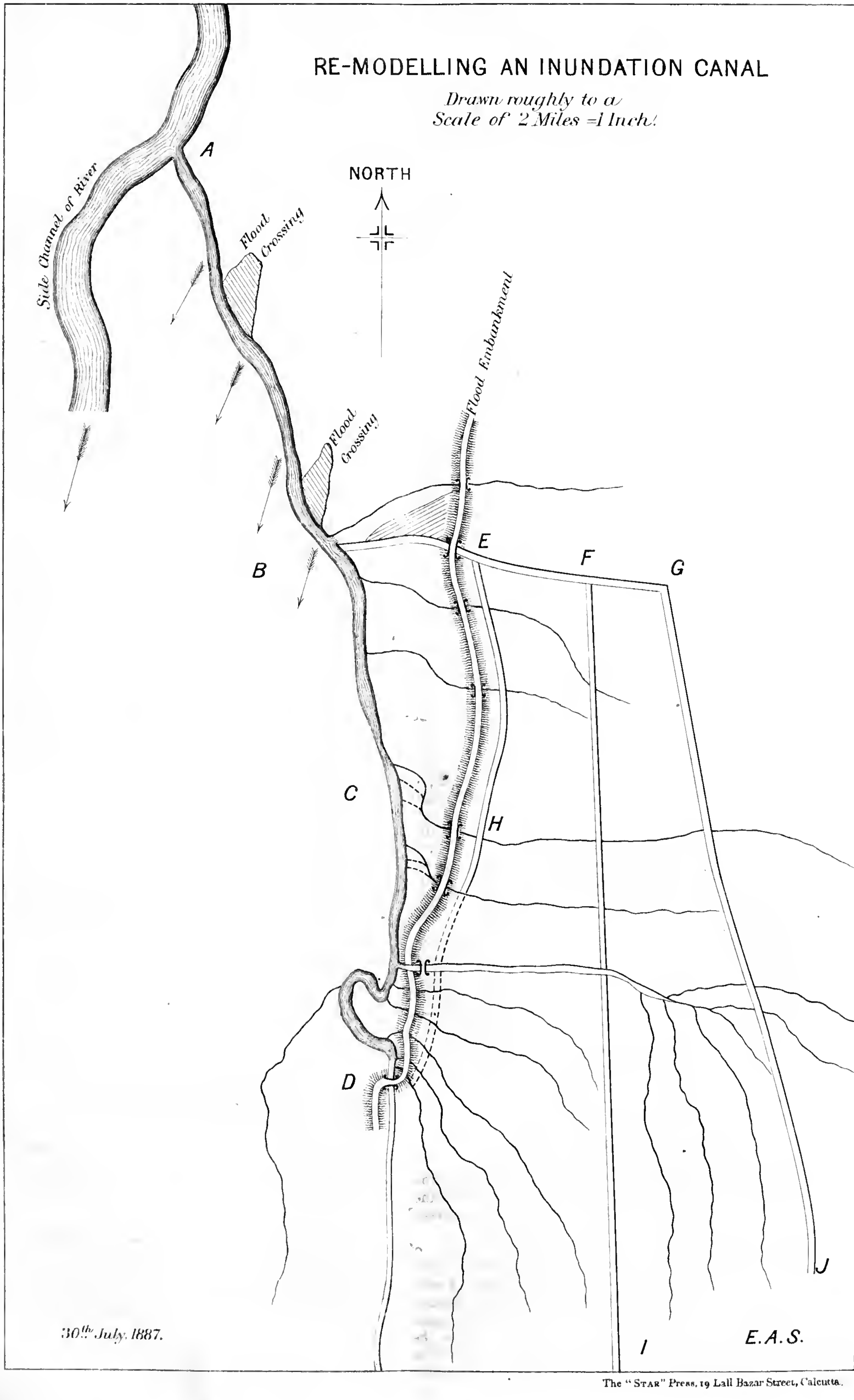
The new cuts above mentioned are all non-silting, and when the cut E H D is completed the only reach of channel that will require annual clearance is the reach A B E which is 8½ miles long. The total length of this canal system is 193 miles.

The river tract is cut up by numerous depressions the remains of more or less silted spill channels. Two such are shewn in the sketch map as crossing the main line. The number is of course much greater but the scale is too small to shew things in detail.

There is the question of how to deal with the flood crossings. There are two which determine whether the reach A B will silt or remain open all the year round. These and some other questions must be reserved for another occasion as this communication is already long enough.

E. A. S.

Koreishi; *July 31st*, 1887.



The "STAR" Press, 19 Lall Bazar Street, Calcutta.

THE NEW TAY BRIDGE.

We are indebted to the courtesy of a subcriber for a copy of the supplement to the *Dundee Advertiser*, containing an elaborate account of the new Tay Bridge, which has just been completed. The lordly Tay, as Scott loved to call it, has a history of its own in connection with bridges. Throughout its length of 126 miles, from the source in Loch Tay to the German Ocean, the river is spanned by no less than 10 such structures. There is a legend that when the Emperor Agricola invaded Briton in A. C. 81 he founded a little station, Victoria, on the site of the fair city and a viaduct was built across the river by his men. Whether the story has a foundation or not, it is certain that a bridge at Perth existed at a very early period in the history of the city. It was, as might well be supposed, constructed of wood, and was swept away by the great flood of 1210. Facilities for repairing damages such as we possess now were unknown in those days, and consequently a calamity like the one mentioned could not be easily overcome. It took a long time to re-establish communication with the opposite bank and early in the 14th century the bridge was spoken of in the language of their times as being still under "edification." The bridge of Tay was looked upon as a structure of great importance in the country. The kings of Scotland from Bruce down to James IV. granted and confirmed charters for the reparation of the bridge at Perth. "In 1601 there fell a rick, probably an arch of the timber bridge of Tay with two men, one horse and one load." One man, the horse and the load were saved, but the second man was drowned. This accident roused the Town Council to action and at their deliberations it was proposed to build a structure of stone. The King James VI. countenanced the scheme, and shortly after his accession to the throne of England His Majesty ordained that £7,000 Scots should be paid in annual instalments of £1,000 towards the funds for the building of the bridge. One Mylne, a famous architect and master mason to King James, started the work on 17th July 1605, and it was completed after twelve long years. But a fatality seemed to hang over the bridge which was boasted of as "a piece of fine and strong workmanship." It was, however, not only superficial in its foundations, but was too low in the arch-ways. The great flood of 1621 again proved disastrous to it as well as to the city. The water could not escape through the eleven low-browed arches, "but rose above them, and being thus gorged, its face and weight bore against the upper part of the structure and covered the key-stones, and then the whole gave way." This was a serious calamity, and owing to the straitened condition of the town funds a national appeal for assistance was made, which was fairly responded to. The King promised 30,000 marks, the Prince of Wales (afterwards Charles I.) put down his name for 10,000 marks; the example set by royalty was followed by the nobility and gentry. But the subscriptions were never realized. The King and some of the nobility died, and the troubles of the unfortunate Charles I. ruined the scheme. For a century and half matters remained in *statu quo* till the Earl of Kinnoull took the project in hand and with the assistance of the Government of the day the bridge was completed in 1771.

We now come to the bridge next in importance, *viz.*, the Tay Bridge at Dundee. The scheme originated with Mr. Bouch, Traffic Manager to the Edinburgh, Perth and Dundee Railway Company. But the idea was scouted at the time as that of a visionary. Mr. Bouch was not the man to be intimidated by opposition, and being once convinced of the feasibility of his plans he worked for ten long years in dispelling scepticism on the subject, till in 1864 it was announced that the promoters intended to apply for a Bill to sanction the erection of a bridge between Newport and the Craig Pier. At this point the Tay was to be crossed on 63 spans. At the fairway the height was to be 100 feet above the level of high water, and before the Dundee rick was reached this height was reduced to between 25 and 30 feet. Instead of curving to the east the direction was to the west, and the junction with the Perth line was to take place at the east end of the Magdalen Green. The announcement caused almost a panic. Vested interests were threatened; the Directors of several Railways, the Town Council and Harbor Trustees of Dundee and Perth, saw that a rival stronger than themselves was in the field and it might very well be supposed they assumed an uncompromising attitude. The Bill was only withdrawn after the North British Co. had openly espoused the project. In the next year a more extended and elaborate scheme was introduced into Parliament. Although it was strongly advocated, public opinion in Dundee had grown and it was regarded by the bulk of the community as both practicable and beneficial. It shared no better fate than its predecessor. Mr. Bouch, nevertheless, received encouragement and support, until in 1869-70 another scheme was submitted to Parliament which received the Royal assent on the 15th July. The structure was to have been completed in three years, but owing to the death of a Mr. Charles de Burgue, senior partner of the firm of Messrs. Charles de Burgue and Co., Contractors, and the subsequent transfer of the contract to Messrs. Hopkins, Gilkes and Co., of Middlesborough, great delay was created and it was not till 1877, the first stone of the bridge having been laid in 1871, that the stucture was finished. A short description of the structure will not be out of place here: Its length was 3,450 yards, and consisted of 85 spans of different dimensions. The piers were 85 in number, of which the first fourteen were of brick, the remainder being formed above high water level with tiers of cast iron columns, bolted together vertically by bolts and nuts, and connected laterally by means of cross-bracing and struts of wrought iron. The number of columns in the group on each pier varied from three to six. Thereunder the largest spans were formed of six columns, bolted to base pieces, which were bedded in stone. The lower portions of these piers consisted of concrete, brick-work and masonry. At piers 28 and 41 the girders were varied so that the lower booms were on a level with the upper booms of the girders on the north and south. This gave additional headway for vessels passing below the bridge. The headway was 88 feet. The superstructure was of wrought iron lattice girders, except one span on the northern portion which was crossed by bow-string girders.

The triumph of engineering skill and commonsense over self-interest and conservatism was signal, although shortlived, as the sequel will show; but not owing to causes which the pessimists and the stolidly ignorant oppositionists had predicted. We are, however, anticipating. The occasion of formally opening the bridge was observed as a red-letter day. Invitations were issued to 600 persons, and even Royalty had consented to honor it with its presence. But, at the eleventh hour, the latter portion of the programme had to be abandoned, owing to the uncertainty of the date on which the inaugural ceremony was to take place. Everything went as merry as a marriage bell, and nothing that could add to the *éclat* was omitted. "The well-laid plans of man and mouse gang aft agee," and the Tay Bridge was no exception to it. It had been a little more than eighteen months in existence, when, on the memorable night of Sunday, the 28th December 1879, in the midst of a fearful hurricane, the large girders gave way, and a train which was then passing over was precipitated into the foaming waters beneath. Of the 90 passengers and others that comprised the living freight, not one lived to tell the tale of that dreadful night. Those who observed the train mount the bridge after leaving the last station, say they saw, for a moment, a flash of lightning envelope it when it reached the centre of the bridge, there was again total darkness and deep silence—then followed the rest. A thrill of horror and dismay passed through the civilized world on the receipt of the news of the calamity. Utmost sympathy was with the sufferers, and the Queen telegraphed to Provost Brown that she was inexpressibly shocked, and felt most deeply for those who had lost friends and relatives by this terrible accident. An official enquiry into the circumstances attending the fall of the Bridge was ordered by the Board of Trade. After hearing all the evidence tendered on the subject the Commissioners arrived at the conclusion that there was no reason to suppose there had been any movement or settlement in the foundation of the piers. The wrought iron had been proved to be of fair quality, while the cast iron had been fairly good, though sluggish in melting. For the work that was to be done, the girders were fairly proportioned. But the iron columns, though sufficient to support the vertical weight of the girders and train, had been, owing to the weakness of the cross-bracing and its fastenings, unfit to resist the lateral pressure of the wind. The Commissioners animadverted on the work turned out at the Wormit Foundry, which were due to want of proper oversight. The Commissioners were further of opinion that the supervision of the bridge was not satisfactory, and that if by loosening of the tie bars the columns got out of shape the mere introduction of packing pieces between the jibs and cotters would not bring the columns to their positions.

Trains in India run at the rate of 30 miles an hour and in the case of the Tay Bridge it was ascertained that they did not run beyond 25 miles at the same space of time. The conclusion was, therefore, that the fall of the Bridge had been due probably to the giving way of the cross-bracing and its fastenings, and that the imperfections in the columns might have also contributed to the same result. Scarcely six months elapsed from the time of the disaster before the North British Railway (Tay Bridge) was brought before Parliament. It was accepted but with one reservation, that Mr. W. H. Barlow, C.E., should advise and report on the best method of constructing the Bridge, with the view of securing the actual and permanent safety of the structure. It was resolved that the old structure should be demolished and a new one take its place Want of space prevents our entering into a long discussion as to the demerits of the old Bridge and the merits of the new one. Suffice it to say that the object aimed at by engineers, *viz.*, to get at stability combined with graceful outlines, and to reduce to the smallest degree the weight on the basal area of the foundations has been attained.

The following technical account of the design of the Bridge will not be unacceptable to our readers :—

A strong, substantial pier has been obtained, while the least possible weight has been thrown on the basal area. The brick and concrete cylinder is encased in a strong wrought iron caisson up to about low-water mark. It is then continued upwards, the shaft being faced with Staffordshire brick impervious to water. Above high-water mark the two cylinders are tied together by means of a strong connecting piece, which is of solid masonry, terminating in the iron plates which form the base of the superstructure Owing to the immense depth to which some of the cylinders have been sunk the masonry up to the base of the superstructure is of itself very heavy. To have carried up the pier in solid masonry to the girder level would necessarily have thrown a tremendous weight on the foundations, and the question which the Messrs. Barlow had to solve was to reduce the superincumbent weight of the structure to a minimum and still have a pier sufficiently strong to bear the compressive and lateral strains which the viaduct and the rolling road would put upon it. These results have been obtained by the adoption of an iron superstucture of a singularly graceful design. Starting from the base plates on the top of the brick work two octagonal columns, each firmly braced inside and plated outside, were carried up till the inner members met in an arch. The other members were continued for a number of feet, and terminated in a base 40 feet in width, on which the girders rest. In this way a very substantial pier has been got, with the obvious advantage that a very heavy weight has been taken off the basal area. The lattice girder is now almost universally adopted in the building of bridges. The clever arrangement of the members provides for a very heavy compression strain, while the girder itself is comparatively light. Messrs. Barlow have retained in the new structure the available girders of the old Bridge, and have supplemented them with girders of exactly the same pattern, but much stronger. The flooring of the Bridge is of steel, and throughout on both sides of the Bridge there has been erected a girder of close lattice work, which serves both as a wind-screen and a protection to persons walking on the Bridge. With the following paragraph on the cost of the structure, we reluctantly take leave of the subject, which has been one of great interest to us and a labor of love. We only trust that our brother Engineers who are engaged in colossal enterprises of the same nature in India will take a leaf out of the experience of our European brethren and avoid all possible failures in the future. This is what the *Dundee Advertiser* says :—"The estimated cost of the Bridge was £640,000. This sum has not been much exceeded. The expenditure in founding the piers was estimated to amount to £282,000 ;

piers 5 to 77 about £268,000; and the girders and parapets £268,000 —the balance of the sum stated being expended on the approaches to the Bridge and the piers and the girders out to and including the skew arches. Taking the cost of the first Tay Bridge, which was £350,000, the North British Railway will have spent fully a million sterling in bridging the Tay."

NOTES FROM HOME.

(From our own Correspondent.)

THE removal of the buildings required for the enlargement of the General Post Office, St. Martin's le grand, has been commenced. The new building is to be of six storeys and is estimated at £125,000 exclusive of site.

On Monday the foundation stone of the Imperial Institute was laid by the Queen in the presence of her many distinguished and illustrious guests. The ceremony is described as semi-state, and the Prince of Wales read an address indicative of the objects of the Institute.

The Newcastle Exhibition continues, on the whole, to be well patronised; a meeting has, however, lately been held of those interested, and has set forth that the great attractions of the place are not sufficiently advertised, nor are there sufficient facilities at present granted by the Railway Companies to get the people to visit its many and interesting exhibits, and steps in accordance with this having been taken, a fresh impetus is expected to be given to the Exhibition. It is scarcely possible that the Mining Engineer will ever see such a collection so specially interesting to him as has been brought together here.

For instance, among the outside exhibits at the north end of the grounds are shewn several of the different systems of haulage which have been found to be practically successful underground. Again, patent wire, plough wire and galvanized hawser wire are shewn with their respective tensile and tortional tests. A piece of music wire is shewn in one unbroken length of seven miles, whilst a small coil of wire represents a sounding line of 100 fathoms in length. These have a breaking strain equal to 200 tons per square inch, with very high tortional equivalents and this exhibit must be regarded as satisfactory to those anxious as to the quality of material used in rope-making, a question of the first importance to the Mining Engineer.

The Royal Agricultural Society's show, which is now also being held at Newcastle, possesses unusual interest for Engineers, for competitive trials of steam engines are being carried out there for the first time since the memorable trials took place at Cardiff in 1872. The situation of the show on Gosforth Moor leaves nothing to be desired. The ground is high and dry and the soil light, and it adjoins the grounds of the Exhibition. The trials of engines are being carried out by Sir Fred. Bramwell and Mr. W. Anderson.

A German paper states that a number of locomotives for an English Steam Tramway in Buckinghamshire are now being delivered by a German engine-making firm, Krauss and Co. The first two locomotives delivered by this firm have already received the approval of General Hutchinson, the Board of Trade Inspector, and are now in general use. This seems to mean that our English Engineers cannot supply suitable locomotives.

The death is announced of Mr. J. Shaw, the Secretary of the South Eastern Railway Company. He succeeded Dr. Smiles in 1868, and at the time of his appointment to this important post he was but 29 years of age, the youngest Secretary of any Railway Company. For some time Mr. Shaw took the management of the Great Eastern Railway.

Prosser's Tram-rail Cleaner is described and illustrated in the *Engineer* and is there spoken of as automatic, requiring only a driver. It salts, sands or gravels the permanent way. It clears the lines and loads up all the refuse it displaces at the rate of eight miles an hour, leaving no deposit behind as at present. Most of the appliances hitherto introduced have been connected to the tram car, and they throw the refuse on one side, and this so ineffectually that no company can adopt them.

The President and Council of the Institution of Mechanical Engineers have sent a letter of congratulation to Lord Armstrong on the occasion of his elevation to the peerage. Lord Armstrong has been a Member of the Institution for 30 years and has occupied the Presidential chair of that body for 3 years. The Institution is extremely gratified that its brilliant Past President should be so signally honored.

The year 1887 has so far failed to fulfil all the expectations which were formed of it. But while this has been the case, it is equally certain that as we enter upon the second half of the year there are some indications of a reassuring character in the iron and coal trades. And the iron trade on the West Coast is beginning to reflect the better state of the two northern counties.

The shipments of iron and steel from the mouth of the Tees for the month of June exceed by nearly 10,000 tons those for the corresponding month of last year.

A District meeting of the Municipal Engineers' Association was held last week at Bolton when visits were paid to various works specially interesting to the members, such as the Destructor, Sewage Works, Infectious Diseases Hospital, the new Fever Hospital and similar establishments. The annual meeting of the Association is to be held next week at Leicester, notes concerning which meeting will be likely to interest your readers.

NOTES FROM CEYLON.

(From our own Correspondent.)

THE new head of the Ceylon Forest Department, Mr. Thompson, a gentleman of experience in India (so they say) has arrived. He officiated here before as Conservator of Forests in Central Province.

Railway Traffic—Is flourishing here with a total comparative increase for week ending 19th June of Rs. 8,592 over same week of 1886 due to tea coming down in three times, as large a quantity: cinchona with a slight increase swelled also by an advance of Blumbago rice and Mamere coffee is far behind now.

Nanu-oya Railway.—The latter proposal seems to retain the gauge, but make a lighter road all round, reducing formation width in cuttings to 17 feet, and building culverts dry. This is evidently risky, subject as we are to such sudden and heavy falls of rain—instance the ruin only the other day to the Situwaka Bridge on the road to Kelani district, the whole abutment of which on the far side, some 40 feet high, having given way. The cause of failure is given as newness of work, the bricks of which were not properly set, and hence could not resist the enormous rush of flood water. The structure will be rebuilt with the same materials and will cost Rs. 1,500, and will be strenghtened in design.

The Restoration of the Dalada-Maligawa at Yapawa.—Yapawa Yapahoo or Subbapabbata (the city on the auspicious rock) was founded about the 13th century during the usurpation of Magha, who came from Kalinga (the Northern Circars) 1219 A.D. by Subba Senapathi, a noble devoted to the Buddhist religion, who being disgusted of the gross impiety of the King quitted Pollonnaruwa and fortified himself on the hill of Yapawa.

The country at this time appears to be in a disturbed state, many Buddhist nobles leaving the court and fortifying themselves in the hills. Much of the elaborate ornamentation still visible at Yapawa was no doubt due to Bosat Wijaya Bahu, son of Prakama Bahu III., who after his accession to the throne was, about 1303 A.D., murdered by his Adigar. His brother who fled to Yapawa was proclaimed king (by the army which remained faithful to the reigning dynasty) under the title of Bhuwaneka Bahu It was this king who transferred the seat of Government to Yapawa, bringing thither the sacred relic, he having resided at Yapawa prior to his accession. It was the seat of Government but for a short time, for during this reign the city was captured and the sacred relic carried off to Madura by Kalu Sekera Rajah, King of Pandi (Madura), who sent an army into Ceylon under the leadership of his tributary, the King of Jaffna. Though not the seat of Government, it still remained a place of considerable importance, eventually being destroyed by the Portuguese about the middle of the 16th century. A gigantic boulder rising abruptly from the plain: a substantial *bund* starting from one side thereof and running into it on the other, enclosing a considerable area, leaving a precipitous side of the rock exposed on the outside as a natural protection, affords a general idea of the city of Yapawa.

The city was approached by water, which was supplied from an adjacent tank, a sufficient depth of water being maintained when necessary by *bunds* raised outside the main or city *bund*, thus affording a moat of considerable width and depth all round the city. These *bunds* are in an excellent state of preservation, the main one being pitched on the outside, in some places with stone, in others by brick on edge.

The only approach to the town was by a flight of broad stone steps leading over the *bund* (still in position.) The entrance now used is simply a breach in the *bund* made by the present priest in charge of the Wihara. A fine double culvert (stone) built through this *bund* (still in use) takes off the water from the space so enclosed into the moat outside. The flight of steps leads into what are now paddy-fields, but was doubtless anciently the business part of the city. After leaving the fields the ground rises until the first flight leading up to the Dalada-Maligawa is reached. This consists of 24 steps with a plain balustrade and leads to a broad terrace originally retained by a stone wall, from which rises another flight of steps, 40 in number, leading over the boulder rock, from which the steps have fallen, but their direction can be traced by the stanchion holes cut in the rock. This flight brings one to another terrace of inconsiderable breadth, from which rises the ground flight leading direct to the palace. These steps are 35 in number, flanked by heavy balustrades and profusely ornamented with wonderfully carved figures. At their summit is a terrace, from which one enters by a grand doorway the palace itself (inconsiderable) from this doorway, whence a magnificent view can be obtained of the low country, a broad platform of made ground runs back to the base of the rock, which rises sheer to a height of several hundred feet. It was the third or topmost flight of steps, with its substantial and elaborate balustrade as well as the surrounding palace that has been restored by order of Government.

As regards the state of building the whole of the left balustrade had fallen down and its *débris* entirely buried, so that the design was taken by the other, which though ruinous could be made out. The search for the missing stones, an expenditure of time and labor, some being found buried at a considerable depth.

The work of restoration includes a good rubble masonry foundation first put in, the wall rebuilt and the carved figures placed in position. Then the other side was pulled down and rebuilt, the stones having been previously numbered. The steps were all rent throughout.

The two Sinhayas were supported by an iron bar let into the chest and base of each, as the forefeet of both had been broken off in their fall. The pieces being found were cemented on.

One of the gaya-sinhas had to be lifted up from the bottom, where it had fallen, the other falling on the steps, was more easily handled. The gaya-sinhas are not a pair, one evidently never having been completed. On the rises of some of the steps were found Tamil figures roughly cut in the stone, shewing the workmen origin. The walling of the hall on the right had disappeared in the same way as the staircase and was similarly restored. A monolithic pillar, 13′ × 2′ 6″ × 2′ stands at each angle of these two halls, and as these columns had to be lifted up a height of 40 feet and the others taken down and rebuilt, some idea of the trouble involved can be imagined, when limited tackle only is at hand.

The lintel of the main doorway had to be raised 13 inches to allow of the jainbs being raised and set plumb ; these jainbs are 11′ 6″ × 1′ 6″ × 1′ 4″ and lintel 8′ 6″ long × 3′ × 1′ 4.″

All the platforms on which these halls rest had to be rebuilt from the wonderfully carved dâda, which turns round the building upwards, the whole top work had sunk inwards, and was both out of level and perpendicular.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, August 6, 1887.

Military Works Department.

Lieutenant G. A. S. Stone, R.E., Assistant Engineer, 1st grade, assumed charge of the Saugor Division on the afternoon of the 5th July 1887, from Lieutenant-Colonel T. O. Wingate, S.C., Executive Engineer, 2nd grade, who has been appointed to officiate as Superintending Engineer of the Presidency and Oudh Command during the absence on privilege leave of Major W. L. Greenstreet, R.E.

Director-General of Railways.

Mr. W. A. Johns, Assistant Engineer, 1st grade, passed the Lower Standard Examination in Hindustani, on the 4th July 1887.

In continuation of Public Works Department, Notification, dated the 10th June 1887, Mr. J. W. Buyers is temporarily transferred to the Superior Revenue Establishment of State Railways in Class I., grade 2, sub. *pro tem.*, with effect from the 16th March 1887.

Mr. W. B. Campbell, Executive Engineer, 4th grade, temporary rank, Burma, is reduced to Assistant Engineer, 1st grade, with effect from 23rd May 1887.

In continuation of Notification dated 27th July, the services of Mr. J. Manson, Assistant Engineer, 1st grade, are placed at the disposal of Agent and Chief Engineer, Bengal-Nagpur Railway Company, with effect from the date on which he may be relieved of his present duties.

The undermentioned officers are permanently transferred to State Railways :—

From Central Provinces.—

Mr. J. B Chirnside, Assistant Engineer, 1st grade.
Mr. J. N. D. LaTouche, Assistant Engineer, 1st grade.
Mr. A. Rowland, Assistant Engineer, 1st grade.
Mr. W. Slane, Assistant Engineer, 1st grade.

From Assam.—

Mr. A. R. Lilley, Executive Engineer, 3rd Grade :
and they will remain posted to the lines of Railway on which they are at present employed.

Madras, August 2, 1887.

Brevet Major Sidney Smith, R.E., Executive Engineer, 3rd grade, is granted three months' special leave from 12th September 1887, to qualify for the Military Examination to be passed previous to promotion to the rank of Major.

S. A. Subrahmanya Aiyar Avargal, Rai Sahib, B.A., B.C.E., Assistant Engineer, 2nd grade, is declared to have passed, on the 11th July 1887, the Colloquial Examination in Telugu prescribed in the Public Works Department Code.

Punjab, August 4, 1887.

Irrigation Branch.

Mr. F. W. Chanter, Executive Engineer, 3rd grade, attached to the Office of Superintendent of Works, Western Jumna Canal, is allowed furlough to Europe for 16 months, under the Civil Leave Code, from such date as he may avail himself of it.

N.-W. P. and Oudh, August 6, 1887.

Irrigation Branch.

Mr. G. Wylie, Assistant Engineer, 1st grade, passed the Departmental Standard Examination in Hindustani on the 21st July 1887.

Burma Gazette, July 30, 1887.

Upper Burma.

With reference to Burma Notification, dated the 4th July 1887, Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, reported his arrival at Mandalay on the forenoon of this date, and is posted temporarily to the office of the Special Superintending Engineer, Upper Burma.

With reference to Burma Notification, dated the 1st July 1887, Mr. J. Leonard, Assistant Engineer, 2nd grade, made over, and Mr. J. A. Price, Executive Engineer, 3rd grade, received, charge of the Myingyan Division on the afternoon of the 4th July 1887.

With reference to Burma Notification, dated the 11th June 1887, Mr. J. Donnan, Assistant Engineer, 1st grade, joined the Myingyan Division on the afternoon of the 7th July 1887.

Mr. J. Leonard, Assistant Engineer, 2nd grade, held charge of the Myingyan Division from the 23rd May to the 4th July 1887.

Hyderabad, August 1, 1887.

With reference to Notification of the 3rd March last, Mr. H. R. F. Ash, Assistant Engineer, 1st grade, passed his examination completing the test for the Departmental Standard as laid down in the Public Works Code.

Furlough to Europe for twelve months, with subsidiary leave with effect from the forenoon of the 1st August 1887, or from such date as he may avail himself of it, is granted to Mr. J. G. H. Glass, Officiating Superintending Engineer and Secretary to the Resident, Public Works Department, Hyderabad, under the provisions of the Civil Leave Code.

Bombay, July 28, 1887.

H. E. the Governor in Council is pleased to appoint Mr. W. E. Pedley to act as Executive Engineer, Karachi Canals, during the absence on privilege leave of Mr. H. M. Thompson, or until further orders.

Bombay, August 4, 1887.

H. E the Right Honorable the Governor in Council is pleased to appoint Mr. G. McC. Harrison to act as Executive Engineer, Shikarpur Canals, during the absence of Mr. J. G. Single on privilege leave.

Mr. D. Rutherford, Executive Engineer, Sholapur, is appointed to act as Executive Engineer for Irrigation, Sholapur and Bijapur, in addtion to his own duties, from the departure of Mr. W. L. S. L. Cameron on privilege leave, pending further orders.

Rao Saheb Himatlal Dhirajram, Assistant Engineer, is appointed to act as Executive Engineer, Kaira and Panch Mahals, during the absence of Mr. C. N. Clifton, Executive Engineer, on privilege leave.

Mr. R. B. Joyner, Executive Engineer, 2nd grade, is allowed furlough to England for two years from such date in August 1887 as he may avail himself of it.

Bengal, August 10, 1887.

Establishment—General.

Mr. L. R. Fraser, Assistant Engineer, is, on re-transfer to Bengal, posted to the Bhagalpur Division.

The privilege leave granted to Mr. T. Beatty, Inspector of Local Works in the Rajshahye Division, in the Notification No. 257 of the 26th ultimo, is cancelled.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 18th July 1887.

52 of '86.—Thomas Fraser Peppe, Sub-Deputy Opium Agent, Shahabad, Arrah, Bengal.—*For preparing for reeling Tussar and other wild silk cocoons found in India and elsewhere, for twisting and reeling the same into thread direct from the cocoon or after having been previously reeled.*

53 of '87.—Rudston Calverley Brown and Richard Wybrants Coryton, Indigo Planters in the District of Tirhoot in the Presidency of Bengal, India.—*For stretching and adjusting the sheet in Indigo Presses.*

The 25th July 1887.

26 of '87.—I. L. Hanser, Missionary, resident of Bareilly.—*For the raising of water from wells, tanks, talaos, and running streams, to be called the "Empire Water Lift."*

99 of '87.—William Garlick and Edward Garlick, Engineers, Builders and Contractors, of No. 24, Chowringhee Road, in the Town of Calcutta.—*For an improved artificial hematite iron stone.*

111 of '87.—John Howard Ross, of Nos. 32 and 33, Wicklow Street, in the City and County of Dublin, Ireland, Engineer. —*For improvements in illumination by oil lamps and apparatus for the purpose.*

112 of '87.—John Howard Ross, of Nos. 32 and 33, Wicklow Street, in the City and County of Dublin, Ireland, Engineer, —*For improvements in oil lamps and appliances thereto for supply of oil and air for combustion.*

P. W. D. NOTICE.

AKRA DIVISION.

Tenders, in sealed covers, in Form No. 14M, for supply of Miscellaneous Stores of approved samples, for a period of 12 months from 1st September 1887 to 31st August 1888, as per list to be referred to at the office of the undersigned, or at that of the Superintendent of Works, Calcutta, will be received up to noon of Monday, the 29th August 1887, when they will be opened in presence of tenderers.

Government currency notes, for Rupees 100, to accompany each tender as earnest money.

For further particulars apply to the undersigned, who does not bind himself to accept the lowest or any tender.

S. C. GHOSE,
Superintendent,
AKRA BRICK FACTORY DIVISION.

DATED AKRA,
The 28th July 1887.

NOTICE.

Bengal-Nagpur Railway.

1st.—Sealed tenders for the supply of 30,000 cubic feet of Teakwood scantlings required for the construction of broad gauge Railway carriages in the workshop, Bengal-Nagpur Railway, will be received by the undersigned up to noon on 20th August 1887, and opened by him then and there in the presence of all parties who may choose to attend.

2nd.—The timber to be seasoned and sound, cut perfectly straight and square and to be free from knots, flaws or cracks. Sizes of scantlings may be obtained from Loco. and Carr. Supdt., Bengal-Nagpur Railway, Nagpur.

3rd.—Seals of tenderers (unable to write) will not be accepted ; they should have their marks verified by witnesses.

4th.—Covers to be superscribed "Tender for Teakwood scantlings for B. N. Railway."

5th.—The tender may be in part or for the whole requirement, and the undersigned reserves to himself the right to accept tenders in whole or in part, but in the event of his accepting in part only, and the tenderer failing to take up the contract, the whole earnest deposit will be confiscated.

6th.—Tenders without earnest money of Rs. 1,000 will not be attended to.

7th.—The Agent reserves to himself the power of rejecting any tender without assigning a reason, and does not bind himself to accept the lowest or any tender.

T. R. WYNNE,
Agent and Chief Engineer,
B. N. RAILWAY.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong Shanghai*, and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.

An allowance is made for continuous insertions.

OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, AUGUST 20, 1887.

THE UNCOVENANTED SERVICE QUESTION.

I.

THE Association for the purposes of advancing the interests of the Uncovenanted Services in India has at last achieved some measure of success, but not without having had to put considerable pressure on the Secretary of State for India. For this result the gratitude of the Services in question is due to Mr. Henry Seymour King, M.P., who, shortly before the last mail left, interviewed Lord Cross, and succeeded in obtaining a distinct promise that the grievances complained of should be enquired into, that the special grievances of the Telegraph Department should be remedied at once, and that, if necessary, a Commission or Parliamentary Committee would be appointed to consider the whole question.

Before addressing Lord Cross on the subject, Mr. King had procured the signatures of no less than 45 members of the House of Commons to a memorial dealing with the injustice meted out to a large body of deserving public servants. The names of these members of Parliament shew that the feeling now happily aroused is a general one, and not confined to any particular party. When Mr. Bradlaugh, Mr. Parnell, and Mr. King agree upon a certain point, it shews that all sections of the Lower House will support any reasonable measure brought forward to remedy the wrongs complained of. Even that great stumbling-block, the Secretary of State for India's Council, has been startled out of its accustomed lethargy, and has awoke to the fact that it is now face to face with a large body of discontented servants who are determined on redress, and have the support of the majority of the House of Commons at their back.

Although, as an Engineering journal, we are principally interested in this matter so far as regards the Public Works and Telegraph Departments, we cannot help feeling that the question should be dealt with as a whole, and that the interest of the Service in general should now be pressed home to the Government. It is not very long ago that certain well-grudged concessions were reluctantly granted to the Public Works Department. Amongst other favours they were informed that the term "Uncovenanted" should no longer be applied to them. It will hardly be believed that this trifling matter met with most determined opposition in Council, and also out in this country. The whole influence of the Stracheys, now happily on the wane, was brought to bear against the removal of an insulting distinction made between the Service they had been connected with in India and the Covenanted and Military Services. One excited old Civilian of the old type, whose name we forget, declaimed at the meeting of Council to the effect that, whatever privileges were granted to the Public Works Department as regards pay, pension, or furlough, no alteration could be made in the term "Uncovenanted," which must be held intact and immutable as a mark of distinction between the Covenanted Civil Service and all other sorts and conditions of men. Finally when the Secretary of State insisted on the abolition of the term in so far as the Public Works Department was concerned, his orders were conveyed to the Department in a circular insulting in tone, and shewing in every line the petty spite of the man who penned it, and his impotent rage at having been over-ruled. We are glad to say, however, that the Under-Secretary to the Government of Indian in the Public Works Department, who was responsible for this disgraceful document, was not a member of the Department, but as we are informed, a retired Schoolmaster. There may have been some analogy passing through his mind at the time regarding the sting of the birch on an unfortunate schoolboy, and the sting of a deliberate insult to the feelings of the gentlemen serving under him; however that may be, the circular in question stirred up a bitter feeling that never subsided until the object of it retired from the Service.

We have no space to deal with this large question within the bounds of one article, and propose therefore now to enumerate the grievances under which the Uncovenanted Services as a body suffer; in our second article those complaints will be generally discussed; and in the third we intend to advert to the special grievances of the Public Works and Telegraph Departments. It should be remembered that the Military and Covenanted servants of the Government of India are exempted from every one of the wrongs complained of, although all the Services in this country are practically recruited from the same class of men socially and intellectually.

Speaking generally, the grievances for which redress is claimed are as follows:—

(1.) That the term Uncovenanted for officers of the superior grades of the different departments is both incorrect and objectionable.

(2.) That officers in the Uncovenanted Service are liable to be superseded by Covenanted and Military officers.

(3.) That service counts only from the age of twenty-two, and not from the date on which it was commenced.

(4.) That more favourable leave rules have been granted to certain officers only, and that the others are justly entitled to them.

(5.) That leave, whether on furlough or medical certificate, is not allowed to count as service towards pension, though it does in the Military and Covenanted Services.

(6.) That no pension on medical certificate is permitted by the Regulations to be earned before fifteen years' residential service in an Indian climate.

(7.) That service in an initial acting appointment is not allowed to count towards pension.

(8.) That there is no graduated scale of pension on medical certificate for service between fifteen and twenty-five years.

(9.) That thirty-years' service in India before a pension can be obtained without medical certificate is too long a term.

(10.) That the maximum limit of pensions is too low.

(11.) That pensions are calculated on the average pay af five years' previous service, which is too long a term.

(12.) That pensions granted are not paid at the rate of two shillings to the rupee.

These are the grievances common to the whole of the Uncovenanted Serviee and we propose to discuss them generally and particularly in our subsequent articles.

"DEFENCE NOT DEFIANCE"

MR. GUILFORD L. MOLESWORTH, C.I.E., has rendered a great service by elaborating a scheme for the establishment of an Engineer Volunteer Corps in India. Although there is no danger in the near future to give cause for anxiety, we must not forget that to be forewarned is to be forearmed. Although it is now a little more than two years since the paper embodying details was read before the United Service Institution at Simla, we do not know if any steps have been taken to realise the idea. However much we may dissent from the general views of Mr. Molesworth in the matter of our frontier policy, opinion is uniform in regard to the adoption of precautionary measures, for the security of the large Christian population of the empire.

The Volunteer movement in Great Britain dates from the latter end of the 15th or beginning of the 16th century, when the old corps—the Honorable Artillery Company of the city of London—was formed, and which bears the same name to this day, though it comprises the three arms of the service. But the great impetus the movement received was about the year 1798, when the national independence of Great Britain was threatened by the aggressive attitude of Napoleon I. A Bill was passed in Parliament, legalising the enrolment of Volunteers, and in the course of a few weeks 157,000 men were in arms throughout the United Kingdom.

In India the formation of a corps was the outcome of the Sepoy Revolt in 1857, since which time it has gone on extending steadily. But owing to several causes, not the least of which is the isolation of Europeans beyond the limits of presidency towns, out of a total of 208,000 of European descent in the country, a little more than 13,000 are enrolled Volunteers, of whom nearly half are employés in the several railways scattered throughout the peninsula; and it is a matter of wonder that an indispensable element—an Engineer Corps—should have been so long neglected.

The scheme propounded by Mr. Molesworth is simple enough. The 'Regimental' system, he very properly observes, is applicable to railways, or in large centres, where a sufficient number of men are available to form both rank and file, or where a separate 'Sapper Company' can be added to an existing body of Volunteers. But in mofussil towns and elsewhere, it would be necessary to adopt principally the 'Staff' system.

In regard to the constitution of the corps, he suggests that the Sapper or Pioneer companies should be similar to that of Pioneers of the line, and the Engineer or Railway battalions similar to that of Sappers and Miners

The Staff Corps is to be composed exclusively of commissioned and non-commissioned officers. The former to be recruited from civil and mechanical engineers and telegraph officers—the latter from the class of foremen and subordinates. For the purposes of such a Staff Corps, Mr. Molesworth proposes to divide the country into districts, coincident with the existing military commands, which would again be sub-divided into centres, which would be the head-quarters of the sub-divisional branches of the corps. In military districts the Staff Corps would form a part of the engineering staff of the military officer in command. In civil districts, it would form part of the staff of the Civil Officer in charge of the district. This is a judicious arrangement, as it will tend to prevent a clashing of jurisdiction and authorities. The important branch of heliography is also not omitted, for it is proposed to select heliographic stations, which would be useful in keeping up communication in case the ordinary telegraph was destroyed.

In regard to the duties of Engineer Volunteers, Mr. Molesworth is very explicit. He would employ them in the concentration of troops by railway, and in many other services, similar to those performed by the Railway Transport Volunteer Corps in England. They should also be capable of organising defensive operations, and of patrolling the line in disturbed times with traveling plated batteries and furnished with electric light.

In order to secure the services of competent men in the Corps, it is necessary that they should be possessed of certain qualifications. To attain this end it is necessary that exercises should be propounded by the military authorities under some assumed condition of possible contingency, and the officers of the Staff Corps should work them out in full detail. They should also enter upon a course of study of the technicalities of elementary military engineering; and of course these examinations should be of a practical nature, so as to qualify them for action in the field. In order, however, to induce volunteers to join such a movement, the Government should hold out inducement to them in any of several ways, *viz.* by lessening the necessary expenses of volunteering, or by affording facilities for qualification, or by the grant of travelling allowances when attending Corps meetings. In this point his suggestions are backed by higher authorities.

The above sketch is obvously superficial and incomplete; we would, therefore, refer our readers to Mr. Molesworth's address itself which is well worth studying, not only on account of its lucidness in laying bare the whole question of volunteering, but the minute details of the scheme, and a help to the solution of the question, how best we can defend ourselves in a case of emergency.

ACCIDENTS ON RAILWAYS DUE TO STORMS.

In May 1886 Major Sedgewick, Deputy Consulting Engineer to the Government of India for Guaranteed Railways, was deputed by Government to enquire into the circumstances attending an accident wherein an entire train of 50 empty covered goods wagons was blown away at a siding at the Asansol station on the 5th of that month. The result of that enquiry showed that although the E. I. R. Traffic Code of Special Working Orders laid down definite instructions in regard to securing vehicles in sidings by safety chains lashed round wheel and rail and locked or by bamboo sprags or sleepers passed through the wheels of the foremost wagons as well as dropping and firmly pinning the brakes, there was nothing in the Code to shew that the same precautions were necessary for, or applicable to, a train of vehicles marshalled for despatch within a few hours of their arrival or marshalling. Section 86 of the Code just named refers to *vehicles in sidings* and not to *trains* in sidings, a distinction which appeared real and necessary when pointed out by the officer in charge of the station, as it would be found difficult if not impracticable to secure a train in the elaborate manner indicated in the Code. Rule III. of the General Rules makes the Station-master responsible for the securing of *vehicles* standing at *stations* and *sidings.*

In the case under notice it would appear that an up goods train arrived at Asansol at 11 A.M. consisting of 50 empties and a brake van which were shunted into a siding with the intention of sending them up country at 9½ P.M. It further transpired during the enquiry that the brakes of only 10 front wagons were pinned down and those of 6 rear wagons were let down and the brake van brake was hard on. Further than this no other precautionary measures were taken to ensure the train of empty wagons against an accident, except that at a distance of 240 ft. from the brake van there had been chained long previously to the rail a low-sided wagon to guard against the possibility of the train or vehicles rolling out on the main line down the incline of 1 in 750 on which the siding holding the train of empties is laid. While the train without the engine was thus standing a north-wester visiting at about 3 P.M. drove back the train against the low-sided wagon which was wrecked by the collision. Two wagons out of the train of 50 empties were derailed and the brake van seriously damaged.

We are of opinion with Major Sedgewick that both Rule III. of the General Rules and paragraph 86 of the Traffic Code of Special Working Orders had been partially disregarded and that had *all* the brakes of the 50 empties been pinned down instead of only the number in the front and rear wagons, or that had the wagons been shunted back to the chained wagon 240ft in the rear of the brake van and secured there in an effectual manner, the accident in question would assuredly have been averted. And when it is further stated that similar accidents are of frequent occurrence on the various lines in this country during the hot weather when such storms, as that which caused the accident do, and are known to, occur, the maintenance of a vigilant outlook and a strict adherence to the existing rules during such seasons becomes the more imperative. But it should be stated in justice to those most concerned that the efficiency of the staff entrusted with the carrying out of these Rules should always be maintained, more so in the season in which there is fear of the occurrence of similar accidents.

Notes and Comments.

Progress in Siam.—It is announced on good authority that the Bangkok Tramway Company may now be looked upon as floated, sufficient shares having been taken up to warrant the construction of the line being at once undertaken.

Unfortunate!—Mr. Robert Gordon, a retired Executive Engineer, made a venture in Upper Burma as a Public Works and Railway Contractor, but he did not prove successful, and he has closed business in Burma and gone to England.

The Secretary to the Resident, P. W. D., Hyderabad—Deccan.—Mr. H. F. White, Superintending Engineer, Burma, has been transferred to Hyderabad in succession to Mr. J. H. Glass. Burma loses a thoroughly good experienced Engineer.

Railway from Pekin to Canton.—A Decree has been issued from the Throne sanctioning the construction of a Railway between Pekin and Canton. It is to be built with Chinese capital and the provincial authorities concerned are to set about finding the necessary funds, and preparing for the work.

Ship-Canals in China.—The novel argument adduced in favor of one of these proposed undertakings is that, even should no dividend ever be earned, the promoters will have had the satisfaction of constructing a masterpiece of Engineering skill; they will have given lucrative employment to many restless intellects; they will have brought healthful breezes and civilising methods to many a home; and they will have written a new, inspiring and glorious chapter in the history of a great Empire.

The Extension of Russian Railways in Central Asia.—Information received *viâ* Badakshan states that the Russians have abandoned an intention previously formed to construct a Railway from Charjui on the Oxus *viâ* Karki to Sherabad, on account of the mountainous country intervening between the two latter places; but orders have been issued to push on the Railway from Bokhara to Sherabad, which would follow the existing caravan route from Bokhara to Balk and Badakshan.

Wholesome Advice.—"Should any new coal mines be brought before the public during the next month or so, they will do well to test the accuracy of the statements made very carefully, and to absolutely refuse to pay large sums for doubtful mining rights acquired for little or nothing. The managements of the different coal concerns here would do wisely if they prohibited *all* their employées from dabbling in mining grants, &c. Men cannot serve two masters conscientiously, at least if they can, they rarely do, especially when the interests are conflicting."

Wanting Employment.—It is possible that, owing to the surplus number of officers of the Public Works Department now available for work (and wanting employment), orders may be issued by the Government of India granting furlough to any who may desire to take advantage of the same, such furlough to count as service. If a sufficient number do not take advantage of this offer, it may be necessary, as a measure of retrenchment, to compel a certain number of Public Works officers to take furlough, until the finances of the country are elastic enough to permit of their return to duty.

Artesian Sources.—A Correspondent writes: India must be rich in springs, although up to the present no really satisfactory results have been obtained from artesian wells. This can easily be accounted for—*firstly*, owing to the imperfect knowledge of the geology of the country, and, *secondly*, from the want of perseverance in going deeper than hitherto has been done. The water that annually falls in this country must go somewhere it is true. The rivers, streams, and evaporation take away most of it, but what happens to the water that has for ages been absorbed by the soil? The only answer that can be given to this question is, that it finds its way underground back to the sea, and this must be going on all along the coast line.

The Indian Gold Mines.—Mr. William Abbott, the consoler of the great crowd of investors in the shares of Indian gold mining companies, strikes a new note. He says there is an opinion gaining ground that in the administration of the Indian mines they are resting too much upon Cornish tradition, the idea being that all that is known about mines and mining comes out of Cornwall. Mr. Abbott does not share in the opinion that there is more to be learned at the present time about mining and mining appliances in Australia and America than in Cornwall. It takes some time, however, to get Englishmen out of a groove; but still, since the Indian gold mines were established in 1881, there ought to have been ample time to gain experience, and shareholders who are impatient, and justifiably so, need not lose heart.

The Bombay P. W. D. Secretaryship.—The Lahore paper says that Mr. Hughes' somewhat rapid promotion—and it is not bad to jump from Rs. 800 to 2,500 a month—has caused a very considerable flutter, not only in the Western Presidency, but even at Simla, where, as we noticed the other day, the Government of India has quite a large collection of senior men, eating their heads off, to use a somewhat undignified phrase. The Government of India is understood to have made the Bombay Government the most liberal offers in the way of selection from among those who, as the world knows, have a vested right to fill all appointments of the kind, if the latter has no one sufficiently capable among its own senior men; but so far, that enterprising and independent Presidency seems perfectly satisfied with its own arrangements.

More Blundering.—The administration of Burma has not been fortunate over their new stern-wheel steamers on the Chindwin. They were entrusted to young inexperienced gentlemen of the Indian Marine and both vessels came to grief under their command. The Indian Marine say they are unsuited for the navigation of the Chindwin, but the Irrawaddy Flotilla Co. think differently as they have steamers of the same type as the Government ones for this river but in charge of experienced *river* navigators. The old stern-wheeler called the "McIver," formerly belonging to the Burmese Government and now carrying the Indian Marine Flag, is successfully worked by an old salt who has had experience on the river Indus, but by a strange anomaly he is not an Indian Marine man, but a member of the Public Works Department!

An Unwise Distinction.—When the half-hearted concessions of 1885 were granted to certain members of the Public Works Department, it was promised that a list would be prepared and published of those members of the Department who were to be included in the Schedule of the improved pension and furlough rules. Up to the present, however, nothing has been done. If the Government of India could by any means be induced to make out this list of names, it would be a real boon to the Department at large, as we understand that several senior officers are prepared to retire, if they are only granted the rules now applicable to men appointed by the Secretary of State for India. Why this absurd distinction between gentlemen appointed by the Secretary of State and those appointed by the Government of India should be still upheld we are utterly at a loss to imagine.

A Deep Water Harbor for Yokohama.—A Company has been formed for the purpose of constructing a break-water or artificial harbor at Yokohama which will afford protection to vessels of heavy draught in any water. Colonel Palmer, R.E., has designed the work and will supervise its execution. Two concrete piers, one 5,000 feet and the other 3,800 feet long, are to be built out into the harbor, the shortest one starting from the Western Hatoba and the other from the eastern side of the Kanagawa fort. The space thus enclosed will afford safe anchorage accommodation for at least 200 large steamers. Bridges will be placed here and there along the break-waters for the use of launches and boats, so that these craft will be saved the inconvenience of having to go to the central entrance; and lines of rails from the Custom House and Railway Station will be carried to the shore end. The estimated cost of the work is put down at 1,000,000 dollars.

Bengal-Nagpur Railway Staff.—The arrangements in connection with the staff of the Nagpur Railway are now complete. Mr. R. A. Way has arrived from England, and will, to all intents and purposes, be in charge of the Asansol end of the line. His salary is, we believe, fixed at Rs. 1,200 a month. Captain Constable, R.E., is to take charge of the traffic management on the Western Section. Mr. J. Manson, who was Mr. Way's Assistant on the Gunduck Bridge, will again serve under that gentleman and will probably be posted to the Damudar Bridge. There is a rumour that Mr. F. J. E. Spring, Under-Secretary in the Railway Branch of the Bengal Public Works Secretariat, has been offered a Division on the line, but we can hardly believe it. Mr. Spring could not find that leisure on the Nagpur Railway which he requires for his literary flights, and if he were to quit his present appointment we fear that the scheme of Technical Education, which he is labouring so hard to produce, would prove but a still-born infant.

Public Service Commission.—At the sitting of the Sub-Committee of the Public Service Commission, further evidence of the Public Works Department was given. Colonel Vibart, Superintending Engineer, said he did not think that the education in the Madras Engineering College was sufficiently good. Cooper's Hill men were undoubtedly better than men locally trained. Royal Engineer officers are the best men. He thought that a European was more manly, straightforward and resourceful than a native. He would not promote any men in the upper subordinate grade to the superior grades. Colonel Pennycuick, Superintending Engineer, said he thought if a native was sent home to be educated he would make a good executive officer, but not otherwise. Cooper's Hill men were exactly the sort of men required. He did not seem to think much of Rurki men who had served under him. Military men were really the backbone of the subordinate department of the Public Works Department. There was nobody like a European soldier for promptitude and hard work. It was quite impossible to obtain men from the local college for the superior grades. Every man in the executive grade ought to be appointed from England.

A Solution.—Our attention has been called to the following suggestions *re* removing the grievances of the alumni of the Indian Engineering Colleges:—There are four first-class Colleges in India, the object and aim of whose existence is to furnish, each, one or two recruits annually to the Engineer grades of the Public Works Department. It is not necessary that all the four Colleges should aim at a high standard of education when the duty they have to do is so humble. Two large Colleges with a really efficient staff of professors and specialists will meet the present wants of India. One high class institution for Bengal and Northern India and one for Madras and Bombay are sufficient, provided each of them is supplied with as efficient a teaching staff as that maintained at Cooper's Hill, and that a large number of appointments—say one-fourth of the total number annually made—are guaranteed to its alumni. In each of these institutions separate classes or branches may be formed to train men to the Forest, Telegraph and Survey Departments in the same way that the Cooper's Hill College is doing now. At all events, the present is a fit opportunity to consider whether high scientific training and the inducements necessary to ensure a fair and vigorous competition cannot be ensured in this country.

The Mysore Extension of the Southern Mahratta Railway.—This Line is progressing slowly to a miserable degree. Local labour in sufficient quantity is exceedingly difficult to be had; in fact, cannot be had in many places, and the Mysorians who do turn out on the works, are mostly a lot of miserable specimens of humanity. It would appear that three-fourths of the Mysore State, through which the Railway is being constructed, is almost depopulated owing to the fearful scourge the famine of 10 years ago made throughout the country, and the unfortunate out-of-the-way cultivators who received little or no help from the Famine Relief Committees have not yet recovered physically from the effects of the dreadful privations and devastation of that terrible period. Hundreds of villages in the taluqs of Arsikere, Kadur, Tiptur and Terikere, which were 10 years ago largely populated, are now nothing but hamlets in comparison. Numerous unoccupied and dilapidated buildings and grim bare walls in everyone of these villages show signs that peace, happiness and plenty reigned supreme but a short while ago, but the unfortunate owners of which succumbed to the plague. Large tracts of splendid arable land are lying waste for want of somebody to cultivate them, and it is hoped that the completion of the railway will bring new settlers and thus revive that which was once a flourishing country. To complete the railway, however, labor, both skilled and unskilled, will have to be imported in large quantities, and although the Engineers and Contractors are doing all they can possibly do, to push the work, yet it is quite certain that a fair start will not be made till the rains are quite over in September next.

Current News.

HEAVY floods are passing now over the Bolan Railway, and it is probable that there will be a detention of traffic.

DOCTOR WATT, C.I.E., has been appointed Scientific Assistant in the Department of Revenue and Agriculture. The appointment is a new one just sanctioned by the Secretary of State.

THE Secretary of State will, in the course of the next three months, give notice to the Oudh and Rohilkhand Railway that the Government will take over the line on the 1st July next year.

IN the month of July last the Maisur gold mine crushed 949 tons of quartz which yielded 822 oz. of gold, and the Nundidroog Mine in June and July crushed 70 tons.

IN the Review of the Sanitary Report of the Central Provinces for 1886, it is clearly announced that the policy of attempting to secure the progress of village conservancy by moral pressure is to be abandoned as a failure.

THE Rangoon Municipality have successfully negotiated a loan of 23 lakhs for drainage with the Bank of Bengal. The terms are favourable for the capitalists, as is usually the case when money is borrowed in a hurry.

THE Secretary, Amritsar Municipality, proposed an Annual Meeting of the Secretaries of the several Municipalities in the North-Western Provinces and Oudh and the Punjab, to discuss Municipal matters to no purpose.

MR. TOWNSEND, the petroleum expert, who has been engaged in exploring for oil near Sibi, will shortly make a thorough examination of the petroleum wells in the neighbourhood of Rawal Pindi. He resumes work in the Sibi district in the autumn.

LATE reports from Lundi Kotal show that work upon the fortified *serai* there is progressing satisfactorily—another proof of the admirable way in which the arrangements with the tribes in and about the Khyber are managed by our frontier officers.

THE Royal Engineer Officers summoned to Simla to assist in the preparation of designs for defence works, are Major W. H. Haydon, Captain E. C. Spilsbury, and Lieutenants E. A. Edgell, W. R. Hilliard, B. B. Russell, and G. Williams.

WE hear that the Irrigation Committee, which was appointed last year to advise the Government as to the best means of restoring irrigation works throughout the Nizam's Dominions, has completed its report, which is now before His Highness' Government.

THIRTY-SIX hours of steady rain in the Siwaliks have caused some landslips in the Mohan Pass. In three places the road is entirely embedded in loose shale, boulders, and trees. Traffic was stopped till the evening on the 9th, by which time a way had been cut through.

THERE are no grounds for the report that the office of the Director-General of Railways at Simla will shortly be abolished in consequence of a despatch recently received from the Secretary of State for India. Matters will remain just as they are for another twelve months at least.

IT is said that a company is being organised in Tanjore for constructing a Railway line from Paumben to Ramasweram, a distance of about thirty miles, and purchasing the necessary materials and rolling stock. This line, if constructed, will be of great use to pilgrims to Ramasweram.

THE following Royal Engineer officers have been posted as follows:—Captain Barnet and Lieutenant Remington to the Mirat command, Military Works, and Lieutenant Hunter to the head-quarters of the I. G. Military Works. Lieutenant G. Williams, R.E., is transferred from the Rawal Pindi command to the head-quarters, I. G. Military Works.

MR. A. O'CONNOR, in the House of Commons, asked the Under-Secretary of State for India, whether it was a fact that the Public Works Department had capped with a corrugated iron roof, painted and boarded up, and turned into a post-office, a mosque at Bijapur, which "is perfect in structure and beautiful in decoration." Sir J. Fergusson said:—The Secretary of State knows nothing of the act of vandalism alleged by the honourable member; but inquiries shall be made. I may add that when this mosque was turned into a post-office the greatest care was taken to preserve its architectural features.

MR. RICHARD WOOLLEY, who recently proceeded home, we believe, to consult the Secretary of State in reference to the Nilgiri Railway, leaves England shortly, having arranged satisfactorily for the immediate construction of that long-talked of line. The subject of a Nilgiri Railway Company has been, one way or another, about ten years before the public, and a fair start, at last, will be most welcome. One of the concessions now obtained is, we learn, permission to invite capital by advertisement in the open London market. This was before refused because the Secretary of State was pledged to some similar Bengal Railway project.

AN application by the Municipal Commissioners of Ahmedabad to raise a loan of Rs. 4,10,000 is published in the Bombay Government *Gazette*. The loan is to bear interest at the rate of 5 per cent. per annum, and the period of repayment is to extend to 50 years. Rs. 1,10,000 is to be devoted to taking up a former loan, and Rs. 3,00,000 is to be spent to commence and carry out a part of a water-supply scheme for the city. The total amount sanctioned for the water-supply is Rs. 6,00,000, but three lakhs will bring the water into the town, and is as much as can be expended during the year; the balance will be required for distributing the supply.

TWO of the subordinates of the Public Works Department, Bombay, namely, Messrs. Hurdewlal Mugatlal, Sub-Engineer, and Maneckji Hormusji Vajifdar, L.C.E., Supervisor, having been recommended by the Superintending Engineer, Northern Division, on account of their long and meritorious services in the Department, have received the ex-officio titles of Rao Saheb and Khan Saheb, respectively, from the Government of India through that of Bombay. Mr. Hurdewlal has served the greater part of his time in Surat and Broach Districts, and Mr. Maneckji in Aden and Surat. Mr. Maneckji is the first Parsee L.C.E., he having passed his final examination in 1872-73.

IT is denied in Simla that there is any foundation for the rumour that the Government are sending Colonel Wallace, R.E., to America to study mountain railways with a view to the construction of a line to Simla. Some time ago the Duke of Argyll applied to the American Government for an Engineer to teach our men to make railways, and as they had an officer on hand with whom they didn't know what to do, they sent him out, and said he was just the man we wanted and would cover India in no time with splendid cheap railways. He was appointed Superintending Engineer of a District, but turned out a complete failure, and as soon as the agreement with him was over, he was allowed to go back to America. This is alleged to be the origin of the rumour; but we have our doubts.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

JOBBERY RAMPANT.

SIR,—You have drawn attention to the appointment of Major Gracey, R.E., in Burma and there are incidents in connection therewith that render it singularly interesting to the Department generally.

Mr. Richard, as you observe, acted through the whole of the troublous times in Upper Burma for an allowance of Rs. 100 a month which raised his pay to Rs. 1,050. Major Gracey, R.E., is appointed, as soon as the country is well settled, on a "special" allowance of Rs. 500, making his pay altogether Rs. 1,850.

Major Gracey, R.E., has been employed during the whole of his service (which is longer than Mr. Richard's by ten months) on Railways. There, it is to be supposed, he shewed his qualifications for a Provincial appointment, which include, of course, the tact, courtesy and consideration for others, required of every administrator. For the last few years he has held the sonorous appointment of "Engineer-in-Chief of Provincial Light Railways and Assistant Secretary to the Government, North-West Provinces and Oudh in the Railway Branch." These immense undertakings being brought to an issue, Major Gracey, R.E., was available for other fields, and his old appointment was supposed to be abolished.

No sooner, however, had he gone than it was found that the Government N.-W. P. and Oudh could not be carried on without an "Assistant Secretary to &c., &c." (as before.) Luckily there is one more officer of Royal Engineers in the Provinces, and Major Pulford, R.E., was naturally appointed. His service has been entirely in the Provincial Branch, principally, of course, in the Secretariat, where knowledge of the works and of the establishment of the Province is not essential. He was called "Personal Assistant to the Chief Engineer," but another officer (a C. E., the supply of R. E.'s having failed) is obtained to assume that responsibility and Major Pulford, R.E., is constituted "Assistant Secretary to &c., &c.," with the control of an establishment consisting of two Assistant Engineers and one Overseer.

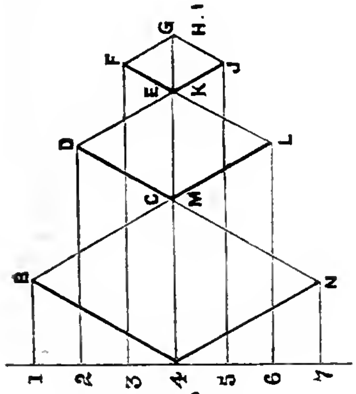
It is currently reported that Major Pulford, R.E., was lately offered a *quasi*-Military appointment on Fortification Works, but his services could not, as might very well have been supposed, be spared by the Government N.-W. P. and Oudh.

UBIQUE.

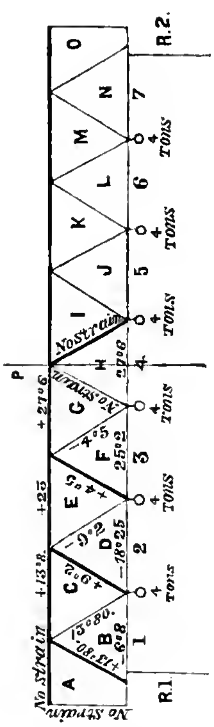
STEEL AND IRON BRIDGES FOR DISTRICT ROADS.

SIR,—In your issue of the 25th June there is an illustration and a description of a bridge said to have been submitted by Messrs. Main and Co., of Glasgow, for bridging a river in Bengal 300 feet wide in 5 spans with a section of 20 feet at one end to open for the purposes of navigation, and to cost Rs. 22,000 delivered in Calcutta.

As the design is said to have been "submitted," I presume that it has not yet been accepted, and I do not believe it could be accepted by any Engineer. The bridge is altogether too light, and instead of carrying a live load of 120lbs. per square foot of roadway surface, it is hardly equal to a load of 60lbs. per square foot without straining the iron to more than 5 tons per square inch. The strains marked on the diagram forming part of the illustration are incorrect for any kind of loading. It appears that the strains have been calculated on the supposition that the load is carried by the upper flange, which, of course, is wrong; but even then the strains indicated are not correct and as the load is carried by the lower flange of the main girders, the error is much greater. The following skeleton elevation of the girder and diagram of strains give the stresses in the flanges and the diagonal bars.



Reaction of R 2. Reaction of R 1.



The strain at the centre of top flange is 27·6 tons and at 4 tons per square inch compression (not deducting rivet holes) = 6 9 square inches gross area required. But the portion of the flange between each apex is under the condition of a strut and must therefore be calculated as such.

Assuming 5″ as smallest dimension we have—

$$\text{Area } a = \frac{W}{2} + \cdot 0003\, W \left(\frac{l}{d}\right)^2$$

$$= \frac{27}{6} + \cdot 0003 \times 27\cdot 6 \left(\frac{7\cdot 25 \times 12}{5}\right)^2$$

$$= 13\cdot 8 + 2\cdot 5 = 16\cdot 3 \text{ square inches.}$$

Messrs. Main & Co.'s design shews one **T** bar $5'' \times 4'' \times \frac{1}{2}''$ = 4·25 square inches, thus straining the iron to nearly 7 tons per square inch, and ignoring altogether the fact that the unsupported length between the diagonals must be considered as a strut.

Again, the first diagonal is a strut and has to transmit a load of say 14 tons.

$$a = \frac{W}{2} + \cdot 0003\ W \left(\frac{l}{d}\right)^2$$

$$= 7 + \cdot 0003 \times 14 \left(\frac{72''}{3''}\right)^2$$

$$= 7 + 2 = 9 \text{ square inches,}$$

gross area required.

Messrs. Main & Co.'s design gives—

1 angle bar $3 \times 3 \times \frac{1}{2} = 2\cdot 75$
and 1 flat „ $3 \times \frac{1}{2} = 1\cdot 5$
$= 4\cdot 25$ square inches gross area.

The next bar is in tension and has also to transmit a load of 13·8 tons requiring 3·45 square inches gross area.

The design shews one angle bar $2\frac{1}{4} \times 2\frac{1}{4} \times \frac{1}{2} = 2$ square inches gross area—thus again straining the iron to nearly 7 tons per square inch

But the design is most defective in the arrangement of the joints. The number of rivets shewn are not sufficient to transmit the strains through the various parts.

Assuming that the rivets will be $\frac{3}{4}''$ diameter and placed singly, how is it possible to get 3 rivets in a depth of 5″ as shewn in design? 3 rivets placed singly require a distance or length of—

$$(3'' \times 2\tfrac{1}{2}'' \times \tfrac{3}{4}'') + (\tfrac{1}{2}'' \times \tfrac{3}{4}'') = 6 \text{ inches.}$$

But even if 3 rivets could be put in as shewn, they would not be sufficient to transmit the strain.

The shearing strength of a Lowmoor iron rivet in tons $= 18\ d^2$ and the working strength $= 4\cdot 5\ d^2$. Assuming that the rivets will be $\frac{3}{4}''$ diameter, the safe strength in tons (single shear) on each will be 2·5 tons. The maximum strain in diagonal bars of 13·8 tons will require—

$$\frac{13\cdot 8}{2\cdot 5} = 5\cdot 5, \text{ say, 6 rivets.}$$

Messrs. Main & Co. put 3 rivets where 6 are absolutely necessary.

I would also point out that the 3 stays are not sufficient to hold the top flange in position within its length, as the portion of the top flange between the apices has not been considered as a strut and is unsupported for a length of about 14′ 6″, it must collapse under a very small compressive strain.

W. F.

THE INDIAN ARCHÆOLOGICAL SURVEY.

SIR,—I saw once a notice of Archæological Proceedings in Madras reviewed in your Journal, and I entirely agreed with your somewhat caustic, if not pungent, reflections.

Archæology is a most interesting study when pursued in a popular as well as scientific manner. It would be *invaluable* if it shed light on the ancient arts and industries of the country. Unfortunately it has been for years in the hands of a lot of dry German *pandits*, full of jaw-breaking inscriptions and manufacturers of unreadable letter-press on coins, &c. These men are engaged solely on the historic side. A sight of some of them with their dishevelled locks and dingy clothes is enough to dispel the idea that they have any artistic sympathy. The neglected state of our monuments is owing to these men having had for years sole access to temples.

They are essentially Dryasdusts of the Jonathan Oldbuck school, but without his sense of humour.

Dr. Burgess may be a very profound scholar, but elaborate works on the Mahomedan or Jaina style of architecture, works rarely seen beyond the shelves of the Asiatic or British Museum, may be interesting to a few *savants*, but is not what the public require for its money. I know that these works are in existence, but I have never read them.

There has been no attempt to popularize Archæology—to make it minister to the wants of Museums, &c., or to make the ornament accessible to the general public. That excellent officer, Colonel Jacob, of Jeypur, is engaged in utilizing the ornament or preparing it for utilization. Others have long been engaged on a similar enterprise.

The work of the Survey had been decentralized on the wise recommendation of General Sir A. Cunningham, whom everyone venerated and respected. It was understood that the head of each survey, and that its administration, would be under its local Government. But the official assurance to this effect, meant nothing Dr. Burgess, the Bombay Surveyor, was not content, and so Government issued a fresh resolution centralizing the work, an arrangement which naturally alienates local Governments. By the new arrangement the Surveyors were made subordinate to Dr. Burgess, "Director-General," and this after Government had given a distinct promise that the office of Director would not be revived. It is very pleasant for the *Director-General*, who collars *additional pay*, a large *travelling bill* in making a stampede ever "Continental India," (as a Government Resolution probably drawn up in his own inflated language terms it), and who retains the right of passing his summers in Europe. Fancy 15 recuperative sea voyages and a residence for half the year in Europe!

The Doctor even insists on advising Government on "monumental conservation," although an adviser ought to personally inspect and see monuments himself, a duty he cannot adequately perform from his back parlour in Edinburgh.

General Cunningham found India, *i.e.*, Bengal and the Punjab, so large that he recommended decentralization and he lived in India. The Doctor does not live in India, but wishes to control everything. His idea of his office is so exacting that even the clerks and draftsmen of the local Surveys are at his "disposal."

The present arrangement from a public point of view is folly and only susceptible of delays. If the Doctor's services are to be available for Northern India, it ought to be as "adviser." The present arrangement may gratify vanity and thirst after power on the part of those unfit to exercise it, but nothing else. The Surveys ought to be under Provincial arrangements. If Dr. Burgess is to be adviser on conservation, better that he lived in the country.

F. S. A.

Literary Notices.

TRANSACTIONS OF THE SOCIETY OF ENGINEERS FOR 1886.

THE volume before us is a welcome addition to the Professional literature of the day. President Nursey's Inaugural Address has been already referred to in these pages, and we may add that it is the most elaborate Summary of Engineering progress of the many Annual Addresses delivered this year. Among the papers that make up the volume we find E. S. Bellasis' on the "Roorkee Hydraulic Experiments," which is an adverse review or criticism of Major Allan Cunningham's investigations and conclusions on the Ganges Canal. P. F. Tarbutt's Paper on "Liquid Fuel" cannot fail to create interest now that the question of the utilisation of Hydro-carbons is a topic of the day.

General Articles.

CALCUTTA PORT IMPROVEMENTS.

Kidderpore Docks.

VII.

Report of Joint Committee of Port Commissioners and Chamber of Commerce of 1883 and Financial Aspect of the Project.

In estimating the financial return to be derived from the proposed docks at Kidderpur, the Joint-Commitee of 1883 thus calculated the gross capital to which interest would have to be charged :—

Capital debt of town jetties and appliances already constructed	Rs.	26,00,000
Estimated expenditure on docks at Kidderpore	,,	2,23,30,105
Extension of tramway from jetties to the docks	,,	7,44,000
Total ...	Rs.	2,56,74,105

And, assuming that the whole of this capital had been expended, and that the works had been completed and in use during 1882-83, they calculated, under the two heads of imports and exports, what the revenue would have been from the shipping and the import and export tonnage of goods for that year given in the tables contained in the earlier part of their report. Besides the 199 ships which used the town jetties, 247 ships, of 373,994 gross tonnage, and 339,497 net tonnage, bringing 474,687 tons of iron, coal and salt could have been accommodated with berths in the docks. But some of the coal was imported for the use of steamers in the coasting trade which would not use the docks, and some of the cargoes of salt ships would be kept on board and discharged by degrees in the stream. Deducting on these accounts, 173 was the number of vessels that would have discharged in the docks, and charging 4½ annas per ton on the tonnage,—calculated on 1,375, the actual average net tonnage, and Re. 1 per ton on iron and 10 annas per ton on coal,—the jetty rates for landing and loading, and Re. 1 per ton on salt, including free storage for one month, the estimate of income from imports was as follow :—

From imports at jetties (ships and cargo) actual	Rs.	6,79,000
From 173 additional vessels	,,	66,912
,, landing 72,617 tons of iron ...	,,	72,617
,, ,, 45,513 ,, coal ...	,,	28,445
,, ,, 200,000 ,, salt ...	,,	2,00,000
Total from imports ...	Rs.	10,46,964

The returns from exports, the Committee estimated, would be—(1) payment by 403 vessels of 486,482 tons net register, at 3 annas per ton, = Rs. 91,215, and (2) the payments made by shippers of 1,191,734 tons of export cargo, at Re. 1 per ton, = Rs. 11,91,734, – total Rs. 12,82,949.

The capital expenditure above stated included the cost of land available for the construction of private warehouses in close proximity to the docks, and the Committee estimated that from this a yearly rental of Rs. 1,20,000 would be obtainted, and a boat dock was included in the project, which would yield, at the usual wharfage charge of 2 annas per ton, Rs. 75,000 per annum from 600,000 tons of boats. The total income of the jetties and docks during 1882-83, had the works the Committee recommended been in operation, would therefore have been as follows :—

Imports	Rs.	10,46,964
Exports	,,	12,82,949
Rent of land	,,	1,20,000
Wharfage from boat-dock	,,	75,000
Total receipts ...	Rs.	25,24,913

Against this income the Committee estimated the annual expenditure for management, working and maintenance at,—actual for jetties	Rs.	3,88,200
Additional for docks	,,	7,38,397
Total ...	Rs.	11,26,597

which amount, deducted from the above income of Rs. 25,24,913, left a balance of Rs. 13,98,316 to meet the charge for interest and sinking fund. In respect of expenditure on jetties this charge would amount to 6½ per cent., but in regard to the docks, which were works of a permanent character, the Committee thought that a sinking fund ought not to be provided for, but only interest. The amount required on the capital expenditure would then be :—

On Rs. 26,00,000 capital debt of present jetties @ 6½ %	Rs.	1,69,000
On Rs. 2,30,74,105 capital debt of proposed docks @ 4½ %	,,	10,38,335
Total ...	Rs.	12,07,335

The net profit account would then be :—

Total Income			Rs.	25,24,913
Expenditure ...	Rs.	11,26,597		
Interest and sinking fund	,,	12,07,335	,,	23,33,934
Surplus after meeting all charges ...			,,	1,90,981

The above was the estimated financial result based on the actual trade of the Port for the year 1882-83; but the works provided for in the Committee's estimate could, without resort to stage berths, accommodate 1,064 ships, *viz.*, 864 in the docks—allowing an average stay of fourteen days for each vessel—and 200 vessels at the town jetties. The income from imports and exports of Rs. 23,29,913 was obtained from handling 372 vessels for the purpose of discharging and loading, and 403 vessels for the purpose of loading only, or 775 vessels in all, 289 vessels less than there would be accommodation for when the docks were completed. The additional income from 289 additional vessels, at Rs. 3,006 each, would amount to Rs. 8,68,734. Looking to the steady and recently rapid increase in the tonnage of vessels frequenting the Port, the Committee thought it might be assumed that these 289 additional vessels would require accommodation by the time the docks were finished, and the income to be derived from the docks and jetties would then be as follows :—

Income based on returns of 1882-83 ...	Rs.	23,29,913
,, from 289 additional vessels ...	,,	8,68,734
,, ,, spare land and boat-dock ...	,,	1,95,000
Total ...	Rs.	33,93,647

To work the additional vessels would involve an addition to some of the items in the estimate of expenditure amounting to Rs. 2,49,800, which would make the total expenditure Rs. 13,74,397, and the probable result on working 1,064 vessels would be :—

Income			Rs.	33,93,647
Expenditure, working expenses	Rs.	13,74,397		
Interest, sinking fund ...	,,	12,07,335		
			,,	25,81,732
Surplus ...			Rs.	8,11,915

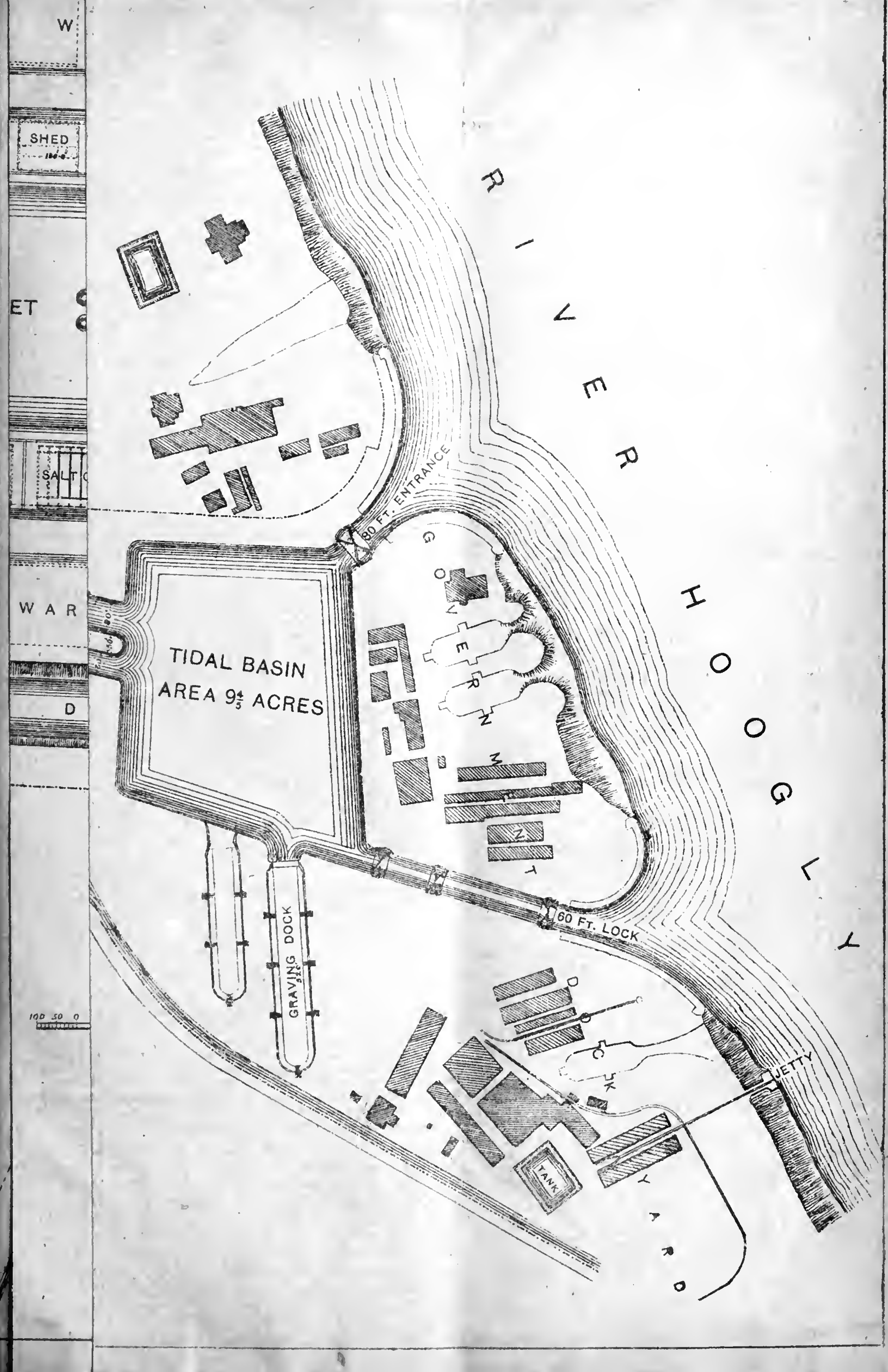
On this the Committee observed,—

"The foregoing estimates show that the present trade of the Port would give much more than a sufficient return to cover all working expenses and interest on capital expended for the construction of the works proposed, and if the trade of the Port increases, as it has hitherto done, and to such an extent as to utilize fully the accommodation which the proposed expenditure will provide, the receipts will be very much increased without adding anything to the expenditure for interest, and only a comparatively small amount to the working charges."

Description of Proposed Works at Kidderpore.

As mentioned in our last article, the Joint Committee decided to recommend that the extension of Port accommodation should be given in the form of wet docks in preference to constructing additional jetties ; and they fixed upon a site at Kidderpore, with two entrances to the docks through the Government Dock Yard. This intersection of the Government Yard would not in any way inconvenience the work then carried on there, and the position was the best and most suitable within the Port for an entrance. The ground behind, as far back as the old Garden Reach Road, on which there were very few masonry buildings could, the Committee believed, all

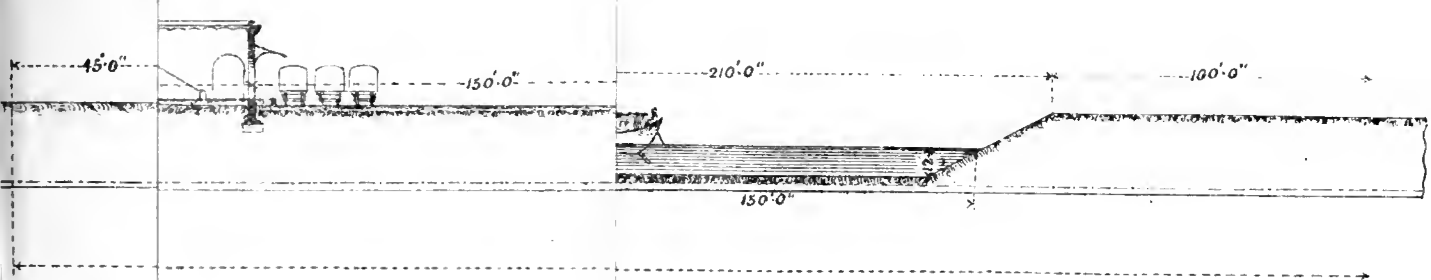
Plate No. 3.


RIVER HOOGLY
80 FT. ENTRANCE
TIDAL BASIN
AREA 9⅘ ACRES
GOVERNMENT
60 FT. LOCK
GRAVING DOCK
DOCK YARD
JETTY
TANK
SHED
SALT
W
ET
WAR
D
100 50 0

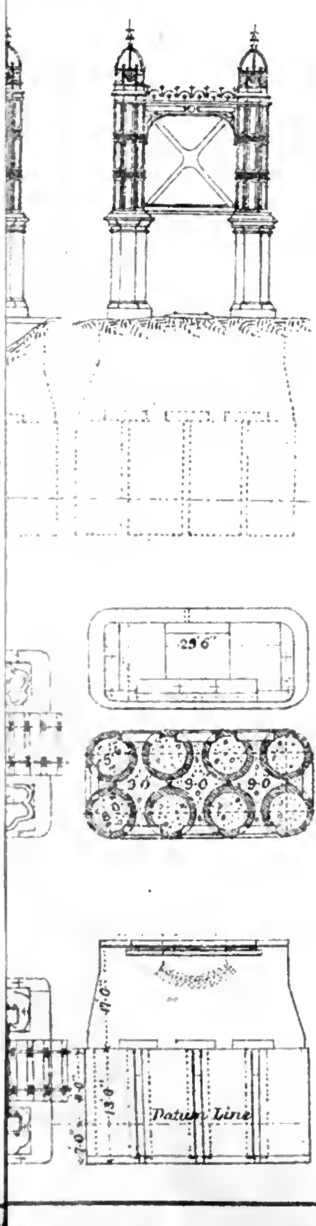
ECTION OF BOAT CANAL

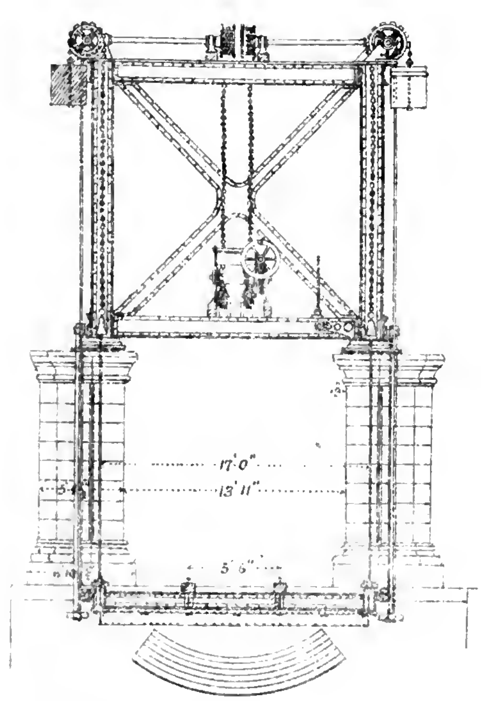
SPACE FO

SF



KIDDERPORE





(Sd.) Wm. DUFF BRUCE, M. Inst. C.E.,
Vice-Chairman of the Port Commissioners.

ho. T. C. Press, Ro

Thos D. Bona, Supdt.

[illegible]

be bought up for about Rs. 1,500 a *bigha*; beyond that road it would cost Rs. 500 a *bigha*; and the open fields beyond that again could be bought for Rs. 50 a *bigha*. The Committee, indeed, after pointing out that the bulk of the work that used to be done in the Government Dock Yard was now done by the Public Works Department and the Port Commissioners on their own premises, proposed that the balance of it also should be so arranged for, and that the whole of the Dock Yard should be made over to the Commissioners for the purposes of the Port, they giving in exchange, if required, a small dock yard they had lately acquired at Sulkeah, which would suffice for the repair of the pilot brigs and the few Government steamers. The audacity of this proposal, which must have made the hair of the Indian Marine Department stand on end, was, however, not so great as that of Mr. Robert Steel's proposal, mentioned in a previous article, to remove Fort William to make room for more jetties. Nevertheless the Government of India concurred with Captain Hext that the proposed exchange was undesirable, as the buildings and dock at Sulkeah required extensive repairs which would take a long time to execute, and the site being above the pontoon bridge was inconvenient; and a compromise seems to have been adopted by which the northern entrance was shifted lower down, the portion of the Dock Yard cut off to the south of this was given up to the Port Commissioners, and land in the other direction, and some pecuniary compensation, was received in exchange.

The site of the proposed docks and entrances, and the manner in which it was laid out by Mr. Bruce in the design adopted by the Committee, are shewn in Plate 3, given with this article. A cross-section of the inner dock, warehouses and boat-canal will be found at the top of Plate 4, also herewith given. The description of the arrangement of the docks and of the accommodation provided in them given by the Committee in their report will not bear abridgment. It is as follows :—

23. *Area of dock and accommodation provided.*—The general arrangement of the dock is shewn on the plans, but may be here briefly described. The outer dock will be 2,630 feet by 600 feet, or about 38 acres in extent, and will accommodate 14 vessels—6 berths for the longest steamers, and 8 berths for sailing vessels or smaller steamers discharging at the same time. The inner dock is 4,700 feet long and 600 feet wide, and contains quay space sufficient for the accommodation of 20 steamers and sailing vessels at the same time. All the necessary crane and warehouse accommodation for working the vessels berthed in the dock has been provided for in the estimates, including a pair of sheer legs, capable of lifting 60 tons, to be erected in the tidal basin. The accommodation in the two docks would therefore be sufficient for 34 vessels; and allowing 14 days for each to discharge and load, or say, 26 at each berth annually, the two docks would accommodate in all about 864 vessels. These vessels could all be discharged and loaded at the quay; but the docks could accommodate a much larger number by arranging for stage berths.

24. *Dock entrances.*—The entrance to the dock would be through a tidal basin about 600 feet by 650 feet; and from the tidal basin to the river there are two entrances—(? exits) one 80 feet wide and the other 60 feet. Between the tidal basin and the dock there are also two entrances of corresponding dimensions,—*viz.*, 80 feet and 60 feet. The 60 feet outer entrance is a lock 450 feet long, but with intermediate gates to take in vessels of less than 300 feet length and light draught. Generally speaking, the gates would be opened about two hours before high water, when the water in the river and tidal basin would be at the same level; but it would often be found convenient to take in a vessel before the top of high water, and in such cases the lock would be very useful. The lock would also be required to pass cargo boats out and in at all times of tide; and during neap tides, if only a few vessels had to be handled, a considerable amount of water might be saved by locking vessels out and in instead of reducing the level of the water in the tidal basin. The plan of entrances and arrangements here described will most conveniently meet the requirements of this river and the large vessels that will use these docks, and greatly facilitate the handling of such vessels in entering or leaving the dock. The site also, as regards the river, is the best and most convenient within the limits of the Port. There are no eddies to contend with, and there is a fine anchorage immediately in front and extending nearly a mile up the river.

25. *Water over dock sills.*—Taking Kidderpore Dock sill as datum, the depth proposed for the outer entrance and the tidal basin would be 14 feet below datum, and for the inner gates and dock 10 feet below datum. The water in the main dock would be maintained by pumping, at a level varying from 16 to 22 feet above datum, or at the level of ordinary spring tides at the different seasons of the year. The lowest neaps rise to only 11 feet above datum; but there are very few such tides, and they occur only in January and February, and in these months only for two or three days. During the remainder of the year the tides always rise to 12 feet and over, so that it would only be on three or four days in the year that a vessel drawing 24 feet of water could not enter or leave the dock. On spring tides the depth on the outer sill would never be less than 29 feet, and during the rains 36 feet. In fixing the depth of the sill at 14 feet below datum, the Committee have been guided by the fact that a greater depth would be of no practical advantage, as vessels which could not leave the dock with this depth of water over the sill could not at such time proceed down the river.

* * * * * *

27. *Arrangements for working tidal basin.*—The arrangements for working the tidal basin on ordinary tides would be as follows :—

Immediately after the top of flood tide the outer gates would be closed and all the water in the tidal basin impounded. Assuming, for the sake of illustration, that the tide on this occasion had risen to 15 feet, and that the water in the dock was 18 feet above datum, the water in the tidal basin would then be 3 feet below the level of the water in the dock, and all the vessels that had entered on that tide would be in the basin. The sluices leading from the main dock would then be opened, and the water in the basin raised to the same level as that in the dock. This would reduce the level of the water in the docks about 4 inches, and raise the level of the basin 2 feet 8 inches, so that the water in the basin and in dock would all be at the same level, and stand 17 feet 8 inches above datum. The depth of water over the dock sill would then be 27 feet 8 inches. The gates leading to the dock could then be opened, and all the vessels that had entered the basin could be taken into the dock. Pumping would now be resumed, and the whole of the water in the basin raised to its original level, given a depth of 32 feet in the dock and basin. Vessels ready to un-dock on the next tide would now be taken out into the basin, and about an hour before low water the gates of the dock would be closed. The scouring sluices at the outer gates could then be opened, and the water in the basin run off until it fell to the level at which the dock-master intended to commence docking on the following tide. This would generally be at the level which the tide was expected to reach 1½ or 2 hours before the top of high water, and for a rise of 15 feet would probably be fixed at 13 feet over datum, or 27 feet on the sill. If fixed at 13 feet, with the water in the dock at 18 feet, the tidal basin would have to be run down 5 feet, or to 13 feet above datum. As soon as the flood tide reached this level, vessels could be taken in or out, and the water in the basin would rise with the tide. During the cold season, when there is little silt in the river, the water might be allowed to flow in direct from the river, but during the rains the sluices from the main dock should be opened so as to raise the water in the basin as fast as the tide rose, and so prevent, as far as possible, river water from entering the dock.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

III.

Rough Rubble Masonry in Plinth.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)
Labor.—			
Masons No. ...	1		
Do. " ...	2		
Do. " ...	1		
Coolies " ...	3⅓		
Do. " ...	1½		
Do. " ...	1⅓		
Bhisties " ...	¾		
Grinding mortar, c. ft.	37	Variable.	Do.
Sundries	...		
Materials.—			
Rough Rubble & quarry chips, c. ft. ...	80		
Stone lime, slaked ...	17⅔		
Sand, dry ...	17⅔		
Surky, " ...	17⅔		
Sundries			......
Petty Establishment ...			......
Total rate per % c. ft. ...			...

Specification.—As for rubble masonry in foundations, except that the stones are to be better selected for shape, and the work is to be more carefully put together.

X.

THE SYDNEY MAIN SEWERAGE WORKS.

(*Expressly for* INDIAN ENGINEERING.)

THE development of these works, which have been in progress for some years, has now reached an important stage. The main northern outfall sewer has been completed and was lately inspected by the Minister for Works, some other members of the Government and a few representative public men. What is known as the northern outfall sewer is the length from the corner of Hyde Park near College and Liverpool streets to the ocean cliffs at a point between Bondi Bay and the South Head, known as Merriverie Cliffs, a distance of about 4¼ miles. Three miles of the sewer on this length have been constructed in tunnel through sandstone rock, half a mile in tunnel through water-charged sand, and three-quarters of a mile in open cutting, the greater portion of which was in water-charged sand varying in depth from 20 to 40 feet. The work through the water-charged sand was, of course, the most difficult and expensive; but the cliffs could not be reached without going through it. At the commencement of operations there were prophets who predicted that the work could not be done, and that it was waste of time and money to attempt it, yet it was carried through successfully in accordance with the original design, without injury to any of the workmen employed, and without a hitch, except a trifling settlement amounting to 1¼ inches at the lowest point on a short length of the sewer. This portion was taken up and relaid as far as necessary, and is now as sound as any other portion of the sewer. That a work of such magnitude and exceptional difficulty has been successfully completed without mishap or serious accident must be a subject of congratulation to the contractors and all connected with the work.

For the driving of the tunnels and ventilation of the sewer 15 shafts were sunk on the centre line, the dimensions being 12 feet along the line and 5 feet across, and base lines 12 feet in length were thus obtained for the alignment of the tunnel below. The distance between the shafts varied, the maximum being 38 chains, or almost half a mile, and the depths varied from 60 to 240 feet, centre line points were fixed for the contractors at intervals of 100 feet and reduced levels at 66 feet intervals. The error found in the alignment at the meeting of drives and the junction of the different contracts never exceeded a fraction of an inch.

The tunnels are all lined, the minimum thickness of lining being 4½ inches, and the sewer is constructed throughout with concrete and brickwork. In the tunnels, as a rule, the lower portion of the sewer up to a height of 12 inches above springing level, is formed with bluestone concrete, and the arch is closed with brickwork. In very wet ground a ring of brickwork was laid inside the concrete in the lower part of the sewer, and the sewer is rendered throughout up to the maximum flow line (three-fourths the height of the sewer) with cement mortar, the brick arch above that level being left bare. The work was carried out in three sections, by separate contracts. The total of all the contracts amounted to £320,000. A large quantity of expensive plant had to be provided for the work, such as steam engines, air compressors, rock drills, winding engines, cranes, pumps and stone breakers, besides tramways. Various new and patented appliances for tunnelling without blasting were tried, but were not entirely successful. As a large proportion of the work yet to be done will be through the city, great efforts were made to devise and project some method of driving the tunnels in rock without blasting, but so far without success.

Three main intercepting sewers will join the outfall sewer at Hyde Park, one of these is under construction, and a branch from it to connect with a sewer made some years ago is well advanced.

The size of the sewer at the junction with the three intercepting sewers at Hyde Park is 6 feet 10 inches by 5 feet 10 inches wide and this size is increased by sections up to Bonai Cliffs as follows: Second section 7 feet 2 inches high, third section 7 feet 4 inches by 6 feet 4 inches, fourth section 7 feet 8 inches by 6 feet 8 inches, fifth section 7 feet 10 inches by 6 feet 10 inches, sixth section 8 feet 2 inches by 7 feet 2 inches, seventh section connecting with the outfall chamber 8 feet 6 inches by 7 feet 6 inches. The fall throughout is 3 feet 6 inches per mile. Numerous bell-mouthed junctions have been built so as to be available when other intercepting sewers under consideration have been constructed. At Deep Dean the outfall sewer crops out to the surface level, and a waste weir is provided for the discharge of storm water into a capacious overflow sewer which empties into Rushalthis Bay. The ground on which this sewer is built is of a soft, yielding nature, and in order to secure a good foundation it was found necessary to sink concrete cylinders of 10 feet diameter and 30 feet apart, until good bottom was found, and turn arches between them, on which the sewer is built. The aggregate depth of the cylinders is 580 feet. The maximum depth to which they were sunk was 30 feet and the minimum 10 feet.

There are two curves in the whole length of the outfall sewer—one 462 feet in length with a radius of 1,584 feet, the other 1,023 feet in length with a radius of 2,640 feet.

The outlet chamber at Bonai is an interesting piece of work. In rough weather the waves beat with great violence against the cliffs, and it was therefore considered necessary that the outlet works should be designed in a simple massive style, without valves or any mechanical appliances which might be liable to get out of order under rough usage, but at the same time to protect the sewer from any violent shocks from waves or compressed air. The arrangement adopted is simple and looks as if it would fulfil the conditions required.

The shaft over the outlet chamber is 200 feet from the cliffs, at the bottom of this shaft a large chamber 36 feet long, 24 feet wide and 31 feet high has been excavated in the solid rock. From this chamber the outlets have been driven, one in line with the main sewer, and the other making an angle of 31 degrees to the north. These outlets are lined with bluestone masonry, all hollow spaces between the backs of the voussoirs and the rock being filled in solid with concrete. The outlets are circular in section, of 4 feet diameter, and have a fall of 1 in 39, discharging between high and low water. The level of the invert of the main sewer where it enters the chamber is 6 feet above high water. There is a fall on an agee curve into the chamber of 3 feet 6 inches. On entering the chamber the flow is divided by a cutwater into two channels running round the sides of the chamber, at the middle of the length of the chamber these channels pass through a weir wall extending across the chamber, by two circular openings 4 feet in diameter, and the sewage after flowing through these openings passes on by the outlets to the sea. The down-stream face of the weir wall presents the concave side of a vertical surface (curved in plan) towards the outlets, and the lines are so arranged that a wave rushing up either outlet crosses the flow of the sewage obliquely, and expends its force partly on the opposing flow of sewage and the remainder on the weir wall. Any obstruction to the flow of the sewage thus caused at the lower side of the weir wall will cause the sewage to rise gradually at the up-stream side, until the wave falls back and the sewage rushes after it. The whole of the masonry in the outlet chamber is constructed of dressed bluestone laid in large blocks. Grooves are provided for fixing stop bounds in various positions so as to be able to shut off any portion of the chamber or either outlet for examination or repair. The arch of the chamber is formed of concrete, and a ventilating shaft 12 feet by 5 feet in plan leads from the top of the chamber to the surface where the mouth is protected by an iron cage.

THE EXAMINER, P. W. ACCOUNTS.

THE lay public,—by which we mean those who manage to drift through an uneventful and useless existence outside the pale of the great P. W. D. and the beneficent provisions of its Code,—will be rather puzzled by the heading of this paper.

The title *Examiner*, in the minds of most people, is generally associated with that rude individual, who peers into carriages at the large railway stations, with a view to detect us in the act of ripping up the seat cushions or writing ribald remarks on the extract from the Company's bye-laws which adorn the walls: but, the exalted personage who forms the subject of this sketch is of quite a different *jât* altogether. He is, in fact, a boss of the first water, whom we Engineers regard with feelings of dread, awe and apprehension, and no wonder,—his particular functions and those of his large office consist in overhauling the complicated accounts of expenditure which we are obliged to furnish monthly, for the digestion of the monster and his satellites.

We seldom have the privilege of any personal acquaintance with the Examiner and consequently are unable to correct the impressions which a long course of worry is sure to produce in the best disposed minds.

It is impossible to depict him otherwise, than as a kind of malignant fiend, a total stranger to human sympathies and failings, who harbours a strong personal bias against us individually, and who gloats with satanic joy, when able to cast any items of our expenditure into that bottomless pit of *miscellaneous advances.*

It is an old saying that the devil is not so black as he is painted, and this applies with some truth to the subject of this essay. Although we P. W. men look upon him as a most unnecessary and "objectionable item," yet, if contrasted with other officials of the Financial Department, he appears almost as a shining angel of light. All Government Departments are saddled with an Examiner, though under a different designation. Accountant-Generals, Deputy Accountant-Generals, Assistant Accountant-Generals, Examiners, Deputy Examiners, etc., etc., have this in common, that they are a festering thorn in the flesh of the various Government officials who have the misfortune to be placed under their blighting influence. The Accountant-General is the king of this objectionable crew; he lords over them, and over all departments with a high and mighty hand. If we compare him to that awful and mysterious personage who preferred to rule in hell to serve in heaven, our Examiner in juxta-position can only rank as high in dignity as, say, Beelzebub.

Everyone detests the Accountant-General; loathing would more correctly express the feeling of the majority; the Examiner is in all conscience bad enough; but as we have remarked before, he pales his ineffectual fires before his chief, who seems to us the very incarnation of malignity.

The Accountant-General is always studiously offensive; his style of correspondence is curt, authoritative and Olympian in tone; he treats you as if you were a thief, caught in the act, to whom summary justice should be meted out. He looks upon District Officers (Collectors I mean), whom we consider as rather big bosses, like dirt beneath his feet, and regards them with undisguised contempt. From the tone of his correspondence one would think he possessed the power of life and death, and had only to give a wink to the executioner, when some miserable Collector's clerk had made an error in one of the miscellaneous accounts, that eventually find their way to the great check office. Now, our Examiner of P. W. Accounts is a bird of the same feather and can be very nasty when he likes, but he goes in more for gilding the pill by a suave manner, and actually condescends so far, as to use the formula "has the honor" when addressing Executive Engineers or Chairmen of District Boards, on his favorite subject of unadjusted objectionable items, or long outstanding miscellaneous advances.

One of the Examiner's most marked failings is a morbid and insatiable craving after vouchers. Every payment, he insists, must be supported by a voucher. You disburse 2 annas for some odd job to a coolie, the Examiner *will* have a regular receipt signed and witnessed in support of the payment. Again, a contractor, resident at a distance, is paid by money-order or you get a parcel V. P. P. The receipts furnished by the Post Office won't do at all, the old P. W. D. system cannot be expected to keep pace with such modern innovations.

He is by no means satisfied with the innumerable forms of accounts with which we are already saddled, but exercises a diabolical ingenuity in the invention of newfangled forms of still greater complexity—in which certificates of payment in person at a certain date, of actual measurement and even reference to a page in a note book—are added. Does he imagine that this will put an entire stop to all cheating or fudging by native subordinates? If he does, he is of a simpler nature than we take him for; but if not, why pile on the agony and directly encourage the production of false statements and certificates? Any ordinarily intelligent Sub-Overseer will easily drive a coach and four through all his new muster roll and contract certificate forms, for the capacity of unlimited fudge is a quality far too strongly developed in them to be stopped or hindered by such simple devices.

The folds of red tape are being drawn tighter every year; the P. W. D. is fairly well stifled altogether by rules and regulations on every conceivable subject. There is absolutely no room for originality or improvement. The P. W. Code—that abomination of desolation, that essence and quintessence of red tape, backed up by innumerable standing orders—holds us in its merciless embrace.

To be successful in the Provincial P. W. D. of the present day the following qualifications are necessary. A thorough knowledge of the Code and standing orders, a blind adherence to standard plans and obsolete methods of construction, with unremitting attention to office routine. Qualifications such as originality of design, improvements in existing time-honored modes of construction and knowledge of recent professional practice and theory, are more a hindrance than otherwise. All you want to be is a good head clerk.

The Examiner, or one of his deputies, is supposed to inspect our offices at least once in the year. We must say this in his favor, that he does not steal upon one as a thief in the night, but gives fair notice of his intended visit, so that certain small matters can be set square in time. It is a terrible ordeal for the clerks; they tremble visibly when the great man enters the office, and *salaam* in a most obsequious manner. I instinctively hold my breath as he seats himself in a chair and proceeds to draw forth formidable rolls of papers, a list of printed questions and an awful looking note book. The first thing he always does is to examine the cash book and is dead sure to spot something wrong, although I had been through it most carefully with the head clerk only the day before.

Then he proceeds to count the cash balance in the chest, to open which the clerk produces one key, while, after a good deal of fumbling, I find the other in my coat pocket. "You keep one key I suppose," says the Examiner, quoting from the printed paper. "Oh yes" I reply with affected jauntiness, omitting to mention the fact that this duplicate key had been given into my keeping only just two minutes before, when the rumble of wheels outside notified the near approach of our dreaded visitant. Then he overhauls every mortal thing; goes right through months of accounts, seeking and, not infrequently, finding, errors of omission and commission, all of which are promptly put down in the note book with evident signs of satisfaction to duly appear afterwards in the report. He drags out those awful statements of objectionable items, miscellaneous advances and deposits, and asks all sorts of disagreeable questions about them, but why describe it further in detail, suffice to say that he keeps me and the office on tenter-hooks for several long hours, and when at last he takes his departure, without having discovered anything very heinous, we give a sigh of infinite relief.

In the old days (I mean 16 or 17 years ago) Examiners were called Controllers and were not nearly so *exigeants* as now. The insatiable thirst for vouchers and signed receipts and impossible certificates of all sorts did not possess them then as now. In the old days I have paid away lakhs of rupees without ever taking a receipt; my own signature was deemed quite sufficient; but things are altered now.

Examiners of P. W. D. are sometimes Military Officers, Majors, R. E., and so on. Why an R. E. Officer who draws higher pay than his civilian *confrères* on the plea of "increased risk to life and limb" should occupy a post so clearly non-combative it is difficult to see. Probably the solution of it is this, that the appointment carries a good salary, and as we well know, all such, are carefully reserved for the Royal Engineers in the Financial or P. W. Department as a further reward for arduous (?) duties in the field.

I made my first visit to the Examiner's Office at Allahabad not long ago. On entering the vast building a thrill of awe ran through me. I saw numberless large rooms chock full of almirahs and crowded with clerks busily writing. What were they doing? Probably picking holes in my accounts or discovering an overcharge in my last travelling bill, thought I in my innocence. With some trepidation I sent my card in to the Examiner. "Nothing like knowing these people, it may appease their rancour somewhat."—I was soon ushered into the great man's presence. He did not rend me in pieces on the spot as I half expected, nor refer even distantly to anything about objectionable items or miscellaneous advances, but was very affable and civil. "Perhaps he is only dissembling," flashed through my brain and, as he stepped into the next room on some business, I seized the golden opportunity of hastily looking at the papers in his basket; but was much relieved at not finding my last travelling allowance bill scored over with a list of disallowances, or in fact anything whatever to do with my district accounts. The Examiner on his return found me blushing guiltily, but I bade him good-bye with a light heart. The Deputy Examiner, whom I next visited and whose signature I recollected was appended to all sorts of formidable documents, was quite hearty. He went so far in urbanity as to give me a peg and talked of cricket, tennis and other matters of a *non-objectionable* nature. I stepped into the *ticca gharry* which was waiting in the porch with the air of a man who had just come unscathed out of a lion's den.

On my way out from home the other day I actually made the acquaintance of an Accountant-General in the flesh and yet live to tell the tale. I found he was an extremely nice fellow and I used positively to hobnob with him over whist. He was a Covenanted Civilian, and belonged to Bombay. The great heaven-born get all the well paid appointments in the uncovenanted services just as the R. E. do in ours. The Accounts Department must be in a bad way when members of both these favored services get the pick of their best posts.

The acrimonious and ferocious tone of their correspondence should really be put down to unchecked Baboodom which must be rampant indeed—the heads of the Department probably limiting the supervision of correspondence to a hasty endorsement.

Any further continuance on this subject will probably be put down by your readers as "objectionable," so I must bring this paper to a close.

THE MEREWETHER PIER, KARACHI.

THIS work, first projected in 1873, during the Commissionership in Sind of the late Major-General Sir William Lockyer Merewether, K.C.S.I. and C.B., was effectually recommended by him to the Governments of India and Bombay, though circumstances delayed commencement before the 24th November 1880. It was appropriately determined by the Karachi Harbor Board to call the Pier by the name of its first promoter, as a small tribute to one who did so much for Karachi Harbor.

GENERAL DESCRIPTION (See plan).

The construction is similar to that of the Calcutta Jetties, but stronger, as having to carry the heaviest waggons of a broad-gauge trunk line.

The Pier projects 304½ feet from its shore abutment on the Harbor frontage of the Railway at Keamari.

It is mainly of wrought-iron, on screw piles, 16 feet apart, and T-shaped in plan; the head 312 feet long × 51 feet wide, and the neck 255 feet long and varying in width as shown in plan. The top is 3 feet 10¾ inches over highest tide level.

The depth of water at face is 26 feet and at back 20 feet at low water datum.

One large or two medium-sized vessels can be berthed along the face, and two of medium size at the back, so as to discharge or load direct to or from the waggons, on lines furnished with turntables and traversers, and connected with the Railway. A specially strengthened line, to carry weights of 30 tons, or locomotives, can run from mid-face, where a 30-ton crane is fixed; also six 35cwt. moveable cranes which run on rails, four on the face and two on the neck.

These cranes are all worked by hydraulic power transmitted by piping from an Engine and accumulator, erected on shore, and which also work capstans for shunting, traversing, &c.

Passenger accommodation also is provided by a platform with steps, approached by a roadway 23 feet wide on the north side of the neck, which is joined to the road opposite the Customs Pier by a metalled roadway 40 feet wide and 748 feet long; and a hydraulic crane of 35cwt. power, for baggage and horses, is fixed near the steps.

Screw moorings are provided, so that large vessels cannot be attached to the Pier; lamps, railings and fencing, and a small office and storeroom are also provided.

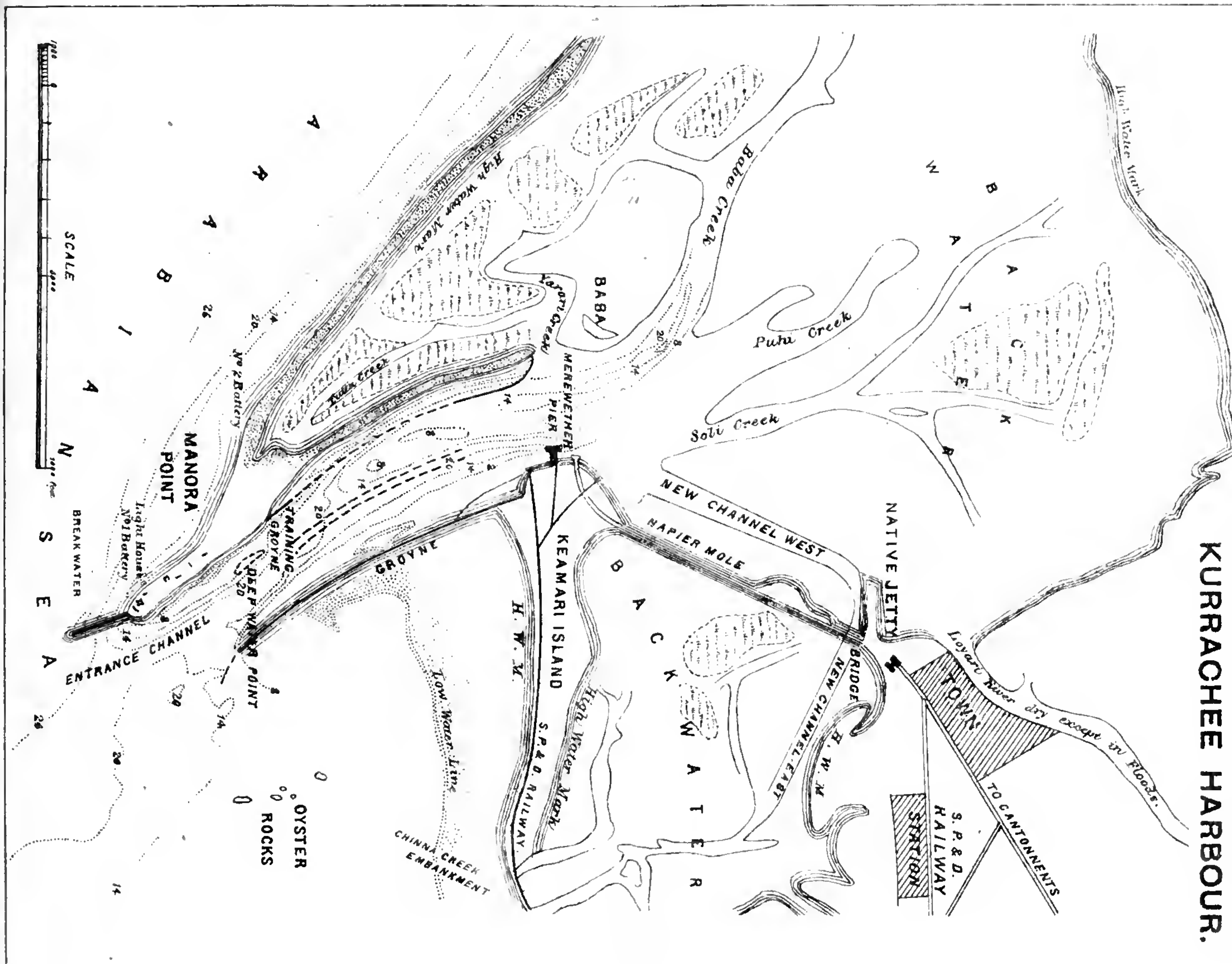
Dredging at front and back was carried out to obtain the requisite depth at low water for berthage without excessive projection of the Pier into the anchorage space.

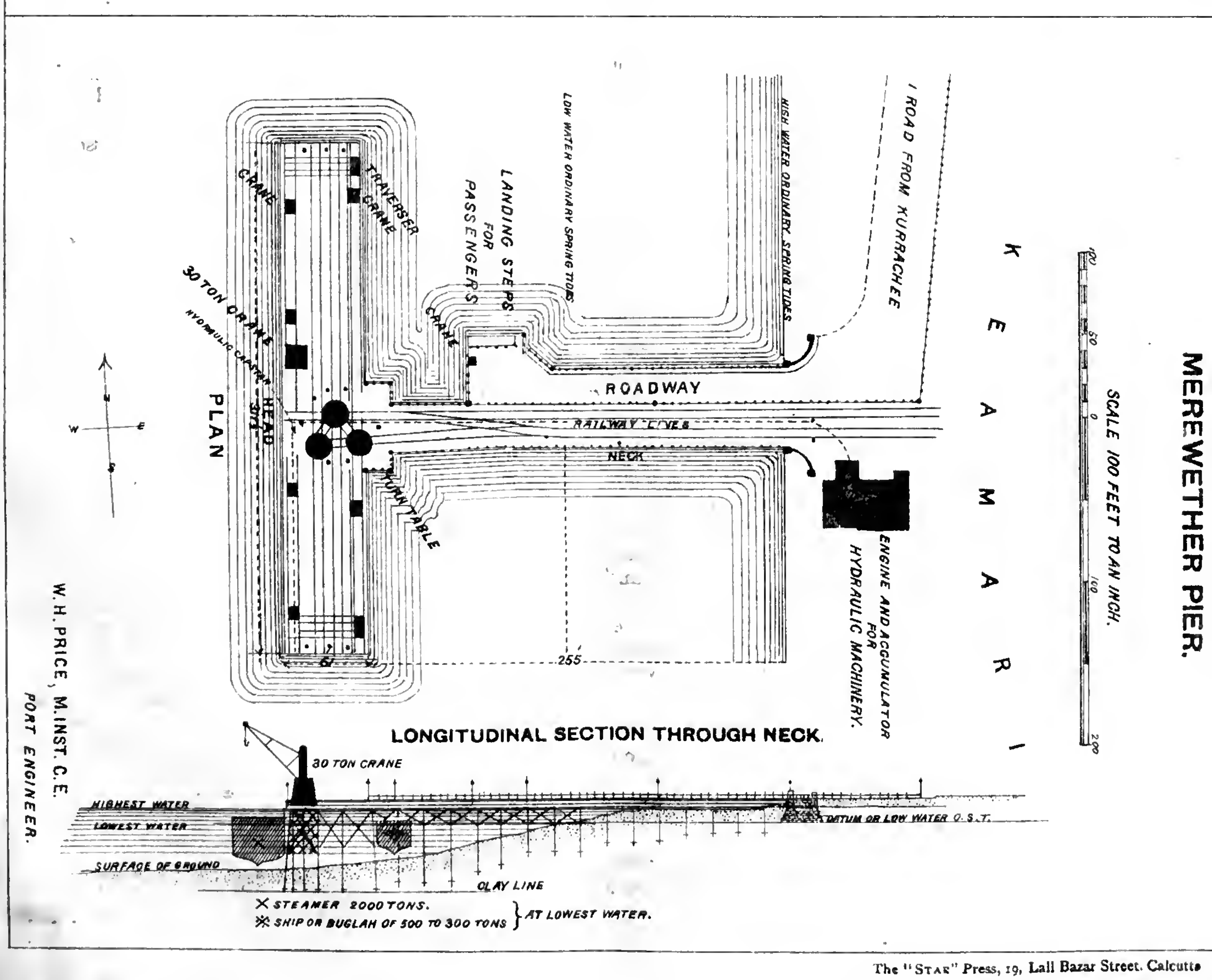
THE ESTIMATED COST WAS Rs. 5,21,126.

The Contract for the Material and Erection was let to Messrs. Thomas Cosser & Co., of Karachi, and the inspection of the material in England entrusted to Mr. W. Parkes, M. Inst. C.E. Mr. W. H. Price, M. Inst. C.E., was the Engineer in in charge.

MALARIAL FEVER.

LIEUT.-COL. A. T. FRASER, R.E., Executive Engineer, P. W. D., Madras, has recorded his views on the above subject. He says that the area of India subject to fever, is immense, reaching from the Upper Godavari to near Calcutta, and from the Eastern ghâts to the Central Provinces. It must affect the general administration; but from their exposure to sun and weather, the malarious climate tells upon the officers and subordinates of the Public Works Department in a very unusual degree. As it is the empirical use of strong mineral poisons, and quinine cannot but be almost as injurious as fever itself. It is to be observed that fever tracts are nearly invariably situated where high mountain plateaus rise from the low country, or upon the top of the more extensive plateaus where the surface is unequally weighted. It is believed that the earth's surface instead of being at rest is in constant motion, to be detected by fine instruments, and it appears that this property may be connected with the production of fever. There can be


KURRACHEE HARBOUR.
SCALE
ARABIAN SEA
MANORA POINT
BREAK WATER
Light House
No 1 Battery
No 2 Battery
ENTRANCE CHANNEL
TRAINING GROYNE
DEEP WATER POINT
GROYNE
MEREWETHER PIER
KEAMARI ISLAND
H. W. M.
BABA
Baba Creek
Puta Creek
Soli Creek
BACKWATER
NEW CHANNEL WEST
NAPIER MOLE
NATIVE JETTY
BRIDGE
NEW CHANNEL EAST
TOWN
Lyari River dry except in Floods
TO CANTONMENTS
S. P. & D. RAILWAY STATION
S. P. & D. RAILWAY
High Water Mark
Low Water Line
CHINNA CREEK EMBANKMENT
OYSTER ROCKS


MEREWETHER PIER.
SCALE 100 FEET TO AN INCH.
KEAMARI
ROAD FROM KURRACHEE
HIGH WATER ORDINARY SPRING TIDES
LOW WATER ORDINARY SPRING TIDES
LANDING STEPS FOR PASSENGERS
TRAVERSER CRANE
CRANE
30 TON CRANE
HYDRAULIC CAPSTAN
HEAD
ROADWAY
RAILWAY LINES
NECK
TURNTABLE
ENGINE AND ACCUMULATOR FOR HYDRAULIC MACHINERY.
PLAN
255
LONGITUDINAL SECTION THROUGH NECK.
30 TON CRANE
HIGHEST WATER
LOWEST WATER
SURFACE OF GROUND
CLAY LINE
DATUM OR LOW WATER O.S.T.
STEAMER 2000 TONS.
SHIP OR BUGLAH OF 500 TO 300 TONS
AT LOWEST WATER.
W. H. PRICE, M. INST. C. E.
PORT ENGINEER.

little question that the fever infects those localities in India where rock is actively decomposing and the surface is heavily and unequally weighted by mountain masses. It has to be remembered that in the Mesozoic Geological period India was the scene of extensive volcanic action, the Bombay presidency being mostly a sheet of trap. Where the rock here is the lowest of all, a very old gneiss, the conclusion is that the earth's solid crust is thin comparatively. The alternative, it seems to be, is that there must be some unobserved weed growing in the fever districts, the spores of which are blown about, or that a mould collects on decayed leaves and swampy ground in certain states of moisture and temperature. The science of the present day has made a great advance in the discovery of disease germs, and the statement that fever is due to malaria, once considered so final and explanatory, will scarcely now hold ground, especially as no effort has been made to detect what malaria is. It is so far encouraging that whatever originates the fever cannot be very complex, that it lies at the surface, and would, it is likely, be immediately found by modern apparatus used by one or more competent scientific observers.

VIZAG.

THE OPENING OF THE JAMALPUR (E. I. R.) WATER-WORKS.

A SPECIAL train for visitors, official and non-official, followed by a separate special train for the Lieutenant-Governor and suite, the former at 4-45, and the latter at 5-15 from Monghyr to Jamalpur.

The Lieutenant-Governor was received by the Municipal Commissioners, who, through their Vice-Chairman, Mr. T. Curtis, read an address.

The Lieutenant-Governor and suite, accompanied by Mr. St. Leger Carter, Mr. A. Mears, Mr. Devon and other Railway officers, walked from the *shamiana* to the reservoir, at the head of which they were received by a detachment of E. I. R. Volunteers.

A speech was read by Mr. Huddlestone detailing the circumstances that led to the resolve to construct the reservoir, namely, the threatened failure of supply in previous years and the increasing demand due to extended working, &c. Mr. Campbell, the Agent, and Mr. Denham, the Chief Engineer, were unavoidably absent. The latter disclaimed any credit beyond selecting the site for the reservoir and giving it over to Messrs. Pont and Devon, the Divisional and Resident Engineers, the former for the design, the latter for carrying it to successful completion. The capacity of the reservoir is 114 million gallons of varying depth, the greatest being 35′ 6″.

The Lieutenant-Governor made a speech in reply and spoke of value of water-supply generally on sanitary and other grounds, and that it was pretty generally admitted by the natives themselves, who were beginning to exert themselves in this direction, to keep up supplies of wholesome water, &c. He acceded to the request that the reservoir should be named after him, and at the request of the Engineer, Mr. Devon, turned a small silver wheel, while the latter revolved a larger one, which allowed the water to flow to the town below and the works were declared by the Lieutenant-Governor to be open. The Lieutenant-Governor, suite and visitors then adjourned to the *shamiana*, where a light luncheon had been prepared.

The reservoir itself will be one of the sights of the place, and winding as it does in amongst the lower range of hills so many additions will be made to the existing stock of boats now plying on its waters, as there is ample room for both rowing and sailing, and there can be no doubt many of the employés will take advantage of the means of recreation offered to them. Possibly angling may be added to this when the place is stocked with fish as is to be done.

A. A.

NOTES FROM HOME.

(From our own Correspondent.)

THE Postmaster-General announces that it has been decided to forward the day mails between British and South Wales by way of the Severn Tunnel and the arrangement will, he trusts, be in operation very shortly. The tunnel, which has been in progress for the past seven years, has been opened for through passenger traffic. The first effect of the tunnel is expected to be seen in the increase of the quantity of coal carried to the metropolis, as the Great Western Railway will now be able to compete on more favorable terms with the sea borne coal.

The Roburite Explosive Company has just been very successfully floated here. The company is formed for the purpose of manufacturing and selling in the United Kingdom, the Colonies and India the new explosive roburite, one of the most powerful of modern explosives. It consists of two non-explosive and perfectly harmless compounds, which may be sent separately to their places of destination, and when required for use can be ground together in any ordinary cement or flour mill, and when thus mixed requires a powerful detonator. It seems as if its greatest merit however, is its use in mining, as it emits no flame to ignite firedamp and further it emits on explosion such a small amount of noxious gases as to have won the highest opinion of miners in Germany, where it has been in use now for some years.

It has been known for some time that photographs could be taken by moonlight, but it is only lately that really good examples have been produced. *Scientific News* of this month gives a fac-simile of a photograph by moonlight, taken by a French firm at Lyons, and which is extremely good, many details being clearly brought out if a glass is used.

Volume 89 of the Proceedings of the Insitution of Civil Engineers has just been issued, its six hundred well edited pages present as usual matter of great technical value and varied interest. Mr. J. J. Webster deals with the subject of dredging operations and appliances very fully in the first paper, and the Engineer and gun founder will find a good paper by Colonel Maitland on the treatment of gun steel. The firm who have so creditably produced these well-printed volumes, contribute a paper on printing machinery, and a record is thereby chronicled of the modern improvements in this particular class of machinery up to the present date. The second section of the book contains nine other selected papers on various Engineering subjects, and the usually carefully chosen abstracts of papers in foreign transactions and periodicals forms the remainder of the book.

I have also received the First Volume of the Minutes of Proceedings of the Engineering Association, a small though flourishing Society of New South Wales, for the year 1885-86. Though on page 1 we read of the presentation of the Annual Report on the occasion of the 15th anniversary of the Association, yet this is the first time that the Association has attempted the task of issuing a volume, and considering the difficulties which are shewn to exist with members whose duties keep them so far apart as occurs with our Australian brethren, the Society must be congratulated in producing a very creditable collection of valuable Engineering information. The work is over 300 pages and the papers are well and copiously illustrated.

The enormus height of the Eiffel tower to be erected on the exhibition grounds, Paris, renders an hydraulic lift in which passengers could perform the whole journey in one operation quite impossible, a succession of short lifts would not do, so a new type of lift has been designed, the main idea of which is that of a huge screw and nut. Below the left cage is placed a trolly with three or more wheels running upon an equal number of rails which ascend spirally and thus form a screw having so many threads. The trolly will be revolved either by an electric motor or by a water-engine but the cage will be prevented by guide-bars.

AMERICAN ENGINEERING NEWS.

(From our own Corerspondent.)

AFTER being closed for over four years, the Hudson river tunnel has been re-opened and pumped out, and the werk of construction resumed. The inventor of the system of tunneling used and promoter of the enterprise claims to have all the financial backing necessary. The work is now progressing favorably, no especial damage having resulted from the long delay.

The best Locomotive in America is said to be No. 444 of the Lehigh Valley Railroad. The test of locomotives made by this Company makes this Engine famous. It is claimed that no other locomotive now running can do as well. She ran 10½ miles in 19½ minutes up a grade of 68 feet, with nine cars and made 12 miles of 96 feet grade in 24½ minutes, pulling 25 per cent. more weight than has ever been pulled up that grade before. She was fired with soft coal and part of the time was blowing off, when worked the hardest. She made one slow-up for cattle on the track. The tests were made by the dynamometer car of the Pennsylvania Railroad.

The work on the Panama Canal still continues slowly. A Civil Engineer recently from Panama says that the American Construction and Dredging Company at Colon are the only contractors doing good and telling work on the canal. Their huge dredges are cutting a broad and deep swath inland, American push and energy alone being visible on the Colon side of the Isthmus. The amount of work done during the past year has been astonishingly small. It drags along in a hopeless sort of way. Several large Scotch dredges, costing $200,000 each, are idle in the Bay of Panama. Others are working doing useless dredging in silt that washes backward and forward with the tides.

Danger on the New York and Brooklyn Bridge is predicted. The proposed system of handling cars at the New York end of the bridge is condemned by the *Engineering News*. Under the new system passengers are to enter the cars from a platfrom between the north and south tracks while the cars are standing where they have discharged their passengers on platform at the other side of either track. Every second train coming in is to be switched to the south track and every second train going out will have to be switched to the south track. The *Engineering News* holds that the proposed plan will not increase the capacity of the bridge in any degree over the increase which can be attained under the present system, with trifling modifications and at merely nominal cost, and that the danger of collision will be much greater than under the plan now followed, because :—

"1. Both the trains are in motion at their maximum velocity, so that their united speeds will be 22 to 25 miles per hour, instead of 0 to 10 miles per hour.

"2. Both the trains are loaded instead of only one.

"3. One of the trains will be gripping the cable, and possibly both.

"4. The collision will be an oblique head collision, the most dangerous class, instead of a rear collision on a straight track."

"In a collision of this sort it is predicted that "both trains would be derailed, the whole side would be taken out of two cars, either train might foul or cut the two cables side by side under the cars, and should either cable be cut every train on any part of the structure would be in danger of wreck."

The *Engineering News* mentions a continuous circulating plan of handling trains, and claims that under this plan a car in every 5 seconds, or 18 cars in every 90 seconds, instead of 3 or 4 as now, could be despatched, trains being continually in motion on an endless track, stopping only to load and unload.

The annual Convention of the American Society of Civil Engineers was opened on the 1st July, at the Hotel Kaaterskill on the top of the Catskill Mountains in New York State. It promises to be the largest Convention yet held by this Society. It will last a week. The Papers of Engineering interest to be read and discussed include *Inspection and Maintenance of Railway Structures; Sewerage Systems; Methods of Sewage Disposal; Cable Railwag Propulsion; Compressive Strength of Steel and Iron; Strength of Bessemer Steel Compression Members; Streses in Bridges; The Kentucky and Indiana Bridge; The Poughkeepsie Bridge,* and others of great interest to the profession.

BURMA.

(From our own Correspondent.)

The question of providing suitable appliances for landing heavy weights from vessels on to the wharves is just now a subject of complaint made by the Irrawaddy Flotilla Co., Ld., against the Port Commissioners, in consequence of that body having notified, that they cannot undertake the responsibility to lift weights over 18 tons. The crane and shears now in use by the Port Trust is capable and tested to carry 30 tons, and since first fitted up has carried boilers and engines weighted up to 27 tons; but from some unaccountable cause (just at the time the Flotilla Company imported a large boiler of 27½ tons) they have ceased holding themselves responsible. The main cause is, no doubt, the unsuitability of the apparatus, as well as deterioration of the gear through want of proper care. An eminent Mechanical Engineer, with vast and varied experience in this line, suggest to us, that the crane most suitable should be a self-jibbing steam crane, supplied from a boiler capable of rapid generation; it should have a self-lowering and raising jib, giving a circular range of at least 80 feet diameter.

The slow progress being made in the erection of the Rangoon Cathedral is indeed a scandal to those who are entrusted with its construction. This structure was first commenced some three years ago and at the present time it is barely raised three feet above the foundation. The work is now entirely at a standstill, as the builders have found some difficulty in following certain parts of the design, which has necessitated the plans being returned to Mr. Chisholm, the Architect, for further information. This delay could well have been avoided, if the Committee had referred the matter to some of our local Engineers. So long as they choose to keep their business within the circle of the members of the Church Lands Committee, and do not enlist the confidence and advice of professional local men as to the disposal of the funds placed in their hands, difficulties will be rather the rule than the exception, and the public delayed in having a central and stately place of worship.

Rangoon is certainly looking up. The improvements now being made are seldom met in India. Side walks about 10 feet wide by 1 foot high, hemmed in by a wall of the same height, well beaten in with laterite and *kunkur*, forming a kind of parapet on either side of the streets are under construction. This will be a geat convenience to foot passengers, not only on account of the cleanliness of the path in all weathers, but the nuisance and accidents of running up against *gharries* and carts passing the main road will be avoided. In a few years hence, with the proposed improvements to the Port, the introduction of Shone and Ault's drainage system, improved water-supply, improved roads and the reclamations of land being made, Rangoon will be far ahead of any of our earlier acquisitions in the East.

The Local Government have at last acceded to the repeated applications of the inhabitants of Shoayghyn, to connect that town with the nearest Railway station, and with that view have ordered the Executive Engineer, Pegu Division, to prepare an estimate of cost. The most likely route that will be chosen is the Pazunmyaung road which leads from Nyaunglebin station to the Sittang river and embankment at Pazunmyaung, about 4¼ miles in length, which was constructed at a cost of Rs. 64,850 in 1885. The only difficulty will be the bridging of the Sittang opposite the town of Shoayghyn.

The cable steamer *Recorder* is now repairing the cable line between Elephant Point and Penang, and we hope to see the transmission of messages from Rangoon to the Straits, &c., more regular. The Eastern Extension Telegraph Company, Ld., have chartered the vessel for this purpose.

NOTES FROM MADRAS.

(From our own Correspondent.)

Since writing my last I have had an outing in the Mysore country. I had the good fortune to meet a Mining Captain engaged on one of the Colar gold mines, and he gave it to me as his opinion that India would shortly be one of the finest gold mining countries in the world. He gave this as his deliberate opinion in the face of the recent remarkable discoveries of auriferous quartz in Australia and Africa; and his personal experience of gold mining all over the world. He is, I should say, one of the most experienced men of his profession in the country.

I made a tour in the Krishnagherry Taluq of the Salem District not long ago, where there are still traces of old native workings for gold to be seen. The reefs are a continuation of those at Colar. Krishnagherry is not far from Colar and is only eighteen miles from Coopum, a station on the Bangalore branch of the Madras Railway, but there being no proper road between the two places, and the country being wild, the place is usually reached by travellers from Madras by alighting at Tripatore—a station on the S. W. Line of the aforesaid railway, next to Jollarpet Junction. It is twenty-five miles there, and there is a good trunk road all the way. I mention these particulars for the benefit of anyone wishing to explore these fields. There is a good travellers' bungalow at Krishnagherry—that is, as travellers' bungalows go here—but travellers must themselves arrange for their commissariat.

The construction of the Villapuram-Paikal and Tripatore-Kadri State Railways has been sanctioned. I believe the

Government contemplate handing over the former line to the South Indian Railway Company to construct for them. I do not quite see the *rationale* of this myself when they have so mang Engineers lying idle on their hands. Besides which the South Indian Railway Company have not been remarkable for success in building on their own account. No Railway in the country has a longer list of failures to show. Possibly it is this very circumstance which is influencing the Government in making over the work to them ; for, if as is generally supposed, men learn more by failures than by successes, the Company in question ought to know a thing or two by this time. On the other hand, the Government should weigh the potentiality of their acquiring a little more experience at *their* expense. It is true there will be no work of any magnitude on the proposed line. This cannot be said of the extension of the Cuddapah-Nellore State Railway from Tirupati to Kadri, on which there will be heavy cuttings and embankments. Mr. Geoghegan, the Engineer-in-Chief of the Madras State Railway Surveys, has gone home on two-and-a-half months' leave for the benefit of his health. Mr. C. A. Bull, Engineer-in-Chief of the Cuddapah-Nellore State Railway, is to act for him. This Railway is to be opened on the 1st proximo, but I believe there is still a good deal to be done on it. It is only eighty miles in length and the country is easy enough, and when started—about three and a half years ago—it was expected it would be finished in eighteen months ; but work on it was suspended during the latter half of 1885, owing to the Russian scare—the Government having more pressing pecuniary obligations to meet elsewhere. Besides this the difficulty of obtaining labour was great. I know several contractors who left the work lamenting, and I do not believe that any "made money" on it. These causes combined have delayed the completion till now—and it is not complete yet. If this looks like a 'bull' I cannot help it. I mean well.

Captain Taylor, our Master Attendant, returned the other day from England, where he was summoned to assist at a consultation for deciding the much vexed question of the proper position for the entrance to the harbor. Having been away from Madras myself, I have not yet heard what has been decided—if anything. The Captain is a red-hot advocate for the N.-E. entrance, and there is little doubt he is right, so I fancy this modification has been decided on. I am told he retires on the 1st November next, after which his present Deputy will reign in his stead.

MATHESON AND GRANTS HALF-YEARLY ENGINEERING TRADES' REPORT.

THERE has been a decided amelioration of trade during the last six months, and the improvement which in January last we ventured to anticipate for the spring is every week becoming more manifest. Manufacturers find that as compared with their experience of the last two years a larger proportion of enquiries and estimates have actual results, while the unprecedented cheapness of materials and consumable stores allows, notwithstanding low selling prices, a profit otherwise unattainable. New enterprises of various kinds continue to absorb capital which has been lying idle, and as there is hardly any sort of commerical venture which does not give employment directly or indirectly to Engineers, a growing activity may be looked for.

IRON of all kinds is at almost the same prices as in January, the slight speculative rise due to hopes of an American demand having been only temporary. The manufactures of finished iron allow no real profit if the deterioration of plant be considered ; puddling furnaces continue to diminish in number ; and the prospects for the future even if general trade improve are clouded by the growing use of steel. For smithing purposes high-class Yorkshire iron is still deemed necessary, and for many important uses is considered safer than steel.

STEEL makers are busier and altogether more hopeful than at the beginning of the year, although the large productive power of the principal works and new economies in manufacture together keep prices low. Plates, and the various forms of sectional steel used by bridge builders are obtainable at prices lower than would have been deemed possible two years ago, this being partly due to the slackened demand for shipbuilding, and partly to the competition of new works. The rail mills are fairly occupied with orders and it is not unlikely that there may be a revival of an export trade to the United States. Owing to the peculiar operation of the customs tariff, exports thither have mainly been confined to partly manufactured steel, such as blooms and billets of which there have been large shipments. But orders for rails have also been coming forward lately. Notwithstanding the enormous power of production in America, exceeding two million tons per annum, the present price there of $40 per ton is about equal to the price of English rails delivered duty paid at an American port. Primarily therefore the competition is determined by the situation of the place of inland delivery, which as regards transport is in some cases more favourable to the imported than to the home-made rail. The conditions of quality have also to be considered, and in this respect some of the American Railroad Engineers consider that they can get better value for their money here than at home. It is not that rails as good cannot be made there, but owing to the rapidity of manufacture, the combinations of makers and other circumstances, the terms of American specifications are less favourable to the buyers than those enforced here.

SCRAP IRON AND STEEL.—The considerable advance which took place last Autumn owing to an expected American demand, was not justified by events ; prices fell considerably, and business is at present dull. There is no market for scrap at the Atlantic Ports of the United States, but large shipments have been made during the current year to San Francisco, at prices ranging from 72*s.* to 75*s.* per ton, including freight of about 22*s.* per ton. Italy has been the principal buyer of old iron rails at prices of about 63*s.* 6*d.* for double-heads and at 62*s.* for flange rails, including freight, but at present sellers demand 2*s.* to 3*s.* more, the supply of old double-head rails being restricted by the railway companies and private speculators holding them for better prices. There is a growing enquiry for old steel rails.

MECHANICAL ENGINEERS.—The numerous branches of trade included under this heading have for the most part felt a decided though moderate improvement during the last six months, and the very diversity of the causes for this revival is a sign that the improvement is widespread. Among Marine Engineers there is as yet no indication of a return to the activity of 1883, and though there are signs that the demand is growing, yet even if to the large ocean and war steamers on hand be added the special craft of various kinds which are building, such as river steamers, torpedo boats and dredgers, the aggregate does not show any marked improvement on the trade of last year. Invention in mining machinery has been stimulated by the gold discoveries in the Transvaal, where the ore demands special appliances. Machine-tool makers are already feeling the renewed inclination and power to purchase of their customers the engineers, and are offering various automatic and labour saving novelties, the present Exhibitions at Newcastle and Manchester showing that in these respects this country retains the lead against foreign competition. Economy in fuel has evidently not reached its final stage : the use of high pressure steam leads to various alterations of old methods ; there are improvements in corrugated boiler flues which allow the minimum thickness of steel plates: the utilization of waste heat is studied and accomplished in various novel ways and the economic combustion of coal is stimulated by the increasing rivalry of gas and oil fuel. Not only are gas engines being improved and cheapened, but petroleum engines are likely to afford an alternative source of power in England, where gas is cheap, and to supply a long-needed want in places where gas is dear or unattainable. Arsenal machines and plant have been much improved, and have been in considerable demand. Improvements in milling machinery will retain in this country a trade that was fast leaving it for Germany and the United States. Cold storage for frozen meat is in increased demand as well as artificial refrigeration for various manufacturing purposes, and it is evident that the expensive process of producing cold by the cooling and re-expansion of compressed air has had its day, and though likely to survive a little longer on board ship, it will even in such cases soon be superseded by the best of the ammonia systems which are not only theoretically more perfect, but much more certain and economical in practice.

AGRICULTURAL ENGINEERS still suffer from the continued depression of the farming interest ; the makers of portable engines, thrashing machines and implements are not fully employed, but it is questionable whether the forced reduction in prices much exceeds the saving in the cost of manufacture. Increased attention is given to the export trade ; portable engines and machinery of English make still hold the first position in foreign markets where customs duties allow their entry, but protective tariffs greatly impede trade in Russia, France and other countries, which formerly bought largely of English goods. The recent Exhibition at Frankfort shows considerable advance among continental manufacturers, much of it being evidently due to imitation of English designs. Compound engines are receiving wider attention here than formerly ; recent trials seeming to shew that this system can be practised with advantage in engines of not less than 20 effective horse power, the improvement lying not merely in economy of fuel in generating a certain indicated power, but in a steadiness of running that diminishes the difference between the indicated and effective force.

LOCOMOTIVES AND ROLLING STOCK.—Engine builders are still unable to obtain remunerative prices, and at present the prospects of improvement are not very good, as the orders from India and the Colonies are insufficient to make up for the deficiency at home, where so many engines are made in the railway workshops. In the United States there is great activity, and manufacturers are less eager than a year ago to compete at low prices in foreign countries with English firms. Various adaptations of the compound system are being tried in England and elsewhere, but except on the L. & N. W. Railway, where an increasing number of such engines are at work, these new methods are only in an experimental stage. The automatic vacuum brake seems likely to be generally adopted, for in addition to the merits it possesses, the fact that so many leading lines are using it will, from the advantages of uniformity, discourage any other kind. Railway carriage builders are more hopeful than at the beginning of the year ; enquiries seem to be more numerous and to rest on a sounder basis, but competition is still severe, and the power of supply in excess of the actual demand.

BRIDGE BUILDERS have continued busy since January, though at very low prices. Large contracts for steel bridges are in course of execution for Japan, India and South America, and a fresh demand from Australasia may be anticipated as one of the first signs of revived trade there. Besides new enterprises requiring bridges there is an increasing demand for renewals both in this country and abroad. In the United States the bridge builders are busier with railway work than they have been for years, and the re-building of the frail structures of iron and wood erected in past years cannot much longer be postponed under the exigencies of modern heavy traffic. In Canada also the time is not distant when the earlier bridges must be strengthened or re-constructed. The choice between steel and iron is no longer an open question ; for bridges it is settled in favour of steel, but for roofs it is only in very large spans that steel is as yet adopted.

PORTLAND CEMENT.—There is a growing demand for export, which, if it continues, will raise this trade out of the severe depression which has characterised it during the last twelve months. At present, however, there is no increase in the consumption at home nor any evident sign of alteration in the prevailing prices which are unprecedentedly low.

On the whole the prospects for the immediate future are good. The sudden fall in all countries of the money value of agricultural produce at a time when the output capacity of engineering factories everywhere had been greatly increased, has had its unavoidable results during the last three years, but the natural growth of the world and the accumulation of capital seeking investment have assisted the necessary re-adjustment, and buyers and sellers are coming together again. India and the Colonies may still be relied on as safe outlets for British manufactures, notwithstanding the tariff vagaries that prevail in so many of the self-governing Colonies.

LONDON: *July* 16, 1887.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, August 6, 1887.

Upper Burma.

With reference to *Burma Gazette* Notification dated the 18th July 1887, the services of Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, are re-transferred to Lower Burma, with effect from the 28th instant.

Lower Burma.

Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, whose services have been re-transferred to Lower Burma, reported his arrival at Rangoon on the forenoon of the 30th July 1887 and is posted temporarily to the Superintending Engineer's office.

Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, is granted three months' privilege leave, with effect from the forenoon of the 3rd August 1887.

Madras, August 9, 1887.

The following intimation, received from the Secretary of State, is published :—

Mr. C. J. Ussher, Executive Engineer, 4th grade, sub. *pro tem.*, is permitted to return to duty within the period of his leave.

Punjab, August 11, 1887.

Irrigation Branch.

Mr. L. M. Jacob, Executive Engineer, 3rd grade, is transferred from the Delhi Division, Western Jumna Canal, to the Upper Sutlej Division, Inundation Canals, which he joined on return from the one month and 27 days' privilege leave granted to him in Punjab Government, Irrigation Branch, Memorandum dated 27th April 1887, on the afternoon of the 14th July 1887. The transfer was made in the interests of the public service.

Mr. Jacob took over Executive charge of the Upper Sutlej Division, Inundation Canals, from Rai Ram Dial Sahib, Executive Engineer, on the forenoon of the 16th July 1887.

Bombay, August 11, 1887.

Mr. F. D. Campbell, Executive Engineer, 1st grade, is permitted to retire from the service, with effect from 10th September 1887.

Mr. W. C. Hughes, M. Inst. C.E., delivered over, and Mr. J. H. E. Hart resumed, charge of the duties of the Joint Secretary to Government, Public Works Department (Irrigation), on the forenoon of 25th July 1887.

Mr. J. E. Whiting delivered over, and Mr. J. H. E. Hart resumed, charge of the offices of the Chief Engineer for Irrigation and Superintending Engineer, Central Division, on the same date, before noon.

N.-W. P. and Oudh, August 13, 1887.

Irrigation Branch.

With reference to Notification dated 9th April 1887, Mr. J. L. Tickell, Executive Engineer, 2nd grade, on return from the three months' privilege leave, resumed charge of the Rohilkhand Canals from Mr. H. Nelson, Executive Engineer, 4th grade, sub. *pro tem.*, on the forenoon of the 28th July 1887.

India, August 13, 1887.

Mr. W. McHutchin, Executive Engineer, 4th grade, sub. *pro tem.*, State Railways, is temporarily transferred to Bengal, Railway Branch.

In continuation of Notification dated 17th May 1887, the designations of the Consulting Engineers to the Government of India at Calcutta and Lucknow will in future be as follows :

Consulting Engineer to the Government of India for Railways, Calcutta.

Consulting Engineer to the Government of India for Railways, Lucknow.

The undermentioned passed students of the Seebpore Civil Engineering College are appointed to the Department as Assistant Engineers, 3rd grade, with effect from 8th September 1887, and posted as follows :

To Bengal.—Mr. Soralji Shavaksha.

To Burma.—Mr. H. Po Thine.

Honorary Lieutenant W. Marr, Assistant Engineer, 2nd grade, Burmah, is promoted to Assistant Engineer, 1st grade, with effect from the 1st June 1887.

Mr. J. S. Beresford, Executive Engineer, 1st grade, North-Western Provinces and Oudh, is appointed to officiate as a Superintending Engineer, during the absence of Lieutenant-Colonel G. T. Skipwith, R.E., on privilege leave, or until further orders.

Director-General of Railways.

Mr. O. J. Shedlock, Executive Engineer, 4th grade, sub. *pro tem.* is, under the Civil Leave Code, granted furlough for one year with the usual subsidiary leave, with effect from such date as he may be permitted to avail himself of the same.

Military Works Department.

The undermentioned officers are appointed to the Military Works Department as Assistant Engineers, 2nd grade, temporary :

Lieutenant J. C. Rimington, R.E.
" W. S. Hunter, R.E.
" E. A. Edgell, R.E.

Bengal, August 17, 1887.

Establishment—General.

Rai Radhica Prosad Mookerjee, Bahadur, District Engineer, 24-Pergunnahs, is granted privilege leave for two months, with effect from the 1st of September next.

Establishment—Railway.

Mr. G. E. Moore, Executive Engineer, Eastern Bengal State Railway, is appointed, with effect from the afternoon of the 11th May 1887, to officiate as Superintendent of Way and Works of that Railway, during the absence, on leave, of Mr. W. Nicholson, or until further orders.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 1st August 1887.

28 of '87.—Robert Harper, of Dinapore.—*For double and single screw pumps.*

52 of '87.—Frederick Alexander Shillingford, of Kolassy Factory, in the District of Purneah and Presidency of Bengal, Indigo Planter.—*For improvements in Indigo Boilers, and the setting up of such boilers with suitable flues in masonry for boiling indigo fecula or other substances in the liquid state.*

96 of '87.—Henry Thomas Arundel Smith, of Hastings, in the Suburbs of Calcutta, Warrant Officer in the service of Government.—*For a double vertical screw hand-power commercial press for hides, jute, &c.*

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong. Shanghai*, and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.

An allowance is made for continuous insertions.

INDIAN ENGINEERING.

VOL. I—Jan.-June, 1887.

A few copies, neatly and strongly bound, on sale.

Price, Rs. 25 cash.

Also some odd back numbers for completing sets.

Price Re. 1 cash.

CONTENTS.

Obituary.

DEASE.—At Bareilly, on the 13th August, of cholera, Robert Poole Dease, Executive Engineer, N.-W. Provinces, aged 35 years 3 months and 10 days.

INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 3, 1887.

THE RAILWAY FROM MOGHALSARAI TO PURI.

BACON writes in one of his essays :—"It is good to commit the beginnings of all great actions to Argus with his hundred eyes, and the ends to Briareus with his hundred hands—first to watch, and then to speed." Let us accept the oracle as an auspicious augury, in connection with the projected railway line from Moghalsarai to Puri, which in one shape or another has been germinating under Government consideration for the last decade, although in 1876-77 the idea extended no further than utilization of the Palamow Coalfield for the benefit of railways to the north-west of Moghalsarai.

Wherefore the surveys at that time ordered had only such limited object in view. Let us hope that the beginning of an end much more comprehensive and useful has now been reached.

Ten years of investigation, exchange of office boxes, and circumlocution, have made it apparent to the Governments of India and Bengal, that embarking on a larger and more ambitious undertaking than the one originally proposed is likely to prove more imperially advantageous, as well as more desirable from the point of view accorded in Council to public convenience. *Ergo*, construction of a line of railway from Moghalsarai to Puri is now favored by both Governments. The supplement to the *Gazette of India* for the 20th August 1887 points out the value of such a line as an insurance against famine, and says that the substantial objects of the project have been well described as—

(1.) To provide a quick and easy means of travelling for the army of pilgrims who visit the shrines of Benares, Gaya, and Puri.

(2.) To open out the resources of large and important tracts of country now almost cut off from communication with the rest of India; to supply them with food if scarcity prevails, or to carry it into other districts if a surplus is available.

(3.) To facilitate emigration from overcrowded districts to those which are but sparsely inhabited, yet capable of supporting a very considerable increase of population.

Since the days when Hudson was Railway King in England, and peers scrambled for seats on Railway Boards of Direction, and middle class John Bull, and his sisters and his cousins and his aunts, in a great boom of enthusiasm, sold out consols wholesale, to invest in the running of the iron horse, probably no Railway scheme has been buttressed up with such consensus of favorable opinion as the one we are writing about. Not only do commercial men and the Anglo-Indian public approve of it; but Government discerns in it promise of healthy political results for the State; and even Native prejudice is disarmed, is rendered placable by consideration of the facilities that are to be afforded for pilgrimage to sacred shrines, and raises no shriek for economy, no wail about the severe incidence of the house tax in Calcutta, or any other irrelevancy.

It should be borne in mind that the Railway project under review practically resolves itself, as the Secretary to the Government of India, P. W. D., says, into two portions, "one providing for the development of Chutia Nagpur, and aiding the coal supply of Upper India, the other securing the famine protection of Orissa, and the opening out of the portions of the Central Provinces and Bengal traversed by the line, but both possessing the object and common interest of facilitating transit of pilgrims to Puri. The two portions become, in fact, separate Railways, linked by a section of the Bengal-Nagpur Railway now under construction, and by a common interest, but free to be constructed by one and the same, or by two totally distinct agencies."

It was primarily intended that the line opening out the Palamow coalfields should start from Meral, and proceed thence *viâ* Bhikhi, Chutterpur, Sultani, Maharajganj, and Kutumbeh to Barun on the river Sone, which is at the head of the Patna Canal, and opposite Dehri, whence the Buxar Canal starts. Since this intention was first formulated various alternative routes have been suggested, and after having been painstakingly considered have been successively rejected. It would be a tedious work of supererogation to recapitulate here all the arguments for and against them. The following extract from the Government Resolution of the 20th August gives the gist of the reasons that have influenced engineering experts and their non-professional jury in arriving at a decision.

In 1884, however, an opinion which had originally been offered in 1882 by Mr. H. H. Risley, B.C.S., that the plateau of Ranchi could be as effectively and more cheaply served by a Railway passing along its northern base through the valley of the Damuda than by one surmounting the plateau itself, was exhaustively discussed, with the result that the alternative line through the valley was surveyed in 1884-85, and is now recognised by both the Government of Bengal and the Government of India as the more suitable of the two. This valley line traverses the Kurunpura coalfield, and also is expected to receive traffic from parts of the Hazaribagh District. At the same time the importance and capacity for development of the Chutia-Nagpur traffic has brought into prominence the necessity that the Damuda Valley line should leave the Chandel route near Jhalda station, and join the Bengal-Nagpur Railway at Purulia, instead of at Chandel, so as to afford the nearest transit to Calcutta. This will shorten the line by 16½ miles, in the first instance, but pilgrims from Benares to Puri will hereby have to make a detour of about 15 miles. This may eventually be avoided, if their numbers should hereafter develope sufficiently to warrant the construction, as a chord alternative, of the portion of the Chandel route (50 miles long) which will thus in the first instance be discarded.

The total cost of the Chutia-Nagpur Railway has been estimated at 435¾ lakhs ; *plus* one lakh, the result of Mr. Molesworth's revisions. The estimates are, in all cases, the outcome of carefully arranged surveys, accompanied by plans, sections, detailed drawings on a large scale, &c., &c. These estimates, we are told, however, must necessarily be considered as subject to the detailed scrutiny which would precede actual operations, and having been framed at different, and not always very recent dates may in many particulars not be in conformity with present rates of labor, or prices of iron and steel. When the estimates were framed, exchange was calculated at a uniform rate of 1*s.* 6*d.* the rupee. It is lower to-day, and likely enough to fall still further before very long; so well-informed business men say.

Obviously, if only because of exchange fluctuations, the total estimate for the new railway line can only be regarded as tentative. Solace for the virtually unavoidable expense to be incurred must be looked for in the development of internal trade, and trust that it will help towards enabling India to pay for imports with exports, and thus to restore to the Lancashire and London sweated rupee some of its lost value.

In the way of direct gain, the pilgrim traffic alone ought to ensure the new line balance sheets with preponderance of rupees on the right side.

CIVIL ENGINEERS' PROVIDENT FUND.

A RECENT number of the *Calcutta Gazette* contains a Resolution of the Supreme Government in the Public Works Department, intimating the sanction of the Secretary of State in regard to the admission of superior officers of the Indian Telegraph Department, to the benefits of the Civil Engineers' Provident Fund. The following revised set of rules embodying the modifications consequent on this order has also been published.

For the purposes of the scheme the officers of the Public Works Department have been classified as under:—Civil Engineers on the effective list of the Public Works Department ; Civil Engineers transferred to the Accounts Branch, or the Superior Railway Revenue Establishment, or to Foreign Service under Chapter III. of the Civil Pension Code ; all civil members of the Superior Accounts Establishment, who are not Civil Engineers ; Civil Superior officers of the Indian Telegraph Department.

There are certain conditions attached under which these officers will join the fund. The monthly deposit may be not less than five per cent., and not more than ten per cent. on the salary of each depositor for that month. In the case of officers in the Public Works Department whose names have been on the roll on the 4th February 1885, or in the Telegraph Department on the 13th October 1886, the deposits will be voluntary, and may be discontinued and renewed at the option of the depositor. Those desirous of joining the fund may pay up arrears within the authorized limits from the commencement of service, or from any shorter time, in one sum, interest being allowed on it from the date of payment. In the case of officers joining either of these Departments after the date mentioned above, they *must* contribute five per cent. of their salary to the fund, and *may* contribute up to ten per cent. Apprentices may be depositors, at their option, but will not be compelled to do so. An officer on leave of any kind may subscribe any sum he pleases, subject to a minimum of 5 per cent. on his leave allowances, and a maximum of 10 per cent. on the salary he would draw if on duty.

The Government on its part undertakes to annually credit to the account of each officer subscribing, compound interest at four per cent. on each payment. The accumulations thus arising will be the absolute property of the officer contributing to the fund, and will be handed over to him unconditionally on his retirement from the Service, or in the event of his death before such retirement to his legal representatives.

Under ordinary circumstances a subscriber will not be permitted to withdraw his subscription, except under the above mentioned conditions. But should he succeed in satisfying the local Government or Administration under which he might be serving, that owing to pecuniary circumstances the indulgence might be extended to him, his deposit may be temporarily withdrawn (1) to pay for the passage of the depositor joining on leave out of India on medical certificate, or returning after such absence; (2) to pay for the passage of any member of the depositor's family coming from beyond the sea, to join him, or going beyond the sea, sick, or from some urgent cause. Withdrawals under this rule will be recovered in twenty equal monthly instalments, compulsorily deducted from salary in addition to the regular contribution whenever full salary is drawn, until the entire amount is refunded. These instalments may, however, be paid in advance.

We feel sure that the officers of the Telegraph Department who come within the operations of these rules will not only be thankful to the Secretary of State for the concession granted, but will largely avail of the benefits held out to them, to lay by a provision for themselves or their families against any contingency which may arise hereafter, but which, under ordinary circumstances, they would have found themselve unable to provide against.

IMPROVEMENT OF OCEAN STEAMERS.

We hear of great efforts being made to obtain the desired end or requirement of great speed for ocean steamers, and learn that the Americans are building or constructing steamers of great length, while the English are not behind them. Now, there is nothing new or novel in the bare fact that greater length to a certain or fixed breadth of beam, tends towards giving a better speed. Experience has taught us this, or shewn it to us clearly ; for we have found such vessels whether sailing or steaming, to be faster. But we also found that there was a limit soon reached to this lengthening of vessels, as such long narrow vessels were very unstable or rolled most dreadfully. Good or great beam was found to be an essential factor or absolute necessity of stability. So that it follows as a consequence that it is an error to build or construct such long vessels of 500 feet in length with so small a beam as 45 or 50 feet or of 10 to every 100 of length. It is true they are thus made sharper or with finer lines, but in increasing the length, we virtually increase the number of the sections, as it were, of the body, so that their combined momentum on the slightest movement or roll overcomes the fixed returning power of that amount or proportion of beam, and the roll is consequently greater or in fact becomes dangerous. To render these long narrow vessels safer, it is proposed to subdivide them into a great number of water-tight compartments ; but still being necessarily unstable, their greater speed is only acquired at the great expense of all comfort or pleasant voyaging, for with an aft or head wind and sea, these vessels must necessarily roll unpleasantly and even dangerously, even to the extent of a liability to turn over or capsize. In fact, it is notorious that steam vessels with a proportion of beam of 10 to 100 or more of length are decidedly unsafe, and they have thence acquired the unenviable appellation of *floating coffins*. There is now before us the Specification of Mr. G. A. DePenning, of Calcutta, for an invention of a new form of vessel, whereby he feels confident that he will overcome or obviate this defect of instability ; while from the length and sharpness or fine lines run of his proposed vessels he confidently expects them to attain a speed of 40 to 45 knots or miles an hour, or over 1,000 miles in 24 : so that the voyage from England to India may be reduced to a week or ten days. We should certainly be glad to see this, and only hope he may soon set about constructing one, or get others to assist him to do so.

We will not here enter into the details of the invention, as we hope to refer more fully to the particulars on some future occasion.

THE LATE MR. FITZHUGH COX.

We regret having to record the death of Mr. Fitzhugh Cox, who died from cholera at Sheikhidin a few hours after arriving there from Bannu, where he was in charge of the Bridge Division on the Frontier Road.

Mr. Cox was a "Stanley" Engineer appointed to the Department as a third grade Assistant in 1867. His first important charge was the Umballa Division, including Viceregal and all Government Buildings in Simla with the Simla-Umballa Cart-road and the Grand Trunk-road from Peepli to Loodhiana. He went on Furlough in the autumn of 1880, and on his return was posted to the Amritsar Division where he designed and carried out the Amritsar Drainage Scheme. He was recently transferred to the Bannu Bridge Division, from whence his name has not been unfamiliar to our readers.

Mr. Cox was a warm supporter of this Journal. He had also been a contributer to the Roorkee "Professional Papers."

The whole tenure of Mr. Cox's service was in the Panjab, and that Province loses by his death one of its most energetic and capable Engineers who combined attainments of a rare and high order.

Mr. Cox was a Member of the Institution of Civil Engineers. His age was 40 years.

TRINCOMALIE NOTES.—*Fortifications.*—The fortification works at Sober Island are being carried on expeditiously. One battery is almost complete, and two are under construction. About 500 men of all ranks are employed in different capacities under the immediate supervision of Captain Campbell and his Assistant, Lieutenant Quill. As matters stand, it seems that the three batteries that are now under progress will be completed by April next.—*Eastern Battalion, Royal Engineers.*—The native recruits lately enlisted under the name of the "Eastern Battalion, Royal Engineers" are being daily drilled and instructed in the various duties of the submarine miner by the European sergeants under the command of Captain Jeffery.

Notes and Comments.

The Consulting Engineer for State Railways.—Mr. Guilford Molesworth, C.I.E., leaves India in or about May next.

Chief Engineer, Kashmir.—We find that this post has been conferred on Colonel DeBourbel, R.E., carrying with it a salary of Rs. 1,200 a month *plus* allowances.

Sir Bradford Leslie, K.C.I.E.—We hear that the Directors of the East Indian Railway have retired Sir Bradford Leslie with a Bonus of £6,000. It was expected that the figure would have at least been a lakh of rupees

Director-General of Mines, Hyderabad-Deccan.—We learn that Mr. Mirza Mehdy Khan, F.G.S., A.R.S.M., is now acquiring a practical knowledge of Mining, with a view of becoming the Professional Adviser of H. H. the Nizam's Government in such matters.

Bengal Portland Cement—possible again.—We are informed that the quiescent Cement Works at Raniganj may soon shew a change for the better. Circumstances point to the recent purchase of the concern from the Liquidators as being little else than a veritable speculation, inasmuch as negotiations are now on foot for working the same by British capital and enterprise.

A Telegraph Line to Mandalay.—A project is about to be submitted to the Government of India, for connecting Chittagong with Mandalay by a direct line of telegraph. If the project be carried out, the line will pass through a country never before explored. It would also be a great convenience, as messages can now only be sent *via* Rangoon, or Munnipore and Chindwin.

The Cremation of Hindus.—The Aryan argument against a Crematorium is based on a religious objection, *viz.*, that any structure of brick and lime or metal made for cremation purposes requires to be purified after each individual cremation, and as such purification requires the removal of the old brick and lime or the melting of the metal, no such structure would be of any use.

A "Proposal" for the Eastern Bengal State Railways.—We are told that a proposal is now before Government from the Bengal Central Railway to take over and work the State lines in Eastern Bengal. The present economical arrangement of a "combined" system has scarcely had a trial as yet, and we are disposed to think that Government ought to work the system for a year or two at any rate before entertaining proposals of this sort.

Mining Companies in the Madras Presidency.—There are ten Gold Mining and Quarrying Companies in South India, having a nominal capital of nearly 21 lakhs of rupees, of which about a half has been paid up. The smallest of these concerns is the Kurnool Diamond Company, Limited, the object of which is to acquire lands in the district of Kurnool and to search for diamonds and other precious stones and minerals, with a capital of Rs. 4,000.

Upper Burma "Gup."—Mr. H. F. White, Superintending Engineer, has left Burma for Hyderabad, *via* Madras, and Mr. Grant, the Irrigation Specialist and his 2 Supervisors are no longer wanted in Burma and are being sent back to Madras. Some of the Upper Burma Divisions are not very happy, as Subordinates are growing discontented either with their work or officers, as several have resigned. One military Overseer has elected to go back to his Regiment.

Artesian Borings in the Suburbs of Calcutta.—We learn that the success of the Port Canning Boring so far has induced the hope in the minds of those guiding the affairs of the Suburban Municipality that a supplementary water-supply might be obtained from underground sources and thus meet a difficulty that is now exercising public opinion in the Indian metropolis. We are informed that a proposal will be shortly brought forward for a trial deep boring, and our only surprise is that this was not done before.

Prince's Dock Extension Works, Bombay Port Trust.—We glean from the Progress Report for July 1887, that, considering the weather, the progress on these Works has been extremely good. The work was a good deal retarded by the *rainfall* which amounted, during the month, to 33·11 inches. The total amount paid to the contractors to date is Rs. 36,49,299. The daily average number of men and women working on the Dock and at the quarries was 2,026, the greatest number in one day (2nd) being 3,128.

Rawalpindi Oil-Fields.—The Lahore paper understands that the prospects of a successful development of the Rawalpindi oil-fields are most favorable. It is not improbable but that deep borings, with the newest kind of apparatus, may shortly be sanctioned by Government. It is gratifying to find that the disparaging opinion regarding this oil-field that has so long prevailed at head-quarters, and which Colonel Lovett ventured to challenge, is not participated in by Messrs. Townsend and Woble, the eminent experts now inspecting the Punjab oil territory.

Coal in New Caledonia.—Large deposits of good anthracite coal, containing from 63 to 85 per cent. of fixed carbon, have for some time been known to exist in the French penal settlements of New Caledonia; but very little has hitherto been done towards developing the industry. It is said that the white population is too idle to work, and that the natives object to working underground. The French ex-convicts, who are living on the island, refuse to work at the rate of a shilling an hour for discharging cargoes of vessels, but the natives reap the benefit of this, as they have no objection to work of this kind.

The Bengal-Nagpur Railway Staff.—A Correspondent writes:—Graves resigned as his post was not sanctioned by the Home Board, having been appointed by Wynne, pending sanction of Home Board. Fairwell relieved him yesterday (25th August) of his charge. Graves, according to rumour, which I believe is true, goes in for contracts. Barry has come and taken up his duties as District Engineer, Damuda Division, his head-quarters being at Asansol. Manson comes in early next month and takes over the Singbhum Division as District Engineer. Way, Superintending Engineer, or, as he is termed, Deputy Chief Engineer, makes Purulia his head-quarters for time being.

Facilities for Hauling In and Out of Dock.—The proposed entrances of the Kidderpore Docks are placed at an angle to the stream and point in opposite directions. As vessels would generally dock before the top of high water, those about to enter would anchor above the upper entrance, and as this points up stream, it would be an easy matter to get the vessel into the dock. On the other hand, vessels going out before the top of the flood would be taken out by the lower entrance head to the tide, and would be under command at once. Vessels entering the Port at the turn of the tide would steam direct into dock by the lower entrance, and vessels leaving the dock after the top of high water would steam or haul out by the upper entrance.

MADRAS *v.* BURMAN TEAK.—It is pretty well known that Malabar teak is as superior to the Burman as the latter is above the Godaveri. The Annamullai teak is virtually the same as that of Malabar, and it is therefore interesting to learn that ten years hence the Nilambur plantations will be in a position to undersell Burma timber in the Madras market. Madras teak is infinitely superior in quality to Burman teak; and this fact is so well recognised that the Madras Gun Carriage Factory used always to get the timber for their gun-carriages from the Annamullais, although they could obtain Burman teak delivered in Madras at a much cheaper rate. It was found that the Annamullai teak had what is technically called a splendid "breaking strain," and could resist shocks from the concussion of discharges of gun powder that would shatter the Burman teak to pieces.

P. W. D. ADMINISTRATION, BOMBAY, 1886-87.—The total expenditure of the past official year in the Western Presidency on civil works, imperial and provincial, local funds, incorporated and excluded, and contributions, was Rs. 61,70,491. In round figures the expenditure on new works was $31\frac{1}{5}$ lakhs; on repairs $18\frac{1}{4}$ lakhs; on establishment $10\frac{3}{4}$ lakhs; and on tools and plant nearly $\frac{9}{10}$ of a lakh. The total outlay on roads, that is "communications," was Rs. 29,83,587, of which Rs. 10,79,123 was spent on original works; Rs. 13,58,435 on repairs; Rs. 4,99,323 on establishment; and Rs. 46,706 on tools and plant. Good progress seems to have been made with feeder roads in connection with the new railways. The expenditure on military works during the year was Rs. 22,35,447, and on irrigation Rs. 26,19,717. Only Rs. 8,23,995 have been spent on defence works throughout the Presidency, which, says a Bombay paper, is just about as much as has been wasted on somebody's "fad" of an impossible printing press, on a site where a chimney cannot be erected.

A BAD INVESTMENT.—The Indian Paper Mills Co., Ld., of Poona, shews a debit of Rs. 32,000 on its first year's working from a capital of four lakhs, divided into 400 shares of Rs. 1,000 each, of which three-fourths were taken up, and Rs. 600 were paid on each share. This unsatisfactory result is set down to the various difficulties which generally come in the way of a new industry, the foremost of which was that of obtaining cheap fibre suitable for making paper. It is asserted that "at last a fibre has been obtained which, the Manager reports, will answer our purpose, and the use of which will necessitate a slight addition to the present machinery, in order to work as economically as possible, and to increase production." Such an unexpected result suggests an enquiry into the fitness of the machinery employed, and shews how incumbent it is on those investing their money in limited liability companies, which undertake to introduce new industries, to make sure in time that the proper machinery is obtained, and that it is placed in the hands of men who have some special knowledge of the work to be done.

THE COALFIELDS OF CENTRAL ASIA.—Coal has been found in many parts of Turkestan, as in the Kara-Tau mountains and in the Boroldai mountains, where a semi-bituminous coal was formerly worked at Ak-Testi-Boulak. Coal has also been most successfully worked in the neighbourhood of Kajent, in Kokine-Sai valley, where there is a seam over 9 feet thick. This coal gave the following analysis: coke, 46·87 per cent.; ash, 4·98 per cent.; volatile matter, 35·04 per cent.; moisture, 14·11 per cent. In the Tsfarin district, also near Kajent, the "First Central Asian Mining Company" have coal mines which in 1884 yielded 3,360 tons, and in 1885 4,717 tons. These mines are capable of giving a much larger output, should better means of communication be provided to Tashkent and other important places of Central Asia. Mr. D. Petroff has opened out mines at about 25 miles distance from Namangan, where the coal is found near the surface, and in a thick seam. It is supplied to the troops quartered at Namangan and Andigan, to which towns it is brought from the mines on mules, and costs about 8*s.* 10*d.* per ton.

RAILWAY GAUGES.—It is not surprising that some controversy should still occur in connetion with such a matter, seeing that in Great Britain and elsewhere the "Battle of the Gauges" raged for many years and was not decided without difficulty. Of late, however, the opinion has steadily gained ground that the best gauge for all practical purposes is the English standard gauge of 4 feet $8\frac{1}{2}$ inches. American engineers have endorsed this decision in the most emphatic manner by changing their gauges, until their entire railway system, with the exception of a very small percentage of narrow gauge roads, has been brought to either the 4 feet $8\frac{1}{2}$ inches, or the 4 feet 9 inches, gauge. No new narrow gauge lines are now built in the United States, while every year a large mileage of narrow gauge is altered to the standard gauge. But it has to be remembered that uniformity of gauge is also a point of vast importance. Immense inconvenience has been caused in America, India and Australia by breaks of gauge, and it has come to be regarded as an axiom by engineers that all the parts of a national system of lines should be rigidly in keeping with the design originally adopted.

WISE AGITATION.—We are informed that a meeting will shortly be convened in Calcutta in connection with the Uncovenanted Civil Service grievances and to intensify Mr. H. S. King's interpellation of the Secretary of State for India. There was a meeting of members of this Service in Bellary on the 30th July, chiefly composed of Engineers, at which it seems that Mr. W. Furnivall presided. It was resolved, a contemporary learns, to form a local committee and to invite all officers to subscribe Rs. 10 to the home association. The Service is evidently not in favor of the principle underlying a graduated income tax. As the payment of pensions at par is the main point at issue, it would certainly be more equitable to find those most nearly entitled to avail themselves of the boon when granted, and who are now necessarily enjoying the maximum of emoluments—we say the arrangement would be much more equitable if these highly placed officers volunteered to bear a moiety of these home expenses themselves. With cholera, fever and sunstroke stalking his career, the young Engineer but a few years from Cooper's Hill, can hardly be expected to entertain much violent solicitude about a pension he will have no practical concern with for thirty years to come. To the senior members of the Service, however, the interest in the question advances in something like geometrical progression.

Current News.

The Bolan Railway line is blocked indefinitely, but a train runs daily from Sibi to Quetta, *viâ* Hurnai, taking passengers free and at their own risk.

Captain C. C. Townsend, R.A., has been appointed to officiate as Superintendent of the Small Arms Ammunition Factory, Kirki, from the 2nd of October.

The Sind-Pishin Line from Sibi to Quetta was opened for public traffic of all kinds on 28th August, and the present free mail service will be discontinued.

The P. and O. Co. launched the other day a steam launch which has been entirely constructed—hull, boilers, engines, complete—at the Company's dockyard at Bombay.

There is some talk of the work of the Revenue and Agricultural Department being handed over to the Public Works Member, but considering the importance of the Department, it would be better if, as in former days, it were separately represented.

It is understood that, as there will be difficulty in finding suitable employment for the Engineering staff now engaged in the Nellore-Tirupati section, after its transfer to the S. I. Railway, that Company is to be asked to take over the staff in their employ.

The Colombo Municipal Council have placed on record its high appreciation of the late Mr. William Ferguson's long and faithful services. A substantial sum of money is to be paid to his family in recognition of those services as Superintendent of Works.

It is now said that Lieutenant-Colonel D. H. Trail, R.E., Examiner of Public Works Accounts, Bengal, is not likely to retire at present as reported; but will resume charge of his former post until he gets an appointment under the Government of India.

Dr. Hehir has been appointed Health Officer and Sanitary Adviser to the Chadarghat Municipality from the date of his arrival at Hyderabad on the salary (H. S. Rs. 150 per mensem) fixed by His Highness' Government and approved by the Government of India.

Lieutenant-Colonel B. J. Goldie, Royal Engineers, is temporarily transferred from the Umballa Division to the Rawalpindi Command, Military Works, with a view to his officiating as Superintending Engineer during Colonel Lovett's absence on privilege leave.

Mr. Bowack, an Engineer, has obtained sanction from the Bombay Government and Port Trust to his project for constructing a graving dock in Bombay Harbor. The site granted him for the purpose is off Butchers' Island, which lies in the upper part of the Harbor.

Sanction has been given to the formation of a company of Sappers and Miners in Burma, consisting one-half of Burmans, one-quarter of Shans, and one-quarter of Kachins and Karens. The men will be enlisted for five years with the option of extending their service.

It is probable that the committee of experts now deliberating in London over that knotty subject, the Madras Harbor works, will recommend the closing of the eastern entrance thereto and the construction of a new entrance on the north-east, at a cost of, perhaps, half a million of money.

Colonel C. J. Smith, R.E., the Consulting Engineer for Railways, went to Trichinopoly, there to execute with Mr. Betts, Agent, South Indian Railway, the agreement with that Company for working the Nellore-Tirupati section, which was inspected and passed by Major Sidney Smith, R.E.

A Madras paper states that Messrs. Fischer and Company, a Bombay firm, recently made proposals to the Madras Government in connection with the subject of lighting Fort St. George by electricity; but the Government are not disposed to undertake the project, and the offer has consequently been refused.

Mr. Creighton, the Locomotive Superintendent of the South Indian Railway, is gradually doing away with monthly paid salaries, and, in lieu thereof, is introducing the system of daily wages, especially in the workshops, thus following the procedure existing at present at the Perambore Workshops on the Madras Railway.

The Viceroy during his tour will see the whole of the frontier railways, and practically do most of his journey by rail, riding to such places of importance off the line as he considers necessary. He opens the Benares Bridge about the second week in December, arriving at Calcutta most probably on the evening of Saturday, 17th December.

The French Government have secured the services of that well-known French Engineer, Monsieur Pierre de Closets, to make a "Revenue Survey" of the French Settlement of Pondicherry, in view to a re-assessment and re-settlement of the lands held therein. M de Closets is assisted by his son in the work, which is being pushed on rapidly.

In view to as much foundation work as is possible being executed before the North-East monsoon commences, in connection with the reconstruction of the large bridges on the North-West Line of the Madras Railway, sanction has been accorded for the entertainment of 50 additional divers for work at the Pennar and Chittravutty bridges, at Rs. 5 and 4 per diem.

Mr. J. S. Pyne, the Englishman who has been at Kabul looking after the construction of the Amir's workshops, is taking leave to Europe. In a recent letter to a friend in India he says that the buildings he has been engaged on for the Amir are nearly 220 feet square, and almost finished. The Afghan bricklayers work well. The people—the civilised community—are very courteous, and His Highness the Amir has been very kind to him so far.

Says the *Straits Times*:—Several applications have been sent in to Government for the vacant appointment of Government Engineer Surveyor, in the room of the late Mr. Billows. Amongst the applicants is Mr. Joseph Leslie, Chief Engineer of the steamer *Arratoon Apcar*, who has been about 21 years in the service of Messrs. Apcar & Co. From the numerous testimonials he holds, Mr. Leslie is evidently a man who stands very high in his profession.

We learn that, out of an indent of twelve Engines, made by the Locomotive Department of His Highness the Nizam's Guaranteed State Railways, from England, five have arrived in Bombay. Also that some five steamers of the Hall Line are now in the Coconada Roads, discharging materials for the same Line. Messrs. Hall, Wilson and Company, the Agents, are making every effort to land and forward them on to Bezwada by means of cargo boats, towed by a steam tug.

Coal traffic on the construction line of H. H. the Nizam's Guaranteed State Railway is now at a standstill, in consequence of the diversion about half a mile from the Garla Station being washed away. The Garla river, a tributary of the Pakal, has breached, and a bridge is now constructed over the diversion. We believe that over 3,000 tons of coal are now stacked at the coal terminus, of Yelanthapad, and cannot be removed till the bridge is constructed and the line cleared for traffic.

We learn that the Madras Government has deputed Colonel Mead, Royal Engineers, the Chief Engineer for Irrigation, to proceed at once to the Godavery District, and report on the damage done in that district by the recent heavy rains. We believe that the water at the Bezwada (Kistna) anicut is still 16 feet above the crest of the anicut. The floods are assuming alarming proportions, and several breaches are reported. The houses of the villagers in and around the district have been seriously damaged.

The system of lending to Guaranteed Railway Companies the services of Engineers belonging to the State is beginning to be felt by the Railway authorities, as, besides the liberal salaries and travelling allowances paid the officers, these Companies have to contribute rather heavily on account of their pensionary and leave allowances. At present the South Indian Railway has two such officers on its Engineering Staff,—Messrs. Gilchrist and Bruce Fox,—who draw salaries of Rs. 700 and 800 respectively, *plus* fixed travelling allowance, Rs. 75, a month.

We learn that, under instructions from the Board of Directors of the Nizam's Guaranteed State Railway Company, the Agent and Chief Engineer has appointed a committee to submit a scheme for the grading of the staff, and to consider and report on the scales of salaries to be adopted on the Railway: the Madras and G. I. P. Railway scales to be taken as guides. The committee will consist of Mr. W. Pendlebury as President, Mr. R. Roberts as Secretary, and Messrs. Dunlop, Robertson, Berkley, Gaye, Martin and a Clerk from the Agent and Chief Engineer's office as members.

The Government has ordered Mr. George Lambert, the Superintending Engineer for Irrigation in Sind, to carry out at once the preliminary reconnaissance survey for a railway from Gidu Bunder at Hyderabad to Umarkot in the Thar and Parkar Districts, the length of which will be about 100 miles. To expedite the work as much as possible it was divided into three sections, and the plans and estimates are likely to be ready for submission to Government by the end of September or beginning of October. The immense grain traffic of these districts is said to be sure to make the line a profitable concern.

After all, a sum of 1½ lakh of rupees has been sanctioned and orders issued for the commencement of preliminary operations in connection with the Periyaur project, which has for its object, the bunding up of the waters of the Periyaur river, which irrigates the Travancore State, and utilising its surplus waters in irrigating the plains of the Madura district. The project, which is a gigantic irrigation one, is the conception of Colonel Pennycuick, R.E., and that officer, we hear, shortly proceeds to England to select and despatch the necessary plant and machinery required for the work connected therewith, and is to return to Madras by the end of the official year, so that the work may be put in hand at the beginning of the next official year. It is understood that the officer selected to be the executive in charge is Mr. H. S. Taylor, Executive Engineer, Madras P. W. D.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE KLITOMETER.

SIR,—The description of the T Klitometer given in your issue of the 27th August is useful chiefly to men like myself, *not* Engineers, but who, in poor and hilly districts, have to turn their hands to a little engineering occasionally,—in default of means for proper professional operations,—and who need more detailed expositions placed before them than the few descriptive words that would suffice for an Engineer, who is already conversant with allied forms of intruments and their use.

If such an appliance had been available to myself years ago, there might ere now have been opened up in my Agency more than the three ghâts I have latterly had constructed—roughly it may be—but of easy gradient and at comparatively small cost.

POLITICAL AGENT.

"SANITATION IN INDIA."

SIR,—Allow me to add, with reference to your Leader on the above subject, that Dr. Laing recognizes the difficulty of the problem, as also that a good deal of opposition will be met with from the great body of the people owing to their prejudices and insanitary habits, so deeply rooted in native society. It cannot be denied that many preventible sanitary evils exist among them, but the drawbacks to any improvement being effected in that direction is the stereotyped reply 'want of funds.' Surgeon-Major Laing, however, is of opinion that, judging from past experience, a good deal might be done to improve the sanitary defects ordinarily met with, by the help of the funds already at the disposal of public bodies. He divides the elements of sanitation in this country into conservancy of streets and houses, water-supply, and drainage; and instead of introducing a regular system of drainage, which would be a costly measure, he proposes to utilize the existing side-cuttings, if they are kept clear of obstructions for the free flow of water. In reference to the sources of water-supply they are wholesome enough in most of the towns and villages; all that is necessary is they should be kept scrupulously protected from pollution. But conservancy, both of street cleaning and domestic cleansing is a stumbling block in the way of all sanitary reforms, since it brings home to the conservative masses their objectionable modes of living, and serves to invite opposition from them.

HYGEIA.

"DISCHARGE FROM CATCHMENT BASINS."

SIR,—In your issue No. 6 of Vol. II., August 6, 1887, page 90 you have quoted values of co-efficients derived by Mr. Heaford. I send you an extract from Hughes' Pocket Book, where M (=Modulus of the Basin) $= \frac{y}{\sqrt{x}}$, O'Connel's formula.

	Area. sq. m.	M=
Ganges at Rajmahal	345,000	85·0
Godavery at Rajmandry	120,000	144·3
Kistna at Beizarrah	110,000	133·0
Tumbhadra	20,000	155·5
Cauvery at Sirangam	28,000	140·0
Do. at Frazerpet	0,415	177·0
Tambraparni	0,587	289·0
Sohan River (Punjab)	0,573	141·0
Banganga at Gopalpur (Jaipur)	0,312	267·0

By Captain H. D. Love, $Q = C\, M^{\frac{3}{4}}$.

	Area. sq. m.	C=
Kistna	97,050	140
Cauveri	27,700	150
Tambraparni	1,750	460

A few more contributions of this sort would induce me to attempt some kind of tabulation applicable generally.

MAISUR; *August* 13, 1887. A. G.

"JOBBERY RAMPANT."

SIR,—Your correspondent "Ubique" is evidently unaware of the amount of work that has to be done at the Secretariat, P. W. Department. The Chief Engineer with the help of his assistants has to manage *Railway*, *Provincial* and *Local works.* "Ubique" must be aware that only a few months ago the whole of the Local works in a few divisions were made over to the Provincial branch of the Department, and that there is no doubt that in a short time the whole of the Local works of the entire Province will have passed into one hand.

Under these circumstances, it would be utterly impossible for the Chief Engineer to manage efficiently all three services with the aid of only *one* assistant. Major Pulford as Secretary and Engineer-in-Chief of Railways of the Province is the *right man* in the *right place.* It has already been hinted in this Journal that Major Pulford's services would be *most valuable* in the Railway branch. An active man should not be *shut up* in an appointment of Assistant Secretary. If he is diffident in *asserting himself*, his superiors should push him forward. I would like to know the man in these Provinces who is better fitted for the post than Major Pulford as Engineer-in-Chief of Railways.

The C. E. who has been appointed as Assistant to the Chief Engineer to the Provincial branch is Mr. F. B. Henslowe, an officer of great experience and of long service in the Department. Failing health has driven Mr. Henslowe to a sedentary occupation, and it is hoped that a well-earned rest will now be secured to him for the rest of his service in being posted permanently to the post he now holds.

R.

New Books and Reprints.

ASTRONOMY AND METEOROLOGY.

BOEHMER (G. H.) List of Astronomical Observatories from the Smithsonian Report for 1885. 8vo, paper, pp 14. Washington.

CHEMISTRY AND PHYSICS.

MATTER and Energy: Are there two Real Things in the Physical Universe? Being an Examination of the Fundamental Conception of Physical Science. By B. L. L. Paul, Trench and Co. ... 2/

ELECTRICITY.

HERING (C.) Practical Directions for Winding Magnets by Dynamos. Post 8vo, pp. 64. Spons 3/6

MENDENHALL (T. C.) A Century of Electricity. (Nature Series.) Post 8vo, pp. 226. Macmillan 4/6

THOMPSON (S. P.) Elementary Lessons in Electricty and Magnetism. 18mo, pp. 456. Macmillan 4/6

ENGINEERING AND MECHANICS.

BARNABY (S. W.) Marine Propellers. 2nd ed. Post 8vo, pp. 90. Spons 6/

HALDANE (J. W. C.) Civil and Mechanical Engineering Popularly and Socially Considered. With 9 Plates. 8vo, pp. 450. Spon 12/6

GEOLOGY, MINERALOGY, MINING.

MERIVALE (J. H.) Notes and Formulæ for Mining Students. 12mo, pp. 166. Crosby Lockwood 2/6

ORTON (E.) Geological Survey of Ohio: Preliminary Report upon Petroleum and Inflammable Gas, by E. Orton, State Geologist. Reprinted for the author, with a Supplement. 8vo, pp. 200. Maps. Columbus (O.) 7/6

MATHEMATICS.

DEIGHTON (Horace) The Elements of Euclid. Books 1 and 2. Newly Translated from the Greek Text, with Supplementary Propositions and numerous Exercise for use in Schools. Post 8vo, pp. 126. Bell and Sons 2/

HALL (H. S.) and KNIGHT (S. R.) Higher Algebra A Sequel to Elementary Algebra for Schools. Post 8vo, pp. 536. Macmillan 7/6

MATRICULATION Mathematics. A Guide to the Mathematics of the Matriculation Examination of the University of London, by W. B. and C. J. (London University Examination.) Post 8vo, sd., pp. 46. Baillière 2/

SMITH (J. Hamblin) Exercises in Arithmetic. Arranged and Adapted to the Sections in Hamblin Smith's "Treatise on Arithmetic." (Rivingtons' Mathematical Series.) Fcap, 8vo, pp. 146. Rivingtons. without answers 1/6; 2/

WOODWARD (C. J.) A B C Five-Figure Logarithms; or, Logarithms with Differences on a New and Simple Plan. Together with Analytical Factors, &c. 16mo, pp. 58. Cornish (Birmingham). Simpkin 2/6

TRADE, COMMERCE AND MANUFACTURE.

ANDERSON (W.) Practical Mercantile Correspondence: A Collection of Modern Letters of Business. 27th ed., revised and enlarged. 12mo, pp. 302. Trübner 5/

HUNTER (Charles) Mechanical Dentistry, 3rd ed., revised, with additions. (Weale's Rudimentary Series.) 12mo, pp. 280. Crosby Lockwood 3/

LENO (John Bedford) The Art of Boot and Shoemaking, 2nd ed. Post 8vo, pp. 252. Crosby Lockwood 2/6

MILLIS (C. T.) Metal Plate Work: its Patterns and their Geometry. Also Notes on Metals and Rules in Mensuration for the use of Tin, Iron and Zinc Plate Workers, Coppersmiths, Boiler Makers and others. (Finsbury Technical Manuals.) Post 8vo, pp. 320. Spons 9/

WATT (Alexander) The Art of Leather Manufacture. 2nd ed. Post 8vo, pp. 648. Crosby Lockwood 9/

——— The Art of Soap Making. 3rd ed., carefully revised. Post 8vo, pp. 272. Crosby Lockwood 7/6

Proceedings of the Institution of Civil Engineers, Vol. LXXXIX.—"Notes on Useful Japanese Timber," by Jno. Henry T. Turner, "Iron and Brass Foundries, Pouist St. Charles Works, Grand Trunk R. R. of Canada," by Fred Lumb Wanklyn. "Australian Timber," by Geo. Chamier. "Setting out the Curves of Wheel-teeth," by William Isaac Last. "Salmon Fisheries in Scotland," by Alexander Leslie.' "Ailsa Craig Lighthouse and Fog Signals," by David Allan Stevenson. "Administration of Fishing-boat Harbors in France." "Further Investigations regarding Wire-gun Construction," by Jas. A. Longridge.

General Articles.

CALCUTTA PORT IMPROVEMENTS.

Kidderpore Docks.

VIII.

Report of Joint Committee of Port Commissioners and Chamber of Commerce of 1883 *and Financial Aspect of the Project.*

The Committee recommended, and provided for in the estimate, the construction at first of only the larger of the two graving docks shewn in the general plan (Plate 3, given in a previous number of Indian Engineering.) The length of this, on the blocks, is 520 feet, and the width of entrance is 70 feet. There would be a separate revenue from this dock, sufficient probably to cover the cost; but irrespective of that the Committee thought the construction of such a dock necessary, there being none on the East Coast of India capable of accommodating the largest class of vessels.

The Committee anticipated that after the opening of the docks Tolly's Nála would become the main line of communication for boat traffic, and they therefore approved of a project then under preparation in the Public Works Department for converting it into a canal by locking and widening and deepening it, and also for cutting a canal to connect the Nála with the Circular Canal at Sealdah (*vide* Plate 1, given with these articles.) This would place the proposed docks in direct communication with the Eastern canals and rivers round Calcutta, and cargo coming into Port by this means of carriage for ultimate shipment could be stored in warehouses in connection with the docks. The importance of such a connection was so apparent that the Diamond Harbour Committee had recommended the extension of the boat canal to the proposed docks at that place. The Committee proposed that the water for the supply of the docks should be pumped from the canal, the water level of which and of Tolly's Nála should be kept at 12 feet above datum. The primary source of the water supply for the docks and the arrangements for maintaining it are thus described in the report:—

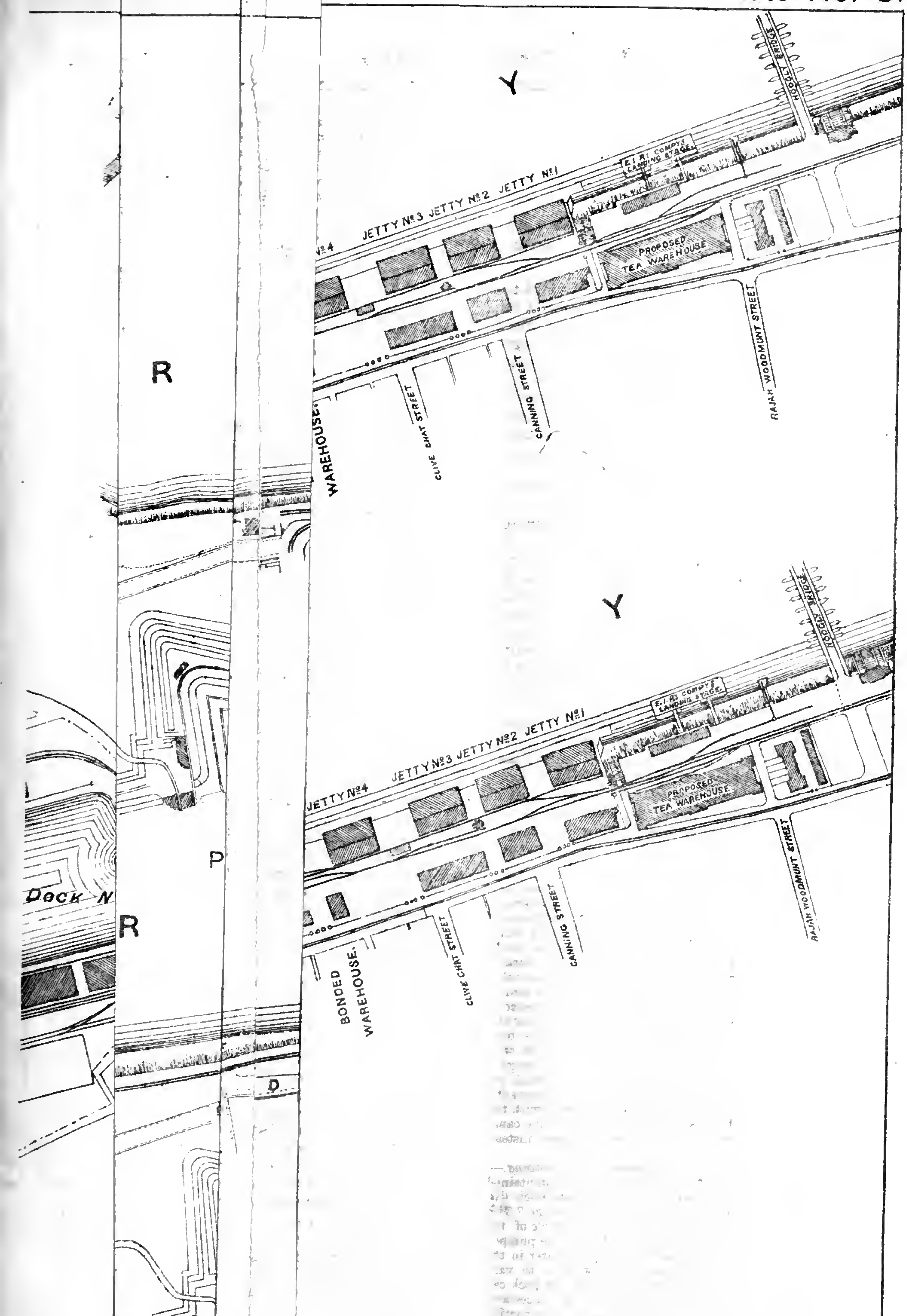
Water to feed docks and canal.—The water to feed the canal and docks would be drawn from the Hugli at Kidderpore Bridge through self-acting sluices similar to those at Chitpore, which would only allow the surface water to enter the canal. It has been found in the tidal canals that the whole of the silt is deposited within a short distance of the entrance. This is practically what might be expected when the conditions are enquired into. The velocity of the water in the canal is so slow that it cannot retain the particles of mud in suspension, and the consequence is that the silt is deposited close to the entrance. The water for the dock would be pumped from the canal at the head of the boat dock, a distance of about 6 miles from the point at which it is drawn from the river; and water travelling slowly through a canal or silting basin (which the canal practically becomes) for this distance, will be almost free from silt before it enters the dock. This arrangement does not, of course, do away with the necessity for dredging; but the dredging will be done in the canal in a position where it will cause very little inconvenience, instead of in the dock.

Height of water in docks and arrangements for pumping.—The level of the water in the dock will ordinarily be maintained at heights varying from 16 to 22 feet above Kidderpore dock sill, according to the season of the year. This is on the average 7 feet above the level of the water in the canals, and the whole of the water for the supply of the dock will therefore have to be pumped on the average about 7 feet. By maintaining the water in the dock at the level of spring tides instead of allowing it to vary with neaps and springs, the level of the bottom of the dock can be kept about 5 feet higher than would otherwise be necessary, and consequently a very great saving effected in the construction of the quay-walls and excavations; but as the depth of the dock has been fixed at 10 feet below datum, the level of the water may vary, without any inconvenience to shipping, from 16 to 22 feet above datum, giving an actual depth of 26 to 32 feet in the dock. During high tides, in the rainy season, the level of the water in the dock would have to be kept at from 21 to 22 feet above datum.

Sanitary arrangements.—By these arrangements the water in the dock would be kept constantly changed, and all the disadvantages that might arise if the water were stagnant would be avoided. In connection with this question, the Committee have taken into consideration the sanitary arrangements which would have to be made for working the docks. Latrines and urinals, properly constructed, flushed and drained, would be placed at convenient distances round the dock; and all water-closets and urinals on board ship would be kept locked and properly secured so long as the vessel is in dock. For the removal of sweepings, ashes, cooking refuse, &c., conservancy boats and trucks would be maintained. With these arrangements strictly carried out, and the water of the dock constantly changed by pumping and discharging, there will be no risk of the water ever becoming foul or in any way prejudicial to health. The practical experience gained in the working of docks at Bombay shews that the fears formerly expressed as to the prejudicial effect of docks on the health of the crews of vessels and the surrounding neighbourhood are entirely groundless, and with the sanitary arrangements now proposed for the docks in Calcutta, the Committee feel confident that no fears need be entertained on this account.

Arrangement of docks for business.—On referring back to our last article and to Plates 1 and 3, it will be seen that the Committee proposed that the docks or, rather, dock should be constructed in two sections connected by an 80 feet opening without gates (to be spanned by a draw-bridge) and that this arrangement was necessitated by the fact of the site being intersected by the "Circular Garden Reach Road." The Consulting Engineer to the India Office, Mr. (now Sir) A. M. Rendel, being of opinion that no docks had yet been built which had involved so many and such serious risks as these, and doubting whether Mr. Bruce's estimate of the cost was sufficient, availed himself of this topographical necessity for building the dock in sections to suggest that it would be sufficient as a first step to construct only a basin and dock measuring together 50 acres; and the Secrerary of State, acting upon this advice, limited his sanction to the construction of the tidal basin, with an area of 9·8 acres, and No. 1 Section of the dock, which measures 36·33 acres,—total 46·13 acres,—together with the necessary entrances from the river and the connection locks. The Government of India on this observed that the postponement of the construction of dock No. 2 greatly modified the financial aspect of the project, for, while two-thirds of the entire expenditure must be incurred in constructing the remaining portions of the scheme, less than half the accommodation would be provided. Nevertheless the Committee's report shewed that the reduced scheme might be expected to yield a surplus, after paying interest and working expenses; and in view of the importance of proceeding with caution the Government accepted without hesitation the decision to delay the construction of the second dock,— a curious mixture of caution and rashness. In studying the arrangement of the docks for the business of the Port it must, therefore, be kept in mind that the works now under construction comprise only the entrances, tidal basin, and one graving dock, and Section No. 1 of the wet dock, with their accessories, at a total cost of Rs. 2,00,00,000.

The outer section of the dock is primarily intended for vessels bringing imports and loading export cargoes, but could be used solely as an export dock. In the inner or No. 2 Section a frontage of 2,200 feet is set apart for the discharge of salt ships, for whose special accommodation six large warehouses, each divided into nine compartments, have been designed. The estimates, however, provide only for the construction of five compartments of each warehouse, to hold in all 50,000 tons of salt; thus leaving room for extension should the trade require it. The landing charges on the salt would cover warehouse rent for one month only; but either private or public warehouses can be constructed immediately behind the dock warehouses, on space reserved for the purpose, where the salt could remain as long as required at an ordinary rate of warehouse rent. Railway lines pass immediately behind all the warehouses, and beyond the railway there is a boat dock, longer than No. 2 Section of the ship dock, where native boats could load salt and proceed direct to the Eastern districts by canal without ever going into Hugli. These arrangements would also enable a ship at once to get rid of her cargo, and all liability in connection with the salt. "Instead of discharging only 60 or 70 tons per day, as is the present practice," say



(Sd.) Wm. DUFF BRUCE, M. Inst. C.E.,
Vice-Chairman of the Port Commissioners.

... could ... her discharge and ... a ... passenger ... at ... the ... front of No. 2 ... will be found ... of ... Two ... The ... of ... of ... and ... tons of ... have ... ships ... this year ... the wharf, and ... might be ... leaving the ... wharf ... large sheds ... deck.

... For the construction of large ... proximity to ... with ... the Commission have ... taking up a strip of land ... of the ... nearly ... for ... purpose ... the ... dock ... partly occupied by ... discharging ... for ... of ... with ... them with the dock ... the fronts of the private ware ...

... and ... by ... —Plans ... the arrangements ... which have since been ... Commissioners, for ... the ... vessels ... the ... Railway ... Kidderpore. The Com- ... of the work as given in the report, ... may be able to judge ... that it would be ... as well as ... convenience ... .

... will be necessary ... satisfactory ... the same manner as ... at the end of ... Road. ... Port ... would ... the ... give the necessary ... The construction of this ... Strand Road ... a great ... considerably ... while ... very much ... as ... the ... and the ... regulations ... to ... of ... stand ... Hills ... provided for ... the ... within ... at ... it would ... be ...

... Station.—The stones to ... dressed to tolerably ... No stone to be less ... to be placed at 5 feet ... thick and less single ... In ... walls the ...

... that ... lifting ... Commissioners' Railway ... increased ... of the bridge was ... The ... it is believed ... the ...

ESTIMATE FOR ...

	... Establishment
	Total

the Committee, "she could complete her discharge and be ready to take in export cargo in about a week."

On the west side of the interior front of No. 2 Section of the dock considerable space will be found provided for landing and stacking coal, ballast, and railway material, but as only Section No. 1 is at first to be constructed, these branches of the import business will, as well as the salt trade, for the present remain unprovided for. The Committee propose to appropriate a quay space of about 1,500 feet for the use of vessels discharging coal and ballast. In 1882-83 75,613 tons of coal were imported, and discharged entirely into boats, all this could be discharged in dock on the wharf, and steamers might be taken thither to coal before leaving the docks. Ballast could be discharged at this wharf into railway trucks and removed to depôts immediately behind.

The remainder of the quay space on the inner dock is arranged for exports, with large sheds at each berth for the collection of cargo.

The necessity for space for the construction of large warehouses, both public and private, in close proximity to the shipping and in direct communication with the entire railway system having long been felt, the Committee have provided in their scheme for taking up a strip of land about 250 feet wide, on both sides of the dock and nearly the whole length of the dock enclosure for this purpose. This space will be separated from the dock warehouses and sheds by a distance of 150 feet, partly occupied by the railway lines for wagons bringing produce for direct shipment; and a double line of sidings, with crossings at frequent intervals to connect them with the dock service lines will be laid along the front of the private warehouses.

Connection of docks and jetties by tramway.—Plate No. 5, given with this article, shews the arrangements proposed by the Committee, and which have since been carried out by the Port Commissioners, for connecting the docks with the jetties and the inland vessels' wharves by an extension of the Commissioners' Railway from Chandpal Ghât along the riverside to Kidderpore. The Committee's description of this work as given in the report, is subjoined. Those on the spot may be able to judge of whether the Committee's anticipations that it would be a public improvement as well as a Port convenience have proved correct.

To obtain room for a double line of rails, it will be necessary to widen the present road by constructing a retaining wall about half-tide level, in the same manner as has already been done opposite the landing stage at the end of Outram Road. For a short distance above and below Fort Point the tramway would have to be carried on iron piles; and at Fort Point it would be necessary to remove the monument so as to give the necessary room for the tramway to pass. The construction of this embankment outside the present Strand Road would be a great improvement to the drive, and allow of its being considerably widened both above and below Fort Point, while it would add very much to the appearance of the frontage as seen from the river; and the traffic could be worked under regulations which would prevent all fear of it ever becoming a nuisance to those who use ths Strand in the evening for purposes of recreation. From Chandpal Ghât to the north end of the carriage stand at the Eden Gardens and from Prinsep's Ghât to Tolly's Nála, wharves for inland vessels might be constructed, and this is provided for in the estimates.

It is an essential part of the scheme that this connection should be carried out. With the tramway connecting the docks at Kidderpore with the jetties, it will be an easy matter to convey goods to the warehouses now being built at the jetties, and it would only be a matter of a little extra haulage to take tea from the proposed new tea warehouse at Armenian Ghât to the import dock at Kidderpore instead of to the jetties. In both cases the tea will have to be loaded into trucks to convey it from the tea warehouse to the wharf, but it would manifestly be very inconvenient to take tea to the docks without a direct tramway along the Strand Road. With this connection, Armenian Ghât is the best site for the tea warehouse, and it is the most convenient site for those engaged in the tea trade.

In Plate No. 4, given with our last preceding article, will be found drawings of the lifting bridge by which this extension of the Port Commissioners' Railway is taken across Tolly's Nála without inclined approaches. The estimated cost of the bridge was Rs. 1,05,000. The principle of this bridge is, it is believed, the invention of Mr. Bruce, and it was first applied by him to carry the Port Commissioners' Railway at its northern end across the Canal at Chitpore. The platform which carries the rail-roadway is suspended from girders, fixed at a height sufficient to give the necessary headway for boats, by chains passing over pulleys with counterpoise weights at their ends. When the bridge has to be opened for the passage of a train, water is let into the tanks in the flooring, and the counterpoise being overcome, the roadway descends, under control from the crab-winch, until it comes to its bearings below: and when the train has passed, the tanks are emptied and a man at the winch easily lifts the roadway up again.

In a previous article, when noticing the Committee's estimate of the outlay on improvements that the trade of the Port of Calcutta could afford, the estimated cost of the docks was stated at Rs. 2,23,30,105, and that of the extension of the railway from the jetties to the docks at Rs. 7,44,000—total Rs. 2,30,74,105. The following is the Committee's—

Summary of the Cost of the Works proposed to be executed in connection with the Scheme for providing Wet Docks at Kidderpore.

		Rs.	Total Rs.
Estimate No.	1. Sixty-feet lock..	18,84,444	
,, ,,	2. Eighty-feet entrance to tidal basin	8,78,324	
,, ,,	3. Tidal basin and 60-ton shears	12,66,051	
,, ,,	4. Double entrance from basin to Dock No. 1	13,65,078	
,, ,,	5. Dock No. 1	71,22,064	
,, ,,	6. Boat canal	9,78,676	
,, ,,	7. Dock No. 2	88,35,468	2,23,30,105
,, ,,	8. Constructing boat wharves and extending the tramway to the proposed docks at Kidderpore	7,44,000	7,44,000
			2,30,74,105
,, ,,	9. Graving Dock	8,70,293	8,70,293
	Grand Total	...	2,39,44,398

(To be continued.)

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

V.

Coursed Rubble Masonry in Foundations.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Masons No. ...	$3\frac{1}{2}$	Variable.		
Do. ,, ...	$1\frac{1}{2}$			
Coolies ,, ...	$2\frac{1}{2}$			
Do. ,, ...	2			
Do. ,, ...	$1\frac{1}{2}$			
Bhistie ,, ...	$\frac{3}{4}$			
Grinding mortar, c. ft.	27			...
Sundries	...		...	...
Materials.—				...
Rubble stone roughly hammer squared, c. ft.	80			
Quarry chips, c. ft. ...	8			
Lime, slaked dry ...	13			
Sand ...	13			
Surkhi ...	13			
Sundries ...	...			...
Petty Establishment ...	...	...	...	...
Total ...	...	...	...	...

Specification.—The stones to be selected for shape, and to be dressed to tolerably square sides with masons' hammers. No stone to be less than 12″ × 9″ × 6″. Bond stones to be placed at 5 feet central intervals. In walls $2\frac{1}{2}$ feet thick and less single bond stones to cover thickness of wall. In thicker walls the bond stones to overlap at least 6 inches.

X.

THE ADHESION OF CEMENT AND OF VARIOUS CEMENT MORTARS TO BRICKS,

With Their Application in the Design of Retaining Walls, Arches, and Similar Structures.

I.

An important and interesting paper on this subject was read before the Engineering Association of New South Wales during its last session, by Professor Warren of the University of Sydney. After calling attention to the tests described by Mr. Mountain, M.I.C.E., City Surveyor of Melbourne, in a former paper, regarding the value of a given cement either for mixing with sand, to form concrete, or with various aggregates to form mortar, Professor Warren states, that while admitting the value of these tests, it must be conceded that it is at least as necessary to know the properties of the materials generally associated with cement in mortar and concrete, which in conjunction with the cementing material, exercise an important influence in resisting the forces which are developed in the concrete or mortar in the uses to which they are applied by the engineer and architect. For instance, the behaviour of a mass of concrete, formed of broken stone, sand and cement, when subjected to a crushing force in the testing machine should be considered. The concrete will fail, not by the actual crushing of the material forming the aggregate, but by a separation of the pieces of broken stone from the cementing material which binds them together. So that while the mass, as a whole, is subjected to an externally applied crushing force, the interior is called upon to resist forces which develop to some extent the tensile strength of the cement, but which fully develop the adhesive strength of the cement, mortar and the materials forming the aggregate. If the resistance of the cementing material to be thus separated from the material with which it is united is less than its tenacity, it follows as a consequence that the adhesive strength of cement is at least as important as its resistance to simple tension.

The experiments recorded by Professor Warren were made in two ways. In one instance a single brick was cemented for about half its length between two others; and in the other instance, one brick was cemented to another, which it overlapped for half its length. After being set in this manner the bricks were allowed to remain for periods of 7 and 28 days respectively before testing. The testing consisted in causing the middle brick to slide between the two outside ones, thus overcoming the adhesion existing between the mortar and bricks on two surfaces. In the second case one brick was made to slide upon the other, which developed the adhesion on one surface only. It was found to be impossible to cause the force to be equally distributed over the two surfaces in the case of the bricks joined as in the first instance, and in nearly every case one side failed before the other, so that the result obtained by testing with the three bricks did not differ much from those obtained with the two bricks.

The bricks and other materials were selected with great care, and the mixing done by skilful assistants. The results of the experiments will be found summarised in the following table :—

Description of Materials.		Mean adhesive strength in pounds per square inch after 7 days.	Mean adhesive strength in pounds per square inch after 28 days.
Neat Cement		168	213
Crushed Sandstone and Cement	1 to 1	117	146
,, ,, ,,	2 ,, 1	53	73
,, ,, ,,	3 ,, 1	26	48
,, ,, ,,	4 ,, 1	16	45
Bluestone Dust and Cement	1 ,, 1	79	136
,, ,, ,,	2 ,, 1	47	84
,, ,, ,,	3 ,, 1	34	45
,, ,, ,,	4 ,, 1	23	41
Nepean River Sand and Cement	1 ,, 1	102	105
,, ,, ,,	2 ,, 1	38	45
,, ,, ,,	3 ,, 1	20	24
,, ,, ,,	4 ,, 1	9	14

The cement used was the "Castle Brand" No. 67, manufactured by W. Levett and Co.

The following table, which was prepared by Mr. Mountain during his incumbency of the office of City Surveyor in Sydney, was quoted for purposes of comparison.

Tensile Strain.—1 inch × 1 inch briquettes mixed with "Castle" cement and different kinds of sand in the proportion of 3 to 1 by weight.

Tensile Strains in Pounds per square inch.

Description of Sand.	Quantity of Water.	At 3 days.	At 7 days.	At 28 days.
Crushed Sandstone ..	10%	104	191	219
Yellow Sand (fine) ...	7½%	43	177	215
White Sand (,,) ...	7½%	132	183	219
Nepean River Sand (fine)	7½%	123	182	232
,, ,, (coarse) ...	7½%	111	173	234

The tensile strength of the cement was found to be at the end of 3 days 472 lbs. per square inch.

,, ,, 7 ,, 609 ,, ,, ,, ,,

,, ,, 28 ,, 740 ,, ,, ,, ,,

By comparing these results the relative adhesive strength of this cement to the materials enumerated may be inferred thus: When mixed with crushed sandstone in the proportion of 1 to 3 the tensile strength was found to be 191lbs. per square inch at the end of 7 days, and 219lbs. at the end of 28 days. Although a tensile force has been applied in this case, the internal resistances developed in the briquettes were the adhesive strengths of the particles of cement to the particles of sand, and this, from the experiment quoted, is 0·311 times that of the tensile strength of the neat cement at the end of 7 days, and 0·296 times at the end of the 28 days, giving a mean value of 0·3035, which may be used as a co-efficient to calculate the adhesive strength of crushed sandstone to the cement when mixed in this proportion. In a similar manner other co-efficients may be derived which may be used in like manner. The adhesive strength of neat cement mortar to the bricks experimented upon may be found by multiplying the tensile strength of neat cement by 0·275.

The foregoing facts have an important application in the design and construction of enclosure walls, retaining walls, piers, abutments, buttresses and arches. With regard to retaining walls the following conditions are usually accepted :—

(*a*.) When the wall is subjected to fluid pressure on one side only :—

1. The centre of pressure when the water reaches its highest position must fall within the centre third of the thickness of the wall at every level.

2. The centre of pressure due to the weight of the wall itself must fall within the centre third of the thickness of the wall at every level. (*Note.*—This will happen in every case, unless the wall or dam is exceptionally high.)

3. The intensity of the vertical pressure at the outer face must not exceed that which the material can safely bear.

4. The angle which the resultant pressure on any bed joint makes with the normal at that joint must not be greater than the angle, of which $\frac{4}{5}$ ths of the co-efficient of friction of the material is the tangent.

(*b*.) When the wall is subjected to earth pressure on one side only.

Here the same conditions apply, with the exception that in condition 1 we substitute the maximum earth for the maximum fluid pressure due to water. In all ordinary retaining walls which satisfy this condition, the intensity of vertical pressure on the outer edge will not generally exceed the safe limit with regard to crushing of material.

(*c*.) In dock and quay walls, which are subjected to both water and earth pressure, the walls must be designed to resist the maximum earth thrust when the dock is empty, and the maximum water pressure, less the minimum earth thrust, when the dock is full.

With regard to arches: The line of resistance is supposed not to pass without the centre third of the thickness of any voussoir, and its direction at any joint must not make with the normal to the joint an angle greater than the angle of friction of the materials. Similar conditions are accepted with regard to piers and abutments of bridges, &c.

The conclusions which follow are somewhat novel and of considerable importance. Professor Warren writes:—In all such cases as the foregoing it has been the usual practice to work in accordance with the above condition, for if the line of pressure in a retaining wall, or the line of resistance in an arch passes outside the middle third of the thickness of the arch or wall, as the case may be, it is generally assumed that there will be an insufficient margin of stability, and that the intensity of pressure on the edge nearest the line of pressure may exceed the safe limit, and the edge furthest from the line of pressure will be entirely relieved of pressure. These will undoubtedly be true if the joint in question is incapable of resisting tensile stress. If, however, the adhesive strength of the mortar in the joint is relied upon to resist the tensile stress, which will be developed at the joint by the deviation of the line of pressure from the middle third of the thickness, the distribution of pressure will be considerably modified, and a much thinner wall will be found sufficient.

(To be continued.)

PAPER STOCK AND FIBRES OF BURMA.

WHILST so much energy and capital are being expended in all directions in developing the different industries and resources of Burma, nothing has been done in developing the paper stock and fibre industry of this Province. It is a well-known fact that the country abounds in fibre-producing plants, and at present we will only confine ourselves to those that come daily under our notice, which grow wild throughout the country. We allude to the different species of bamboo, China grass, and pineapple.

Some years back the Reverend E. B. Cross, of the American Baptist Mission at Toonghoo, prepared a quantity of paper stock and fibre from these plants, and sent it to America, where it was manufactured both into a superior kind of cloth, much resembling silk, also paper of different qualities. This idea of his was simply an experiment to shew the Karens the uses to which these common plants can be put, and since which he modelled a loom from the bamboo, whch he instructed them to use; and cloth (though not fine) is now woven by them for their own use.

We do not go so far as to advocate the immediate erection of weaving factories, but an undertaking less expensive, and more profitable, that is, the preparation of paper stock and fibres for export.

The cry from the largest factories in the United Kingdom, Australia and the Continent is the want of a good and cheap substitute for Esparto grass, rags, &c., used in the production of paper. Although enormous quantities of the former are imported to England, and in recent years large quantities of a kind of wood pulp from Norway and Sweden, still the ever-growing demands of paper manufacturers cannot be supplied, and they are at a loss what other material to fall back on. To meet this increasing want, bamboo stands pre-eminently as the best substitute, if properly prepared, of yielding paper fit for any purpose.

Mr. Thos. Routledge, of Ford Paper Works, Durham, the first importer of Esparto, and one of the best authorities on commercial fibres, remarked that the bamboo stands before all other fibre-yielding plants in the manufacture of paper and for spinning purposes. His authority is sufficient to induce a venture in this direction, more especially in a country like this, where it grows in profuse luxuriance and variety in species. It may be seen from the thickness of an ordinary rattan to about 2 feet in circumference (*Bambusa Gigantea*), whose stems are used by the natives as water pails, &c. Without describing its numerous uses, we will only describe its textile and paper stock properties. The only requirement for developing this industry is its preparation to fit it for commerce, the same manner as jute, hemp, &c. It would never answer if the bamboo was dried and sent for export, as besides the bulk, it would be too hard for the purpose, and would incur extra expense by being subjected to the trouble of boiling with high pressure. The best course to fit the bamboo for an article of commerce would be to pick only tender stems, then subject to a treatment of boiling in caustic alkali, after which to wash, tease and dry and pack it into bales ready for export.

The most favorable sites for erecting such factories would be the banks of the Irrawaddy and Salween, as both localities are in easy communication with the interior, as well as the principal seaports. Besides preparing paper stock, the fibre of the plants can also be prepared for spinning purposes. The mode of treatment is very similar to that followed in the preparation of paper stock, care only being taken in the selection of bamboos, those possessing the least knots or largest internodes being best suitable; and such species are common and abundant in Burma. The fibres of bamboo, China grass and pineapple can be similarly treated as jute, and spun so fine that an expert could barely distinguish the product from real silk; besides these fibres possess an advantage over jute, as they require very little chlorine when bleaching, while jute requires a large quantity, and even then, a pure white is not obtainable, without serious deterioration to the strength of the fibre, which is the inevitable consequence where a large quantity of chlorine is used. At the present time large quantities of cloth woven from China grass and bamboo are brought into the Rangoon markets by Chinamen from Bhamo, and although the material is not manufactured with modern looms, still the quality appears so fine as to resemble tussore silk.

While writing on the subject of fibres, we may add, that the cultivation of jute as an experiment undertaken under Government was very successful, but to make it a paying concern, the operations should be carried out on an extensive scale. The local Government in view of encouraging this industry, has offered to purchase from the Karen cultivators of good jute, the produce, and also offer a bonus to the largest cultivator.

This venture, though a novel idea, is well worth the attention of capitalists, and is bound to prove a most remunerative industry.

H. T.

NEW TYPES OF CHEAP ROOFS.

I.

BY W. G. BLIGH, EXECUTIVE ENGINEER, P. W. D.

AN efficient substitute for the use of timber in roofs of buildings has long been felt a crying necessity in this country.

Wood not only decays rapidly under the unfavorable climatic influences to which it is exposed, but its price has risen enormously of late years, so that it is now very much more expensive in this country than in Europe. The price of sawn timber beams of any size varies from Rs. 3-8 to Rs. 4-8 per c. ft. in many parts of the N.-W. P.—a price which is simply ruinous.

With a very few modern exceptions the vast majority of all buildings in India are roofed with wood; as time goes on very extensive renewals have to take place, which become heavier every year. The question of cheap, efficient and permanent roofs is, therefore, a matter of extreme importance, not only to the Government, but also to private firms and house proprietors whose name is legion. In this paper we propose to deal with the subject of cheap roofing for ordinary sized buildings and to give a statement of comparative cost of the different kinds of permanent roofing as compared with each other, and with the obsolete types which through ignorance are still being blindly followed.

The forms of roof at present commonly in use in India consist in the flat terrace roof and the sloping tiled or thatch roof.

The terrace roof is carried by heavy wooden beams, at intervals of 3 to 5 feet, across which burgahs or rafters of small scantling are laid about 12 inches apart, and these again are spanned by tiles or bricks, above which the concrete forming the body of the roof is placed. It forms an excellent clean roof, but it does not last ultimately beyond 40 years. When the timbers begin to decay and sag, leakage is sure to take place. and in addition to these disadvantages it is *very* expensive. The tiled roofs of bungalows are generally formed of light country tiles of small size, laid on grass rolls, which are supported by a bamboo and bullie or cut rafter frame and rough trusses. How rough, anyone may see for themselves whom curiosity or the chase of the wily civet-cat has induced to penetrate the mysterious and gloomy regions above the ceiling cloth. This type of roof is undoubtedly cheap, but it requires constant attention and repairs and renewal of the grass and tiles once every seven or eight years. It is by no means water-tight and from its temporary and inflammable nature is not suited for offices, record-rooms or godowns.

The modern tiled roof, as is seen in all our Government buildings and palatial barracks, consists of Double "Allahabad Tiling," an enormously heavy material, supported on small rafters at intervals of 12 inches, which are supported by the rafters which must be at pretty close intervals. This roofing is very dear and very hot. The spaces in the tiles let in the hot air, and from this reason the upper stories of our barracks are absolutely uninhabitable during part of the year. A roof of this description will probably last longer than any other kind constructed of wood, because the timbers are thoroughly well ventilated; but as regard coolness and comfort it is inferior to the country tiled roof already described. It is cheaper than the terrace roof, provided the walls are *pucca*. A house roof can easily be converted from sloping into terrace. The upper portion of the inner walls become outer as the verandah roof is pitched at a lower level, as is exemplified in Fig. 1, Plate I., by the dotted outline.

As will be shewn later on, when arched roofs are not employed, *kucha* walls protected by plaster can be used with perfect safety.

The substitutes for the old type of flat roof first described are as follows.:—

(1.) Arch or vaulted roofs.
(2.) Rail girders with slabs or jack arches.
(3.) Rolled beams.

The brick vaulted roof is now gradually finding its way into general favor in Government departments, and its universal adoption must be only a matter of time. It has almost every advantage to recommend it—permanency, economy and ease of construction. The best form is the tied segmental arch. The semicircular form has no advantage whatever either in point of economy or appearance. It is sometimes claimed for this form that it requires no tie rods, there being no horizontal thrust at the spring line. This is a delusion, however, the thrust exists right enough at the point of rupture at a height $\frac{h^2}{2c}$ above the spring line, and here it has to be met and deflected by the weight of the splayed backing which has to be carried up solid above this height.

In the case of an unbalanced half-arch, as in Fig. 2, Plate I, the outer wall would have to be made at least 3 feet thick and to batter outwards to carry off the thrust, and ties would be just as necessary as with the segmental form. The point of rupture is at R.

Specimens of this type of roofing may be seen in some of the stations of the E. I. R.

It has nothing to recommend it.

The contraction of air space in the room is greater. The increased length of arching adds to the expense, and the exposure of so large an area of extrados to the weather is a distinct disadvantage. From all this we can see that the semi-circular type can be dismissed as inferior in every respect to the segmental. A segment means, of course, any portion of an arc less than a semicircle, but here we will define it any arc of less magnitude than 120°.

The horizontal thrust of a segmental arch is very closely equal to the (height of half arch *plus* loading, backing, etc.) × cot of tangential angle at springing.

The following table gives the nat. co-tangents of different magnitudes, which is useful for reference:—

Proportional rise.	Magnitudes of arc.	Tangential angle.	Nat. cot.
	120°	60°	·577
$\frac{1}{4}$	108°	54°	·726
$\frac{1}{5}$	88°	44°	1·035
$\frac{1}{6}$	74°	37°	1·327
$\frac{1}{7}$	64°	32°	1·600
	60°	30°	1·7321

The best proportion of rise to span that can be adopted is undoubtedly the quadrant. The horizontal thrust here is almost a minimum, its value being W × ·73; in addition to this the angle of the direction of the thrust with the vertical is less than the angle of friction of brick or stone surfaces, the value of resistance of friction being ·8W against ·73W, ·8 being the co-efficient of friction of building material. Hence there is *no* tendency to detrusion of the skewbacks. This is an important point, as continuous bearing at back of skewbacks, such as iron bands or solid stone skewbacks, to prevent bulging between the ties is rendered quite superfluous. Where the arch acts as a flooring, economy of space is a desideratum, and the rise can be reduced to $\frac{1}{6}$, which, except for very small spans, I consider about the safe limit.

Method of Construction.

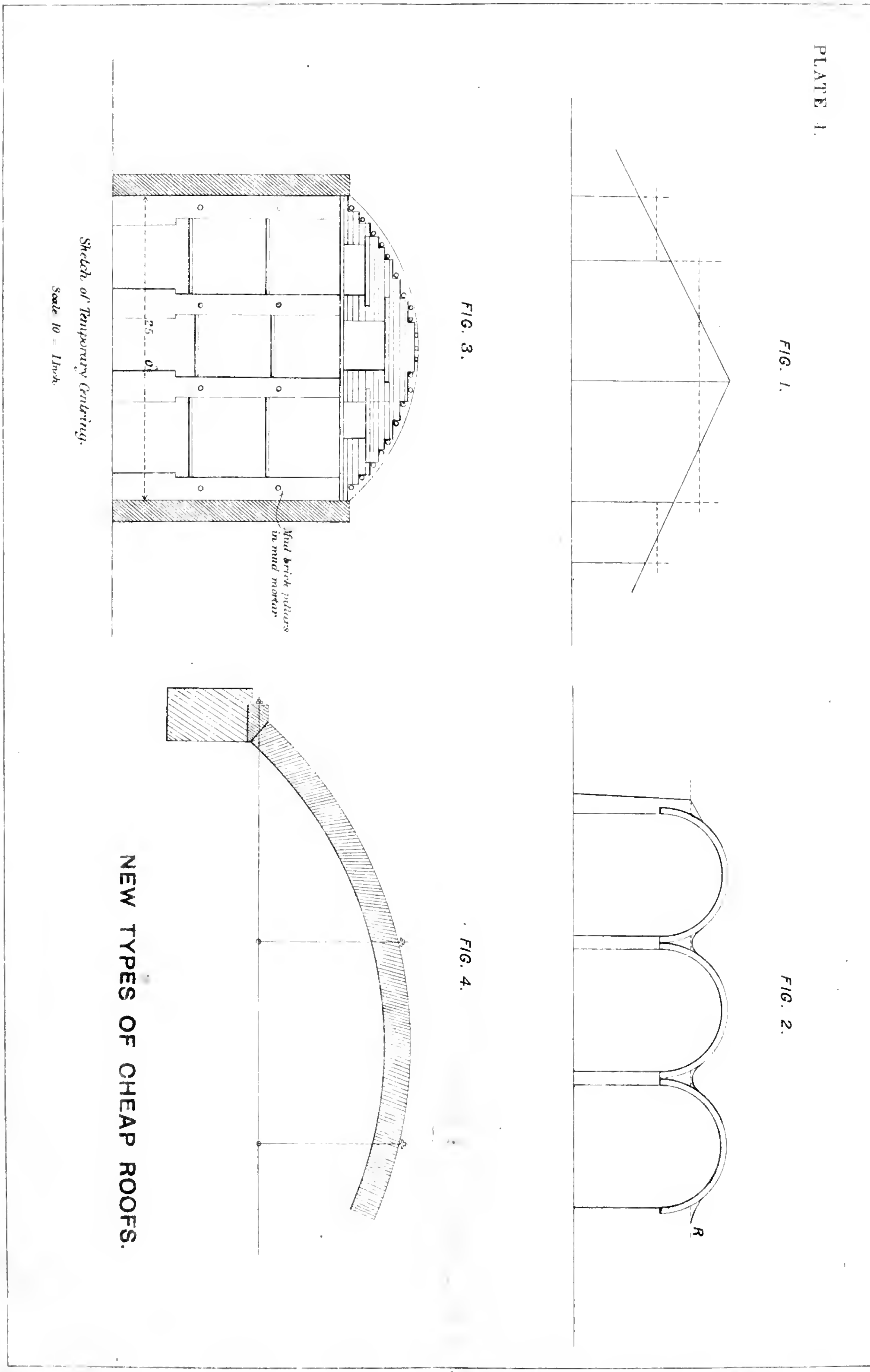
The walls having been constructed up to the spring line of the vault, should be allowed some time for the lime to set. In the meantime the centreing can be proceeded with. In large high spans this forms a considerable item in the cost. The best kind of centreing is a temporary one, formed as follows:—A row of mud brick pillars is built at convenient intervals, and, say, 10 feet apart along the sides of the walls, and opposite to these one or two rows in the centre of the room. These pillars can be constructed of sun-dried brickwork, but must be connected with each other at intervals by bullies built into the work to give lateral stability. Just below the spring of arch stout bullies should be placed across each line of pillars, and on these a thin profile erected of *pucca* brick laid dry 12 inches thick. On the steps on top, which roughly correspond to the curve, longitudinal laggings of bullies are placed connecting each profile continuously. And lastly on these the correct profile is made up by grass, bamboos and mud covered with a thin coating of lime plaster. See Fig. 3, Plate I.

The profiles can be placed about 10 feet apart.

A large quantity of bullies, bamboos, etc., are required for this centreing, which would be useless after the completion of the work.

The best plan, where the work is done departmentally and demolition of old tiled roofs is not available, is to get the bullies on hire and return after completion of the work. Old beams of wood, rails, etc., are very useful for forming the platform on which the profile is built. Prior to constructing the profiles the skewbacks should be built and the tie rods and washers fixed in position, as it often happens that some of them will fall inside the profile. The best position for the ties is through the centre of skewback, as shewn in Fig. 4, Plate I. My practice has always been to end the tie rod within the wall and build it in. There is no object in having the washer and nut exposed outside the wall; in fact, it is a distinct disadvantage. Once the centering is struck the tie rods should never be interfered with.

(To be continued.)



The "STAR" Press, 19, Lall Bazar Street, Calcutta.

NOTES FROM HOME.

(From our own Correspondent.)

In considering the recent Royal Naval Review, *Engineer* thinks that to place four eighty-ton guns on one ship, as is done in the case of the *Inflexible*, is to put too many valuable eggs into one basket, and prefers to see four ships with one of these guns apiece. The mass that the *Inflexible* offers as a target is highly objectionable, and it is considered that there is in the present style of warship too much top hamper and suggests that naval architects should consult a little more with naval men than is at present done. The Nordenfeldt submarine torpedo boat is considered the acme of a fighting craft and it is pointed out that Goverment trials of this ship, which are now being carried out, may result in such changes as to again remodel the whole navy and completely upset the principles upon which our own ships have been heretofore constructed.

The half-yearly meeting of the Railway Companies that have been held shew by a slight increase in the dividend a satisfactory indication of some improvement in the extent of the trade of the country, and it is one which will further beneficially affect trade for the dividends are spread over thousands of investors who again put them into circulation. The cheapness of iron and steel is looked forward to to further reduce expenses and so continue the satisfactory progress so far recorded. In the South Eastern Report statistics are given shewing the growth of third-class traffic over that of the other classes. In 1867 the railway carried 1,915,000 first-class passengers as against 1,176,000 in 1887. In the former year 3,634,000 second-class passengers as against 2,926,000 in 1887. But in the third-class in 1867 there were 12,495,000 as against 22,940,000 in 1887.

On the Brighton Railway a very good result has followed a liberal policy of reducing the fares. A day ticket to Brighton used to be 4*s*., it has now been reduced to 3*s*. on 3 days a week. In three months their numbers have increased from 22,963 to 70,719, and the receipts from £2,307 to £5,331.

Among the list of recent launches and trial trips is to be noticed the steel paddle steamer *Empress*, built for the London, Chatham Dover Railway for their service between Dover and Calais. Against a head sea this ship attained a speed of 21.3 knots per hour. She is 1,200 tons gross register, is 325ft. long by 35ft. by 22ft. to the upper deck. There is a rudder at each end so as to facilitate the movement of the ship in entering and leaving port. The vessel is supplied with a set of compound direct-acting engines. She is fitted with an electric light installation and is in every respect completely equipped.

The *Victoria*, the largest and latest addition to the P. and O. Company, was also recently tried and attained a speed of 17·4 knots an hour. She is a vessel of 6,267 tons, having a capacity of 1,200 tons more than the present largest vessel of the Company's fleet. This ship is said to be the finest ship that has ever left the Clyde. Her trial trip shewed that she can maintain a speed of 15 knots an hour at a consumption of 100 tons of coal per 24 hours, a matter which will ensure economy.

I drew attention in one of my former communications to the destructive action of sea water upon concrete as shewn at the Aberdeen Docks. The method adopted at the sea walls and groins at Hove and Seaford on the Sussex Coast of facing the concrete blocks with flints in Portland cement deserves to be noticed as likely to effectually protect the mass of concrete forming the wall from being got at and injuriously affected by the action of the sea water, and moreover forms an extremely good-looking face work to these important coast defences.

The Congress of the Sanitary Institute of Great Britain is to be held at Bolton from 20th September to 15th October. In connection with the Congress there is to be a Health Exhibition of various objects, which directly or indirectly come under the category of sanitary appliances.

An interesting treatise on cable or rope traction as applied to the working of street or other Railways has just been issued. The author, Mr. B. Smith, gives some details of the working of this system in San Francisco, in Chicago and in New York. In the case of the two last, which are taken as representative cities, the cost is given as about half that of horse traction. This system is to be tried in the new subway under the Thames. Opinions differ widely as to the advisability of adopting that plan, as it is by some urged that as the tunnel is to be lighted with electricity, electricity would be the readiest motive power. The work of Mr. Smith gives some valuable information on wire rope, the manufacture of which has made such rapid strides in recent years.

The ruinous conditions which have for the past years played such havoc with the fortunes of two of our principal Dock Companies—the East and West India and the St. Katherine—has led to a proposal for an amalgamation of the two concerns, and a Committee drawn from the respective Boards is now engaged on its terms, and it may be hoped will bring it to a happy issue.

At the annual meeting of the Panama Canal Company, held in Paris, last week, M. Lesseps said that the works would be modified to enable the project to be completed in 1889. With reference to the recent issue of capital brings the liabilities of the Company to 73 millions sterling. A third series of this class of new obligations is not indistinctly intimated as required for next year bringing the capital to 91 millions sterling.

Mr. W. Richard Stevens, Solicitor, succeeds the late Mr. Shaw as Secretary of the South-Eastern Railway; as at present arranged, Mr. Stevens will combine the two offices of "Solicitor" and "Secretary."

NOTES FROM CEYLON.

(From our own Correspondent.)

Failure of Concrete Docks.—A matter of the highest importance and interest to all connected with the construction and management of harbors has been brought to light in Aberdeen. Two years since the Aberdeen Harbour Commissioners opened a graving dock. The dock was formed of Portland cement concrete, the steps being lined with granite ashlar. A few months ago it was noticed that the concrete entrance walls, which are not lined with granite, had become swollen and that cracks had made their appearance to the surface. An investigation as to the cause was at once made, and Mr. Smith, the Harbor Engineer, suspecting that chemical action was inducing the mischief, conferred with that eminent analyst of Chemistry in Aberdeen University, Professor Brazier, who analysed briquettes of the Portland cement used in the construction of the dock, and also samples of the concrete taken from its walls, with the result that the action of the sea water on the cement itself, as well as on the concrete, caused an expansion and softening of the cement, in consequence of the deposit of magnesia from the sea water, and also led to the formation of carbonate of lime by the union of the carbonic acid contained in the sea water with the lime in the cement. At Aberdeen there is a breakwater of nearly 1,000 feet composed entirely of concrete, which since its construction 15 years ago has required patching in various ways; but the idea that chemical action was at work never occurred to the Engineer until now. Let us hope science will also come to our aid and find out a paint or substance which will counteract this tendency.

Here is rather a curiosity in the way of a *Gazette*, it would certainly be hard to tell what permanent appointment each held.

Survey Department.—The following acting appointments have been sanctioned consequent on the leave of absence granted to Mr. D. G. Mantell:—Mr. J. H. Grinlinton, acting 3rd Chief Surveyor to be acting 2nd, *vice* D. G. Mantell; Mr. H. L. Ward, acting 4th to be acting 3rd, *vice* Grinlinton; Mr. S. J. More, acting 5th to be acting 4th, *vice* Ward; Mr. C. H. Allen, acting 2nd District Surveyor to be acting 5th Chief Surveyor, *vice* More; Mr. C. C. M. Tyers, acting 3rd District Surveyor to be acting 2nd, *vice* Allen; Mr. W. H. Thornton, acting 4th District Surveyor to be acting 3rd, *vice* Tyers; Mr. J. Snowden, acting 5th to be acting 4th, *vice* Thernton; Mr. J. L. Hampton, acting 6th to be acting 5th, *vice* Snowden; Mr. H. P. Lovering, acting 7th to be acting 6th, *vice* Hampton; Mr. R. B. Campbell acting

8th	to be	acting	7th,	*Vice*	Lovering;	Mr.	J. W. Viner	acting
9th	,,	,,	8th	,,	Campbell;	,,	J. W. B. Campbell	,,
10th	,,	,,	9th	,,	Viner;	,,	H. Erskine	,,
12th	,,	,,	10th	,,	Campbell;	,,	G. Waddell	,,
13th	,,	,,	12th	,,	Erskine;	,,	T. M. Mantell	,,

14th District Surveyor to be acting 13th, *vice* Waddell.

Mr. A. E. Maddock, acting Assistant Surveyor on Rs. 8·75 per diem to be acting 14th District Surveyor, *vice* Mantell.

(To be continued.)

BURMA.

(From our own Correspondent.)

Coal refuse, or small coal has now turned out a profitable item of fuel. It is in the recollection of all that small coal was at one time a source of nuisance to the proprietors of collieries, but with this progressive age all things are turned to a beneficial account. Small coals are largely imported to this Province, and we now find all the steam mill owners, the Flotilla Co., the local Railways and Tramways using this cheap fuel. The small coals are compressed into cakes before importation, and its use has been greatly enhanced, not only on account of the low price it commands, but the limited bulk it takes in storage in steamships, where space is limited, also in tenders attached to locomotives. This is certainly a good idea, and will add considerably to economise steam fuel in motive power.

We note that many inventions have lately been tried on the local State Railway, in locomotives, couplings, signals, &c.; but nothing has yet been done to improve the permanent way, which is the basis of railway construction, and on which economy and safety rests. We have frequently seen rails distended or contracted on lines, which are the principal causes of loose nuts and displacements of keys. To remedy this evil the local Tramway Co., in constructing their new lines, use a lock washer and safety railway key, which effectually prevents these evils. This ingenious appliance consists of a simple disc of metal, with a projection, which forms the key. It embeds itself into the surface of the wood or material used, the washer being secured in position by the key, and by screwing the nut it becomes locked, and all that is necessary to lock the nut is to bend over the edge of the washer against one of its sides. When it is thus secured, it has been found that vibration causes no displacements.

The safety rail key is a piece of steel which forms a sheathing to the key, protecting the head when being driven in, thus providing a better driving surface. The end of the liner is bent over the inner side of the chair, and by this means the durability of the wooden key is increased; it also provides for expansion and contraction and all tendencies to become loose through vibration. The makers of this ingenious appliance is Messrs. Merryweather & Co. It is claimed that the use of this lock washer and safety railway key reduces disrailment and other accidents to a minimum, and materially effects the economy in line construction.

The local Tramway Company, in view of extending their undertakings, has deputed Mr. H. Bateman, their Chief Engineer, to proceed to Mandalay, for the purpose of selecting routes for the laying down of a Steam Tramway in that city. Materials and locomotives have also been indented for.

Mr. F. Oliver, a Railway Contractor, is now making extensive purchases of pingadoe sleepers for the S. I. Railway and extension lines. We may remark that railway sleepers are now at a premium; in fact, with the large quantity taken up by Government for the Tounghoo-Mandalay line, Burma can ill afford to spare this valuable timber for export.

Archæology.—An elaborate report of the researches of the Government Archæologist, Burma, is now in the press, and contains some illustrated plates and photos. The report is based mainly on the inspection of the Arracan Division and Tounghoo District. From the compilation we gather that in the Arracan Division the most important sites of ancient cities and temples on the Kaladan, Lumru and Mayu rivers, also Myohaung, the capital of Arracan kings for several centuries, have been inspected. Numerous pagodas and buildings were found exhibiting a curious admixture of Hindu and Burmese architecture and sculpture. Several pagodas and structures of unique design were inspected, they are partly temples and partly fortifications, serving as places of refuge during times of war; most intricate labyrinthian passages lead through the massive stone work of the building to spacious halls. Very extensive network of stone walls, moats and embankments is still preserved. Nearly all the structures are built of massive stone blocks, the exterior being cut into ornamental designs, shewing that both Indian and Burmese have joined in architecture. Peculiar to these designs are the variously colored tablets, red, blue, yellow and white, set into the stones in the shape of single banyan leaves or arranged as rosettes, ancient roughly cut rock sculptures being numerous along the base of the hills. Shrines covered on the outside with exquisite decorative designs are also found in a preserved state.

In Tounghoo it would appear that few remains of importance exist. All the structures found are of the ordinary style, the materials used being either of brick or wood, ornamental architecture being very poorly developed. The absence of higher types of architectural designs is attributed to the country having been in constant warfare with their neighbours. All that now remains of ancient ruins being mere heaps of bricks.

The Moulmein Municipality has so far satisfied themselves with the experiments conducted by the Agent of Sinclair's Duchess of Edinburgh combined chemical and manual fire-engine, that it has been decided at the last meeting to purchase one of these engines. Its merits, though recognised in Rangoon as a fire-engine for small fires, did not satisfy the Rangoon City Fathers.

NOTES FROM BANGALORE.

(From a Correspondent.)

An old friend, (not yet in his dotage,) has told me, that when writing a letter, the first theme to touch upon is the weather, as this places one on a friendly footing and all goes smoothly after. It is not a bad one for a Bangalorian to begin with, for we have the advantage of you Presidency-Town-folks here. We are *always* nice weather people. Mind, I do not say *good*, but *nice*—the latter has a sort of Wellerian tenderness which suits me and my surroundings. Just now we are very nice—rain, but not too much; sunshine, but not too much; zephyrs just a few, and hot and cold as kindly blended, so that such an atmosphere suits a poetical mind. Any poets in your midst, Mr. Editor? Send them here.

Our gardens, rural, domestic, and public, are teeming with flowers of every hue and variety. Vegetables and fruit are "first-class," as our worthy Superintendent of the Lal Bagh can testify. He, by the way, is surpassing himself in all the beauties he is laying out there. One really feels too good for this world when viewing his floral and botanical wonders. If that young lion there did not give an occasional roar, as he does, we could never return to everyday life after a visit to the Lal Bagh.

Municipal Commissioners are energetic everywhere, but whose more so than ours. They have just completed for us a nice shady walk along the Lake, which, unlike the Owl and the Waverly pen, is a boon both to *ladies* and "men." This boon is known as Kensington Park, and would be a nice spot for a Jubilee statue. If your Madras Correspondent still thinks sea-air will not agree with Her Majesty, and if he sees any alarming results in Her in consequence, please tell him to communicate with us, and arrangements could be made to use Kensington Park as a sanitarium. Arriving at the Lake as we have done, makes one think of our water-works scheme, which is still only such

A little scheme it was to them,
A scheme, and nothing more.

I mention it in a Pickwickian sense, but I must say our air is too poetical and not sufficiently engineerical. See Madras and its Harbor Works. What a scheme *that* is! It cuts into one sometimes I assure you; but we are hopeful, and when of that persuasion cannot be far wrong. Perhaps its advantages could be ruminated upon with advantage to this Correspenpent, but minutes fly, and the post runs, so it must be left to solitude.

Au Revoir.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Punjab, August 25, 1887.

With reference to Government of India, Public Works Department, Resolution dated 25th July 1887, His Honor the Lieutenant-Governor is pleased to notify the grant of furlough to Captain H. E. S. Abbott, R.E., Executive Engineer, from the 27th August 1886, the date from which that officer elected continuous Indian Service.

Irrigation Branch.

Mr. W. J. Greer, Executive Engineer, 4th grade, sub. *pro tem.*, from the 2nd Division, Bari Doab Canal, which he left on the afternoon of the 10th August 1887, to the office of Joint Secretary to Government, Punjab, Irrigation Branch, on special duty, which he joined on the afternoon of the 11th August 1887.

Mr. E. S. Bellasis, Executive Engineer, 3rd grade, from the Delhi Division, Western Jumna Canal, which he left on the afternoon of the 24th July 1887, to the 5th Division, Sirhind Canal, which he joined on the forenoon of the 26th July 1887, and took over executive charge from Major S. L. Jacob, R.E., on the afternoon of the 27th July 1887.

Major S. L. Jacob, R.E., Executive Engineer, 1st grade, from the 5th Division, Sirhind Canal, which he left on the afternoon of the 27th July 1887, to the office of Superintending Engineer, Bari Doab Circle, which he joined on the forenoon of the 28th July 1887, and of which he took over charge from Major J. W. Ottley, R.E., on the afternoon of the same date.

N.-W. P. and Oudh, August 27, 1887.

Irrigation Branch.

Mr. G. Wylie, Assistant Engineer, 1st grade, Etawah Division, Lower Ganges Canal, passed the Lower Standard Examination in Hindustani on the 4th July 1887.

Madras, August 23, 1887.

With reference to notification published in the *Gazette of India* of the 28th May 1887, Colonel K. A. Jopp, R.E., Deputy Consulting Engineer for Railways, is appointed *ex-officio* Under-Secretary to Government, Public Works Department, Railway Branch.

The following transfers are ordered :—

Mr. H. S. Taylor, Executive Engineer, 3rd grade, sub. *pro tem.*, from the West Coast Division to the VI. Circle, for charge of the Periyar Project.—To join forthwith at the public expense, and to report to the Superintending Engineer, VI. Circle, at Madura.

Mr. F. J. Wilson, Executive, Engineer, 4th grade, temporary rank, from the Buckingham Canal Division to the IV. Circle, for charge of the West Coast Division.—To join at the public expense, on return from privilege leave.

Mr. C. H. B. Burlton, Executive Engineer, 4th grade, from the Kistna Eastern Division to the V. Circle, for charge of the Chingleput Division.—To join at the public expense, on the expiration of his privilege leave.

Mr. A. M. Foord, Executive Engineer, 4th grade, temporary rank, from the Tanjore Division to the V. Circle, for duty in the Chingleput Division.—To join forthwith at the public expense, and to hold charge of the division until Mr. C. H. B. Burlton's return from leave.

Mr. J. D. Grant, Executive Engineer, 1st grade, sub. *pro tem.*, is granted furlough for two years from 1st September 1887, under section 50 of the Civil Leave Code.

Mysore, August 20, 1887.

Mr. D. Ranga Rao, Assistant Engineer, officiated as Executive Engineer of the Hassan Division, from the 2nd May to 1st July 1887 inclusive.

India, August 27, 1887.

The services of Lieutenant O. M. R. Thackwell, R.E., Assistant Engineer, 1st grade, sub. *pro tem.*, State Railways, are, on his return from leave, temporarily placed at the disposal of the Military Department for employment in the Military Works Department.

The reversion of Mr. P. P. Rogers from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, State Railways, with effect from the 14th December 1886, as ordered in Public Works Department Notification dated 11th April 1887, is cancelled.

The Governor-General in Council is pleased to order the following promotions and reversions of Executive and Assistant Engineers attached to State Railways, with effect from the dates specified :

Mr. E. H. Hallum, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, permanent rank, with effect from 1st January 1887.

Mr. B. Baxter, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 1st January 1887.

Mr. H. Luckstedt, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 1st January 1887.

Sheodyal, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st January 1887.

Captain J. Burn-Murdoch, R.E., Assistant Engineer, 1st grade, and Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 1st January 1887.

Mr. H. Phillips, Assistant Engineer, 1st grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, permanent rank, with effect from 1st January 1887.

Sheodyal, Assistant Engineer, 1st grade, and Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 1st January 1887.

Mr. C. S. Killick, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent rank, with effect from 1st January 1887.

Mr. W. E. Newham, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 12th January 1887.

Mr. W. B. Taylor, Executive Engineer, 1st grade, sub. *pro tem.*, to be Executive Engineer, 1st grade, permanent rank, with effect from 19th February 1887.

Mr. P. P. Dease, Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 2nd grade, permanent rank, with effect from 19th February 1887.

Mr. J. M. Salmond, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 19th February 1887.

Mr. W. C. L. Floyd, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 19th February 1887.

Captain W. Pitt, R.E., Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 19th February 1887.

Captain W. V. Constable, R.E., Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 19th February 1887.

Mr. R. W. L. Toozs, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 19th February 1887.

Mr. E. E. A. Kuster, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 20th February 1887.

Mr. H. W. Bennett, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 22nd February 1887.

Captain W. V. Constable, R.E., Assistant Engineer, 1st grade, and Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 25th February 1887.

Mr. H. G. F. Smith, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 25th February 1887.

Mr. E. H. Tuck, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 27th February 1887.

Mr. H. G. S. Savory, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 6th March 1887.

Mr. R. E. Wright, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 22nd March 1887.

Mr. P. W. Dangerfield, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 22nd March 1887.

Mr. D. Morris, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 22nd March 1887.

Captain R. C. Maxwell, R.E., Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 22nd March 1887.

Mr. H. T. Gwyther, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 22nd March 1887.

Mr. C. J. Cole, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 22nd March 1887.

Mr. C. E. C. Montressor, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 22nd March 1887.

Mr. J. F. H. Collet, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 27th March 1887.

Mr. E. L. Hunt, Executive Engineer, 1st grade, sub. *pro tem.* to be Executive Engineer, 1st grade, permanent rank, with effect from 28th March 1887.

Mr. W. A. Lesmond, Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 2nd grade, permanent rank, with effect from 28th March 1887.

Mr. J. L. P. Hogan, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 28th March 1887.

Captain R. C. Maxwell, R.E., Assistant Engineer, 1st grade, and Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 28th March 1887.

Mr. W. G. Gilchrist, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 28th March 1887.

Mr. F. H. W. Morse, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 28th March 1887.

Mr. W. McHutchin, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 28th March 1887.

Mr. E. F. Gordon, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 28th March 1887.

Mr. E. J. Alexander, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 1st April 1887.

Mr. J. Manson, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 5th April 1887.

Mr. W. R. Shaw, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 7th April 1887.

Mr. G. Mills, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 11th April 1887.

Mr. R. C. Dyson, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 12th April 1887.

Mr. J. N. D. LaTouche, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 28th April 1887.

Mr. F. R. Bagley, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 29th April 1887.

Mr. M. J. Chabrel, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 29th April 1887.

Mr. R. L. Campbell, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 29th April 1887.

Mr. G. Deuchars, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 29th April 1887.

Mr. H. B. Taylor, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 9th May 1887.

Mr. W. G. Gilchrist, Executive Engineer, 1st grade, sub. *pro tem.*, to be Executive Engineer, 2nd grade, with effect from 26th May 1887.

Mr. F. R. Bagley, Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, with effect from 26th May 1887.

Mr. M. J. Chabrel, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 26th May 1887.

Mr. R. L. Campbell, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, temporary rank, with effect from 26th May 1887.

Mr. M. J. Chabrel, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 3rd June 1887.

Mr. R. L. Campbell, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 3rd June 1887.

Mr. R. W. Roberts, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 10th June 1887.

Mr. W. H. Cole, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 10th June 1887.

Mr. F. Reilly, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 10th June 1887.

Mr. E. H. Clementson, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 10th June 1887.

Mr. R. T. Mallet, Chief Engineer, 2nd class, temporary rank, State Railways, is temporarily attached to the Office of the Director-General of Railways, with effect from the 11th August 1887.

Military Works Department.

The following appointments are made to the Engineer Establishment of the Military Works Department, with effect from the dates specified :

Lieutenant M. L. Tuke, R.E., to be an Assistant Engineer, 2nd grade, sub. *pro tem.* Dated 15th March 1887.

Lieutenant H. V. Biggs to be an Assistant Engineer, 2nd grade, permanent. Dated 30th June 1887.

Baluchistan.

Mr. H. Humfress, Assistant Engineer, 2nd grade, transferred temporarily to Baluchistan, is posted to the 2nd Division, Frontier Road.

Consulting Engineer's Branch.

Mr. W. D. Barrow, Assistant Engineer, 1st grade, attached to the Indian Midland Railway, is granted six months' special leave on urgent private affairs.

Director-General of Railways.

Mr. G. T. St. A. Nixon, Assistant Engineer, 1st grade, is transferred, in the interests of the public service, from the Sind-Pishin State Railway to the Tounghoo-Mandalay Extension of the Burma State Railway.

The undermentioned officers have been granted by Her Majesty's Secretary of State for India leave on medical certificate for the periods specified opposite their names in extension of the furlough previously granted them:—

Mr. P. H. Cresswell, Assistant Engineer, 1st grade,—extraordinary leave for six months.

Mr. H. L. Butcher, Assistant Engineer, 1st grade,—leave for two months.

Bengal, August 31, 1887.

Establishment—Railway.

Mr. J. C. Mills, Assistant Engineer, 1st grade, Assam-Behar State Railway, is granted three months' privilege leave, with effect from the forenoon of the 14th August 1887.

Mr. B. Baxter, Executive Engineer, 3rd grade, Assam-Behar State Railway, is granted privilege leave for one month and 20 days, with effect from the 20th August 1887, or such subsequent date as he may be allowed to avail himself of the same.

Central Provinces, August 27, 1887.

Rao Sahib Ishwari Pershad, Assistant Engineer, attached to the North-West Road Sub-Division, is granted two months' privilege leave, from such date as he may avail himself of it.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 22nd August 1887.

194 of '86.—John Joseph Reveley Humes, of 18, Lilford Road, Camberwell, in the County of Surrey, England, Engineer.—*For improvements in Hydrocarburetted Air Engines.*

10 of '87.—James Alfred Campbell Rogers, Civil Engineer, Cawnpore.—*For an improved Sugarcane Crushing Mill to be called the "Rajah."*

38 of '87.—Henry Hamilton Remfry, of 5, Fancy Lane, Calcutta, Solicitor and Patent Agent.—*For improvements in freezing and refrigerating machines.*

78 of '87.—Armand Flamache and Emile Picard, both of Brussels, in the Kingdom of Belgium, Engineers.—*For improvements in or appertaining to lock-nuts.*

87 of '87.—Charles Auguste Paillard, Manufacturer, of 27, Rue Kléberg, in the City of Geneva, Switzerland.—*For improvements in the manufacture of compensation balance wheels for watches and chronometers.*

109½ of '87.—Edward William Serrell, Junior, of the City, County and State of New York, United States, temporarily residing in Chabeuil, in the Department of the Drôme, in France.—*For an improved process and apparatus for preparing silk cocoons for reeling.*

110 of '87.—Frank Albert Smith, Gentleman, residing at Steelton, in the County of Dauphin and State of Pennsylvania, one of the United States of America.—*For improvements in Domestic Refrigerators and apparatus for the manufacture of Ice.*

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong. Shanghai*, and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 10, 1887.

THE CALCUTTA CEMETERIES.

IT is satisfactory to learn that the Committee appointed to enquire into the question of the extension of Christian cemeteries in Calcutta has closed its labors, and the knotty subject of the disposal of the dead, which has exercised the public mind of the Metropolis for some time past, is in a fair way of being satisfactorily settled. The appointment of the Committee, as some of our readers are probably aware, is the result of a representation made by the City Burial Board in the beginning of the present year. It was urged that the portion of the land remaining untenanted in the Circular Road Cemetery would be filled up at no distant date, and then the point would arise what was to be done in regard to the future requirements of a large body of Christians of all denominations in Calcutta. Several alternative proposals were put forward and considered, but it was ultimately recommended to extend the Circular Road Cemetery so as to provide ground for not less than 20 years' use at an estimated cost of six lakhs of rupees.

The deliberations of the Committee extending over six sittings, have been published. It appears that the average annual number of *pucca* graves at present is 60, and of *cutcha* graves 500, including pauper burials at 200. After carefully examining the vacant area in the cemetery the Commitee have come to the conclusion that the land reserved for Catholics and Dissenters is, beyond doubt, sufficient for many years to come. The space allotted to members of the Church of England is 64,000 square feet, and may be presumed to suffice for a considerable period. It is estimated that an area of 48,000 square feet is sufficient for 300 *cutcha* graves, and an area of 9,000 square feet for 50 *pucka* graves; there remains, therefore, 7,000 square feet which will be available for additional paths if necessary, and for other purposes. Besides the above, further available space will be secured, for by a recent ruling of the Burial Board, a *cutcha* grave may be re-used after a period of ten years has elapsed, and the older ground of the cemetery will be augmented, in the course of four or five years, by a space of 15,000 square feet for *cutcha* graves.

It has also been resolved to economise the unused portion of the cemetery. There is a tank from which water is drawn for garden purposes. This, the Committee recommends, should be filled up by earth brought from the Kidderpore Docks, where excavation is going on; there will be thus an increase of about 8,300 square feet of land, while water will be provided for the garden by sinking Norton's tube wells, or, if possible, from Municipal hydrants.

Although these facilities exist yet it will be necessary to take up more land. The most convenient course would be to act on the suggestion of the Burial Board and acquire land eastwards and southwards of the existing cemetery. But here a difficulty presents itself. In order to acquire an additional area of 57 bigahs it will cost six lakhs of rupees, whereas, by excluding the Kurrya Bazar and Bunniapookur frontages, which are valuable properties, an area of about 30 bigahs of land to the east of the cemetery might be acquired at a cost of Rs. 2,40,000.

But as this even appears to be an extravagant price to be paid, the members of the Committee examined several sites about Kurrya and Tiljulla and eventually fixed upon a spot in the latter place known as Kossye Bazar. The corner of this spot is about 400 yards distant from the Circular Road Cemetery, and the land can be had at the moderate figure of Rs. 40 a cottah. It is at present in a thoroughly insanitary condition, and its reclamation and drainage would confer a great benefit on all concerned.

The next point submitted for the consideration of the Committee is the possibility of economising space by adopting an arrangement of graves different from that which has hitherto been in use. On this score it recommends the introduction of a system of terrace-graves or graves in blocks. This will not only effect economy in space, but will have the advantage of securing a firm foundation for monuments which is not provided by the present arrangement of isolated graves. In order to construct them economically all the cells in a block should be of one uniform size, and the different sizes of cells will have to be provided on some such scale as the following :—

No. I.	For infants	... 3/½′ by 1/½′
No. II.	For children	... 5′ by 1′10″
No. III.	For adults	... 6/½′ by 2′
No. IV.	For adults (extra size)	7/½′ by 2/½′

An average number of about 20 graves should be included in each block: the blocks would be separated by narrow paths where none exist at present. As regards construction, a bed of concrete, 9 or 12 inches thick and projecting 9 or 12 inches beyond the enclosing walls, would carry the walls, of which the outer ones in each case would be two bricks or 20 inches thick. The size of the cells would be subdivided to suit the requirements of single interments and those for family use. Anyone wishing to make provision for a large family might hold one vault in his name for a certain fixed period. The Committee, moreover, propose that the land required for the full period should be taken up at once instead of piecemeal as exigencies arise.

The block system will effect a real saving of space in regard to *pucca* graves, which, under those conditions, will require a superficial space of 36 feet for one grave. At the rate of 60 annual interments in these masonry graves the space required in one year will be 2,160 square feet, and in fifty years, 108,000 square feet; but even allowing an average of 80 burials every year the area required will be only 144,000 square feet.

Following the calculation in regard to *cutcha* graves, the space for each being 32 square feet, at the rate of 600 interments per year, the space required for seven years will be 134,000 square feet, with the additional space afforded of each grave being re-used after 10 years.

The total space required for graves of all descriptions will be 278,400 square feet, leaving out the space for paths, drains, enclosure walls, gates, chapels, &c.

The probable cost of the whole scheme will be about Rs. 2,10,000.

The last question for the consideration of the Committee is how to provide funds for carrying into effect this necessary extension. After examining closely the present rates, and the rates imposed at Bombay, the members have arrived at the conclusion that the rates on masonry graves should be largely increased. If the scale suggested by them is accepted there will be a clear annual income to Government of Rs. 9,000. Now, as the current annual expenditure placed at the disposal of the Board is Rs. 8,000, the above amount leaves a sum of Rs. 1,000 per year as surplus to Government. At first sight it seems to be quite inadequate a return on Rs. 2,10,000 which is required to complete the arrangement. But further reflection will show that the yearly grant of Rs. 4,000 to the Board will be saved to Government and Rs. 1,000 gained, and the total of Rs. 5,000 a year added to the income from the surplus land must be regarded as the interest on the outlay, "a financial position," as the Committee remarks, "very much more satisfactory than that which now exists, or has hitherto been contemplated as probable."

PERAK.

I.

WE have been favored with a copy of the Annual Report on the State of Perak for the year 1886 which in every way is an improvement on its predecessor. Sir Hugh Low, H. B. M.'s Resident, Perak, has made the report as interesting and instructive as circumstances would permit, as it deals with most of the subjects of interest in connection with the State in a manner which leaves nothing to be desired.

The financial and trade results of the year 1886 shew steady progress which with the extension of a system of roads and facilities of transport may be expected to increase.

The revenue from all sources amounted to $1,688,276 being an increase of $28,062 on an estimate of $1,660,214 and an excess of $166,191 on the revenue collected in 1885.

The receipts under all heads, except four, exceeded the estimates framed in the previous year—the deficit on "Customs" which occurred entirely in Larut being abnormally high. The land revenue, which shews real progress and promises further substantial improvement, amounted to $73,148-31 or an increase of $11,644-00 over the preceding year.

The total outturn of metallic tin from the various districts of the State in the 5 years ending with the year under notice, amounted to *pikuls* 986,255 shewing an over production in 1886 of *pikuls* 22,024 as compared with 1885.

The total expenditure of the State amounted to $1,465,325 as against a forecast of $1,660,669, exhibiting a saving of $195,343 and an increase of $148,699 on the expenditure of the year with which comparison is instituted. The savings appear under the heads "Hospital," "Establishment," "Transport," "Revenue Services," "Works and Buildings" and "Specials."

On the 1st of January 1887 the "Assets" over "Liabilities" had increased to $731,195 from $535,538 and it was contemplated to invest the sum of $250,000 from the cash balances in securities of the Government of India.

The value of the Export Trade of the State figured $8,674,031 being an increase of value as compared with 1885 of $2,183,085 of which $126,813 are credited to *specie* and $1,772,813 to *tin* of which there was an increased export of *pikuls* 22,022 as before mentioned. The value of Imports of the year under notice fell short of that of 1885 by $157,003, the decrease occurring entirely in Larut.

The prices obtained remained high during the year partly owing to diminished production in other countries and partly due to low price of silver.

Under the head of "Public Works" we find the expenditure on Works and Buildings amounted to $224,228. The works which absorbed this amount consisted of the addition of a European Ward to the General Hospital in Larut; a ward for females (in progress); a brick and tile house for the Resident Surgeon at Yeng Wah Hospital; two wards added to the hospital; two waiting rooms and a small ward for lunatics. The block of solitary cells at the jail, over the building of which since 1884 two contractors failed, cost $34,623-45. Besides these there were completed a house for the Treasurer, a building for the Head-Quarters Staff of the 1st Perak Sikhs, extension of the market equal to its original size at a cost $11,000; centre part of the building for the Perak Museum, the "Cottage" built at an elevation of about 4,500 ft. for the accommodation of the Resident and several other minor buildings. The water-works generally were kept in good repairs and supply extended to the Railway yard, Thaiping, and the Yeng Wah hospital. The drainage was maintained at a cost of $13,275 in addition to an expenditure incurred in 1885 and 1884 of $26,366. All these works were efficiently controlled by the District Engineer Mr. G. A. Lefroy to whom great credit is due for the economical administration of his department and the superiority of work done. Convict labor formed an important feature in the construction of works of public utility and the utilization of such labor has had advantageous results. All contracts for Public Works and Roads are made by the local Magistrate whose only assistant is an Inspector of the works belonging to the Public Works Department on a salary of $100 and the work is said to have been done at a moderate cost.

Roads, Streets and Bridges were kept up and constructed at a cost of $313,886. The road through the pass which divides Perak, Larut from the valley of Perak River was completed by Mr. Ward and the Corps of Ceylon Pioneers at a cost of $34,732. The establishment of this intercommunication has considerably facilitated access to the mining districts above Kwala Kangsa and given an impetus to trade generally thereby increasing the revenue of the country. The extension of the road from Kamunting to Sungei-Ara, which is supposed to form the best line of country for a cart road into Patani, passing through Selama and the Upper Krian, cost $35,000. At Kwala Kangsa an expenditure of $13,486 was incurred in the extension, 2½ miles, beyond Salak of the cart road from Enggor *via* Salak to Ipoh on the Kinta River. In this town (K. Kangsa) one mile of streets were metalled at a cost of $4,870 with hard gravel and 71 chains of new streets laid out barrelled to receive metal at a cost of $1,345. The bridle road in lower Perak constituting the main trunk through this district from Tapah to Tanjong Malim in Bernam, 54 miles, absorbed $45,946. Another like road 22 miles from Teluk Anson to join the main road at Tapah, cost $11,895. The main trunk road from Kinta Gap to Papan was completed at an outlay of $11,915 and several other roads of minor importance help to make up the expenditure quoted above.

The total Receipts from Railway under several subheads amounted to $55,157, the maintenance costing $36,794 leaving a balance of $18,363. The returns on the capital expended in the construction of the Railway and purchase of rolling stock are a little over 5%, but the capital account has not yet been made up in a trustworthy manner. The charges for freight are ridiculously low,—a box of opium worth $1,000 being carried for 4 cents! During the year one new Engine, six 3rd class carriages and ten high sided wagons were added to the existing rolling stock and there appeared room for more carriages and wagons. No serious accidents or breakdowns occurred and the road was efficiently maintained throughout the year. The State sustained a great loss in February last by the death of the late Resident Engineer and Traffic Manager, Mr. Jones, whose duties have since been satisfactorily performed by Mr. G. A. Lefroy, Larut District Engineer in addition to those of his own office.

ABOUT THE TRADE RESOURCES OF THE CHUTIA-NAGPUR DIVISION, AND THE NEW RAILWAY.

FIVE years ago, when Mr. H. H. Risley was Assistant Commissioner of Manbhum, he put together a Note on the trade of Chutia-Nagpur, which has been printed in the last Government of India *Gazette*, in connection with the proposed Benares-Puri Railway, and now lies before us.

This Note is in a broad economic sense exhaustive; and we incline to trust to its conclusions to a great extent, if only because Mr. Risley is no bigoted statistic-monger, but willing enough to admit that his evidently carefully considered marshalling of facts and inferences is not an infallible pronunciamento, but only a guessing at truth. Good guessing, we venture to believe; result of careful enquiry, comparisons, codification. He is of opinion that the Railway through Manbhum and Singbhum may count upon carrying the surplus produce of those districts, of a great part of Lohardugga, and of that portion of Hazaribagh which exports by way of Gola and Chasnanda or Jhalda. To the east of Ranchi it ought also, he thinks, to absorb the whole trade of the country, except that of the extreme eastern border of Manbhum district. It is written "I say *ought* to absorb advisedly, because great allowance must be made for the strong attraction of Raniganj, and for the time required for an important trade centre to establish itself on the new line. Until such a centre springs up, the experience of Barakar teaches us that a large proportion of the traffic with Bengal will run direct to or from Raniganj, even though it has to cross the new Railway to reach its consignees."

The Chutia-Nagpur Division, through which the new Railway will run, is rich in mineral wealth. Over the whole of its area coal bearing shales and sandstones abound. There are numerous iron and mica mines which have been worked unintelligently by natives, on primitive native methods, and which might be worked with profit by Europeans. Copper is found in Singbhum, and lead containing a large proportion of silver has been met with in Hazaribagh and Manbhum. So have tin and antimony. Gold is washed in small quantities from the sands of the rivers Suburarekha and Sunkh in Lohardugga, and the Ib and Brahmani in the State of Gangpur. Good building stone is found in many places throughout the Division.

Mr. Risley gives the following list of the chief exports of Chutia-Nagpur :—

Rice—
Indian-corn—chiefly from Manbhum.
Wheat—from Hazaribagh.
Pulses.—Mung (Phaseolus Mungo).
Urid (Phaseolus Roxburghii) known as Biri in Manbhum.
Gram (Cicer arietinum), not grown in Lohardugga.
Oil seeds.—Sursua—Mustard.
Til (Sesamum orientale).
Tisi—(Linseed.)
Surgujia (Guizotia oleifera).
Cotton—only from Palamow.
Timber—from South Lohardugga and North Singbhum.
Bamboos—
Chope—or rope made of jungle fibre.
Bábui—String made of bábui grass.
Tusser Silk—Manbhum and Hazaribagh.
Tusser Cocoons—
Hides—
Shellac—from Ranchi and Manbhum.
Ghee—Hazaribagh and Palamow.
Tea—Hazaribagh and Lohardugga.
Jungle Products—Petals of the *mohua* tree.
Catechu, Resin, Sticklac, Dye substances of various kinds.
Wax, Gallnuts (*haritàki.*)
Coal }
Iron } from Hazaribagh and Lohardugga.
Mica }

The Chief imports are—	Tobacco.
European piece-goods.	Umbrellas.
" twist.	Brass utensils.
Blankets.	Paper.
Salt.	Wines and spirits.
Spices.	Oilman's stores.
Molases.	Gunny bags—to Hazaribagh.

There is a large export of rice to Behar, of oilseeds to Calcutta. The value of the hides exported in 1879-80 was estimated at Rs. 35,000 In the same year the gross produce of tusser cocoons was set down at 3,150,000, sold for export at from 4 annas to 8 annas per 100 cocoons. A considerable amount of ghee is exported from Palamow, where cattle are driven in for pasturage from Shahabad, Mirzapur, and Gya. The export demand for sticklac is usually larger than the Division can supply. Imports of piece-goods into Lohardugga for local consumption and re-export are said to be increasing rapidly. About 100,000 maunds of salt are supposed to be consumed annually in Lohardugga district. Most of it is Liverpool salt, imported from Calcutta, by way of Raniganj, Purulia, Chattra, and Gya. Tobacco is imported from Patna.

In Manbhum, the trade in potstone plates is said to have increased greatly of late years. The opening of the railway will probably help on further increase. Mr. V. Ball writes thus on the subject :—

"Chloritic schists, passing on the one hand into Talcox, and on the other into serpentinous rocks, occur not uncommonly in the sub-metamorphic and somewhat less frequently in the metamorphic series. In buildling, the varieties of this material have only been used on a small scale for ornamental purposes, for which some of them, as being tough and at the same time easily carved, are particularly suited. They are more extensively employed in the manufacture of altars, idols, plates and bowls. In the southern part of Manbhum on the frontiers of Singbhum there are numerous workings, which generally take the form of narrow mines, but are deserted during the rains. From these mines a considerable quantity of stone is annually extracted ; the blocks are roughly dressed to the shape required, be it for *lingam*, plate or bowl. They are then fixed in a rude lathe, cut into form, and finished with a smooth surface. When finished, they are carted off to Bardwan, where they are in great demand, and a portion are sent on to Calcutta for sale. One class of the varieties used stands fire well, while the other does not. The former is, of course, the most esteemed by the natives. The cracking of the latter is probably due to the water in combination in the more chloritic varieties which becomes released on the application of heat. In many of the ancient temples in Chutia-Nagpur, images made from this material are met with."

With reference to the construction of the new Railway, Mr. Parker, the Engineer-in-Chief, suggests that permanent-way and English material should be landed at False Point, and brought up to Cuttack by canal: Puri, as an open roadstead, would not be a safe landing place, although more convenient. There are workshops at Jobra, where probably engines and wagons could be set up ; and, for the Puri section, he thinks it might perhaps be worth-while to run a temporary line from Jobra to Naraj, on the surface of the ground, crossing the Katjori by a temporary bridge, which would not cost much since the river is fordable in the dry season.

For the rest, labor is cheap and abundant, and there are no especially formidable physical difficulties in the way of this new Railway undertaking. Parts of the country to be traversed are reputed very unhealthy ; but that is a difficulty engineers in India have often faced before ; for which the exigencies of their profession prepare them ; from which they are not likely to shrink. Meanwhile the mainly important matter is that all available information points to the conclusion that the trade resources of the Chutia-Nagpur Division are fully equal to making a Railway through it pay ; and will improve as the country is opened out and developed. And the profit derivable from the pilgrim traffic is beyond cavil.

LIGHTNING CONDUCTORS.

WHEN middle aged readers of INDIAN ENGINEERING were Fourth Form boys acquiring the humanities under Dr. Birch's tutelage they learnt probably, as their forefathers had learnt for generations before, how Zeus the cloud compeller, and Phoibos the far-darting shot lightnings down from the quaking skies, when they happened to be in what schoolboys call "a wax." Of course, as Christian boys, they were not expected to believe in these manifestations. But no better staple of belief was set before them; science was a goddess unrecognized by Lempriere, unknown in any Pantheon at that time existent.

Without their knowledge or consent the gist of the old world notion insinuated itself into their minds: they never conceived of lightning save as descending from above. Since that time a good many old gods have been upset from their thrones, a good many traditions of the elders have been exploded, and the sovereignty of science has been recognized. *Les rois sont morts Vive ia Reine!* We have given over disputations about Greek plays and the Greek particle; and are desirous of knowledge about the facts and actualities of the busy world in which we live, and move and have our vital interests. And, *inter alia,* old world dogmas about lightning and its causatives and antidotes fail to satisfy the diligent enquiring scepticism of modern times. The age is utilitarian, and sees ground to doubt whether the assurances of protection held out by lightning conductors are not—very much over-rated, let us say.

Are our so called protectors themselves traditions of the elders, no better and no more serviceable?

Is there reasonable ground for belief that lightning is altogether cloud confected, and shot down upon a passive world without any by your leave, or with your leave, from earth's latent electricities? Is the metal rod we set up to oppose lightning a fetisch without more power than any other scarecrow? Is it not possible that the bolt shot from above is, and can be, of no effect until it meets an upward tending electric current?

Doubts like these, which have, from time to time, found expression in various quarters, have been freshened in our memory by a pamphlet now lying before us, entitled *Loss of life and property by lightning, at home and abroad.* The author is Mr. W. McGregor, late Chief Superintendent of Indian Government Telegraphs, Assam Division, who has for many years taken an active interest in the subject and written sundry other pamphlets about it, incited thereto at one time by a storm at Bedford, at another by a storm at Croydon, at another by a fatal fall of cliff at Dawlish. Mr. McGregor's desire is to inaugurate a society for the protection of life and property from lightning, and for the investigation of phenomena attending lightning stroke. The primary object of the society would be, we are told, "to supply householders and public bodies with advice and instruction based on the authorized and well matured directions contained in the valuable Report of the (Lightning rod) Conference, and embodied in the rules framed and published under its sanction."

Mr. McGregor does not believe in the inherent virtue and protective power of a lightning rod stuck up haphazard anywhere about the premises it is designed to safeguard. Unfortunately many people do. Mr. McGreger would like to see all metal employed in the construction of a building properly distributed, and placed in electrical communication with the earth plate, or iron water main pipe. He would have all lightning conducted on strictly scientific principles. And he would have all the arrangements made periodically tested by a qualified officer of his proposed society for the protection of life and property from lightning. But bearing in mind how jealously every Briton holds fast to the fiction that his house is his castle, and resents intrusions, we incline to doubt the capability for good work of such a Society. Nevertheless it seems to us one of those cases where Government (*not* a Society) would be justified, *pro bono publico,* in such an amount of meddling with a man's household arrangements as adequate supervision might entail. The Health Officer and his Nuisance Department practically enforce similar disregard for the my house my castle theory —with very little friction, and the best of results. Let the Municipalities of the future or the local Governments of the future authorize similar domiciliary visitations, with a view to inspection of lightning conductors and their construction and location.

Mr. McGregor cites some curious instances of what he considers cases of quite preventible death from lightning We quote, in his own words a very curious one:—

"23rd August 1884, the Artillery barracks at Nassirabad were struck by lightning. The flash struck the upper storey first, passed through the wall, and injured two men; it then crossed to the other side of the building leaving no trace of its path, but killing six men in its course out, through the open door. The building sustained scarcely any damage; and although the men last struck were sitting in a line, the centre men escaped unhurt."

Medio tutissimus is an ancient time-honoured maxim; but it does not sufficiently account for the escape of these centre men. One wants to know something more about it. Again, one would like to know why women and girls, apparently, enjoy greater immunity from lightning stroke than men and boys, and why men and women enjoy greater immunity than the brute creation. *Apropos,* Mr. McGregor writes:— "This strange classification has been noted in France; the same is apparent in reports of death accidents amongst natives in Assam, and was illustrated in a most marked manner on a tea plantation, where I was told that the gentleman and his son were killed, while the lady and daughter remained uninjured, when at the breakfast table in the verandah."

Such a society as Mr. McGregor advocates might assuredly do useful work in the way of collecting, sifting, and systematizing information in connection with lightning phenomena.

Notes and Comments.

Public Health Laws Imperative.—Mr. Shone says that Legislative enactments now in force, having for their object the reduction of fatal accidents in mines and on railways to a minimum, have undoubtedly had a most salutary effect; and yet, in point of numbers, the deaths which occur annually, and which are directly traceable to railway and mining accidents, are infinitesimally small as compared with the number of deaths which take place annually, and which are due directly or indirectly to foul drains and sewers. But, because the deaths from the former sources are generally sudden and violent, their character rouses public attention; whereas the deaths from the latter source are, to a large extent, invisible, and on that account, and upon no other, public attention is not incited against them.

The Utilisation of Prison-Labor.—The difficulty of finding suitable and remunerative employment for convicts, whether intra-mural or extra-mural, has not been solved in the Punjab. With regard to intra-mural labor, or labor in close proximity to the jail, Dr. Gray reports that several Superintendents have proposed the employment of convicts on brick and tile making. This form of labor would no doubt be sufficiently penal, and otherwise suitable, but it might be difficult always to find a ready market for the sale of the bricks or tiles, and certainly the plan could only prove remunerative in the vicinity of large towns. The experiment, however, is worth a trial, and the amount of success of the proposal of the Superintendent of the Central Jail, Lahore, to work the brick-fields in its neighbourhood, will be some index of what might be expected.

Iron Pier at Gopalpur.—A revised estimate for the Gopalpur pier, amounting to Rs. 3,05,000, has been sanctioned. The original estimate amounted to Rs. 2,30,903. A contract, however, was entered into with Messrs. Massey and Company for the execution of the work for Rs. 2,27,903, with the addition of extra work which it was known would be necessary, but could not be estimated for till the work was in hand, such as lengthening or cutting off piles, extra screwing down, &c., for which a schedule of prices was entered in the contract. The height of the platform of the pier is 16 above H.W.M. and the extreme range of the tides is 10 feet. As the work has progressed, there has been evidence of continual shifting of the sand at the site of the pier, and the section of the bed from which the length of piles in the original estimate was estimated has so altered that piles of much greater length are now necessary. Hence provision had to be made for additional cross bracing and horizontal ties. The original estimate did not provide for the abutment of the pier which was to be built separately of masonry; but it now decided that it would be better to prolong the piles at the shore end, and revet the sand slope further back, and it is found that this can be done at about the cost of the masonry abutment. The revised estimate also provided for this work.

Disintegrator and Turbine.—The following are some statistics relating to the turbine and disintegrator which have been put up on the Government cinchona estate at Naduvatam, for the grinding of the bark, which may be of interest:—The length of the band connecting the turbine with the disintegrator is 35 feet; the circumference of the driving wheel of the turbine is $3\frac{1}{2}$ feet; the circumference of the driving wheel of the disintegrator is 11 inches; when going at full speed, the band revolves at from 80 to 90 times per minute; the turbine from 800 to 900 times. The disintegrator from 3,100 to 3,500 times; the tank supplying the turbine is 130 feet above the turbine, and its dimensions are 31 feet × 21 feet × $5\frac{1}{2}$ feet, with a capacity of 3,580 cubic feet. When the turbine is driven at full speed, the tank is emptied in 32 minutes. The discharge of water, or the amount used by the turbine, is therefore $1\frac{4}{5}$ cubic feet per second. Using the 16 to 1 inch screws, the disintegrator, when driven at full speed, if properly fed, grinds up 600lbs. in 30 minutes. The whole of the work has been executed by the native blacksmith and carpenter attached to the estate, and the way in which the work has been done has been approved of by the P. W. D.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

A DIFFICULTY.

Sir,—With due respect I beg to inform you that I passed the Rurki College examination for *Overseer* grade in 1882, and unfortunately I am working in the lower subordinate grade since then, but I find no hope of my promotion to *Overseer* grade.

Thinking you are experienced officer of the P. W. D. I would beg to ask your opinion what steps I may take to be successful.

B. R.

[There are L. C. Es. in Bombay, and B. C. Es. in Madras working as Overseers.—Ed. *I. E.*]

C. Es. AND R. Es.

Sir,—In your issue of the 28th May you published a very silly letter from a correspondent about Mr. Grant's deputation to Burmah in which he said that "R. E. after R. E. refused to go, though they should have been ordered to go" or something to that effect. It was not worthwhile noticing this at the time, but as you have now (page 105 of your issue of 15th August) alluded to the matter again, it is as well to let you know the actual facts.

Your correspondent and yourself are apparently unaware that the duty on which Mr. Grant is employed is a purely *civil* one on which neither R. E. nor C. E. could be ordered without his own consent.

Moreover the statement that "R. E. after R. E. refused to go" though true in a certain sense is altogether misleading.

What actually happened was this: The Government of India asked for the services of a particular officer (a C. E.) whom they named, to advise the Burmah Government on the subject of Irrigation. They asked that if the particular man named could not be spared, the Madras Government would recommend another man; they stated the terms offered, Rs. 10 per day in addition to departmental rates. The officer named by the Government of India could not be spared, and the Madras Government asked another man (also a C. E.) whether he would like to go; he declined and then two R. Es. in succession were asked, both of whom declined, as they were just going on furlough, and as regards one of them it is certain that his health would not have allowed him to go to Burmah: the post was then offered to three C. Es. in succession, the third of whom (Mr. Grant) accepted it.

It was therefore declined, not "by R. E. after R. E." but by three C. Es. and two R. Es. before it came to Mr. Grant; of course, there was never any question of "ordering" any one to go out of the province in which they had undertaken to serve.

In your note of 15th August you speak of it as an "anomaly" that Mr. Grant gets a special allowance of Rs. 300. Where is the anomaly in the matter?

A man was wanted for special work and it was necessary to offer sufficient inducement for a qualified man to undertake it. As a fact I believe the Government of India did want to cut down the extra pay to Rs. 150 and Mr. Grant declined to go on those terms.

In spite of your dislike to R. Es. in general *I am sure that you would not wish your readers to remain under a misapprehension as to actual facts, and have therefore given you the above information, which you may rely upon as accurate.

R. E.

*We beg to disclaim. To us personally and to many others, both C. Es. and R. Es., it is extremley painful to dwell on the controversy that has appeared in this journal *re* a difference that is really and truly an invidious distinction, and anent which a distinguished R. E writes: "A remedy is required, and sooner or later must be found—possibly when the Secretariat is monopolised by C. Es. which it must be in a few years. You advocate the claims of the C. Es. to the highest appointments, and you are quite right to do so, and so long as the controversy is not prejudiced by personal matters or imperfect information, no one can complain."—Ed. *I. E.*

EXAMINER P. W. ACCOUNTS.

SIR,—I not only agree with the writer of the Article, entitled "The Examiner, P. W. Accounts," which appeared in your issue of the 20th ultimo but which I have only just read, that any further continuance on that subject, from him at least, would be put down by your readers as "objectionable," but I think that the whole of his article is most objectionable, both in matter and in style.

I wish to say that I hope it is not true, as your contributor, in his "penny-a-line" production, tries to make your readers believe, that the manners and business methods of Examiners have of late years changed for the worse. I retired from the service eight years ago. While in it, I served under three Controllers or Examiners, so far as I recollect, and though one of them used to be rather annoying in the particularity of his monthly questions—for instance, in requiring me to state my reasons for making some stupid mistake or other to which I could only reply either that I had no reason, or that from sheer ignorance I made it,—I always found them, one and all, ready to help in any difficulty. My first Examiner was the late Mr. Harry Marten ; I was not long under him, and I never saw him ; but even when I was only a sub-divisional officer I experienced great kindness from him, when I had occasion to consult him by letter about some chiefly personal matter. I served for some years under the late Mr. F. R. Boyce, and while in charge of a Mofussil Division I can safely say that I used to look forward to his visits of inspection. As I always did my best to see that the accounts were properly kept, I had nothing to fear, and I was sure that if there was anything wrong it would be put right in a kindly and paternal spirit, and that no fault would be found for the sake of fault finding. Here I may say that, when a change was made with regard to the preparation of "Objectionable Items" or Audit Notes, or whatever they are called, and Executive Engineers were required to "own up" instead of having to reply to criticims sent from the Examiner's Office, I took full advantage of the new procedure by making a point of confessing everything irregular or doubtful that I could detect in my own or my assistants' and subordinates' accounts ; and I found that this saved a great deal of trouble, and made every one more careful. At one stage in my service I had a lot of special duty, and knocking about, without having a divisional charge and a regular office establishment, and I had frequent occasion to call on Mr. Boyce in his office in Calcutta to consult him, and to get orders for money advances, and I always found him very pleasant and helpful. So, also, on occasions of taking furlough and other leave, he used to transact my business with the utmost courtesy and promptness.

I would fain hope that the third and fourth paragraphs of your contributor's production are efforts of pure imagination. Mr. Boyce was, so far as I know, a welcome guest of the Executive Engineers, when he went on tour. He was full of human sympathies, and if he had failings I never discovered them. The next three paragraphs seem equally to be works of pure fiction.

With only one part of your contributor's letter do I find myself in accord, and that is where he denounces the practice of not only appointing Royal Engineers to the Account Branch of the Public Works Department, but allowing them to remain in it for perhaps their whole service in India. This is quite indefensible. It might be useful for all Executive Engineers to have a turn of duty for a year or more in the Accounts Department ; but more than this should not be the privilege of Military men.

1st September 1887. A SUBSCRIBER.

The London *Architect* gives notes as to estimating the probable cost of large buildings by a rate per cubic foot. It is commonly taken that one shilling per cubic foot is a fair price for London buildings. The Home and Colonial Offices in Parliament Street cost 11$\frac{6}{10}$*d.* per foot, measuring the 12 feet of concrete laid over the whole of the site ; or 1*s.* 0$\frac{1}{10}$*d.* per foot, if the concrete was excluded. In late estimates for the War and Admiralty buildings, the basement was estimated at 9*d.* and the superstructure at 1*s.* per cubic foot. But later examination and evidence prove that the shilling rate should apply to the whole building, as the tower and part of the building above the roof would cost 1*s.* 6*d* per cubic foot. This shilling rate per cubic foot agrees very closely with the 25 cent rate usually adopted in the United States for a good class of buildings.

Literary Notices.

TRANSACTIONS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS. December 1886—May 1887.

WE confess to having been somewhat remiss in respect to these valuable serials. In the December (1886) number we notice an article on "Railroad Levels" with reference to the relative heights of the surrounding ocean. We learn that the "prevailing winds" must be considered as a factor in varying the elevation of the water. Waddell's Specifications for the strength of Iron Bridges in the February (1887) number are in conformity with the views set forth in the authors' book advertised for sale in this Journal. Dorsey's Paper on "Irrigation," and Foote's on a "Watermeter for Irrigation" in the March number, are likely to prove interesting to Indian Engineers. We find from the former that as regards the cost of works, the canal systems of Upper India, bear very favourable comparison with those of France, Spain, and California. In the item of "Duty of Water" the figures given indicate that there is a waste of water in some districts of India. Mr. Foote solves the difficult problem of distributing or dividing the water for irrigation. The water-meter invented by him seems to supply a deficiency. It is said to work well ; and is simple, cheap and accurate. The May number contains an article on "Formulas for the Weights of Bridges" which is in every way worthy of the attention of that section of the Profession chiefly concerned with the designing of Iron Bridges.

INSTITUTION OF CIVIL ENGINEERS OF IRELAND.

THE Transactions forming Vol. XVII—or the Papers read during the 51st Session, ending June 1886—are of rather more than usual interest. All the Papers are of a valuable character, upon widely different subjects, affording useful information to various branches of the Profession.

President Aspinall's address deals with subjects more immediately connected with Mechanical Engineering, and refers to a number of subjects connected with modern engineering, in which incidental reference is made to the Denham-Olphert Sleeper in this wise : "On some of the Indian Railways where iron sleepers are used, a wooden wedge has been driven under the rail with the idea of giving additional elasticity." The address concludes with the trite observation that in these days mechanical genius must be found hand in hand with Scientific research if great results are to follow.

Mr. James Otaway's Paper on the Harbor of Waterford—the results of Sir John Coode's opinion and advice—is wanting in novelty as regards technical works.

Mr. Maguire's Paper on Technical Education for Artizans is an attempt to consider the best means and indicate the best methods for supplying an acknowledged want. The purpose of the Paper is to consider the best form of technical training for artizans, mechanics, and designers, which, in addition to fitting them and their children for the occupations they are to follow, shall also afford the means of enabling the highest and most industrious amongst the students to advance through a system of higher training to higher positions as foremen and managers of works. The author correctly defines "real *technical* education as that which applies the principles of the natural sciences to the practice of the mechanical arts." Workmen and apprentices both need a knowledge of the theory or science connected with their practice. On the Continent, the numerous art and technical schools are universally stimulating the growth, and improving the tone of manufacturing industries. "When we can educate our workmen in applied science and art as the German artisans are educated, also teaching them manually and practically in the school, we can hold our own against the world." This Paper is the most elaborate and exhaustive that we have yet seen on the subject of which it treats.

General Articles.

THE USE AND MISUSE OF CONCRETE IN BREAKWATERS.

The Harbor Works at Aberdeen.

I.

In a series of articles recently published in these columns the *misuse of concrete* as a material for the construction of breakwaters has been amply exemplified, resulting as it did in the destruction of the Madras Harbor just as it approached completion, and the necessity of reconstructing a large portion of the works on a different design. The designers of the new work were, of course, greatly hampered by having the ruins of the old work in the way, and by the necessity of embodying them in the new section; but the symptoms of failure which have lately appeared in the Colombo breakwater, which has to some extent been taken as a model for the restoration at Madras, throws doubt on the soundness and, therefore, on the ultimate success of the principles they have adopted. We will now give an account of other harbor works in which concrete was most ingeniously and successfully used, in a variety of ways, long before the Madras works were designed, but which works unfortunately were not adopted as a model in the case of Madras.

The entrance to the Harbor of Aberdeen, at the mouth of the river Dee, is much exposed to the eastward, and so long ago as 1812 Mr. Telford was consulted as to the effect of a breakwater which had then been constructed with the view of protecting the piers then in progress. He pointed out that if the old south pier was not extended parallel with the north pier to the full length, the effect would be a contraction of the Harbor entrance, and the formation of a shoal within the north pier-head. That result followed, and the state of the Harbor entrance from 1812 until the end of 1873, when the "New South Breakwater" was finished, was exactly as had been anticipated. Moreover, as the end of the old south breakwater was immediately opposite the termination of the north pier, it could obviously afford no protection from south-easterly seas, and the danger to vessels entering during south-easterly gales was increased. Therefore, —we are condensing Mr. Abernethy's statement of the circumstances, made during a discussion upon papers read at a meeting of the Institution of Civil Engineers, —after a long consideration of the question of removing the breakwater seaward, and extending the north pier, a plan brought forward by Mr. Cay in 1867 for effecting these purposes was adopted. With certain modifications in the direction of the breakwater, and also in the details of the North Pier, made by Mr. Abernethy and Sir John Hawkshaw, whom the Harbor Commissioners consulted on four occasions, the works proposed by Mr. Cay were successfully carried out; and it was in consequence of having had an opportunity, in 1877, of seeing them, and informing himself as to their nature and the mode of their construction, that the present writer in the series of articles, published in January 1882 in the *Englishman* newspaper, which have been quoted from, as to other points, in the articles on the Madras Harbor, advocated the adoption of Mr. Cay's methods of using concrete in the restoration of the Madras Harbor Works.

In his paper describing the works Mr. Cay explained that, in his original design, a solid wall of Portland cement concrete blocks was to have been founded on a bed excavated in the bottom of the sea. Liquid concrete hearting was to have been introduced into the upper portion of the work, and an apron of concrete blocks was intended to have been laid along the toe of the breakwater, where necessary, to protect the foundation. But, in carrying out the works, Mr. Cay tried various methods of building with liquid concrete, deposited *in situ*, and the results proving satisfactory, he altered his design and built the deep-water portion of the breakwater thus:—"The foundation, after the loose material had been removed, was constructed of large bags of liquid concrete. On this foundation the work was raised, with concrete blocks of from 9 to 24 tons each, to 1 foot above low water of ordinary neap tides; from this level to the roadway, a height of 18 feet, the structure was entirely of liquid concrete deposited *in situ*. The toe of the work was protected by an apron formed of a row of bags, each bag containing about 100 tons of concrete."

Bags of concrete were adopted for the foundations, in the first instance, on account of the difficulty of levelling the granite rock on which the first 500 feet of the work had to be founded; and the result being successful, they were used for the foundation of the rest of the work, which was built on a bottom consisting, for about 100 feet, of boulders and gravel, and afterwards of clay mixed with gravel, covered with large stones. The bags were deposited by iron skips or boxes, of $5\frac{1}{4}$ tons, and afterwards 16 tons, capacity. The bags were fitted into the skip, and temporarily lashed at the top so as to line it. When filled with the liquid concrete, the temporary lashings were removed and the mouth sewn up. When the divers had correctly placed the skip over the desired spot, a trigger was pulled, which released the bottom of the skip and discharged the bag. The foundations were thus rapidly laid, the ground being cleared in advance, by the divers, of loose stones and sand; and the bags were laid to the proper level, from information supplied by the divers. If a bag stood too high it was beaten down while fresh; or when partially set, the top of the bag was removed and the concrete was cut down to the required level. Small holes on the surface were filled with bags deposited by hand. The proportions of the materials of the concrete which Mr. Cay found most suitable for this kind of work were—1 of cement to $2\frac{1}{2}$ of sand and $3\frac{1}{2}$ of gravel. Drawings of the skips used will be found in *Figs.* 8 to 13 of Plate 1, which we reproduce from the Proceedings of the Institution of Civil Engineers.

(To be continued.)

THE STRENGTH OF THIN TIED BRICK ARCHES

By Edward W. Stoney, M.E., M. Inst. C.E.
Resident Engineer, Madras Railway.

The writer some years ago proposed to use thin flat tied brick arches for roofs, and in order that no doubt should exist as to their being safe, and quite strong enough for the purpose, made many experiments to determine their strength under various conditions of loading.

In order to save expense, as many experiments as possible were made on each arch rib, they were generally first loaded uniformly all over, but not sufficiently to break them, then loaded uniformly over half the arch till signs of failure appeared, and finally loaded at the centre till they broke.

The result of this mode of testing was, that the arches having been previously strained, did not in the latter experiments exhibit their full strength.

In order to get strictly fair comparative results, three similar arch ribs of each span should have been built at the same time, and each of those then tested to failure under similar conditions; one with a uniform load all over, another with a uniform load over half the arch, and the third with a load at the centre.

The following tables give a summary of the results of these experiments.

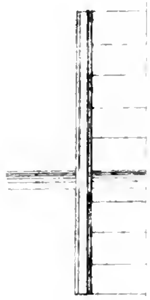
Although the experiments described are incomplete, it is hoped that they may prove of interest and value, having been made on real arch ribs of from 10 to 30 feet span.

The results obtained were considered so satisfactory that the writer designed roofs based on them, which have been largely used for railway stations, bungalows, &c., during the past eight years.

These have proved quite water-tight, cost almost nothing for repairs, and were built at less than half of the cost of the ordinary flat or sloped terraced roofs.

August 25, 1887.

PLATE I.



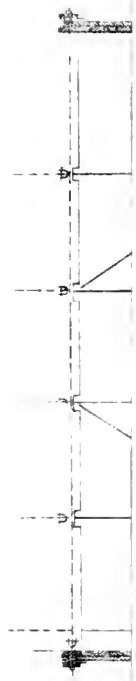
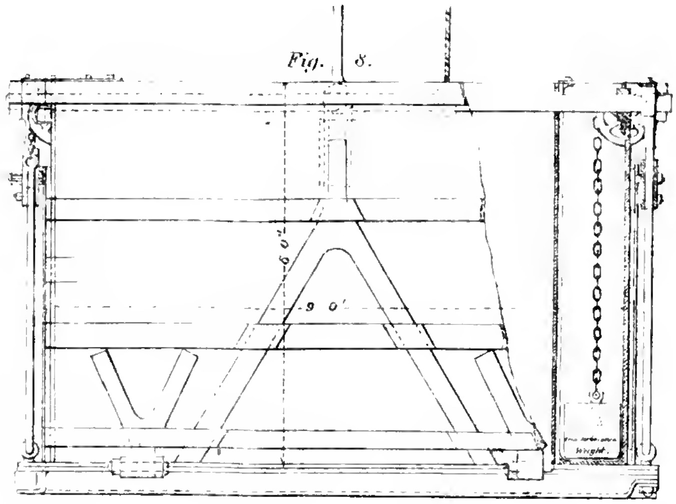


Fig. 8.



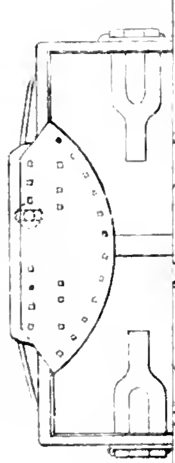


Fig. 11.

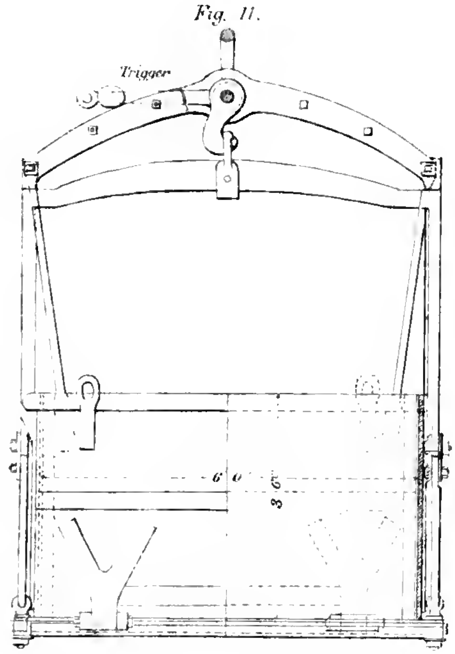


Fig. 13.

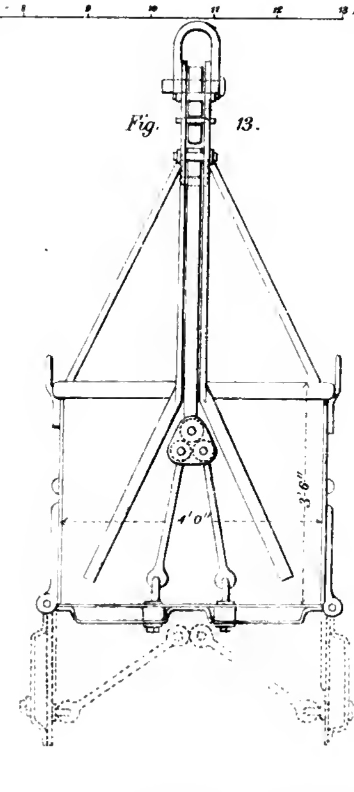
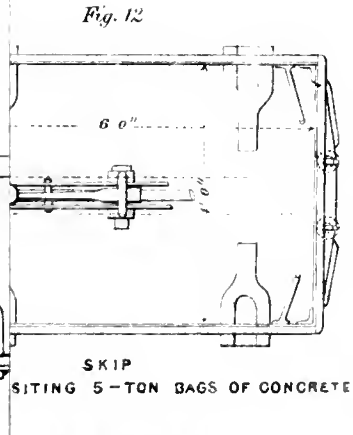


Fig. 12



SKIP

USED FOR ...SITING 5-TON BAGS OF CONCRETE

HARBOUR.

Breakwater.

The "STAR" Press, 19, Lall Bazar Street, Calcutta

THE STRENGTH OF THIN TIED BRICK ARCHES.

Table shewing the best results obtained when testing the strength of thin brick arch ribs of different dimensions loaded in various ways.

Disposition and mode of applying loads.	Dimensions of Arch.								Remarks.
	10 feet span, 1'-3" rise, 4½" thick, 2'-3" wide.		14 feet span, 1'-9" rise, 4½" thick, 2'-3" wide.		20 feet span, 2'-6" rise, 9" deep, 2'-3" wide.		30 feet span, 3'-9" rise, 9" deep, 3'-4" wide.		
	Total Load. lbs.	Load per sq. foot. lbs.	Total Load. lbs.	Load per sq. foot. lbs.	Total Load. lbs.	Load per sq. foot. lbs.	Total Load. lbs.	Load per sq. foot. lbs.	All loads are exclusive of weights of arches. 10 and 14 feet arches weigh 43lbs. a sq. foot, 20ft. and 30ft. arches weigh 75lbs. a sq. foot.
Greatest load over whole arch and which did not cause any signs of failure	6,630	294·67	5,850	185·71	10,608	235·73	19,197	191·97	In no instance was sufficient weight put on uniformly over the whole arch to cause any sign of failure, as it was not desirable to crack them, being wanted for further experiments.
Uniform load over half arch at which failure began	1,560	138·66	1,872	118·86	3,315	147·34	Not	tried	These are the loads at which cracks first appeared.
Uniform load over half arch at which it broke	1,872	166·40	1,989	126·28	4,329	192·40	Not	tried	
Load at centre at which failure began ...	1,872	......	936	......	Not	tried	Not	tried	Cracks first appeared with these loads.
Centre breaking load ...	2,652	......	1,365	......	Not	tried	Not	tried	
Moving load which produced no signs of failure	Not	tried	2,178	69·14	2,014	44·76	Not	tried	Greater loads would have been borne, but as the arches were required for further tests in other ways these were not put on.

EDWARD W. STONEY.

THT STRENGTH OF THIN TIED BRICK ARCHES.

Summary of results obtained when testing the strength of thin flat tied brick arches.

Mode of applying load to arch.	Greatest load put on without producing signs of failure. Total lbs.	Greatest load put on without producing signs of failure. lbs. per sq. foot.	Load at which arch began to shew signs of failure. Total lbs.	Load at which arch began to shew signs of failure. lbs. per sq. foot.	Breaking load. Total lbs.	Breaking load. lbs. per sq. foot.	Remarks, &c.	Deflection at centre.	Permanent set at centre after removal of loads.
	All these loads are exclusive of the weight of the arch.								
	No. 1	Arch, 10	feet span,	1′-3″ rise,	4½″ deep,	2′-3″wide.		Inches.	Inches.
Uniform over whole arch ...	4,953	220·13	Not	tried	Not	tried	As this load produced no signs of failure, the testing was discontinued. Before the testing was commenced the tie rods were slackened, to test the strength of the mortar in the arch, this slacking caused the arch to crack slightly, which of course weakened it.	·29	·07
Uniform over half arch	Not	tried	1,170	104·00	...	...	With this load the bottom joints opened slightly in two places, this arch had previously borne a uniform load all over it of 4,953lbs. and had been cracked by slacking the tie rods.	·09	
	...	...	...	...	1,482	131·74	The arch bore this for two minutes and then broke ... Rise	·04	
Load over centre ...	1,248	...	1,872	...	...	...	Deflections increased uniformly up to a load of 1,248lbs; with 1,872lbs bottom joints at centre began to open.	·51	
	...	...	...	...	2,652	...	Arch bore this half a minute and then sank to centres placed under it.	1·05	
	No. 2	Arch, of	the same	dimen-	sions as	No. 1.	Built 16th of October, tested 16th February following.		
Uniform over whole arch ...	6,630	294·67	Not	tried	Not	tried	This load left on 24 hours, then removed, no signs of failure.	·56	·18
Uniform over half arch	1,170	104·00	...	...	...	...	With a load of 1,170lbs. no appearance of cracks or failure, when load increased to 1,560lbs. a very slight crack appeared in extrados 2′-2″ from the springing; when 1,872lbs. had been on five minutes the arch failed, sinking on to centres placed under it.	·19	
	...	...	1,560	138·66	1,872	166·40			
Load over centre ...	Not	noted	Not	noted	...	...	Broke at old cracks made by previous testing with a load of 1,170lbs.; the deflection at the centre was ·53 inch.	·53	
	...	...	...	...	1,287	...			

	No. 1 Arch, 14 feet span, 1'-9" rise, 4½" thick, 2'-3" wide.								
Uniform over whole arch ...	2,178	69·14	Not	tried	Not	tried	This load produced no cracks, &c.	·16	
Uniform over half arch ...	Not	tried	Not	tried	1,374	87·24	Broke when this load had been on half a minute.	·26	
Load over centre	Not	tried	Not	tried	Not	tried			
Moving load over arch ...	2,178	69·14	Not	tried	Not	tried	No signs of failure produced by 20 men in rows of two walking back and forward over the arch.	·18	
	No. 2 Arch, same dimensions as above. Built 23rd November, tested 22nd January following.								
Uniform over whole arch ...	5,850	185·71	Not	tried	Not	tried	This load left on 24 hours without producing any signs of failure.	·48	·10
Uniform over half arch	Not	noted	1,872	118·86	...	...	Began to fail.	·08	
	...	...	...	...	1,989	126·28	Broke with this load.		
Load over centre ...	Not	noted	936	...	...	...	This load caused a crack $\frac{1}{16}$" wide at the centre.	·41	
	...	...	...	...	1,365	...	Arch broke after sustaining this load half a minute	·67	
Moving load over arch ...	948	30·10	Not	tried	...	...	8 men walked over arch without injury to it; it would carry more, as other tests were desired no more were put on.	·15	
	Arch 20 feet span, 2'-6" rise, 9" deep, 2'-3" wide. Built 25th December, tested 23rd January.								
Uniform over whole arch ...	10,608	235·73	Not	tried	Not	tried	As there was no room to put on more load, load was removed; there was not the least sign of any failure.	·42	·06
Uniform over half arch	...	...	3,315	147·34	...	...	No appearance of cracks with 2,652lbs., with 3,315lbs. slight cracks appeared where arch finally broke.	·15	
	...	...	...	...	4,329	192·40	With this load arch sank on to centres under it, when the load was removed the arch sprang back into place and the cracks closed up.	·73	·18
Moving load	2,014	44·76	Not	tried	Not	tried	18 men in rows of two walked back and forwards over arch, no signs of failure or permanent set produced by this load.	·10	
	Arch 30 feet span, 3'-9" rise, 9" deep, 3'-4" wide. Built 14th August, tested 10th February following.								
	19,197	191·97	Not	tried	Not	tried	When this load had been placed on, the grantite skewbacks cracked and the load was then taken off. There was no appearance of any failure in the arch and the rib was not further tested.	1·18	·36

These arches, with the exception of the 20 feet span, were built of stock bricks set in surki mortar, made of equal parts of lime, sand and surki.

EDWARD W. STONEY.

NEW TYPES OF CHEAP ROOFS.

II.

GREAT care must be taken to keep the ties perfectly horizontal by intermediate supports on the centreing. This is most important. For small spans up to 15 feet, my usual practice has been to make a fixed head at one end of the tie and the screw and nut at the other. In larger spans the threading of long ties through washer holes in skewbacks, etc., render this impracticable and a screw should be formed at each end.

The best washer is a strip of ½″ plate, say 9″ × 6″, smaller for lesser spans. As has been already noticed with arcs much flatter than 108° a continuous support in the shape of a plate or long slab of stone is required behind the brick skewback. My practice has generally been to mix Portland cement with the mortar in the skewback. It does not cost much, makes a good job, and sets quickly. The minimum spacing of tie rods, except under exceptional circumstances such as a flat arch carrying a floor, is 3 feet.

The diameter and spacing of the ties is, of course, dependent on the span.

The following table gives dimensions of ties and thickness of arches required for different spans, the rise of arch being taken as ¼:—

For Rise one-fourth of Span.

Span.	Thickness of Arch.	Dia. of ties.	Dist. apart of ties.	Thickness of Wall.	Material of Walls.
10	4½″	½″	4′	1·6	*Kacha-Pacca*
15	9″	⅝″	3′	1·6	,, ,,
20	9″	¾″	3′	1·6	*Pucca*
25	1′1½″ & 9″	1″	3′	2·0	,,
30	1′1½″	1⅛″	3′	2·3	,,
35	1′1½″	1¼″	3′	2·3	,,

In these calculations the allowable stress on tie rods is taken as 4 tons per square inch. The live load is assumed at 40lbs. per s. ft.—a very liberal allowance.

For other arcs the formula given below will work out result.

W = Weight of 1 ft. length of ½ arch, etc.
W^1 = Live load one ,, ,, ,,
D = Distance apart of Ties.
S = Span.
θ = Tangential ∠

The required sectional area of tie in square inches =

$$\frac{(W+W^1)\,d}{8940} \quad \cot\theta$$

All notation in lbs. and feet, or the result can be obtained direct from the Table. Let a denote area of the rod in square inches deduced from column 3, and θ^1 tangential angle of any arc of other magnitude than a quadrant, then x, the required area of tie $= \dfrac{\cdot 726a}{\cot\theta^1}$

The diameter of the rods thus given are *net* and the ends must be headed up ⅛″ larger for the screw in cut.

In spans above 12ft. 6 in. the rods require a permanent support in the centre and above 20 ft. should be hung in two places. These suspenders are ½″ diameter with a turn at the lower end, which is threaded on to the rod, the upper end goes through the arch and is provided with a small washer screw and nut. After the centreing is struck if any settlement takes place, these nuts should be screwed up tight to afford support to the rod.

The arching is constructed of separate rings of brickwork carried up in lengths up to the point where a course of headers is inserted. For large arches, there should be 7 courses of double headers. One at skewback, two between skewback and crown, and one at crown forming the key.

The lower ring should be completed up to the bond header line before the upper is commenced. See Fig. 5, Plate II.

In this example there are nine bond courses, the upper end bricks of each section will generally require cutting to fit. To insure radiation a square should be supplied to the masons in the shape of Fig. 6, Plate II. The bricks should never be cut, the radiation being insured by the varying thickness of the mortar in the vertical joints.

Each side of the arching should be carried up equally so as to balance each other.

When the arch is commenced the tie rods should be very gently brought to their bearings by nuts at either side. When half the arch is done, the nuts should be screwed up tight, and when the whole is completed, again turned with powerful wrenches till they will not move; then each rod should be carefully sounded so as to insure perfect and uniform tension. I have known arches fail from inattention to this particular; it is extremely important that a high initial strain should be put on the ties, before the centres are struck. This should not be left to native mistries, but each should be personally inspected and sounded by the Engineer in charge. Ventilators can easily be constructed in this type of roof by making circular or elliptical holes of annular rings in the crown. These rings should be laid in Portland cement and the bricks all cut to wedge shape. 1′ or 1′ 6″ diameter holes at frequent intervals, covered by a large "handi" or earthenware pot, inverted and whitewashed within, form a perfect ventilator and lighter. Fig. 7, Plate II is a sketch of ventilator commonly used.

Square sky-lights can also be used of any size, pieces of iron rails or thick slabs of stone being let into the arch work to span the longitudinal openings.

On completion the centreing should be allowed to remain up for 2 or 3 weeks till the lime has fairly set. The striking is an easy matter, and is effected by knocking out the top bricks of the profiles, which being only a brick and a half thick are easily removed and then the laggings fall. The work should commence at the crown and work down towards the side. By putting in a number of men the whole arch can be struck simultaneously. It is, of course, a great advantage to have the arch as light as possible, and perforated or hollow bricks should be utilized if available.

In Messrs. Jardine, Skinner's lac godown in Mirzapur I experimented on a hollow arch, which, it is believed, would prove a great success, being undoubtedly lighter, stronger, and cooler than any solid arch. The method of construction was this: One layer of 4½ inches deep was laid down, then on this bamboos were laid slightly propped at each end and made level by mud. On these the second ring was laid, then a course of 12 inch through headers and the process repeated. In a few hours the inner filling was pulled out and a hollow left. In a long roof properly shaped planks could be used, but it would have to be built in sections of 10 feet or so, the ends stepping out at an angle of 45,° that the next length will overlap the projections of the finished section. The arch experimented on was a rampant arch under a flight of steps shewn in Fig. 8, Plate II.

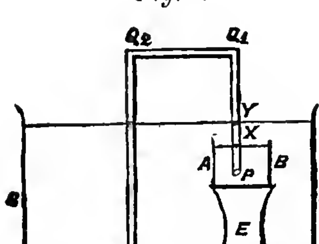
(To be continued.)

THE COMMON SYPHON.

By A. EWBANK.

II.

Fig. 3.



THE following simple experiment occurs to me to illustrate the principles of the syphon. In *Fig.* 3 a small

PLATE II.

FIG. 5

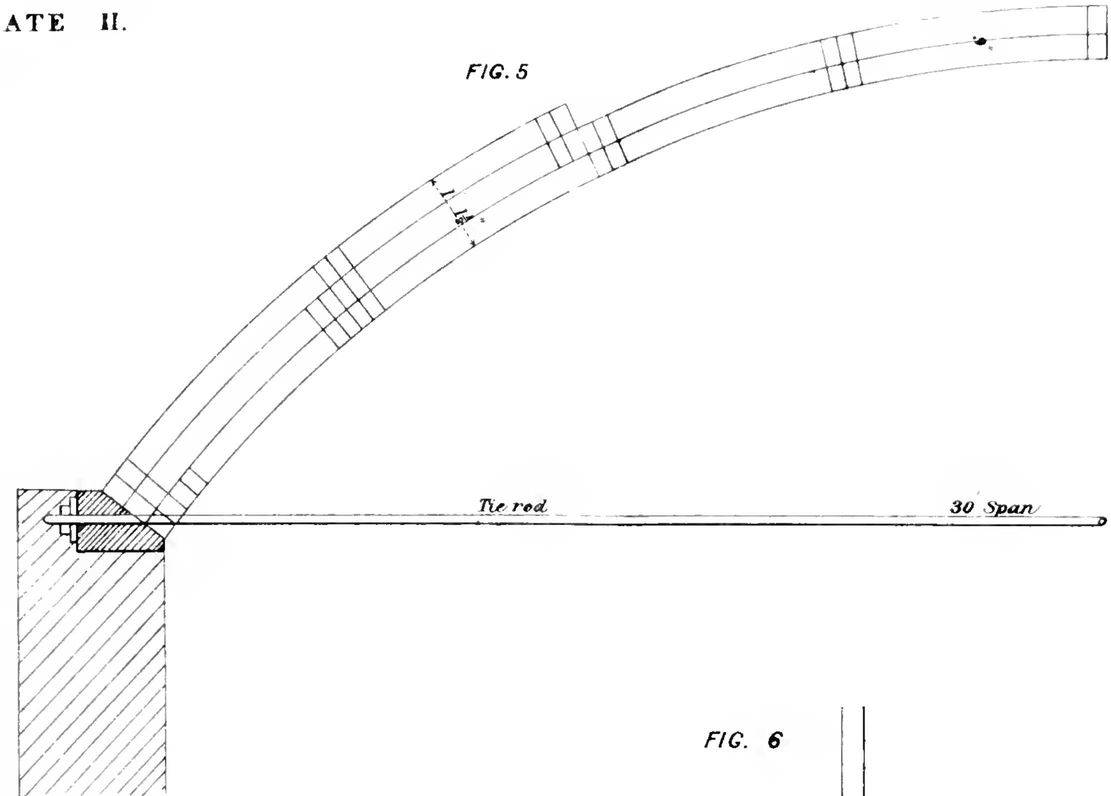


FIG. 6

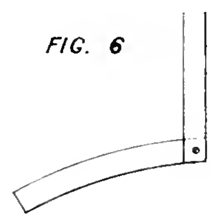
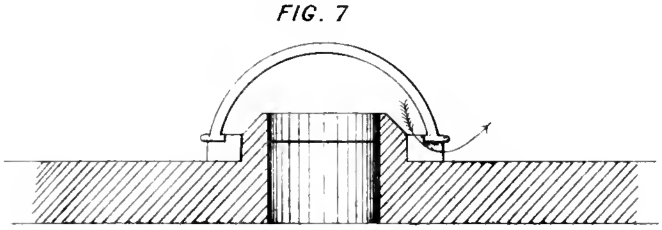


FIG. 7



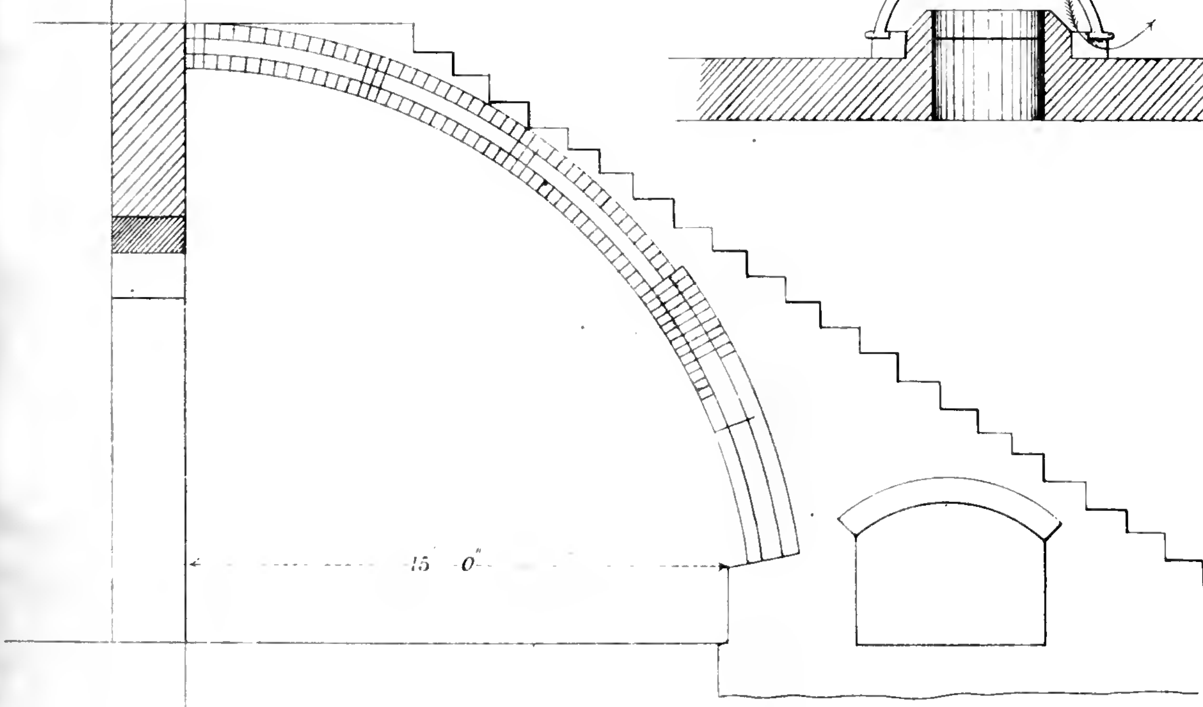


FIG. 8

Hollow flying arch staircase in Messrs. Jardine Skinner's Lac Factory, Mirzapur.

NEW TYPES OF CHEAP ROOFS.

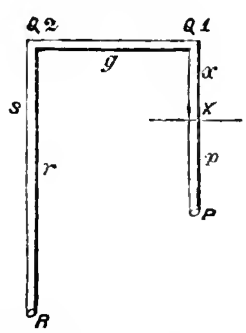
The "STAR" Press, 10, Lall Bazar Street, Calcutta.

vessel A B contains mercury. The mercury surface is at X. A B stands on a support E in a larger vessel C D. Water is poured into C D till it rises above A B and flowing in gives a layer of water above the mercury. We may continue to add water till the water surface is at Y. PQ_1Q_2R is a small syphon initially full of mercury. P reaches to the bottom of A B and R is lower than P. Then mercury will flow from A B and be deposited at the bottom of C D. Finally both the small vessel and the syphon will be full of water and then the motion will cease. During this process the level Y remains unaffected. In the figure the water does not cover the whole of the syphon. If the syphon were entirely immersed the result would be the same.

Water is heavier than air and this is the real reason why the water syphon works successfully in an atmosphere of air. Similarly mercury is heavier than water and so the mercury syphon should work successfully in an atmosphere—so to say—of water. Such was the reasoning that suggested the experiment here described.

That the syphon works because water is heavier than air may be seen if we consult *Fig.* 2.

Fig. 2.



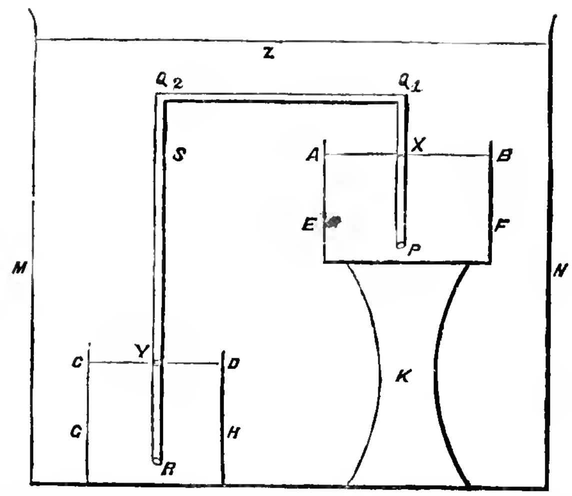
In considering the forces that act on the rope of water we treated the statical air pressure at R as being equal practically to that at X. Then the air pressures were merely of use to keep the water particles in the syphon jammed together and so make the water into a flexible solid. But in reality the air pressure at R exceeds that at X by the weight of an *air* column R S in the syphon. As we denoted the water column mass by $\mu\ (r-x)$ we may put $\beta\ (r-x)$ for the air column mass. Here β depends on the section of the tube and on the density of the air. We neglected $\beta\ (r-x)$ not so much because it was supposed to be small absolutely as because it was small compared with $\mu\ (r-x)$. If instead of water we had a much lighter non-volatile liquid, or if, instead of air, we had much a denser circumambient gas it might not be legitimate to neglect $\beta\ (r-x)$. Mathematics, as this Journal has more than once found occasion to observe, are not exact sciences, but sciences of just or appropriate approximation.

Now if $\beta\ (r-x)$ be not negligible, let us divide the static air pressure at R into two parts. One of these will equal the pressure at X and will be told off to balance it. The remainder depends on this $\beta\ (r-x)$.

Then instead of the value for f given by the equation $\frac{f}{G}=\frac{r-x}{r+g+h}$ or $\frac{\mu\ (r-x)}{\mu\ (r+g+h)}$ we shall have the more accurate question $\frac{f}{G}=\frac{\mu\ (r-x)-\beta\ (r-x).}{\mu\ (r+g+h)}$

Now suppose the gas exactly as heavy as the liquid then $\beta=\mu$ or $f=0$. And this happens whatever inequality there may be between the branches of the syphon. If the gas were heavier than the liquid, the liquid would be driven up from R and be poured through X or P into the vessel. If R itself dips into a lower vessel of the same liquid the process will continue and the lower vessel will empty itself into the upper vessel. Thus the syphon will appear to have reversed its natural action.

Fig. 4.



Such a process is illustrated by *Fig.* 4. M N is a large vessel containing mercury. In this vessel are cylindrical vessels E F and G H, of which initially the lower, G H, contains water, and the upper, E F, contains mercury or it may contain a little water at the bottom. The syphon enters E F, and G H through apertures X, Y in pistons A B, C.D. These pistons can move freely within the vessels. It is for the sake of the pistons that the vessels are cylindrical and the pistons are simply required to keep the water below them from touching the mercury above them. Without these separators the water would rise up through the mercury like bubbles of air through water. Above Z, the surface of the mercury, there is atmospheric pressure. But this pressure being transmitted equally to all parts of M N will not affect the movements within M N.

For these movements depend on differences of pressure. We may, therefore, omit considerations of this air pressure. Or we might pour upon Z an additional layer of mercury in substitution for the air pressure.

Now let the syphon full of water be placed as the figure denotes. The weight of the water column S Y is what tends to produce a discharge of water through Y or R. The part Y R being in water has, as it were, no weight. But the mercury pressure at Y exceeds that at X or S by the weight of the mercury column S Y. Thus the water is driven up into the vessel E F. As the water moves up the tube RQ_2 the piston AB will rise and C D will descend. If when C D reaches the bottom,—we suppose R to be at the very bottom,—and if when all the water of the vessel G H has entered the syphon we could imagine the piston C D to vanish, then some mercury would enter at R. Mercury would enter till it reached the level of X and after a little oscillation the mercury would rest with its surface S at the same level as X then occupies.

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

THE Jubilee Exhibition at Newcastle-on-Tyne continues to be one of the most attractive centres in the provinces. It is remarkably well arranged, ample space being allotted to buildings and gardens, the buildings being compactly designed in plan as a hollow square with central garden, and the rest of the grounds being equally devoted to objects of interest, instruction and pleasure, the whole covering an area of 40 acres.

One of the most important exhibits in the grounds is the one which affords the visitor an opportunity of seeing thirteen systems of underground haulage that are in use in the principal coal mines of the kingdom and though the exhibit does not show the complete list, yet they embrace probably the systems that are in most frequent use and consist of an endless chain going over the tubs. In this system the end of the tub catches the links of the chain and are so carried forward. Then follow the various systems actuated by endless wire ropes, over, under and at the side of the tubs. In some of these the tubs are run at fixed distances from each other, and one of the conditions of the exhibition is that the systems should show how the curves are managed, and in this certainly some ingenious arrangements are shewn. A large proportion of the systems are varieties of the clipping the constantly running rope which is generally under the tubs either running singly or in sets of fourteen having a bogey with a fixed clip for attachment to rope and travelling in front of the set. Many of these systems have heretofore been kept a secret and the visitor to coal mines has very rarely been able to get at the systems of haulage that have been in use hence a very great interest has naturally attached itself to this exhibit and no doubt a considerable amount of good will result therefrom both to the coal pit owner and to the miner.

The North of England Institute of Mining and Mechanical Engineers are now paying a visit to Newcastle and will find plenty of material for securing a successful and interesting visit. The Exhibition of course a very considerable item of interest in the prospectus of visits, and the systems of haulage to which I have referred were very critically examined and criticised by the members who on the first day of the visit spent a considerable time in viewing such portions of the Exhibition as offered the technical interest in their special branch of Engineering, and in which the Newcastle Exhibition is preeminently rich and instructive. The representation of a coal mine in the north gardens was of course inspected The entrance to the pit in a few yards leads the visitor to the bottom of the shaft where one cage is shewn in position. A Fowler's Improved Compound semi-portable Engine and Boiler is situated near the shaft, and is used for hauling the tubs along the Engine plane. This is arranged for one of the systems of endless rope haulage where the rope is suspended above the tub by means of forks of which several varieties are used. At the end of the engine plane "the landing" is reached from which the tubs are brought to and from the workings by hand putters or pony drivers. The seam has been represented as 6 feet thick—it then passes into a thinner seam. This is worked on the long wall system, which consists of removing the whole of the coal packwalls being inserted between and on each side of the roads to carry the roof. The thicker seam is worked on the board or pillar system the boards being 15 feet wide and crossed at right angles by walls 7 feet wide. The mode of removing the pillars is shewn in one of the workings. An example of post and stall work is also shewn. A lead mine is also shewn and was visited and explained. It is contiguous to the coal mine. The members also visited other objects in the Exhibition but space will not allow here of more than a passing notice. The second day of their visit was occupied in visiting the many collieries which were opened to them by the kindness of their respective owners, and where many objects of interest were found and inspected. On the third day a steam boat trip down the Tyne took the members to various places and works and was very much appreciated and on the last day of the meeting works were visited in Newcastle aad Gateshead and a paper read upon the Federation of the Mining Institutes of Great Britain. The author of this paper, the Secretary of the Institution, points out the advantages that a combination of the other Mining Institutes would offer—the economy of working—and the increase of value to the joint Proceedings. It is proposed to make London the central head quarters of this body which would comprise an estimated total of about 2,500 members.

AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

The annual report of the New Croton Aqueduct Commission for 1886 is an interesting résumé of the operations of the department and the progress of the work from the beginning.

The length of the tunnel and open cuts from Harlem river to Croton dam will be $28\frac{1}{2}$ miles and the total length to the Connect avenue gate house, $30\frac{3}{4}$ miles. There will be a pipe line $2\frac{3}{8}$ miles long to the Central Park reservoir. Of all this there have been excavated $22\frac{1}{4}$ miles of the tunnel and $1\frac{1}{2}$ miles open cuts. There now remain but two miles of tunnel to make.

At the recent convention of the American Society of Civil Engineers a paper by Professor George F. Swain, Assoc. Soc. C. E. and Engineer to the Railroad Commission of the State of Massachusetts, on the "Calculation of the Stresses in Bridges for the Actual Concentrated Loads" was read the following of which is an abstract:

"In the calculation of the stresses in Bridges, the loads assumed are either a system of concentrated loads, at certain given distances apart or a uniform load with a concentrated load over the drivers of the locomotive. The first method of assuming the load has been considered to conform most accurately to the actual conditions of loading, and of late years has been specified by almost all of the leading railroads. It may be doubted, however, whether such a loading really is any more accurate than a uniform loading would be, inasmuch as the actual loads passing over a bridge are different with every train, and the weight with every train, and the weights of engines and cars are constantly varying. The author is in accord with the recent movement towards going back to the method of uniform load with locomotive excess as sufficient in most cases for all practical purposes, nevertheless, the actual loads are still extensively prescribed, and should certainly be used in the calculation of certain portions of the time. The present paper has for its object to explain in detail the methods of finding the loading giving maximum stresses in each member, and of determining those stresses themselves; and the methods presented will be found applicable to the solution of many other problems of frequent occurrence, as well as to the calculation of the stresses under the assumption of a uniform loading.

The first point to be discussed is the maximum moment at any point on a beam, and the already well-known theorem is demonstrated, that for the maximum moment at any point the average load per running foot on the two sides of the point must be as nearly equal as possible. The application of this theorem to the finding of the maximum moment is illustrated and amplified. The method of finding the position of loading causing maximum shear at any point are next taken up, and a very simple method of finding these shears explained. A method is then taken up by which moments, shears, or stresses may be determined by means of what are called lines of influence, and which., by its perfect generality, allows of the solution of a great variety of problems, both for concentrated and for uniform loads. Considering, for instance, the moment at any given point P, the line of influence for this moment may be defined to be a line whose ordinate at any point Q represents the moment at P due to a load unity acting at Q. By the use of these lines some important theorems are demonstrated regarding the loading causing maximum stresses, and it is shown that in order to find—in the above example, for instance—the moment at P due to a given system of concentrated loads, it is only necessary to multiply each load by the ordinate to the influence line at the point where that load acts, and sum up the result. It is further shown that in order to find the moment at P due to a uniform load g per running foot covering any given portion of the span it is sufficient to multiply g by the area included between the influence line and the axis of abscissas within the portion of the span covered by the load.

These principles are then applied to finding the maximum stresses in trusses of various forms, in floor beams, floor beam hangers, etc. For double intersection trusses the best method of solution is believed to be that by influence lines, which, though rather tedious, is perfectly simple, and allows of the exact determination of maximum stresses for the actual loads.

Trusses with curved chords are then considered and the modifications shown which are necessary in the application of the preceding principles. A method for calculating the stresses in the diagonals is also given, which consists in finding the horizontal components of the stresses in the chords, the difference of which is the horizontal component of the stress on the diagonal. This method is believed to be rather more expeditious in many cases than the more common one of finding the shear in each frame and subtracting from it the vertical component of the stress in the curved chord.

The stresses in cantilivers are most simply determined by means of influence lines, which find one of their most beautiful applications in this connection. The forms of the influence lines are such that the loading causing maximum stresses are found by the same rules as for simple girders while the maximum stresses themselves are found by a very simple process requiring the use of no formulæ except a few simple arithmetical ones.

For the calculation of continuous girders and draw spans the method of influence lines allows of a simplification of the ordinary methods. In fact, it is a characteristic of the method in all its applications that it enables the computer to see at every point exactly what he is doing, and it renders him almost independent of formulæ. Besides simplifying many of the ordinary methods of calculation, it reduces the liability to error, by rendering the result easy to check and by showing them to a certain extent graphically.

Without going too much into detail, it is difficult to prepare a satisfactory abstract of this paper. It is hoped that these few lines have given an idea of its character, that those who desire may peruse it in detail.

Another subject of great moment and practical interest to railroad officials and the travelling public that was discussed at the recent convention of the American Society of Civil Engineers was the Inspection and Maintenance of Railway Structures.

This discussion was very animated and occupied two sessions of the convention. It was called forth by a circular issued by the Secretary to the prominent railroad experts of America. Some of the suggestions made by the Secretary and which brought some very suggestive and interesting replies are as follows:—

What measures, legal or other, can be taken to ensure a proper inspection of railway bridges?

What is proper bridge inspection?

Should there not be a standard specified rolling load much heavier than as now generally used, and a specified engine wheel base for rolling loads?

Is it not expedient to adopt a standard bridge floor?

Should not bridges of small span be made strong enough for a buckle plate floor, and a continuous coat of ballast on the bridge, and if so, up to what span should this apply?

Should not a safety guard (Latimer), be used at all openings over a certain width?

Should there not be required either overhead crossings, or in their place, inter-locking apparatus with derailing switches?

Is legislation as to any of these points, or as to any others you may suggest, expedient, and if so, what sort of legislation?

In this connection the experience of the Master Car Builders' Association has been referred to, which, it is stated, has proved that the action of large committees reporting to the Society, and the adoption of standards after ample discussion, have been found very valuable.

BURMA.

(From our own Correspondent.)

The various means invented for producing bricks and tiles, are interesting alike to the makers, who strive to produce the most novel and approved machinery in the market, and to the public, who eagerly seek after mechanical devices to effect remarkable results, and as a brief description of approved appliances in this direction, is always welcome, particularly in a branch of industry so extensively carried out in the East, I record with pleasure that even natives in Burma have confidence in the capabilities of modern appliances.

The native Company who purchased the rights and good will of Messrs. Robinson Bros.' Brickfields has recently imported a novel appliance, the invention of Mr. Penfold, for manufacturing bricks and tiles. This machine is a two process brick and tile machine, and turns out 10,000 moulded bricks, or drain tiles per day. A brick press is also attached which presses about 8,000 bricks. The appliance is for use in clays that require pugging in the process of brick making, and may be used either alone or in combination with any other clay crushing machinery. It is fitted with a strong cylindrical pugmill which is so arranged as to thoroughly mix or pug the clay, and at the same time feed the propelling or expressing rollers; the apparatus is fitted with a compressing chamber and die and has a side delivery cutter, whereby bricks can be produced of a first rate quality, at a considerably less cost than by any other method; and is decidedly a great improvement on the rotary brick press commonly used in this country. The former saves a deal af manual labor, which the latter is entirely dependent on for its results in outturn.

From a series of observations and experiments lately conducted in the local Arsenal for the purpose of finding out the best means of preserving iron which, in a damp country like Burma, fast decays through rust, it has been satisfactorily decided by the Committee, that the following process has terminated with the best results. The process consists of a set of 3 small gas furnaces, for the production of carbonic acid, these are constructed by the side of a chamber containing the iron to be operated on, beneath the chamber is a series of pipes in which before entering the chamber, the air is heated by means of the waste heat from the furnace, which alternately oxidises and deoxidises the iron. The articles are heated by burning the fuel inside the closed chamber; heated air in excess of the quantity necessary for the perfect combustion of the gas, is made to enter along with the fuel and this together with the product of combustion (carbonic acid gas) produces next the metal magnetic oxide, and on the top of it a film of sesqui-oxide, which is reduced to magnetic oxide, by shutting off the supply of air, and applying for a short time carbonic oxide only. The time required for the treatment varies from 6 to 10 hours, and on withdrawing the articles they are found to be covered with a protective coating of an enamel-like consistency. This process besides hardening the iron renders it more durable.

The Royal Engineers are now busy blowing up wreckages and other impedimenta in the channel of the river. The steam dredger and excavator is also engaged in clearing. The dredger appears an excellent contrivance, fitted with the most recent inventions. It consists of a grab and bucket worked by a crane specially designed for streams with strong under currents. A vast amount of labor is economised in discharging—the cranes which work the grab and bucket are portable, running on 4 wheels, and on the same platform is a vertical boiler of the cross-tube type, with steam and water fittings fixed on a hot water supply-tank. The self-acting bucket and grab can be fixed on an ordinary crane by means of a patent block, and brake arrangement one bucket worked by one man, will discharge 600 tons of mud in dredging a day; when the grab and bucket are not required for special work, they can be disconnected, and the crane can be used for ordinary lifting purposes; such as raising timber or stone. The makers are Messrs. Priestman Bros.

The want of suitable appliances for cutting hard rock and boring granite for blasting purposes is greatly felt by the Engineers in Railway line and road construction in Upper Burma. The slow progress now being made is in a great measure due to the absence of such apparatus, more especially so in the country along the Chindwin river, which is intersected with hard rock and granite. It would indeed be a wise policy if Government meet this pressing want, and in doing so should select those most suitable to the country, that is portable apparatus that can be easily packed and carried by a pony or carried by two men.

Through the courtesy of one of the leading firms in Rangoon specially interested in the coming Exhibition to be held at Glasgow in 1888 I was enabled to glance over the plans of the buildings, and arrangement of the grounds. The elevation is Byzantine in character, consisting of a central dome, flanked by cupolas on either side. The design appears very similar to that of the Crystal Palace; but considerably more ornate than any of the recent provincial exhibitions. The buildings will occupy 10 acres, the remainder of the portion of the Kelvingrove Park, destined for the use of the exhibition being utilized for various purposes, it has also been suggested to erect a model of the Bishop's Palace which occupied a site near the Cathedral and the utilization of this model, as a museum of antiquities. The machinery annexe will be 300 feet × 250 feet. The floor of a portion of the building will be some 6 feet lower than that of the main building, so that heavy machinery can be received at the ground level. Timber will for the most part be employed in the construction of the building and all precautions necessary against fire will be strictly enforced.

The local Government have given a month's notice to a number of non-service men employed in the Toungoo-Mandalay State Railways, to make room for permanent railway employés from India: this treatment will undoubtedly cause great discontent, as most of the hands made their engagements on the understanding that they would eventually become permanent in their respective appointments; besides many have thrown up appointments which they held prior to coming to Burma. With regard to the Engineers brought out from Ceylon special arrangements have been made to send them back to join their old appointments.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

As electric installations are being erected in and about mines for various purposes, it may not be amiss to warn intending users that there appears to be some looseness in the technical expressions used by electrical engineers. Motors are said to be of 20 horse-power which are incapable of yielding more than 12 horse-power. The best of the so-called 2,000 candle-power lamps only yield a light of about 800 candles. It would be much better if electric installation companies would apply ordinary weights and measures to electric appliances, and prevent the abuse of technical expressions. There is no gain to either purchaser or seller if a lamp of 2,000 candle-power is wanted and one of 800 candle power is supplied: the purchaser condemns the lamp, because it cannot yield the light which the makers never intend it to produce.

Inventors are taking up the question of safety mining lamps, and frequent notices appear of their experiments. As a rule, however, the tests applied do not in all cases furnish reliable results. There is a great difference between trying a lamp in a tornado of air in a small pipe and using it in the comparatively still air of the mine. Practical tests of the lamps in mines would speedily remove the conceit of some of these gentlemen who waste their own money and the time of others, to whom they describe their inventions.

A very great improvement in levelling staves for use in mines has been effected by Mr. William Ramsay, of Tursdale Colliery Co., Durham. It consists of painting the usual divisions upon a translucent substance such as glass. The "sights" are taken with greater rapidity and less risk of error as compared with the ordinary form of staff.

The question of the effective representation of the interests of mining engineers is receiving great attention. One proposal is to form an institution for colliery managers, and the other to unite the various provincial associations now in existence. This latter scheme promises to be successful if the jealousies of the various districts can be removed. It would start with over 2,000 members, and the general reduction of working expenses shou'd permit of the subscriptions being reduced to one guinea for members with a special class for students and working miners at half a guinea. The members should be charged an entrance fee of say ten guineas, members of existing institutes only excepted. The advantages of such an amalgamation would be very numerous; the transactions would record all that was worthy of consideration, all legal decisions, &c, &c.; and such an institute would be able to speak on behalf of and represent the interests of mining engineers on all occasions, to the Government or otherwise.

The boring of brine pits in the neighbourhood of Middlesbro' is being actively prosecuted. It is watched with some interest, as the pumping of brine may break up and submerge the land and cause considerable damage to houses and other structures. In the Cheshire salt district such cases are very common, and the landslips from their suddenness are frequently attended with danger to life, and are beyond all control. A recent fall near Marton Hall in Cheshire is like a crater, being about 600 yards in circumference. Great consternation would be shewn in the Middlesbro' district should such an occurrence take place.

It is a frequent matter of regret to colliery managers that the workmen do not more frequently avail themselves of the power given to them by the legislature to appoint two of their number, from time to time, to examine and report upon the safety of the mine at which they are employed. The men carry it out very seldom and at very few mines, it has consequently become a dead letter. The excuse is sometimes made that if they did so, they would be discharged; but it does not appear that any manager would be so blind to his own interest as to lose so good an opportunity of acquiring information as to the condition of his colliery. Most managers would gladly avail themselves of such reports and promptly remedy all matters of complaint.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "Star Press," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—Street & Co., 30, *Cornhill, E.C.*
NEW YORK.—The Scientific Publishing Co., 27, *Park Place.*
ROME.—Loescher & Co.
STRAITS SETTLEMENTS.—"The Straits Times," *Singapore.*
CHINA and JAPAN.—Lane, Crawford & Co., *Hong-Kong, Shanghai,* and *Yokohama.*
JAVA.—G. Kolff & Co., *Batavia.*
AUSTRALIA.—Gordon & Gotch, *Melbourne, Sydney,* and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.
An allowance is made for continuous insertions.

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 17, 1887.

THE ASSAM RAILWAY.

The one and fourpenny rupee now ruling the exchange market will have many sins of omission to account for when arraigned before a Committee of 20th century experts, wrathfully inclined towards the stupidity and want of enterprise of an age inept at securing to itself practical advantages in the way of railway inter-communication, save through the orthodox medium of a prearranged guarantee. We are told in the last *Gazette of India* to hand (September the 10th, 1887) that "fully as the Government of India recognise the importance of opening up by railway the tracts of Eastern Bengal and Assam now in question, they are not in a financial position which would justify the offer of a guarantee for a purely commercial railway, and must therefore adhere to the decision of January 1883, by which the project was classed in 'Schedule B,' and can receive no aid from the State beyond such as is comprised in a concession known as Bengal and North-Western Railway terms."

The decision arrived at by Government in connection with the embryo railway to Assam seems to us more than a pity; for there is a general consensus of opinion, public as well as professional, that such a railway could not fail to pay substantial dividends, and to approve itself to the good sense of the Anglo-Indian commonalty at large as a work of general utility and convenience. It is a truism to say that distinction ought to be made between loans contracted by Government on productive and on unproductive public works; on works that pay market rate of interest on the money expended on them, and works like Viceregal Lodges at Simla, or Grant-Duffian upholsteries at Ootacamund, that are so much dead weight on the taxational capabilities of the country. But this is a differentiation in audit of public accounts seldom taken into account by the men who rule India from serene Olympian heights. Lulled to sleep by cool mountain breezes, easy work, and untroubled surroundings, they sink into oblivion the cares and necessities of the toiling world at their feet, but hidden from their sight by circumlocutory official fog and mist.

The financial markets of the world are open to them, and are had recourse to for frivolities; but whenever the claims of something really practical, useful, humanitarian and dividend in the future promising are set before them, they fall back on the antiquated, evasive *non possumus* of mediæval popes, who could "possum"; but didn't choose to. It is more than a pity. The Government of India professes to consider as to this Assam Railway scheme to which it has given its *imprimatur* of approval that the project should be taken up by a company, or an administration—whatever that may mean. Something English in constitution, we may fairly assume. But English companies have their hands pretty full just now of Indian enterprizes on which they have embarked without more knowledge of the country they are financially experimenting on than can be derived from hearsay.

Until their experiments are proved successes; until substantial dividends are derived thereform, and can be triumphantly quoted, the stay-at-home English commercial world, to which India is practically *terra incognita*, is not likely to go deeper into unguaranteed Indian ventures; cannot in reason be expected to. And it is useless to expect anything from native capitalists. Nothing short of burial in underground vaults, or secretion in unlikely hiding places, seems to them a safe investment of money.

The case is otherwise as regards the Indian Government. It knows what is right and desirable. Our extract from last Saturday's *Gazette* proves it. And yet with traditional Secretariat perversity, it holds aloof from the right and desirable embodied in the Assam Railway scheme on the plea of impecuniosity, and for all the world as if Government loans were not, now-a-days, snapped up by capitalists and investors, at abnormally low rates of interest. Barring an even-handed practice of justice no sublunary Government could have better title to the esteem and kindly regard of the governed than in rigorous exercise of the virtue of economy.

That much may be granted absolutely. But furthermore, Government ought to understand the real meaning of the word economy; should not allow itself by virtue of a word Shibboleth to lapse into a penny-wise-and-pound-foolish state, for such a state is the utterest upsetting of real econony it has ever entered into the heart of man to conceive. Unfortunately, it is a state of misconception habitually rife in British conduct of national business.

The Government Resolution we are considering changes its initial tone of dubiety for one of more assuring promise towards the end of its lucubration, suggesting, however, with reference to the claims on the part of the tea industry, which have been prominently and persistently put forward, that it "cannot consider the matter upon the comparatively narrow basis of the cost of export of a single, not very bulky, though highly important article: they must look at the immigration, planting, and commercial interests as a whole. From this point of view, they cannot but hold that it is better to confer the benefits of railway communication upon fertile, but not completely landlocked tracts, than upon such as are at present tolerably well served by steamer transport; that it is more prudent to allot rail and steamer to different portions of a developing province than to bestow both on one alone; and that it is in the best interests of Upper Assam to place it in direct communication with the seaport nearest to it, namely, Chittagong."

That is, of course, an evasion of the point at issue: Chittagong, even with Alnaschar dreams to back it, must prove a sorry, spendthrift apology for Calcutta. But the evasion is nevertheless encouraging, as incidental evidence that the need and importance of devising more convenient ways of inter-communication between Assam and its legitimate trade centres than now exist, is recognized.

PERAK.

II.

In the Department of Surveys much useful work has been done. In Larut 1,601 acres were surveyed for the Land Office, 720 for the Mines Department and $74\frac{3}{4}$ miles of roads. The base line of $4\frac{1}{2}$ miles for the trigonometrirical survey was completed in February and kept cleared, and 1,7 28 angles were taken fixing the position of 14 trigonometrical points triangulating an area of 100 square miles, and the summits of 9 hills were cleared and trigonometrical stations fixed upon 7 of them. The work done in Kwala Kangsa included an area of 989 acres of mining and agricultural blocks and some temporary and permanent trigonometrical stations. In Krian a circuit of 3,031 acres were surveyed together with 406 blocks, $8\frac{3}{4}$ miles of road at a cost of $1-46 per acre which contrasts favorably with similar work done in other districts of the State. The adverse climatic influence to surveys, has evoked special remark from the Resident which we are in a position to confirm from a short residence in the country some years ago. The swampy nature of a good portion of the low country combined with the heavy rainfall and the obscuration of the mountain tops by clouds, for weeks together, induce fever from which survey parties suffered much and to which many had succumbed.

Telegraphic communication had been extended from Batu Gaja in Kenta to Tapah, 28 miles, and thence to Teluk Anson the Port of Perak River 22 miles, placing this important locality in communication with Penang. Several telephonic lines were initiated and established at important places and their usefulness recognised During the construction of these lines great difficulties were experienced from meteorological causes, instruments at one or two places being fused by lightning and intentional interference in the shape of cutting down of the lines. Notwithstanding all these adverse circumstances the lines worked satisfactorily. The total length of telegraph and telephone wires in use on close of the year under notice was $250\frac{1}{2}$ miles and the messages passed over the lines during the year are put down as 71,553.

The Sanitary condition of the various districts cannot be considered as satisfactory with the death rate at 9·32 per cent and the average daily sick at 722·66. There appears to us ample room for improvements in *this direction* and the water-supply of the districts in which miners congregate, and with an efficient, energetic and intelligent officer at the head the result would be most gratifying.

We find in the same Report that the main portion of the Museum was completed, but the accommodation it afforded was not sufficiently large to receive all the interesting collections made by Mr. L. Wray the Curator. From the specimens collected by the same gentleman an unrecorded resemblance has been established between the avifauna of the mountains of Perak and of Sumatra and India. There had also been made many ethnological collections including 12 stone implements found in Perak. Science and the State sustained great loss in the untimely death of the Rev. Father B. Scortechini, an accomplished botanist. By the *hiatus* thus caused it was thought the contemplated scheme of publishing a complete Flora of Perak would have fallen through, but thanks to Dr. King of the Royal Botanical Gardens of Calcutta, who has, with the assistance of Sir Joseph Hooker, promised to accomplish the work himself. The Survey, Geological and the Minerological Departments of the State suffered serious loss in the demise of Mr. W. Cameron, who was a distinguished officer, and of Mr. H. Kunstler, naturalist, leaving Mr. Wray the only representative of science in the State. Both these officers fell victims to the zeal with which they prosecuted their researches under hard conditions of life in unhealthy districts, and Mr. Wray we are told, suffered so seriously from fever that he narrowly escaped with his life.

The European Mining Companies in the Districts were doing satisfactory work and had achieved good results, but Captain Cheng Ah Kwee was, as before, by far the most extensive and successful miner.

The native population of Lower Perak, we are told, subsist almost entirely on the produce of the *nipa* trees which grow spontaneously on the banks of the rivers. The leaves are manufactured into *attaps* and exported to tobacco plantations at Deli in Sumatra where they are largely used for sheds.

It is satisfactory, however, to notice that the prosperous condition of the tin trade led to the prosperity and contentment of miners in the closing of whose accouuts no serious difficulties were experienced, but on the other hand we cannot omit drawing attention to the serious impediment caused to work and the great inconvenience felt by the District officers in the conduct of their multifarious duties from the insufficiency of hands placed at their disposal. Without an efficient staff no real progress could be expected and before a dead lock sets in the machinery of Government in the Districts whence the "wail" comes, some active and effective measu res should be adopted.

Before taking leave of our subject we must congratulate the Resident on the results achieved and the excellence and exhaustiveness of his report.

OUR TRANS-FRONTIER RAILWAYS: THE EXTENSION ACROSS THE KWAJA AMRAN.

THE different projects for the extension of the Kandahar Railway through the Kwaja Amran Range are now before the Government of India.

One of these projects (a 1 in 40 line through the Kojak Pass) is identically the same as that prepared by General Browne, R. E. and his staff last year. General Browne's Estimate amounted to a little over 300 lakhs: the estimate just submitted amounts to 124 lakhs only.

This great saving is not due to any reduction of rates, but simply to adopting a judicious and workmanlike alignment: a very little investigation was sufficient to show the practised eye of the Railway engineer that all those lofty viaducts, bridges and innumerable short tunnels and the inevitable " corkscrew" without which General Browne considers no mountain line is complete, were utterly unnecessary and that the vagaries on the extraordinary line adopted by him were either attributable to gross ignorance or to a desire to give the work an undue importance as a stupendons Engineering feat.

All the projects now submitted were prepared by Civilians under one of the most distinguished Civil Engineers in India who, however, did *not* receive the special allowance of Rs. 400 per month, nor the military pay, nor the extra house rent &c. allowed to General Browne.

Quousque tandem? How long will it take the Government to see the wicked waste of public money which such appointments as these cause? and why cannot the Indian tax-payer be made to understand that it is General Browne *et hoc omne genus* whom he has to thank for the Income Tax?

THE REASON WHY?

WHATEVER the ultimate results of the labors of the Public Service Commission may be, one thing is clear, that the mass of evidence tendered before them has brought to light a number of facts which under no other circumstances would have been available either to Government or to the people at large. It is true that there has been a good deal of conflicting testimony on various points, but that is all the better, for one-sided statements do not help us in unravelling difficulties, and truth cannot be arrived at unless every shade of opinion is thoroughly sifted.

We have always held to the belief, right or wrong, that the education and training imparted to the alumni of Indian Engineering Colleges is at present scarcely of a character—speaking generally—to ensure their being employed in the higher grades of the Department with advantage. That we were not singular in the belief is apparent from what has been so emphatically said over and over again before the Commission—the weight of opinion being in favor of the views we hold. In confirmation of which let us turn to the evidence given in Madras by Colonels Vibart and Pennycuick, whose utterances are certainly entitled to respect from the opportunities they have had of studying the question at issue. The former does not mince matters, but says in the blandest manner possible:—" I do not think the education in the local Engineering College is sufficiently good for employment in the higher grades of the Department." Colonel Pennycuick is as plain spoken. He thinks that " if a native was sent home to be educated he would make a good executive officer."

There can be but one inference drawn from these statements,—in the wholesale character of which, we cannot, however, agree,—and that is the education given to the young men of the country is sufficient to qualify them for the subordinate grades of the Public Works Department and no more. The responsibility could not be said to rest with the Principal or the tutorial staff, for they are picked men whose qualifications could not be questioned, and we speak from personal experience. Neither is the curriculum at fault, for it has been determined in view of ensuring a sound teaching in the higher and more technical branches of Engineering. We must, therefore, look for the cause elsewhere. It lies in the men who are being trained for the service. No amount of teaching will rectify natural defects. It needs no demonstration to convince our readers that the natives of the country are deficient in "the qualities of resourcefulness and fearlessness of responsibility," which form the special characteristics of Europeans. These high attributes are put to the test in the face of a sudden calamity, such as has happened and may occur again in a country like India, and no institution can supply what nature has denied. Of course, the current duties of an office may be safely left in the hands of a man with mediocre abilities, but that is beside the question. We cannot always trust to him in the hour of trial which puts to a severe test those latent qualifications which are a *sine quâ non* to the performance of an Engineer's duties.

Why, then, should there be a number of Colleges to train one or two recruits annually for the higher grades of the Public Works Department? With a high standard of education as imparted at present, and such humble work to perform, it is an anomaly to keep up high class institutions, with an expensive professional staff. They should be suited to the requirements of the time, and the demands that are likely to be made on them.

COPPER.

CURIOUS outcome of very "mixed" nationalities, ideas, and prejudices is the American of the present day. Interesting too is the fashion in which nature is, in the best sense of the word, what the French call opportunist; never making her secrets cheap by revealing them before until occasion arises, never behindhand when there is real occasion for invention of her secrets. An American paper does not believe in the British gospel of Free Trade, and is spread-eagly inclined as "the controlling copper producer of the world," and arrogating to himself power to regulate the market price paid for copper throughout the world. It is beyond question, the New York oracle declares, "that no influential mine, the world over, outside of this country, except two in Spain, and three at the Cape, can now increase its output, without correspondingly increasing its losses. Under these circumstances, most foreign mines must, at present prices, exhaust sooner or later their reserve capital, and their owners' stock of hopes, and be numbered with dead enterprises." In the self-same article from which we have made this extract, it is written "therefore the indications are in favor of higher prices, unless some extraordinary increase of production occurs." And again, "it would seem as if the market of the world will demand an increase of supply from new or growing mines of about 60,000,000 pounds, to supply its augmenting demands, and to compensate for the inevitable decline of old and declining producers." No fears as to "inevitable decline" of American production, or exhaustion of long worked mines in the ever new continent trouble the mind of the New York journalist, although it is admitted that no new ones have been discovered in that country for some years past. New York is able to see that mines in other countries may be exhausted, but is not able to conceive that a like fate is, in the nature of things, likely enough to overtake American mines too. A special providence is to watch over and safeguard them and their interests.

The writer of the article referred to gives no sign that he has ever heard of India as a possible factor in the world's copper market. Perchance, when the new Benares-Puri Railway gets constructed, and dovetails into the resources of the country to be tapped by it, he may gain a wrinkle or two on that subject. For our part we see no valid reason for belief that either English, or French, or any other old-world copper mines are, as yet, "played out." It is not to us apparent that the exercisings of the gospel of Protection have either annihilated Free Trade or afforded crushing arguments against it; and, incidentally, we venture to hope that, in a not too-far-off future, the presently unconsidered increment from India's copper resources may prove an appreciable factor in calculations concerned with the world's output of that metal. Over and above the new fields of discovery that will be opened out by the Benares-Puri Railway, the Kurruckpore range of hills in the Monghyr and Bhaugulpore districts has yet to be tapped; and so for that matter have the Himalayan and Vindhya ranges. And in India we have cheap labor as a set-off to counter balancing working disadvantages.

Notes and Comments.

THE E. I. R. AGENCY.—There is no foundation for the rumor that Sir Theodore Hope is to be the Agent for the East Indian Railway when his term of office on the Viceroy's Council expires.

A GRAVE INJUSTICE.—We learn that Government has finally refused to continue to Mr. H. J. Richard, Superintendent of Works, Upper Burma, the additional monthly allowance of Rs. 100.

BOMBAY WATERWORKS.—A Correspondent writes:—Mr. Clarke is at home just now, but he will return in November. The Corporation have sanctioned Rs. 6,000 for Additional Work Prevention Staff for remainder of financial year and the appointments are being filled up rapidly. The Vehar and Tulsi Lakes are both overflowing, the monsoon having proved a good one.

THE BENGAL IRON WORKS.—We are informed that the Bengal-Nagpur Railway Company are negotiating with the Government of India for the purchase of these works, which will, no doubt, form a desirable adjunct to the operations of the Company, and without which considerable inconvenience would be felt during the progress of the Damada bridge work, which, we understand, will soon be put in hand.

RAILWAYS IN CHINA.—Formosa is to have a railway, running from Tamshi, the principal port to Chinighna; a length of eighty miles. There are no formidable Engineering difficulties in the way: the only noticeable streams to be crossed will be spanned by three iron bridges. Messrs. Jardine, Matheson and Co. are said to have secured the contract for rails; but we are not told at what rate.

THE PROPOSAL FOR THE EASTERN BENGAL SYSTEM.—We hear on very good authority that the scheme proposed by the Bengal Central Railway to take over from Government the Eastern Bengal System, although not recommended by the Government of Bengal, is likely to come to pass, as it is favored by the Secretary of State. The amount to be raised is said to be £7,000,000. What will be done with the staff is a large question.

Oyster Island Light-House.—The work of constructing the proposed permanent light-house on the island is not yet begun. Borings for a suitable foundation have been made and final proposals will be submitted after the rainy season. The question of erecting a light-house on the north-west corner of Cheduba island has been under discussion. It is unlikely that funds to carry out this project will for some time to come be available.

The Agent and Manager, Madras Railway.—The Board of Directors of the Madras Railway have resolved that it is not expedient to unite the offices of Agent and Manager with that of Chief Engineer, and have appointed Mr. F. B. Hanna, one of their Engineers, as Agent and Manager, Mr. Robinson, at present occupying all these offices, preferring to revert to his position as Chief Engineer. Mr. Hanna is a Graduate in Arts and Engineering of Dublin, having taken his License in Engineering in 1863.

Boiler Inspection in Burdwan.—There are now 178 boilers in the Raniganj Sub-Division, and Mr. H. J. S. Cotton, President of the Steam-Boiler Commission, is in favor of the extension of the Boiler Act to that part of the country. He suggests that this should be accomplished by the appointment of a third Inspector on Rs. 225 a month, and is sanguine that the result will be eminently successful. This we are disposed to doubt; but as we hope to discuss this matter later on, we reserve our opinion in the meanwhile.

Municipal Lethargy and Monsoon Damages.—The late floods at Gujrat have imperilled the safety of the Civil Station, and the inhabitants are beginning to think once more, as they have often thought before, that something ought to be done to keep the Bhimbar river under control. But this is the end of the year's rainy season, imminent danger is over for a twelvemonth, and the subsident, freebooting Bhimbar will now put on a look of meek muddiness, and sing small till it floods the Civil Station next year or the year after next.

The Equitable Coal Co.—The report of this Company for the half-year ended 30th June is a very dismal affair, disclosing a loss on the working of Rs. 17,382 and reducing the balance at credit of Profit and Loss to Rs. 8,151. The Directors remark that it is much to be regretted that the result is so unsatisfactory, which is mainly attributable to a lower range of prices, combined with the fact that extensions recently undertaken have not yet been able favorably to affect the working of the collieries. The shareholders have adopted the report unanimously, so no more need be said.

Railways in Persia.—The Shah of Persia's visits to Europe are bearing fruit after their kind; and a Belgian syndicate has obtained a concession for the construction of a railway from Teheran to the holy city. The Syndicate is now maturing plans for the construction of this line, and eventually of other lines in Persia. The moral of the concession is that royal tours cost money, and concessions bring money into a depleted treasury. The railway line is another pair of boots altogether, and will be taken into consideration perhaps when the Belgian Syndicate wants to commence active operations. Then the issue will be in the hands of the God *Buckshish*.

Railways in South Africa.—The Durban correspondent of the *Times* telegraphed to that journal on the 3rd of August last:—"The Natal Council will be prorogued to-day. It has agreed to entertain the question of a cession of a share of the Customs duties, to any inland State which may be prepared to carry forward the Natal Railway from the Border. The Cape Parliament has agreed to the proposal to confer with other States and Colonies regarding a Customs Union, and with the two Republics regarding railways. The finances of Cape Colony and Natal continue to improve. The Natal railway extension to the coalfields is to be commenced when the loan has been sanctioned."

A New Departure.—We hear that Mr. R. T. Mallett, Chief Engineer, Railway Branch, now in Simla, is appointed Consulting Engineer for Guaranteed Railways, Central Circle, comprising Indian Midland and Bengal-Nagpur Railways, with head-quarters at Jubbulpur, during the absence of Major W. Shepherd, R.E., who is deputed to visit Mexico to study the working of Fairlie Engines on stress inclines. Sir A. M. Rendel, Consulting Engineer to the India Office, recommended that a *Civil* Engineer and a Locomotive Engineer should be sent, but by utilizing the known versatility of the Corps the expense of sending *two* officers is saved. Major Shepherd's experience in sheep farming in the Far West has probably led to this selection.

Madras Indigo.—The head of the Madras etcetera department has covered himself with departmental glory by discovering something that everybody else in the Benighted Presidency interested in indigo has known for the last century. To wit that Madras indigo is adulterated with mud, stiffest clay procurable. He does not seem to have discovered that this foreign element is used simply to add to the weight of the dye stuff, and without any regard to color. Some indigo planters are very fond of going in for color; but it is nevertheless amoot point whether disregard for it, and concentration of energy on the attainment of a weight incompatible with anything like pretention to good color, does not pay better in the long run except for factories with very special advantages in the quality of the water used for *mahai*, and a cultivation not scattered, but lying within a ring fence, as it were, nowhere more than a couple of miles from the vats.

Civil Engineers' Provident Fund.—The Government of India is now pleased to rule that the privilege *re* officers who were in the Department on the 4th February 1885, wishing to join the Civil Engineers' Provident Fund, that they might pay up arrears, within the authorized limits, from the commencement of service, or for any shorter time, in one sum, shall continue in force till the 31st December 1887, and shall then cease absolutely, except as regards officers now on leave out of India, who may return at a date subsequent to the 30th September 1887; in such cases the period for payment may be extended to a date not exceeding three months after the date of their return from leave. Officers who have already joined the Fund are also permitted to pay up arrears in one sum at any time, prior to the 31st December, subject to the same condition as to officers on leave out of India. Except as above permitted, no future payments on account of salary drawn prior to admission to the Fund can be made either by officers who are already in the Fund, or by new subscribers.

Current News.

The bridge over the Sutlej at Suni, the capital of the Rana of Bhajji, has broken down.

It is believed at Dehra Ismail Khan that there is likely to be a survey expedition of the Gomal Pass during the coming winter.

Captain H. D. Olivier, R.E., is appointed to the charge of the Ordinary Military Works, now under the Executive Engineer, Bombay Defences.

Sir Theodore Hope will accompany the Viceroy in his journey to Beluchistan as well as along the Sind Saugor Railway, and thence onwards to Peshawar.

A Company, we hear, is about to be projected in London for ths construction of a steam tramway from Kaneasamudrum to Kolar Road, on the Madras Railway, and cutting through the gold fields of Kolar.

Sir Charles Elliott leaves England by the steamer of the 2nd December, arriving at Calcutta towards the end of the month, when he takes over the Public Works Department from Sir Theodore Hope.

The site for the Secunderabad water-supply first chosen, at Jeedimatha, was abandoned, and another at Shammerpett, six miles distant from Bolarum, was after a while discovered to have sufficient elevation.

Mr. H. Wood, Assistant Controller of Stores of the East Indian Railway Company, is expected to return from leave and resume charge of his office on the re-opening of the public offices after the general holidays.

The *Railway Service Gazette* learns that the continuation of the Bilaspore-Etawah Railway from Umaria is to be proceeded with immediately, and that the contractors have received an intimation that the line must be carried to Bilaspore by 1889.

Mr. Rose, an Engineer of the British P. W. D., is, we learn from a contemporary, doing a meritorious work in Aurungabad. He has deciphered the inscriptions on the Armenian tombs in the confines of the city, and has been thereby enabled to fix their erection towards the end of the seventeenth century.

It is said to have been settled that Mr. Guildford Molesworth will retire at the end of the approaching cold weather. "It remains to be seen," the Allahabad paper remarks, "whether in these days of reductions, his post will be filled up." To the lay mind, the Government ought to be able to place sufficient faith in the expensive engineering agency ordinarily at its command.

The Madras Government have directed that, as an experimental measure, all tanks and channels coming under the category of "Minor Irrigation Works," which have already been investigated and put into thorough order, be handed over to the ryots for their maintenance in the future, the Collector of the district concerned supervising the proper and efficient upkeep of the tanks and channels so handed over.

At the suggestion of the Traffic Manager of the Madras Railway, the Agent of the Company is having contructed a composite carriage, at a cost of Rs. 11,000, to be available at Raniguuta junction station, in view to serving the passenger traffic that may be expected to pass on to the Madras Railway Company's system, on the opening of the Tirupati-Nellore section of the Cuddapah-Nellore State Railway at an early date.

The dispute in the House of Commons about the Ruby Mines cannot be as near settlement as some people wish; for a systematic examination of Mines by an officer of the Geological Survey has been ordered with the view of determining the amount of the wealth stored there. The Mines are usually understood to cover an area of twenty-five or thirty square miles, but Captain J. A. Hobday gives credence to rumous of rubies being found over a much wider area.

In the annual report of the Simla Municipality just issued, suggestions are made for the improvement of the water-supply at an estimated cost of two and a half lakhs. The sum is not a very formidable one, but is quite beyond the resources of the Committee, who can only fall back for assistance on the Punjab Government. That Government is itself however notoriously "hard up"; and it would therefore seem that the Government of India will at last have to do something for the place, for whose existence and requirements it is altogether responsible.

Mr. J. H. E. Hart has been gazetted Chief Engineer, first class, and Secretary to the Bombay Government in the Public Works and Irrigation Department, Colonel Goodfellow, v. c., R.E., succeeding Mr. Hart as Chief Engineer for Irrigation. But it is stated that Mr. Hart does not intend to remain; that he will take up the office of Secretary for fifteen days only, and then go on furlough with the object of retiring at the end of his leave. Thus, what a Bombay paper styles the "burning question" as to who is to be Secretary to Goverment in the P. W. D., is re-opened. Colonel Goodfellow appears to be next on the list, after Mr. Hart.

His Excellency the Governor of Bombay in Council, acting under instructions from the Government of India, is pleased to place the services of the following officers at the disposal of the Government of India, with a view to their being gazetted temporarily to the Military Works Department for Defence Works:—For Kurrachee—Major W. H. Haydon, R.E., and Lieutenant W. W. Baker, R.E. For Bombay—Lieutenant-Colonel E. D. O. Twemlow, R.E., Captain E. C. Spilsbury, R.E., and Lieutenant P. E. Dixon, R.E. For Aden—Lieutenant-Colonel J. D. Cruikshank, R.E., Captain W. J. Lister, R.E., and Lieutenant J. Dallas, R.E. The services of Lieutenant-Colonel A. R. Seton, R.E., on his return to India, are also placed at the disposal of the Government of India for employment as a Superintending Engineer for the Defence Works of Western India.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

STRENGTH OF OLD RAILS.

Sir,—If you and the correspondent on "New Types of Roofs," or some one who has had the experience would say what weight with what bearings are safely carried by old rails of specified shape and weight, it would be a very useful piece of information, as many inexperienced men are building with these and filling their distances by guess.

A. M. B.

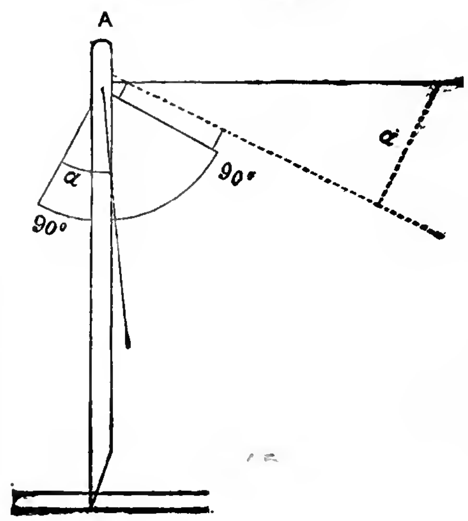
[This information will be forthcoming.—Ed. *I.E.*]

EXAMINER, P. W. ACCOUNTS.

Sir,—Your correspondent, "Subscriber" who, taking, every thing quite *au serieux*, has chivalrously flourished the cudgels on behalf of our much maligned Examiner, must I fear, to use a vulgar but happy expression, be considered to have had his leg pulled.

Penny-a-liner.

THE KLITOMETER.



Sir,—Your correspondent "Political Agent" seems to fancy the klitometer, but surely there is a much simpler form as follows:—A. B. stout iron shod staff flat face on one side at top. This is jobbed finely into ground. It has a wooden board quadrant fixed on it by a screw with a head which allows it to be tightened up in any position. The quadrant can thus be fixed into any angle, *e.g.*, a and at the plumb line depending from its centre; and the line seen along the two nail heads for sights is the slope you want. The quadrant is, of course, graduated both ways for depressions and elevations.

A. M. B.

THE BOMBAY P. W. D. SCANDAL.

Sir,—Your correspondent "Executive" appears to have been drawn by the article in the column of "Current News" in your issue of the 13th August. It was a pity, however, that he took upon himself to speak for all the Civil Engineering members of the Bombay P. W. D. without knowing their opinions and the facts connected with the temporary promotion of Mr. W. C. Hughes to be Chief Secretary with rank and pay of Chief Engineer first-class. He is incorrect regarding Mr. Hughes' service as Assistant Engineer and as to the length of time during which he was in Executive charge of works. These, however, are minor points, since it is very certain that he will not remain where he now is when the modifications and reorganizations that have been rendered necessary by financial pressure, and, I believe, suspected to a great extent by the Finance Committee, have been worked out and established.

The rank given him was merely a *matter of accounts* and demanded by the Examiner of P. W. Accounts. The *whole* rank and the *whole* pay *or nothing* was his reading of the rules regarding the case. I beg to state, therefore, that I for one, and several who are aware of the facts, are not exasperated, because the work was unexpectedly delayed and has already lasted five months and we rejoice that the right man was in the right place and that a *Civil* Engineer has at last acted as Chief Secretary to Government, P. W. D. We know, at all events, what the alternatives were, and that if a Civilian or a spare R. E. from Bengal had acted during the crisis, that he would probably have stuck fast over us, whereas now our own head men (who were then either too busy with their other duties or ill) will most probably now fall into their proper places, while the man who did the hard work for five months will get the well earned pay of the post, and I hope, when all is known, the hearty congratulations and good wishes of the Civil Engineers of the Bombay P. W. D. We shall at all events know when orders are expected immediately.

ANOTHER EXECUTIVE AND A C. E.

[The G. O. confirming the above has been already issued.—ED. *I.E.*]

WORKING THE "BROKEN MINE."

SIR,—I am much surprised at seeing no answer to the very practical question put three weeks ago by "Colliery Manager" on the above subject.

To the Colliery Manager in India, who need not necessarily be educated in pit work as at home, such questions are of grave importance and will no doubt trouble him very much. There are not very many colliery men in India, but I think there must still be a few who have had the practical as well as the theoretical experience and could give this question an answer; at any rate it would be interesting to have the opinion of some of our M. E's. on the subject.

There are, however, in "C. M's." question considerations of the nature of roof, rise and size of seam, small size of pillars, and above all the 4′ 0″ seam so near above, that can only decide on the system of working the "Broken." I have carefully studied them all and give it as my opinion that the best method to adopt in this special case would be the old style of "lifting off" from the headways course.

This could not, as in ordinary cases, be performed E. and W. on account of the seam's inclination, but all lifts might be carried (extended) two pillars, which would only be a distance of 12 yards and not too far with such a good roof and floor.

To begin this operation I presume that "C. M." has given the best attention to the seam above and also that he knows the difficulties to be afterwards encountered by contortions, slips, stythe, &c., in working this seam after goaf has been formed below: that he also knows by experience that all top seams *should* be worked first for the reasons spoken of.

To proceed, it would be necessary to lay out a district, and for this purpose one of the boards should be selected for a wagonway, having a sheath of boards on each side 90 or 100 yards, to facilitate the "putting." Every alternate headways course would only be laid; as working to the rise alone would give him only 15 feet and would not pay the cost of laying the way. Let him take the full 12 feet at a breast hole into and cross the headways above and continue until holing into the goaf.

"C. M." must take care to work the "Broken" at a decent angle, say, 50,° or so to assist his remaining pillars and for the purpose of making his wagonway his "closing" board.

A seam so conditioned with roof and small pillars requires great caution to procure good fall, which can only be done by quickly abstracting the coal and creating big areas of newly formed goaf before the timber is drawn.

If the timber of small areas is allowed to be drawn "creep" will be the result. Such a hard roof could not break and would gradually settle upon the small pillars and cause upheavals in the floor, crush the coal, break the timber of existing working places near to, and create falls of roof. Or perhaps a loss of many pillars of coal. When once a seam is under such conditions it takes a long time, much trouble and expense to regain an equilibrium.

"C. M." must have at least two men in one place—or three if he can do it—to quickly get through an unpleasant duty.

Hoping some other pitman will give us his suggestions.

"C. M." can have a sketch if he requires it.

DANDOTE.

New Books and Reprints.

ARCHITECTURE.

OUR National Cathedrals (the Richest Architectural Heritage of the British Nation): Their History and Architecture, from their Foundation to Modern Times, with Special Accounts of Modern Restorations. Lavishly Illustrated with separate Colored Plates, reproduced from fine Steel Engravings, and very many original Wood Engravings in the Text; thus fully Illustrating all the Cathedrals from many points of view; the whole carefully compiled and revised with the aid of Dignitaries of the Anglican Church. Vol. 1. Roy. 8vo, pp. 250. Ward and Lock 10/6

ASTRONOMY AND METEOROLOGY.

SUNLIGHT. By the Author of "The Interior of the Earth." 2nd ed., with Alterations and Additions. Post 8vo, pp. 192. Trübner. 5/

CHEMISTRY AND PHYSICS.

COHEN (J. B.) The Owens College Course of Practical Organic Chemistry. 18mo, pp. 212. Macmillan 2/6

HARCOURT (A. G. V.) and Madan (H. G.) Exercises in Practical Chemistry. Vol. I: Elementary Exercises. 4th ed. Revisd by H. G. Madan. Post 8vo, pp. 596. Frowde 10/6

MY Microscope and Some Objects from my Cabinet. By a Quekett Club-Man. 8vo, pp. 78. Roper and Drowley ... 1/6

STOKES (G. G.) On Light: Burnett Lectures, in Three Courses, Delivered at Aberdeen in November 1883; December 1884; and November 1885. (Nature Series.) Post 8vo, pp. 350. Macmillan 7/6

STUTZER (A.) Nitrate of Soda: Its Importance and Use as Manure: Prize Essay. Rewritten and Edited by Paul Wagner; according to the Views of the Committtee of Judges, partly considering the Second Prize Essay. By Prof. A. Damseaux Gembloux. Cr. 8vo, sd., pp. vii—98. Whittaker and Co. 2/6

ELECTRICITY.

ESSON (W.B.) Magneto and Dynamo-Electric Machines, with a Description of Electric Accumulators: A Practical Handbook, with Use of the German of Glacer de Cew. 2nd ed., enlarged, with a New Preface and an Additional Chapter on the latest Types of Machines. With 99 Illusts (The Specialist's Series.) Cr. 8vo, pp. xi—312. Whittaker and Co 7/6

MASON (C.F., M D.) A Compend of Electricity, and its Medical and Surgical Uses. With an Introduction by C. H. May, M.D. 12mo, pp. xv—108. Philadelphia 5/

ANNOUNCEMENTS.

By Messrs. Macmillan & Co.:—

Absolute Measurements in Electricity and Magnetism. by Andrew Gray. Cr. 8vo.

School Course of Practical Physics. By Balfour Stewart and W. W. Haldane Gee. Part I.: Electricity and Magnetism. Cr. 8vo.

ENGINEERING AND MECHANICS.

ARMOUR (J.) Power in Motion: Horse Power, Wheel Gearing, Driving Bands and Angular Forces. (Weale's Series.) 3rd ed. 12mo, pp. 190. Crosby Lockwood 2/

BEATON (A. C.) Pocket Technical Guide, Measurer and Estimator for Builders and Surveyors. 4th ed., carefully revised and priced according to the present value of materials and labor. 64mo. Crosby Lockwood 1/6

BUTTS (E.) The Civil Engineer's Field-Book. 12mo. New York... 12/6

CAPSTAFF (J. S.) Tabulated Weights of Angles, Tees and Plates in Iron and Steel, for the Use of Shipbuilders, Manufacturers, &c. 32mo, pp. 70. W. Scott 2/6

DYE (F.) Hot Water Supply: A Practical Treatise upon the Fitting of Hot Water Apparatus for Domestic and General Purposes. Post 8vo, pp. 90. Spon 3/

GILLESPIE (W. M.) A Treatise on Surveying; Comprising the Theory and the Practice. Revised and Enlarged by Cady Staley, President of the Case School of Applied Science. With numerous Illusts., Diagrams and various Tables. 8vo, hf.-leather. New York 18/

LOW (D. A.) An Introduction to Machine Drawing and Design. New ed., enlarged. Post 8vo, pp. 104. Longmans 2/

MOOS (N. A.) An Elementary Treatise on the Strength of Materials and Strains in Structures. For the Use of the Senior Students of the College of Science, Poona. Roy. 8vo, sd., pp. viii—84. Griffith, Farran and Co. 3/6

NEWMAN (John) Notes on Concrete and Works in Concrete. Especially Written to Assist those Engaged upon Public Works. Post 8vo, pp. 148. Spon 4/6

SAUNIER (C.) A Treatise on Modern Horology in Theory and Practice. Translated from the French by Julien Tripplin and Edward Rigg. With 78 Woodcuts and 22 Colored Plates. 2nd ed. Roy. 8vo. Crosby Lockwood 42/

WELLINGTON (A. M.) The Economic Theory of the Location of Railways: An Analysis of the Conditions Controlling the Laying-out of Railways to Effect the most judicious Expenditure of Capital. Revised and Enlarged ed. Illust. 8vo, pp. xx—980. New York 25/

MATHEMATICS.

BOTTOMLEY (J. T.) Four-Figure Mathematical Tables. Comprising Logarithmic and Trigonometrical Tables, and Tables of Squares, Square Roots and Reciprocals. 8vo, pp. 50. Macmillan ... 2/6

ANNOUNCEMENTS.

By Messrs. Macmillan and Co:—

Kinematics and Dynamics. An Elementary Treatise. By J. G. Macgregor. Illust. Cr. 8vo.

Geometrical Conics. An Elementary Treatise Drawn up in accordance with the Syllabus issued by the Society for the Improvement of Geometrical Teaching. By a Cockshott and F. B. Walters. Cr. 8vo.

A Treatise on Analytical Statics. By J. Todhunter. New edit., revised by J. D. Everett.

A Key to Mr. Todhunter's Conic Sections. By C. W, Bourne. Cr. 8vo.

A Key to some Examples in Messrs. Jones and Cheyne's "Algebraical Exercises." By W. Failes. Cr. 8vo.

A Companion to "Weekly Problem Papers." By John Milne. Cr. 8vo.

Algebra for Schools and Colleges. By Charles Smith. Cr. 8vo.

By Mr. John Murray:—

Exercises in Algebra. By Edward Peake Rouse and Arthur Cockshott. (Eton Mathematical Series.) Cr. 8vo.

GEOLOGY, MINERALOGY, MINING.

GEIKIE (Archibald) The Scenery of Scotland, viewed in connection with its Physical Geology. 2nd ed., with 2 Geological Maps and numerous Illusts. Post 8vo, pp. 492. Macmillan ... 12/6

HOWORTH (Henry H.) The Mammoth and the Flood: An Attempt to Confront the Theory of Uniformity with the Facts of Recent Geology. 8vo, pp. 496. Low 18/

General Articles.

NEW TYPES OF CHEAP ROOFS.

By W. G. Bligh, Executive Engineer, P. W. D.

III.

To further illustrate this subject, sketches of various segmental tied roofs designed and erected by the author and now standing are given. The object is more to prove that any abnormal thickness of walls is quite unnecessary, and also that this style of roof can be safely built on *kacha-pucca* walls, *i.e.*, brick or stone laid in mud mortar and simply lime pointed outside.

No. 1, Plate III, is a section of the chemical godown of the Lucknow Paper Mills built in 1886.

The exterior walls are composed of *pila* bricks laid in mortar with the exception of the skewbacks and cornices which are *pucca* brickwork. The inner arcaded wall is *pucca*. The exterior walls are 1′ 7½″ thick. The building is double storied and the floor is carried by an arch flatter than ⅛th rise. The ties for these arches are formed of one length of rod (welded) screwed up outside the wall. The upper arches are separately tied.

The cost of this building was extraordinarily low and its successful construction proves that *kacha-pucca* work for the walling can be safely used up to 15 feet span which effects a great saving in cost.

No. 2, Plate III, is another example of tied arching over *kacha-pucca* work. The walls of the building are here composed of coursed rubble masonry laid in mud mortar (lime pointed)—*kacha-pucca* in fact, the verandah openings, and door arches, the skewbacks, cornices and top cornice of wall, being built with lime mortar. In my opinion a vast amount of money is needlessly wasted in the country by building everything *pucca*. In the ordinary one-storied buildings with their thick walls (18 inches being generally considered a minimum thickness) *kacha-pucca* work is practically every bit as sound and is very much cheaper.

No. 3, Plate III is a section and plan of another godown at the Lucknow Paper Mills. The exterior walls are 1′9″ thick with occasional projections averaging about 2′ mean thickness. The spans, 28′, are believed to be the largest ever constructed on this system in the N.-W. P. The walling in this case is necessarily *pucca*. The cost of this building, considering its large area, 4,200 sq. ft., was also very low.

The arch in No. 4, Plate III, is a similar segment. The material of the walls and arch, excepting the central loft, is all of coursed rubble masonry. The building is of two floors, formed of jack arches carried by stone girders, which rest on square masonry pillars.

It was originally intended to have two other rooms of 20′ span each on either side. The walls are 2′ 3″ thick; the skewbacks are of ashlar.

No. 5, Plate III, shews a section of roof used for the 22′ span. The rise is only one-sixth. One-fourth would undoubtedly have been better. These roofs are subject to immense vibration which they have stood without injury.

In a large span it is as well to adopt a parapet wall with gargoyles or iron pipes to throw off the rain water. The drainage of a double span roof, as in *Figs.* 1 and 3, Plate III, is effected by sloping down the surface of backing from the centre to each end.

The less material put in the haunches of these arches the better. The arc is in equilibrium and loading the haunches only increases the thrust and tends to deflect the line of pressure out of the axial line of arch. The tie rods should be of "Best Refined" iron, welded when necessary to make up long lengths. The diameter of ends which are cut for the screw should (as noticed before) be ⅛″ larger than the rod to allow for cutting the threads of screw. The screws and nuts should be very carefully made, as of course everything depends on their holding The round iron is very cheap, easily obtained in the bazar, and the rods can be made up by any intelligent mistrie with proper dies.

This type of roof is practically unknown in Europe for the very simple reason that it would not pay. Brickwork costing eight times as much as it does out here and ironwork being half the price or less, rolled beams with light jack arches are cheaper. In addition to which buildings are usually many stories high with thin walls which require flat girders to hold them together.

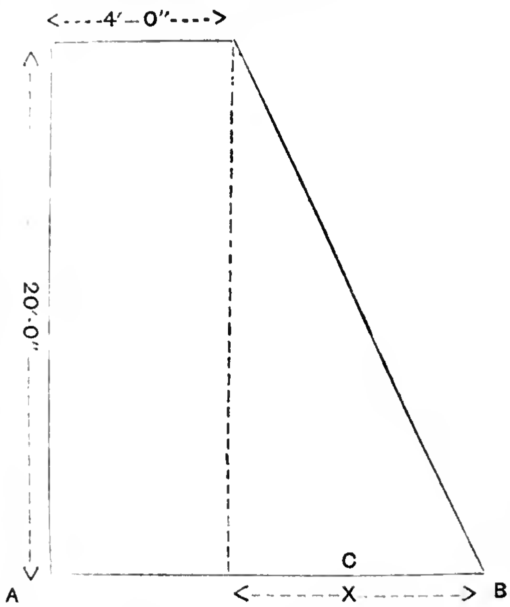
(*To be continued.*)

THE ADHESION OF CEMENT AND OF VARIOUS CEMENT MORTARS TO BRICKS.

With Their Application in the Design of Retaining Walls, Arches, and Similar Structures.

II.

The following examples were chosen to illustrate a method of dealing with such questions, and to shew how much the adhesive strength of the mortar may increase the strength of such structures.



Example.—To determine the thickness of a retaining wall at the base, having given the thickness at the top, and the head of water, first when there is no tension at the joint A B, and secondly when tension is developed at the corner A.

First, there is no tension at A.

Let the thickness of the wall at top be ... 4′ 0″

" " head of water be ... ... 20′ 0″

" " material of the wall be concrete weighing 140lbs. per cubic foot.

" x be the extra thickness of the wall at the base.

" X be the distance of the centre of gravity of the wall from the edge B.

The section of the wall being a trapezoid the area of the section will be equal to the product of the sum of the two parallel sides by half the perpendicular distance. As in this case the two parallel sides are $x + 4$ and 4, their sum will be $x+8$, and half the perpendicular distance is 10, therefore the area of the section of the wall is equal to 10 $(x+8)$.

Again, as the weight of concrete is 140lbs. per cubic foot, the weight of the wall will be $140 \times 10\ (x+8)$.........(a).

Taking moments round B we see that the total weight of wall is the resultant of the weights of the rectangle 4×20 and of the triangular part.

But the moment of the total weight round B will be $140 \times 10\ (x+8)$X, X being the distance of the centre of gravity of the wall from the point B.

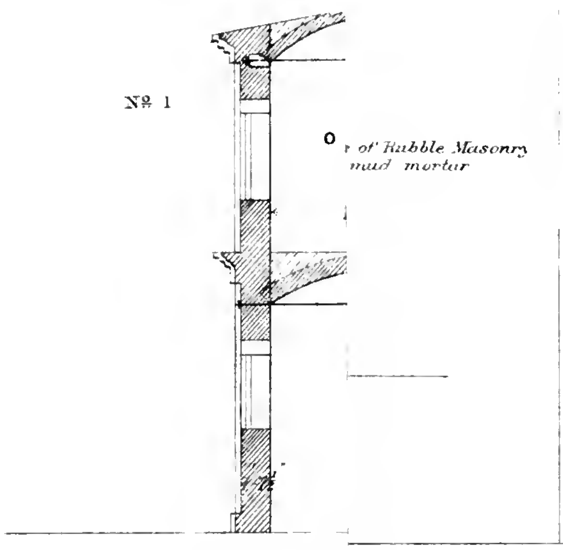
Again, the weight of the triangular part is $140 \times 10x$, and the distance of its centre of gravity from B being $\frac{2}{3}x$, its moment will be $140 \times 10x \times \frac{2}{3}x$.

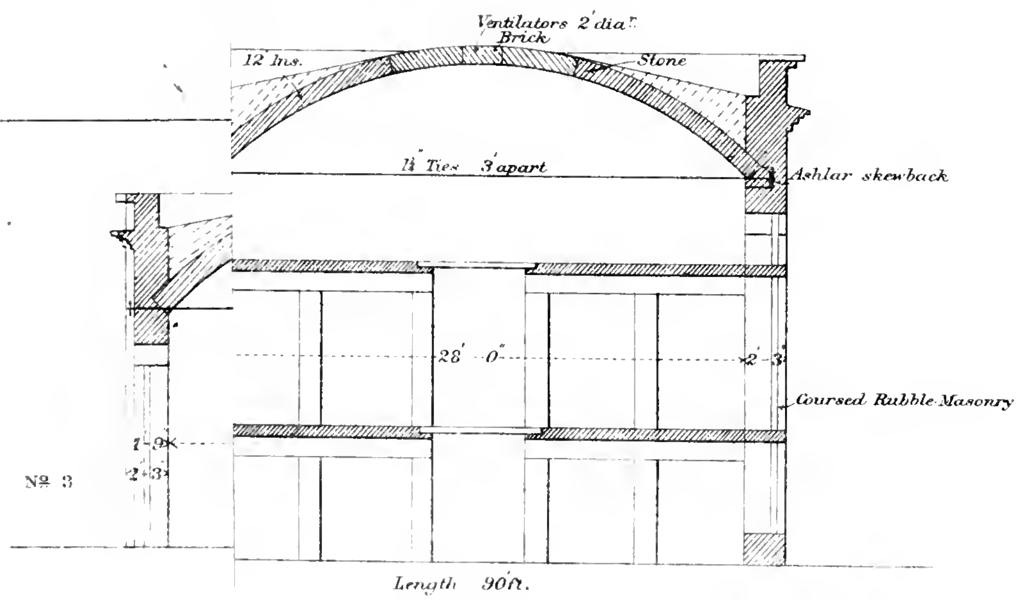
The weight of the rectangular portion is $140 \times 4 \times 20$, and the distance of its centre of gravity from B being $x+2$, its moment will be $140 \times 80(x+2)$.

Therefore $140 \times 10 \times X\ (x+8) = 140 \times 10x \times \dfrac{2x}{3} + 140 \times$

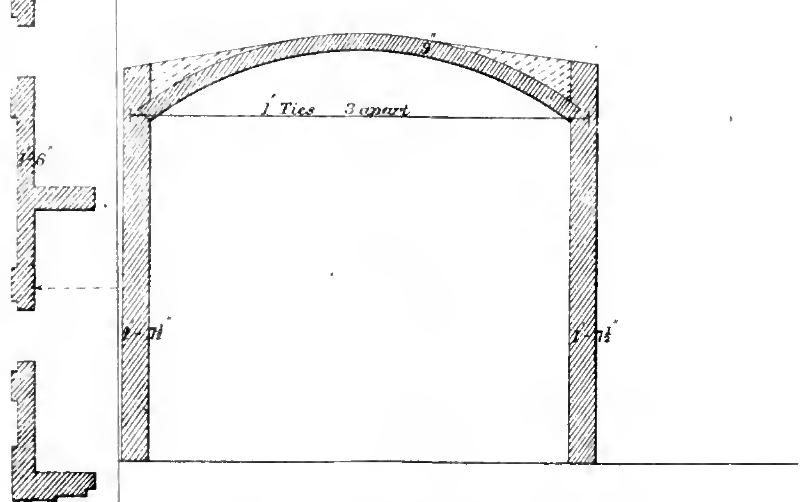
PLATE III.

NEW TYPES OF CHEAP ROOFS.





JARDINE, SKINNER'S LAC GODOWN, MIRZAPORE.



LUCKNOW PAPER MILLS.

Section of Engine Room, 200 ft. in length.

The "Star" Press, 19 Lall Bazar Street, Calcutta.

$$80\ (x+2) \text{ and } 10\ X\ (x+8) = 10x \times \frac{2\,x}{3} + 80\ (x+2)$$

$$\text{or } 10\ X\ (x+8) = \frac{20\,x^2}{3} + 80\ (x+2)$$

$$X = \frac{20x^2+80\,(x+2)}{3 \times 10\ (x+8)} = \frac{20\,x^2+240\,x+480}{3 \times 10\ (x+8)} = (b)$$

Now take a point C in A B such that B C $=\frac{1}{3}$ A B. Then the distance of the centre of gravity of the wall from C will be equal to the distance of the centre of gravity from B less B C, that is to say, X—B C.

$$\text{But } X = \frac{\frac{20x^2+80\ (x+2)}{3}}{10\ (x+8)}, \text{ and as B C is } \tfrac{1}{3} \text{ A B, and}$$

$$\text{A B} = x+4, \text{ then B C} = \frac{x+4}{3}$$

$$\text{Therefore } X\text{—B C} = \frac{\frac{20x^2}{3} + 80\ (x+2)}{10\ (x+8)} - \frac{x+4}{3}$$

From which we find that the distance of the centre of gravity of the wall from C is

$$\frac{x^2+12x+16}{3\ (x+8)} \quad \ldots \quad \ldots (c)$$

Take moments about the point C. The weight of the wall being $1400\ (x+8)$ {see (a)}, the moment round the point C will be the product of this weight by the distance of the centre of gravity of the wall from C, or 1400

$$X\ (x+8) \times \frac{x^2+12x+16}{3\ (x+8)} + \frac{1400\ (x^2+12x+16)}{3}$$

The moment of the water is $\frac{1}{6}\,w\,h^3$
where w = 62·5 lbs. per cubic foot
h = 20 feet (height.)

$$\text{Then moment of the water is } \frac{62\text{·}5 \times 8000}{6} \quad \ldots (d)$$

In order that there may be equilibrium the moment of the weight of the wall must equal the moment of the water. We have therefore the following equation:

$$\frac{1400}{3}(x^2+12x \times 16) = \frac{62\text{·}5 \times 8000}{6}$$

Whence $x^2+12x - 163 = 0$

Solving this equation we obtain $x = -6 \pm \sqrt{199}$

$$x = -6 \pm 14 \text{ nearly}$$

Taking the upper sign we find $x = 8$, so that x being a little more than 8, the total thickness of the wall will be a little more than 12 feet at the base.

Secondly when there is tension at A.

In this case take moments about B instead of C. The distance of the centre of gravity of the wall from B is

$$\frac{20x^2+240x+480}{3 \times 10\ (x+8)} \quad \ldots \quad \ldots \quad \ldots (\text{see } b).$$

$$\text{or } \frac{20\ (x^2+12x+24)}{3 \times 10\ (x+8)} = \frac{2\ (x^2+12x+24)}{3 \times (x+8)}$$

The weight of the wall being $1400\ (x+8)$ .. ... (see a).
The moment will be

$$1400\ (x+8) \times \frac{2\ (x^2+12x+24)}{3\ (x+8)}$$

$$= \frac{2800}{3}(x^2+12x+24)$$

$$\text{The moment of water is } \frac{62\text{·}5 \times 8000}{6} \ldots \quad (\text{see } d).$$

And as the two moments must be equal, we have

$$\frac{2800}{3}\ (x^2+12x+24) = \frac{62\text{·}5 \times 8000}{6}$$

or $x^2+12x+24 = 90$ (nearly)
whence $x^2+12x-66=0$
Solving as before we find
$= x - 6 + 10$ (nearly).

And neglecting the negative sign $x = 4$ feet, so that in this case the increase of thickness at the base will be 4 feet, giving a thickness of 8 feet instead of 12 feet.

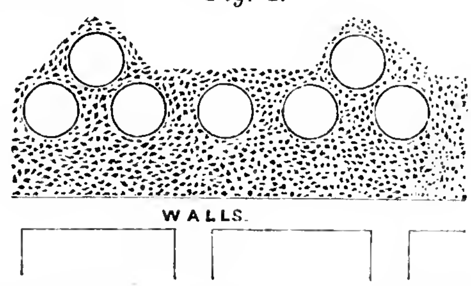
(To be continued.)

BUILDING CONSTRUCTION IN PENANG.

GOOD bricks are not procurable in Penang, even the small brick used for ordinary purposes—a brick 8″ × 4″ and varying from 1½″ to 2″ thick—is brought by sea into Penang. For a new public office in course of construction a very good brick is being made and brought into Penang by country boats; it is a brick of the usual English size and in color very like a fine brick splashed with red.

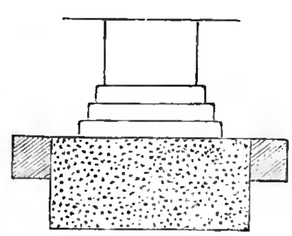
The soil in Penang is little more than a morass, so that although the new offices building is some 50ft. and more from the Quay wall, still it has to be protected by a series of 6ft. diameter wells, 1 brick thick, sunk some 30ft. deep on curbs and filled in with Portland cement concrete. The wells are ranged as shown in Fig. 1, and the dotted space is all filled in flush with Portland cement concrete and about 3ft. thick.

Fig. 1.



The wall foundations are shown in section, Fig. 2, with rough granite blocks, making up the sides. The concrete where granite blocks are not used is laid against boards, afterwards removed, and the ground filled in between. Portland cement concrete is apparently lavishly used; it is composed of broken granite, rather large, 7, sand 2, cement 1, and makes a good hard concrete, judging by the way, in which the ground floor is being kept up. For about 4′ 6″ the soil is evidently a damp one.

Fig. 2.



Rough blocks of granite are freely used in building; it is quarried from the Hills immediately at the back of Penang and does not involve more than five miles of carriage. There are some good granite masons. All labor is Chinese and they use scabbles as in England; they make small tomb, Chinese, head-stones circular, the smallest about 2′ 6″ long and 8″ in diameter with a rough

Fig. 3.

end to let into the ground. The work is very excellent, smooth and very true. A very dark grey close grained stone used as flat slabs can be surfaced for polish. Granite up to 10ft. long and tapering for 1′8″ at one end to 1′3″ at the other, is extensively used for pillars. All the new country boat jetties have granite pillars of this description.

A house in Penang, if a fire were to occur in it, would be gutted in a quarter of an hour. Wooden beams, wooden partitions and wooden roof, covered with a V-shaped tile; all the roofs are pent roofs tiled. A pair of long high parallel walls is the only masonry of a Penang house in the city, whereas outside a series of pillars running up the two stories is the character of the construction, all the rest being filling and partitions. Some of them would rival the London suburban speculative style in character. The Bengali could learn a lesson in the character of small houses which are built on a series of timber legs, all open beneath, keeping the occupants well above ground. There are a few of the European residences outside Penang very pretty house-like structures. The China shop-keeper's house is a vast improvement on the Calcutta Chitpur shop-keeper's den—pretty, open, clear and well ventilated to the street, fully 15ft. to the first floor level, carved open woodwork in door and two side window grilles gilt and ornamented with their coarse-colored pottery fillings to verandah openings.

As a mechanical appliance the bellows contrivance of a China blacksmith in comparison with the Bengali smith's bellows is the difference between the old Rocket Engine and a 64-ton 4-wheeled coupled Engine of to-day. It is a clever contrivance of a square cylinder with a piston worked backwards and forward, two small grids in the front admitting the air. The China smith in Penang uses wood charcoal and he is a clever worker in iron.

The new market is a plain useful building, sloping sides with a double row of short iron columns on tall granite pedestals.

The timber used here is mostly Johore teak.

B.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. VI.

Coursed Rubble Masonry in Plinth.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Masons No. ...	5½			
Do. " ...	2½			
Coolies " ...	2½			
Do. " ...	2			
Do. " ...	1½			
Bhistie " ...	1			
Grinding mortar, c. ft.	26	Variable.	Do.	Do.
Sundries	...			
Materials.—				
Rubble stone, c. ft. ...	85			
Quarry chips, c. ft. ...	4			
Slaked lime, dry, c ft...	12⅓			
Sand " ...	12⅓			
Surkhi " ...	12⅓			
Sundries	...			
Petty Establishment ...				
Total per 100 c. ft. ...	...	...	...	...

Specification.—All stones to be fairly squared blocks, of 6″ minimum thickness, and 14″ minimum length, and 9″ minimum width. The face stones to be chisel drawn at edges truly squared. Face joints up to half an inch permissible. The masonry must be brought up in perfectly horizontal courses. Selected blocks not less than 2 feet long to be used as bonds at 5 feet intervals. The bond stones to overlap at least 6 inches across the width of a course.

X.

INUNDATION CANALS.

An Example of the Working of a Canal Head.

Fig. 1 gives a sketch of a ten-mile reach of the river during the cold weather of 1856-57. The dotting shews the sandbanks, and the horizontal hatching shews the islands covered with tamarisk jungle. On the right bank the cobweb shews the system of dykes or bunds for impounding the water of the mountain torrents so as to make the land moist enough for cultivation. The boundaries of the river bed proper are shewn by thick black lines. The dotted network on left bank attempts to give some idea of the depressions which are only partially silted reaches of ancient side channels of the river.

The popular idea is that new canal heads have to be made nearly every year. In this case the canal head has practically been in the same place for at least 30 years. The favourite native remedy for the bad working of a canal is the excavation of a new head. The men of this canal once attempted to make a new head, but they had not the industry to complete it.

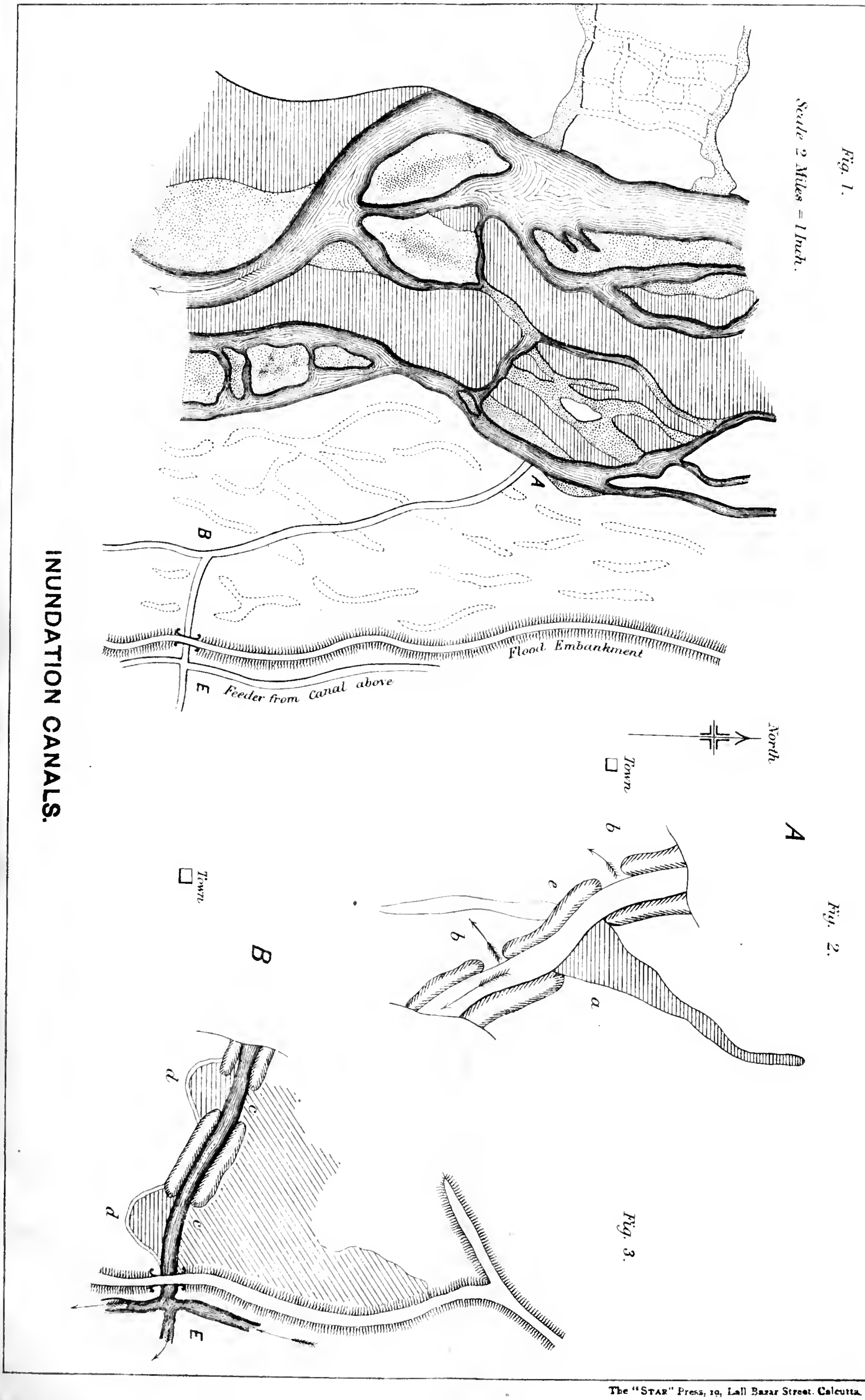
The only change in the river for the past 30 years with which this canal is concerned is the more distinct separation of the most easterly side channel from the river. The side channel has now fairly stable banks on both sides, and communication is kept up with the river at long intervals by cross creeks. If there is any doubt about the side channel getting a sufficient supply the most convenient and favourable creek is cleaned. The creek clearance has not yet in 8 years been a heavy or even a big item. This point is always settled early in the cold weather.

After the clearance of 1880-81 the canal ran for 18 months. Before and since the canal has always silted very heavily in the first 2 miles from the head, and in the next 5 miles 2 feet to 3 feet 6 inches. The reason for its not silting in 1881 is not known. The river floods of 1881 were moderate, but there have been other years in which the floods were also moderate. No periodical observations have ever been taken to shew the rate at which silting progresses. But the usually good supply to the end of September and sometimes well into October and its sudden cessation point to the probability of the silting taking place very late in the season. This is one of the canals in which the bed and side slopes are of pure sand, and the flood crossings may have some effect on the silting.

From *Fig.* 1 it will be seen that the conditions for the safety of the flood embankment are as bad as they can be. Of course the tendency of the spoil banks along A B E are to keep up the water in the pocket at E. The southerly slope is nearly 1 foot 2 inches per mile, so that if there was a perfect *cul-de-sac,* the water level in floods at E should be as high as at A or about 9 feet higher than the normal if the tract was as an open plain. It may be noted here that the contours of this tract run fairly East and West—the highest ground being, however, nearest the river. The easiest safeguard against the heaping up of the water at E would appear to be the running of a spur in a South-Westerly direction from the flood bank to the point A.

As a matter of fact the arrangements made at flood spill crossings have hitherto been found sufficient to prevent any very serious and abnormal strain on the flood bank.

In *Fig.* 2 is given a sketch of the method of heaping a flood spill crossing on the main line A B. *a* is the ravine formed on the up-stream side when the back water is draining into the canal; *b,b,* are the openings left in the right bank on high ground to act as waste weirs when the canal channel is gorged; *c* is a good stout bank across the depression or flood spill to prevent the stream from deserting the channel provided for it. In the annual clearances the old practice of banking across the ravine *a* is forbidden. The canal supply is now allowed to head up in the ravine. If it spills over the sides it is not lost to the canal, as will be seen from *fig.* 1, that which is not



INUNDATION CANALS.

The "STAR" Press, 19, Lall Bazar Street. Calcutta.

absorbed *en route* must flow back above flood regulator E. In the old practice of banking across the ravine the canal channel was not only choked by the *debris* from the ravine, but also by the whole of the spoil thrown across it when the spill water commenced draining in. All this stuff was pure sand. The tendency is for the back water to fill the ravine with a deposit in which there is more or less clay. Now clay dissolves readily in water and is carried much further than sand by running water. At the same time clay is denuded more slowly. The result is that the choking of the channel is greatly decreased.

On the branch channel B E the flood crossings are managed differently. The canal in this distance has acquired sufficient command of level for the full supply to be well above the normal natural surface. Here from the openings *c, c,* (*Fig.* 3) a large lake is allowed to form on the North side. In the dry season this lake keeps the flood bank water tight. On the South side the ring bunds *d, d,* are made. These ring bunds are cut through by the regulating establishment when the water level rises within 2 feet of the top of the upstream wing walls of the flood regulator E. Masonry escape heads would be better than the ring bunds *d, d,* as stupidity on the part of the man in charge might cause an accident. There are, however, no funds for a more perfect style of regulation.

In the basin *c, c,* splendid wheat is grown with only the trouble of ploughing and sowing. The soaking it gets in the summer suffices to carry the crop through, and the annual fresh supply of silt keeps up its fertility.

KOVEISHI ; *August* 27, 1887. E. A. S.

NOTE.—There is an error in the paper on Inundation Canals in the issue of August 13th, 1887. The words "*the silting*" should be cut out in last line of the fourth paragraph from the end. The meaning is that though the width of main line has been kept the same the supply has been increased year by year by improving the draw of the first take-off and not that the silting has increased.

E. A. S.

NOTES FROM HOME.

(From our own Correspondent.)

THE annual meeting of the Institution of Mechanical Engineers is now taking place at Edinburgh and it is the first time that the Institution has visited this town; the meetings are held in the class room of the Edinburgh University. The Secretary read a paper on the Forth Bridge. The author, Mr. Malcolm Wood, gives particulars of the structure and progress of the bridge. It may be mentioned that in addition to its own weight the bridge is constructed to support, without exceeding in any member the unit stresses permitted by the Board of Trade, a load equivalent to trains of unlimited length equal to one ton per foot run on each line of railway, or passing trains consisting each of two engines and tenders at the head of 60 coal trucks weighing 15 tons each, and also to withstand a lateral wind pressure of 56lbs. per square foot of exposed surface of train and structure. It is calculated that this pressure would be equivalent to a total of more than 8,000 tons. The rivet steel has from 26 to 28 tons tensile strength per square inch. A discussion followed in which a doubt was raised as to the effect of elongation tending to disorganize the structure, but other speakers spoke with great confidence of the stability of the bridge.

The Sanitary Institute of Great Britain announce that their Annual Congress will be held at Bolton on 20th September and two following days under the Presidency of Lord Basing. The address in Sanitary Science and Preventive Medicine will be delivered by Professor Reynolds, F.R.S. In Engineering and Architecture by Professor T. Hoyter Lewis, F.S.A., and in Chemistry, Meteorology and Geology by Dr. A. Dupré of Westminster. As is usual with these meetings of the Institute, an exhibition of sanitary appliances and apparatus will be held in connection with the Congress.

The shifting *en masse* of an iron railway bridge weighing 1,600 tons is the latest American feat. It is not quite clear from the story why it had to be shifted, but the bridge which crosses the Conemaugh river at Johnstown, Pennsylvania, is 250 feet long and was moved 75 feet down the river. Trestles were erected on each bank and rails laid on the top, the bridge was then lifted on the trestles and moved slowly to its new site.

A Mr. Theodore West, a practical railway man, has issued a series of sheets containing drawings of locomotives. The first series of six sheets illustrate the early history of the locomotive and contain 192 figures of engines and tenders with a few early coaches arranged according to date. Two sheets are devoted chiefly to engines on the Stockton and Darlington Railway (the first public railway in the kingdom) and contains not a few curious and little known forms. Mr. West has also issued in pamphlet form three lectures delivered before the Cleveland Institute of Engineers upon these sheets, in which is given a graphic account of the progress of the locomotives in England and America.

In the ceremony of sinking the first of the cylinders used in the construction of the new bridge to be thrown across the Dee by the Cheshire Lines Committee, Mr. Gladstone stated that he agreed with Sir E. Watkin in the advantages that would follow from the construction of the Channel Tunnel and further commended the great pluck of Sir Edward in persevering with his endeavours in the face of such opposition as existed against the scheme.

The Manchester Ship Canal may now be called a work in progress. The Company have paid into the Bank of England the purchase money for the Bridgwater Canal and the Mersey and Irwell Navigation. In *Engineering* will be found an article giving the history of the project up to date, being a summary of what has in piecemeal already appeared in that journal. Amongst other interesting facts recorded in this account is a note that the late Captain Eades, of the Mersey Docks and Harbor Board, received £4,000, the largest sum ever paid, for engineering evidence.

Sir Joseph Bazalgette has just issued a report upon the remedial works now in progress at Barking, in which he says that the precipitation works at the northern outfall will be in full operation in August 1888, the contractors having in February last undertaken the works for £406,000, and agreed, subject to a penalty of £300 per week, to complete them in eighteen months. The works already executed are valued at £54,000.

The recent great fire at Whiteley's establishment affords some useful lessons with regard to fireproof construction, and an examination of the ruins shews unquestionable advantages of the Dennett system over the ordinary builder's "fireproof" construction. The results so far as the fireproof qualities and strength of the Dennett Arching are in question are very satisfactory.

At the meeting of Mechanical Engineers in Edinburgh the second paper was by Mr. Arrol, of Glasgow, one of the contractors of the Forth Bridge work, and described the machine tools and ingenious devices for carrying out the work. It was stated in the discussion which followed on the paper that as a general rule holes 1 inch in diameter were drilled 1 inch deep in 1 minute; that ropes running 1,500 to 1,600 feet per minute could be trusted to last for two years, and with regard to the power required in rivetting that varied with circumstances, and amongst other things a good deal depended on the heat of the rivet. It required more power to close steel than iron rivets. A 9-inch machine would do for iron rivets, but it required a 10-inch machine for steel rivets the same size. An objection was made to leather in hydraulic apparatus, but the author stated that they had tried metallic packing without success. Mr. Kelsey's paper on the Tay Bridge was a suitable preparation for the visit which was paid to Dundee and the bridge on the 3rd day of the meeting.

A full and interesting account of the construction of the Forth Bridge is given in *Engineering*, being a lecture before the Royal Institution by Ben Baker, M.I.C.E., one of the Engineers of the undertaking. At the last meeting of the Company the report stated that the piers and girders of the north and south viaducts were completed and that at South Queensferry and Fife the steel columns with their connections and bracings had been carried to their full height of 370 feet, while at Inchgarnie columns were up 283 feet above the sea level.

BURMA.

(From our own Correspondent.)

The subject of sanitation in the town proper of Rangoon has lately engaged the attention of the public, as well as the Health Officer and Municipal Engineer. In no town so densely populated, is this necessity so greatly needed, more so when we consider the nature of the buildings erected by grasping landlords in this city. All available building sites are purchased by these men and converted into Barrack buildings (mere hovels and dens of sickness and disease). From the last Sanitary Report we learn that all the mortality and sickness is mainly due to the insanitary condition of the city, and all efforts of both the Health Officer and Engineer to improve matters in this direction were over-ruled by the native members of the Municipality, who form the majority of landlords, and it is high time that the Government should step in and put an end to this disgraceful neglect, and that, too, in one of the most flourishing ports in the East.

The Municipality is now in communication with the local Government and application for sites has been submitted, with a view of carrying out the high pressure water-supply and sewerage schemes. 6½ acres of land have been taken up near the Royal Lakes for ejector station and the sewerage outlet is fixed west of Monkey Point defence works.

The Government, with the approval of the Commander-in-Chief, has decided to raise a local corps of Sappers and Miners at Mandalay. The corps will consist of Burmans, Shans, and Karens, in the proportion of half of the former to quarter of each of the latter. The corps will be officered by European Royal Engineer officers selected from Bengal, Bombay and Madras. The native commissioned and non-commisioned officers will be chosen from the Queen's Own Sappers and Miners. The men are to be enlisted for 5 years, at the end of which they can be re-engaged at option.

This benevolent idea, though intended for a good purpose, will not realize its object. From experience it has been found that the indigenous tribes are averse even to semi-military discipline. As a body, they make bad policemen in Lower Burma, where the routine falls far short of military duties. Added to this, they are naturally an indolent and lazy race, and cannot compete with an ordinary Indian coolie in labor, and when we consider that a Sapper, besides his military duties, performs a deal of manual labor, both of which qualifications are wanting in the Burmese, I believe the corps will be a disastrous failure.

With the rapid progress now being made in the construction of the Toungoo-Mandalay Railway, it is confidently believed that the whole line will be in working order by the end of the next year The first section from Mandalay to Kyouksi is completed as far as Jagoondine bridge and material and ballast trains are now running. The most difficult girder bridge accross the Myitnge river is fast approaching completion. The first section on the Toungoo side to Pyinmana is expected to be finished before October. Large quantities of rolling stock and railway materials are being hurriedly despatched to Upper Burma. While writing on Railways, I would add that Mr. A. R. Colquhoun, formerly of the D. P. W. and now a Deputy Commissioner, Upper Burma, at present on 6 months' furlough, is ably advocating the extension of Railways in Burma, as the only means of pacifying and prospering the country and states that it is a false economy to stay the introduction of Railways on a considerable scale. His advocacy has already had effect on some of the leading Chambers of Commerce at Home, who are now pressing the Imperial Government for further Railways in Burma. We hope to hear more on this subject on the arrival of Mr. Robert Gordon, who has lately left this Port for England. This gentleman has been to and fro since the annexation of Upper Burma in connection with an English Railway Syndicate in England.

The Irrawaddy Flotilla Company, Limited, have turned their attention to improving the engines and boilers of their fleet of steamers, and with this view are substituting triple expansion engines and high pressure boilers, which are now generally recognised as the most perfect form of mechanism for the economical utilisation of steam: by which at least 20 per cent. in fuel is saved. This ecomomy is believed to be well founded, particularly when older or more imperfect types of engines and boilers were superseded, greater economy in fuel and labor and as much as 30 per cent. upon the capital outlay has been effected. There can be little doubt as to the superiority of the triple expansion over the ordinary compound engines, as it is a well known fact that the ideal efficiency of steam increases with the initial pressure or temperature at which it is generated, provided a suitable ratio of expansion is maintained. I also think that the practical limit of economical expansion in a great measure depends on the dead load of the engines, as compared with the live load; and to support this fact, we learn from experience, that actual loss begins to take place in an engine after the expansion has dropped below the average pressure required, to overcome the dead load, that is, the frictional resistance of the engine, propeller, shafts, &c., since after this point all further nett work done must be at the expense of those cylinders whose pressure at the time is above the average dead load pressure. The cylinders, then, in which the pressure is below this point, are practically robbing those cylinders in which the pressure is above this point. The limit, then, to which expansion can be carried from low initial pressures, such as 60 to 90lbs. per square inch is soon reached, and no efforts to increase such ranges of expansion will be of any further practical economical effect.

The drawbacks as to wear and tear, to which high pressure naturally tends, have also been in a great measure removed by the attention given in constructing the engines and the care taken of their wearing surfaces.

From a report submited by the Assistant Superintendent, Geological Survey, to the Chief Commissioner, on the coalfields of Upper Burma, we learn that the Kale coalfield, Chindwin, is merely a small portion of what promises to be a much larger field. From all the seams visited it would appear that a 10-feet seam found in this neighbourhood is in the most favorable position for working. The coal is of good quality, but of a friable nature. It contains numerous small veins and pockets of fossil resin noticed in cretaceous coals found in Assam and Tenasserim, which is a good sign, as cretaceous coal is more likely to extend to a distance, than uncertain seams of tertiary age. No pyrites were detected by optical examination. The position is favorable, being in direct communication with Chindwin. It is recommended to put down experimental borings, to test the extent of its lateral extension, and the depth to which it reaches. One boring should be put down 100 feet, at which depth it is anticipated coal will be found, and other borings 2 to 300 feet apart. These borings are to be conducted on the two sides of the river as preliminary trials to see the distance the coal extends. Should these trials be successful, it will be followed by mining. The workings by the local natives have been stopped on account of the dangerous nature of the workings, also the ruining of future mining prospects. The method followed by the Burmese is very dangerous and diggings carried on to any extent have always fallen in for want of support. The workings inspected consist of quarries driven in, the workmen remove the upper 7 or 8 feet of the coal, leaving the upper surface without supports. Coal for present use can be obtained by driving an inclined tunnel, on the coal, from the top of the bank of stream to the west, which is expected will reach the coal in 20 or 30 yards, which tunnel need not incline downwards more than 10°. The means for working the coal depend upon the results of the borings. It is recommended that one or more shafts should be sunk to the east of the outcrop, within the area proved by the borings; if only one should at first be sunk, the tunnel driven on the outcrop could be used as another outlet to the mine in order to secure efficient ventilation. From the high inclination of the seam, it will necessitate very deep shafts, after the coal near the surface has been worked out, and the bad character of the roof, as seen at the outcrop, if it continues deep will require careful timbering. But details as to the working of the mines will be left to a professional mining engineer. It is recommended that an efficient European staff be employed to ensure its results successfully.

The whole section as seen is as follows in descending order the dip being to the east at 45°:—

	Strata.	Thickness. Ft.	In.	Remarks.
1	Sandstone	5	..	only 5 feet are exposed.
2	Carbonaceous clay with jetty bands of coaly matter ...	2	0	
3	Fine bedded shales ...	20	0	
4	Hard, calcareous, shaly sandstone containing fossil remains	2	0	only a local bed.
5	Shale containing concretionary masses resembling No. 4 ...	50	0	

	Strata.	Thickness. Ft.	In.	Remarks.
6	Coaly matter	2	0	maximum thickness.
7	Carbonaceous sandy shales ...	10	0	
8	Sandy shales	20	0	
9	Clayey shales	30	0	contains courses of exfoliating ferruginous lumps
10	Hard band of a heavy stone ...	1	0	
11	Shales	30	0	
12	Very much broken and decomposed shales	5	0	
13	Good coal	10	0	
14	Inferior coaly shale ...	1	9	
15	Brown clayey shale with strings of coaly matter ...	1	7	
16	Grey shale	7	0	
17	Coaly matter	0	9	
18	Clayey shale	1	0	
19	Coal, coaly matter and clay shale	2	0	
20	Shale with coaly strings ...	12	0	
21	Carbonaceous papyraceous shale	3	0	
22	Yellowish shales	11	0	
23	Sandstone	4	0	
24	Shale	1	0	
25	Sandstone	1	0	
26	Shale	5	0	
27	Carbonaceous shale ...	1	0	
28	Yellowish shale	4	10	
29	Coaly matter	4	7	
30	Loose shale	2	6	
31	Good bituminous coal ...	0	6	
32	Carbonaceous shale ...	0	10	
33	Yellowish shale ...	21	0	
34	Sandstone	1	0	
35	Sandy shale with bands of sandstone	10	0	
36	Soft sandstone	30	0	
	Total ...	314	4	

NOTES FROM MADRAS.

(From our own Correspondent.)

Nothing has yet been decided about the entrance to our harbor, so that Captain Taylor's trip home appears to have been fruitless. It seems strange that a committee of experts assisted by any amount of disinterested evidence and advice should not be able to make up their minds as to one of two courses—but there are many strange things in this world. If the *pros* and *cons* of the case are so very evenly balanced the question might be decided by the well known expedient of tossing up a coin. This does not appear to have occurred to the Committee—I have much pleasure in placing the suggestion at their disposal. Meanwhile tipping rubble into the sea for the foreshore has had to be stopped for fear of tipping in the wrong place. And now the contractors for rubble quarrying and tipping are crying out because they have got no work to do. Block-making is going on and a good deal of work on shore in connection with additional conveniences for the traffic of the port. The Acting Superintendent is also engaged on a marine survey of the harbor and its neighbourhood. So far no serious silting has occurred. An attempt is about to be made at wood-paving the level crossings of the railway lines on the Beach Road. The timber to be used is errool, which is not subject to the attentions of white ants. It is to be obtained by cutting up unserviceable sleepers in slices four and a half inches thick—the depth of a rail. These chocks will be laid on a bed of concrete—except where they rest on the transverse sleepers themselves—and the interstices grouted with liquid cement. I believe the Municipal Engineer is watching the experiment with much interest, but I fancy its cost will preclude its adoption to any great extent.

The Madras State Railway Survey Department has now I believe, been abolished, as sufficient lines have been surveyed for the present. Mr. Geoghegan, the Engineer-in-Chief, will be provided with some other appointment on his return from furlough. The only two lines to be taken in hand just now are the Villapuram-Paikal, which runs through the South and North Arcot districts, and is one hundred and thirty-four miles in length; and the extension of the Cuddapah-Nellore Line from Tirupati to Duramavaram in the Anuntapur District, which is one hundred and fifty-seven miles in length. These lines are both to be on the narrow gauge, and the South Indian Railway Company I now hear have applied to have both made over to them to be incorporated with their system. I believe this is likely to be arranged. The hitch is that the Company desire to have the new lines under the present Agent and Chief Engineer, but the Consulting Engineer to Government is of opinion that the charges under those officers at present are quite large enough and the new lines should be under separate management.

The Guaranteed Railway Companies are beginning to repine at the practice of Government of lending them Engineers from the D. P. W. whenever they apply for sanction to entertain additional ones. They complain of the high salaries and allowances they have to pay them—not to mention the contribution towards their pensions. It would appear from this that Railway Companies at least can get men cheaper in open market. I should say in addition to this that the service yielded by a servant engaged by onesself and working at one's will and pleasure must always be more satisfactory than that of one *lent* by so overpowering a friend as the Government of the country.

Another gigantic irrigation scheme is about to be started in this Presidency. It is known as the Periyaur project. The scheme is to dam up the waters of the Periyaur river in the Madura district and irrigate a large extent of country thereby. We have already carried out several such works as you must be aware, but there is plenty of room for more. We cannot have too many of them, for they are both beneficial to the country and remunerative to Government. The present scheme is, I believe, the conception of Colonel Pennycuick, R.E.—that is, so far as anything in the D. P. W. can be the conception of any one officer. It appears to me that that department is worked on the principle that no man shall have either credit or blame for anything—they are both spread out so. We were quite bewildered not long ago in trying to decide, between conflicting claimants, as to who should have the credit of having *built* that ditch called the Buckingham Canal. Well, to get back to the Periyaur project. Government have sanctioned one and a half lakhs of rupees to make a start with during the current official year, and have appointed Mr. H. S. Taylor as Executive Engineer to initiate operations

NOTES FROM CEYLON.

(From our own Correspondent.)

II.

The P. W. D. Report for 1886 has just seen the light, attached to which is a diagram shewing the fluctuation of total departmental expenditure for the last fifty years commencing with Rs. 400,000 in 1844. The figures went up by leaps and bounds from Rs. 7,00,000 in 1854 until it exceeded Rs. 55,50,000 in 1878. Here the culminating point was reached and the diagram shews the regularly descending side of a sharp pyramid until the descent is arrested at Rs. 20,00,000 in 1884. Thence we have a steady ascent to Rs. 26,00,000 in 1886, although in the latter years of the series the cost of maintenance of roads was very largely reduced under the operation of the "MacBride System," which its author, the Director-General, defends against all comers with an emphasis worthy of his own belief in the said method.

There are diagrams of minor works, such as expenditure on buildings, canals and irrigation and on such sundries as miscellaneous contingencies. There are also those shewing items of expenditure, repairs and mileage of roads in the various provinces of Ceylon. Another gives items of expenditure, construction of roads, from which it will be seen that the annual outlay under this head rose from Rs. 2,00,000 in 1858 to Rs. 12,00,000 in 1877, going down to Rs. 5,00,000 in 1873, culminating with Rs. 18,00.000 in 1878, going below Rs. 1,00,000 in 1882, 1883 and 1884, and rising again to Rs. 4,00,000 in 1886. Turning to the detailed report we find that the expenditure of the department in 1886 was Rs. 26,00,622, being Rs. 4,11,344 in excess of the previous year—an increase of 18¾ per cent. The Director-General indicates that he deems it hardly fair that his department should be the only one represented as a spending one, and he desires figures for the revenue derived from its operations. A very large proportion of the works undertaken are expected to be reproductive, but many fail in being so and he does not hesitate to insinuate that such will be the result in regard to certain works which were either commenced before he took charge or undertaken without his approval. "It is impossible, with the very imperfect information, to give even an approximate percentage that the revenue derived bears to the expenditure incurred. I find that the revenue derived from tolls on the principal roads amounted to Rs 3,86,123·7.

The Road ordinance funds received in money and labor (the latter at quite a fictitious value) amounted to Rs. 2,09,501. Therefore, the actual sum provided from other sources of revenue required for the official maintenance on an improved system of the whole of the principal roads of the colony (2,899·92 miles) amounted to Rs. 2,53,433·93.

Wattagoda-Pundaloya Road.—This railway feeder was begun in 1885, and although but 7½ miles in length and estimated to cost Rs. 1,26,823, the distance completed was but 3 miles. The delay was due to various causes, none of them, however, in any sense connected with my department. The principal one being the difficulty experienced in arriving at terms upon which the lands required were to be acquired. That this delay increased the cost of construction there is no doubt; labor was discharged and disorganized in consequence thereof. There were also other difficulties which tended to delay progress, yet in spite of everything 3 miles were opened for traffic. A saving on the original estimate was effected sufficient to meet the cost of the fourth mile and provision is made in the Supple Bill of 1887 for the continuation of the road as far as the 6th mile, leaving only 1½ mile for future sanction. Considering the heavy nature of the work, the construction rate per mile—Rs. 16,900—cannot but be regarded as satisfactory. The appreciable reduction in cost of up-country roads dates from the extension of the Udapussellawa Road from Amherst to S. Margaret's Note, by the Road Officer Mr. Robins, a Contractor's Engineer, but who left the department soon after, dissatisfied with Ceylon. It was completed for Rs. 17,750·50 per mile inclusive of compensation. I believe it will be possible in the future to maintain this comparatively low rate, save under exceptional circumstances. It may be, therefore, stated without fear of question that within the last ten years the cost of road construction in the Central Province has diminished in the proportion of three to two.

Bridle Road to Haputale Gap.—This work was begun and finished in the year, and the Director goes on to pour forth a lament on its unsatisfactory condition, owing to restrictions imposed on him by the Railway Engineers, and recommends, in the event of the Railway not being sanctioned, the construction of a cart road to the Gap—a distance of 28½ miles—as a feeder to Nanu-Oya Station.

Bridle road—Carolina to Norton,—shews delay on account of the hesitation to accept Government terms regarding the right to cut the road without compensation for lands acquired therefor, and shews a reduced estimate from Rs. 30,000 to 15,000 per mile on account of the heavy work being avoided and also this explanation given in paragraph referring to Udapussellawa road Bridge over the Kehelgama-Oya at Aberdeen Estate explains policy to be correct in erecting a bridge in advance of a much needed cart road—span 100 feet height of roadway above river 48 feet (? low ordinary or flood) lattice girder with curved ends cost Rs. 12,000 in Government factory. Then follow other minor works, chief of which in point of expenditure are Queen's Cottage (stables) Newara-Eliya, Rs. 8,047, and record shelves Kandy Kachery, Rs. 1,695.

Elahera Scheme.—The new channel under this scheme was cut from Kuduganga to the old Elahera channel under Mr. L. Creasy, was attended with unexceptionable drawbacks which no other work in progress can parallel. Expenditure Rs. 39,995 02.

Then come a bit of minor irrigation works in the Central Province. In the Western Province the new Lunatic Asylum absorbed Rs. 74,544, and it is re-assuring to learn that all that is needed for the present is almost provided.

Fort Conal, Colombo.—The main drain—which is the initial work in connection with filling in the canal, was completed at the cost of Rs. 19,900, the filling in being performed by convict labor. The design for widening and planting York Street with ornamental trees will not be carried out at present owing to lack of funds

The Sita Waka Bridge.—Difficulty was experienced in founding one of the piers, owing to a treacherous foundation; and also to the many occasions the river was in flood, increased cost of work and lead to an over-expenditure. Total length 283 feet, height above river 50 feet, floods 45 feet, rise of width of roadway in approaches 18 feet, concrete roadway on buckled plates, bridge piers, c. concrete blocks upon which cylinders supporting the girders are fixed, foundation, generally speaking unsatisfactory without any indication of rock below. The south pier only is founded on rock. Estimated cost Rs. 45,000, probable cost Rs. 55,000. This bridge is the one which since collapsed in the floods in June and has cut off communication with the Kelani tea district. One pier entirely. This and that to be erected over the Kelani is made out of the materials of the old Kelani railway bridge.

Extension of the Bulatkohopitiya road, for which a sum of Rs. 16,890 was allowed and 3 miles 16 chts. constructed therefor. The road now terminates at Glenalla Estate at the bottom of the West Doloernbage hills. It is an instance of an exceedingly cheap road. Estimated for construction to be gravelled with a rough stone foundation, the foundation was omitted and the road metalled instead.

(To be continued.)

REPORT ON THE AURIFEROUS TRACTS, MYSORE.

(Concluded from Page 34.)

JALAGARNAHALLI FIELD.

We next proceeded South about 14 miles from Arsikere to a village called Jalagarnahalli, where we discovered a small old working. Apparently, it had been worked at a very ancient date, the whole or greater part of the *debris* having been washed into the pit. This old working forms a connecting link between those of Channarayapatna and Arsikere Taluks. I made no test here as I was perfectly satisfied by the appearance of the country rock and reefs of quartz that the pit was sunk for gold.

KARDIHALLI FIELD.

We proceeded from Banavar North-East to the village of Kardihalli where about half a mile to the East of the village, we came across 5 old workings.

In the centre of the auriferous belt stands a granite hill called Chotnare Marti with Tirumaladevaragudi or temple on it which throws the auriferous country to the East and gives the reef the appearance of running North-East, but when the granite is passed to the East, the auriferous lode takes the strike again to the North or again takes a bearing of 334°. I tested the old working to the North of this granite hill and found a very good shew of gold, the quantity of earth for the test being very small as the water had to be carried in chattis from a considerable distance. These old workings promise a very fine yield of gold on deep sinkings being made. The formation of the country rock is the same as that described to the South of the Malikal-Tirupatibetta, being alternate series of granite and chloride schist with trap and hornblende dykes.

The portion of the gold-bearing zone passing through this taluk is well worth the attention of capitalists, it being rich in the precious metal, with a fine healthy climate and every facility for the opening up of mines and the Railway passing within 4 miles of the first old and within 3 miles of the last old workings described above. They are now preparing for the construction of the Railway and it will be completed within two years, the distance from Bangalore to Arsikere being about 105 miles and to Banavar 114. Fuel is in abundance. Timber for mining can be had from Hassan, a distance of about 35 miles, and building material is in abundance in the neighbouring localities. Labor is cheap and abundant. The mullers used by the ancients are in shape the same as Readwin's pans, the motive power used for the reduction of the quartz in the mullers being manual labor, while that used for Readwin's pans is steam. An observer seeing the pans and mullers would be struck with the similarity of the process employed by the ancients and that of the present Readwin's system. The latter system is not used on mines generally, being considered very slow and expensive. From stones picked up from these mines, it was clear a rubbing process took place after the quartz had passed through the mullers, as we found several smooth stones that were used in the final reduction of the quartz.

TARIKERE TALUK.

On the 9th August 1886, we proceeded to the village of Hanne and examined Hannebetta where we found a large cavern on the North-East side of the hill. This is a natural cavern formed by the storm water from the high peaks above it, the country rock being micaceous schist. It was reported that Jalagars washed for gold in the nullahs that lie to the North, but upon enquiry of a Jalagar whom we interrogated, we found that no washing had been done in or about the place, but that he used to go to Honnali annually during the rains and washed there for gold. We proceeded next morning to Bukkambudi, inspected three tunnels on the top of Bairedevaragudda and took samples of minerals from them, which as far as can be determined at present, are antimony, iron and some form of chloride with considerable traces of soda, the whole being utilized for the coloring used in the manufacture of glass bangles. Close to the village we found old glass furnaces used for the reduction of these minerals.

CHANNAGIRI, TARIKERE, CHITALDROOG TALUKS.

We next proceeded to Ubrani, about 6 miles to the West of Bukkambudi, and descended a ghaut to the West in the Ubrani jungle, where gold was reported to be found. But upon examination of some shallow pits, I found that they had been made for smelting iron ore and burning charcoal. Upon washing, not a trace of gold was to be found about the place. On the 12th August, we proceeded North-East to Suryangudda where we found some old pits on the top of the hill from which stone had been taken by Dankana, char for carving images for the temples in the surrounding villages. We washed here and found a small trace of gold, but no quartz appeared in any of the pits; neither was there any sign of the ancients having worked for the precious metal. We proceeded from the top of the hill to the valley North and close to the foot of the hill, and in a nullah called Huggisiddanakatte commenced a regular investigation by washing and were successful in finding a very fair show of gold. Iron pyrites abound in this nullah and in a regular form. We picked up several specimens of twin pyrites and many beautifully imbedded in the soft micaceous schist which forms the matrix. The portion of the country now described from Ajjampur to here is, as far as I can judge at present, the South-Eastern flank of a new traverse which runs to the West, taking in Holalkere and running on North to Davangere and West as far as Harihar. The granite band passing North from Ajjampur to Ramgiri and thence to the East of Holalkere on to Anagode and from Anagode to Uchangidurga in the Bellary District, forms the Eastern boundary of what we may now call the fourth auriferous series or that which embraces Honnali with its surrounding gold-bearing country, and the West boundary of the Hunsur-Bellibetta-Arsikere series. From here we proceeded to Holalkere on the 15th August 1886 and from Holalkere to Chitaldroog to investigate the Shethalli run which passes East of Nagamangala, Chiknayakanalli and Chitaldroog. The granite band above described is crossed on a ghaut about 4 miles from Holalkere on the road to Chitaldroog and the Melkote granite series is again crossed close to the Town of Chitaldroog on the same road forming the Eastern boundary of the Hunsur-Bellibetta-Arsikere series and the West boundary of the Shethalli run.

KOTE MARTI FIELD.

We proceeded to the Kote Marti Hills, a range about four miles North-East of Chitaldroog. We commenced a series of prospecting tests along the West flank of the hill. We found large quantities of gold (in proportion to the stuff washed), the gold here being very, very fine, and with only the rough appliances of a Jalagar whom we hired at the village of Gudda Rangavvanahalli, a considerable quantity of fine flake gold must have escaped, as upon my finishing off the washing in my own pan, fine gold floated upon the water in much larger quantity than usual in other washings I have made. We proceeded South along the foot of the hill to the Gonur Tank and had another washing made. The gold in this washing also was very fine and in good quantity. There are several reefs of quartz running at a bearing of 300° with their dip to the East. I took some quartz from several of the reefs and had it reduced at the Traveller's Bungalow at Chitaldroog and on washing it found several petals of gold, but like that found in the alluvial washing, very fine plate gold The country rock here is chloride schist and a continuation of the same zone or belt that passes East of Chiknayakanhalli.

BELLIGUDDA.

We proceeded to the Belligudda (Silver hill), about 4 miles South of Chitaldroog. The hill stands about 800 or 900 feet above the level of the surrounding country. On the summit of the hill on the North-West side, runs a heavy band of micaceous schist rock. This band was worked by the ancients in four places and the quantity of stuff removed is very large as the pits are now of an immense size. Judging from a small quantity of mineral collected by us, these pits appear to have been worked for the extraction of a mixed mineral, antimony and copper, and no doubt upon assay, a small quantity of silver. The reducing furnaces for this mineral were at a distance of about two miles to the North-West of this hill. We got some slag from these furnaces which will undergo assay. No doubt the kanchu (antimony) ornaments and household utensils used in and about Chitaldroog in ancient days were taken from these mines, and at the present day, workers in kanchu or antimony still carry on their calling in the town of Chitaldroog. Some samples of sulphur and antimony were got for our inspection by the Amildar of Chitaldroog from Bangarakkanahalli, about 12 miles North-East of Chitaldroog; but as he reported that only one solitary block of stone containing this metal was to be found in the locality, we did not proceed to the place, as more important work lay to the North of us.

[This Report has now appeared in an Official Publication issued by the Government of Mysore.]

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Punjab, September 1, 1887.

Mr. T. E. Ivens, Executive Engineer, Peshawar Provincial Division, is granted furlough for six months, under Section 50 of the Civil Leave Code, with effect from the 1st October 1887, or such subsequent date as he may avail himself of it.

September 8, 1887.

With reference to Government of India, Public Works Department Notification No. 228, dated 13th July 1887, Mr. C. F. Tufnell, Executive Engineer, 4th grade, temporary rank, is, on re-transfer to the Punjab from the Simla Imperial Circle, posted to the Simla Provincial Division, which he joined on the forenoon of the 16th August 1887.

Mr. C. E. V. Goument, Executive Engineer, 4th grade, temporary rank, is transferred from the Kohat Division to the Bannu Bridge Division.

Burma, August 27, 1887.

Lower Burma.

Mr. H. F. White, M.I.C.E., Superintending Engineer, 3rd grade, temporary rank, on transfer to Hyderabad, relinquished charge of his duties as Superintending Engineer, 1st Circle, Lower Burma, on the afternoon of the 22nd August 1887.

Lieutenant W. R. Morton, R.E., Assistant Engineer, 1st grade, is temporarily transferred from the Rangoon Division for employment in the Public Works Secretariat.

September 3, 1887.

Lower Burma.

Mr. A. T. Chiodetti, Assistant Engineer, 2nd grade, Burma State Railway, is granted furlough for one year, with effect from such date as he may avail himself of it.

N.-W. P. and Oudh, September 10, 1887.

Buildings and Roads Branch.

With reference to Government of India, Public Works Department Notificatian No. 276, dated 1st September 1887, appointing Colonel F. D. M. Brown, V.C., S.C., to officiate as Superintending Engineer, during the absence on privilege leave of Mr. W. D. Brockman, or until further orders. Mr. J. W. Alexander, Executive Engineer, 1st grade, is appointed to officiate as Superintendent of Works, *vice* Colonel Brown, and is posted to the 3rd Circle, Provincial Works.

Irrigation Branch.

Mr. M. Nethersole, Temporary Executive Engineer, 4th grade, Traffic Manager, Ganges Canal, is appointed to officiate as Executive Engineer of the Meerut Division, Ganges Canal, during the absence of Mr. R. A. Cordner, Executive Engineer, on one month's privilege leave.

Babu Jogendro Nath Mukarji, Rai Bahadur, Executive Engineer, 3rd grade, sub. *pro tem.* is, on return from leave on medical certificate, re-postsd to the II. Circle, Irrigation Works.

Madras, August 30, 1887.

The following transfer is ordered :—

Mr. J. Traill, Executive Engineer, 3rd grade, from Kistna Western to Kistna Eastern Division. To join at the public expense on relief by Mr. A. B. Todd.

The following posting is ordered :—

Mr. A. B. Todd, Executive Engineer, 4th grade, sub. *pro tem.*, to the II. Circle, Kistna Western Division. To join on return from furlough.

September 6, 1887.

The following intimation, received from the Secretary of State, is published :—

Mr. B. H. Young, Assistant Engineer, 1st grade, Madras, permitted to return to duty within period of leave.

The following promotion and reversions are ordered :—

Colonel H. Smalley, R.E., Executive Engineer, 1st grade, to be Superintending Engineer, 3rd class, temporary rank, with effect from date of assuming charge of III. Circle.

Mr. C. J. Peters, Superintending Engineer, temporary rank, 3rd class, to be Executive Engneer, 1st grade, sub. *pro tem.*, with effect from date of relinquishment of charge of Circle.

Mr. J. D. Grant, Executive Engineer, sub. *pro tem.*, 1st grade, to be Executive Engineer, 2nd grade, permanent, with effect from 1st September 1887.

The following transfers are ordered :—

Colonel H. Smalley, R.E., Executive Engineer, 1st grade, from the North Arcot Division to the Chingleput Division, as a temporary arrangement. To join at the public expense.

Colonel H. Smalley, R.E., Executive Engineer, 1st grade, from the Chingleput to the North Arcot Division. To join at the public expense.

Colonel H. Smalley, R.E., Executive Engineer, 1st grade, from the V. Circle, North Arcot Division, to the charge of the III. Circle. To join at the public expense on relief by Mr. C. J. Peters.

Mr. C. J. Peters, Executive Engineer, 1st grade, sub. *pro tem.*, from charge of the III. Circle to the V. Circle for charge of the North Arcot Division. To join at the public expense.

Central Provinces, August 27, 1887.

Rao Sahib Ishwari Pershad, Assistant Engineer, attached to the North-West Road Sub-Division, is granted two months' privilege leave, from such date as he may avail himself of it.

September 3, 1887.

The reversion of Mr. P. P. Rogers from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, State Railways, with effect from the 14th December 1886, as ordered in Public Works Department Notification No. 116, dated 11th April 1887, is cancelled.

The Governor-General in Council is pleased to order the following promotions and reversions of Executive and Assistant Engineers attached to State Railways, with effect from the dates specified :—

H. Luckstedt, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent, with effect from 1st January 1887.

September 10, 1887.

Mr. C. S. R. Palmer, Assistant Engineer, 1st grade, is transferred from the Nagpur Division to the Office of Chief Engineer, Central Provinces, as a temporary measure.

Hyderabad, September 1, 1887.

Lieutenant E. Houston, R.E., Assistant Engineer, 2nd grade, attached to the Secunderabad Division, has been transferred to the Military Works Branch, and he was accordingly relieved of his duties in this province on the forenoon of the 8th August 1887.

Furlough to Europe for two years with subsidiary leave, with effect from the date on which he may be relieved of the charge of the Secunderabad Division by Major H. C. Fox, R.E., is granted to Mr. M. P. Coode, Executive Engineer, 3rd grade.

Mr. J. Craig, Executive Engineer, 1st grade, having been transferred from the East Berar Division to assume temporary charge of office of Superintending Engineer and Secretary to Resident in the Public Works Department, took over charge of the office from Mr. G. K. Watts, Assistant to the Superintending Engineer and Assistant Secretary to the Resident, on the forenoon of the 20th August 1887.

India, September 3, 1887.

Mr. H. G. S. Savory, Executive Engineer, 4th grade, temporary rank, State Railways, is temporarily transferred to Baluchistan.

With reference to Public Works Department Notification No. 261, dated 18th August 1887, Mr. J. Craig, Executive Engineer, 1st grade, Hyderabad, is appointed to officiate as Superintending Engineer and Secretary to the Resident in the Public Works Department, until relieved by Mr. H. F. White.

Colonel F. D. M. Brown, V.C., S.C., Executive Engineer, 1st grade, North-Western Provinces and Oudh, is appointed to officiate as a Superintending Engineer, with effect from the 1st August 1887, during the absence of Mr. W. D. Brockman on privilege leave, or until further orders.

September 10, 1887.

The Governor-General in Council is pleased to order the following promotion and reversion, with effect from the 3rd August 1887 :

Colonel K. A. Jopp, R.E., Executive Engineer, 1st grade, to Superintending Engineer, 3rd class, temporary rank.

Mr. F. E. Robertson, Superintending Engineer, 3rd class, temporary rank, to Executive Engineer, 1st grade.

Mr. A. B. Gatherer, Executive Engineer, 1st grade, Assam, is transferred to Burma and appointed to officiate as Superintending Engineer, with temporary rank in the 3rd class.

Bengal, September 7, 1887.

Establishment—General.

Mr. J. C. White, Executive Engineer, 4th grade, sub. *pro tem.*, is confirmed in that grade, with effect from the 1st of August 1887.

Mr. W. B. Starkey, Assistant Engineer, 1st grade, sub. *pro tem.*, is confirmed in that grade, with effect from 1st August 1887.

Mr. T. H. Clowes, Assistant Engineer, 1st grade, sub. *pro tem.*, is confirmed in that grade, with effect from the 11th August 1887.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 29th August 1887.

45 of '87.—George Dubern, of No. 63, Lower Circular Road, in Calcutta.—*For improved Ice Machinery.*

86 of '87.—Arthur William Uglow Pope, of Amritsar, Punjab, District Traffic Superintendent, North-Western Railway.—*For a method for ensuring correctness in line clear messages on Railways and an apparatus for carrying this method into effect.*

88 of '87.—Michel Lion Lion, of 32, Chiswell Street, London, England, Boot Manufacturer, and Frederick Cutlan, of Castle Hill, Wellingborough, England, Engineer.—*For improvements in the manufacture of boots and shoes.*

128 of '87.—Charles Henry Russell, of 80, Gray's Inn Road, London, in the County of Middlesex, England, Gentleman.—*For improvements in apparatus for the reception of coin and the automatic delivery of goods in exchange therefor.*

135 of '87.—Jules Weirich, of Béziers Hérault, in the Republic of France, Engineer.—*For improvements in the treatment of auriferous minerals.*

The 5th September 1887.

163 of '86.—The Bright Platinum Planting Company, Limited, of 27, Clement's Lane, London, in the County of Middlesex, England.—*For improvements in the deposition of Platinum by electricity.*

147 of '87.—Samuel Robert Baildon, of Whitefrairs Street, City of London, England, Gentleman, and James Kershaw, of Wood Street, City of London, England, Gentleman.—*For improved means and apparatus of moving or vibrating punkhas.*

151 of '87.—Sandford James Kilby, Superintendent of the Customs' Preventive Service and Salt Department, Calcutta.—*For automatically tallying the discharge of any quantity of salt, coal, metal, grain, or any other material, weighed or hoisted by his patent box or tray, or by any other machine used for such proposes to which it may be attached, the title of which is "Kilby's Automatic Counter."*

Notices.

The Office of Publication of Indian Engineering *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING CO., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong. Shanghai,* and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

CONTENTS.

Obituary.

HENDERSON.—ON 18th August at Kew Gardens, Robert Mein Henderson, Civil Engineer, Public Works Department, India, late of Thayetmyo, aged 46.

INDIAN ENGINEERING.

SATURDAY, SEPTEMBER 24, 1887.

THE BOMBAY P. W. D.

THE long-expected Resolution of the Bombay Government on the subject of the re-organization of the Public Works Department in that Presidency is at last published, and the appointment of Secretary to Government has, after a lapse of 5 months, been given to the senior man on the list, Mr. J. H. E. Hart, M. Inst. C.E. Why the Government should have taken so long to make up their mind concerning this appointment is a mystery, but there are circumstances connected with its having now been made which are explicable only on one supposition. Mr. Hart attains the age of 55 years in August next year and we understand that he is about to proceed immediately on furlough, so that Government will have the benefit of his services as Secretary for a week or 10 days only. This being the case, his appointment appears to us to be contrary to all precedent, and we can only suppose that it has been made with the deliberate intention of keeping out the next senior man—Colonel C. Goodfellow, V.C., R.E., who has the reputation of being an excellent officer and a very successful Superintending Engineer. We have heard rumors of the dislike of His Excellency Lord Reay to the Royal Engineers as a body, and his action in this matter tends to confirm them. Colonel Goodfellow will no doubt *act* while Mr. Hart is on furlough, but he will shortly become a Major-General, and not being *pucca* Secretary to Government will almost certainly have to leave the Department before he can become so, which would probably be next August—*voilà tout.*

Mr. Hughes, whose appointment as sub. *pro tem.* Secretary to Government apparently caused a great flutter in the Department, reverts to Executive Engineer, 2nd grade, and Under-Secretary to Government. We understand that his having been gazetted as Chief Engineer, 1st class, sub. *pro tem.*, was purely a matter of accounts, the Examiner Public Works Accounts not finding any way by which acting pay might be drawn by the Under-Secretary while performing the superior duties, so that the Government were obliged either to leave him without any extra remuneration, or to act as they did.

As regards the re-organization, four of the Irrigation charges are abolished, and the work of these charges is to be incorporated with that of the Executive Engineers, Public Works Department, of the districts concerned. This means a reduction of four Executive Engineers; but another resolution, published the same day, transferring the services of a number of Royal Engineer Officers to the Government of India for employment on the defence works of Western India, seems to imply that the reduction will not seriously affect the civil members of the Department.

On the whole, we are inclined to think that the Civil Engineers on the Bombay establishment are to be congratulated on their prospects, while as regards the Secretaryship we cannot but think that Colonel Goodfellow has, at the least, been hardly dealt with.

THE RAILWAY TO ASSAM.

INFORMATION filters slowly through Government's Circumlocution Offices; and it does not seem to have struck the compilers of the *Gazette of India* for September the 10th that there has been great dilatoriness, very needlessly protracted incubation, in printing therein notes written by the Consulting Engineer to Government, by Mr. Buyers, Engineer-in-Chief, Bengal-Assam Railway, and by Mr. Ward, late Officiating Chief Commissioner of Assam.

These notes date from 1883 onwards. However, we have got them at last; and perhaps it will be as well not to investigate too closely the condition of our gift horse's mouth.

Mr. Molesworth considers Mr. Buyers' Report on the exploration of the North Cachar hills very satisfactory, showing, as it does beyond a doubt, that these hills are by no means insuperable difficulties in the way of a railway's progress through North Cachar, and affording a very direct line into Assam. He is in favor of crossing the river Barak at Badarpur, rather than the alternative route *viâ* Jelya Jila; the advantages of the latter from an engineering point of view being neutralized to a certain extent by the necessity for an expensive crossing at the Jatinga river, which adoption of the Badarpur route avoids. With a view to the development of Assam, a line of railway through the North Cachar hills appears to him vastly preferable to one following the course of the Brahmaputra to Dubri. It is evident, he says, that the Chittagong and Silchar lines *must* be made (the italics are ours) and that the rich country through which that line is to pass will amply justify its construction irrespective of its efficiency as a line into Assam. If this line is extended through the Cachar hills, to Dibrugarh, it will open out the very heart of Assam, developing an important coal trade and enabling the grain districts of Sylhet to pour of their abundance into Assam. Whereas, a line from Dibrugarh to Dubri would run parallel to the Sibu, traversing, for the most part, a district not capable of much development, and already provided with means of communication by steamer. The distance from Dubri to port, *viâ* Chittagong, would be from 150 to 200 miles less than that covered by the route *viâ* Dubri to Calcutta, and would involve no break of bulk. Whereas a line *viâ* Dubri would be hampered by two breaks. The British India Company's steamers now make Chittagong their point of call, and by utilization of that port all the difficulties and dangers attendant on navigation of the Hugli would be avoided.

Mr. Buyers' report deals with survey operations commenced in 1882-83. There was little doubt, he writes, "that a railway could be carried from Chittagong to Cachar without encountering any extraordinary difficulties, but it was not known if it would be possible to extend the line across the North Cachar hills into the Brahmaputra Valley, and this was the main question which the exploration was intended to decide. Should these hills offer an impracticable barrier, the line from Chittagong would terminate in Cachar in a *cul de sac*, and all hope must be abandoned of giving the Brahmaputra Valley direct railway communication with a seaport of the value of which there could be no doubt. Other benefits, economical, administrative, and strategical, which it was anticipated would result from the establishment of this connection, combined to render the solution a question of interest and importance." Doubts were set at rest by exploration, and a practicable route for the railway has been discovered, the highest elevation occurring in which is but little over 2,000 feet above mean sea level, and which presents no abnormal engineering difficulties. It is confidently anticipated now that the hills can be surmounted with maximum gradients of about 1 in 70, at an estimated cost of Rs. 1,30,000 per mile. As to its location and prominent items of construction, it will be convenient to quote from Mr. Buyers' Report. He writes:—"The Badarpur line takes off from the Chittagong-Cachar line near mile 157 from Comillah, and crosses the Barak river where a narrow spur of rock, on which is situated a small ruined fort, projects from the south bank, and forms a suitable foundation for one of the bridge abutments. The river here has a tolerably straight reach, but the north bank is to some extent subject to erosion, as it is composed of an alluvial silt. The estimate for the bridge is framed on a design, the chief characteristics in which are the employment of steel girders of 250 feet span, supported by steel cylinders, resting on brick wells, which are estimated to be sunk to a depth of 80 feet below the bed of the river. Three spans of 250 feet are provided, giving 750 lineal feet of waterway. The cylinders, two of which form a pier, are $16\frac{3}{4}$ feet in diameter at the bottom, diminishing to 12 feet at the top, and it is intended to fill them with cement concrete. The abutments are of brickwork. High brick piers are considered objectionable, as the country is subject to violent earthquakes." After crossing the Barak river the line runs north, flanked for a distance of nearly five miles by a low range of hills. Near Bikrampore, the country rises above the influence of Barak floods, and it is proposed to place an engine-changing station near mile 166. The Arung river is crossed near mile 168, with a bridge of three 40 feet spans, and beyond this the line enters a small valley, up which it runs to mile 171, when it curves sharp to the left, and, passing by a tunnel slightly over 200 yards long through a narrow neck in the intervening range of hills, emerges into the Jatinga Valley at a point in the right side, about $3\frac{1}{2}$ miles above the gap through which the river issues from the hills into the plains.

The estimate for this Assam line amounts to Rs. 25,25,486 for a total mileage of 19·789 miles; which gives a mean rate of Rs. 1,27,620 per mile; but this includes cost of the Barak bridge, amounting with its proper share of establishment to Rs. 6,32,359, which should in fairness be distributed over a longer section. Exclusive of the Barak bridge, the mean mileage rate is Rs. 95,666.

STONEY AND WINTER'S SYSTEMS OF LOCKING RAILWAY POINTS.

We had occasion some time ago to notice in these columns Messrs. Stoney and Winter's pamphlet on their Patent Switch Locks, and have since had the pleasure of seeing the models of these locks, which has enabled us to form a fair idea of the operation, utility and advantages of the three systems inaugurated by the inventors.

Succinctly stated, the first, or the "Locking Bar" system, used on Indian State metre-gauge Railways, consists of a T-iron locking bar, about 20 feet long, having its rear end pivotted in a chair, while its fore, or locking end, is free to move up and down in a suitable guide arranged on the switch chair. On this end is fixed an iron wedge called the "upper" wedge, while one of the tongue rails carries the corresponding or "lower" wedge, whose inclined surfaces extend laterally and endwise slightly beyond the end of the tongue rail and so arranged as to receive the "upper" and work accurately with the same.

The weight of the *locking bar* is counterbalanced by a movable or adjustable weight on a lever whose fulcrum is on a chair placed within a short distance of the switch chairs on which the *wedged* tongue rail slides. The motion of the locking bar is vertical, rising and falling to the extent of the depth of the lower wedge by the horizontal or lateral movement of the switches, which when at mid-travel the apex of the upper wedge will be directly over that of the lower one, and no sooner the "upper" falls upon the "lower" wedge, either right or left of the latter, it effectually locks the points, which remain immovable so long as the weight of a running train, an engine or a vehicle is on the locking bar automatic in its action. This system can be made to suit any circumstance, but it would not be advisable, though it would be *quite safe*, to run through them *trailing* if wrongly set, for fear of springing the tongue rails under the required strength. If the switches under this system be made to return always to the same side, or remain right or left when thus left, they may be run through *trailing even though wrongly set or held by a pointsman !* The advantages of such an arrangement are obvious to require further elucidation or explanation at our hands.

The second plan of the locking gear which may be used with or without the locking bar consists of the stock rails being secured to the switch chairs, which together with the projecting *bearing* having jaws for the reception of the central eye of the rocking lever forms one casting—thus ensuring a perfect gauge. The central eye of the rocking lever is introduced into the bearing just referred to and held in position by means of a bolt on which the lever moves radially by the operation of the point rod. The rocking lever is T-shaped, having the central or vertical limb smaller than the other two, which are not quite right-angular with it, and on which are fixed two L-shaped plates called *drivers.* On the tongue rails are bolted two bent triangular plates with the hypotenusal side presenting the appearance of two differentially inclined planes or surfaces, which face the L-plates or *drivers* on the rocking lever. When the latter attains its maximum travel the *drivers* acting on the triangular horn plates of the tongue rails force the points home against the stock rail and held in this locked condition by the travelling load. Without the locking bar the apparatus depends on the action of the loaded T-shaped handle moving in a vertical framework whose shorter arms act on a horizontal bell crank having arms of unequal length. The longer arm of the bell crank is conned with the switch rod, which receives its motion from the T-shaped handle through the bell crank.

The third, or the Automatic Rocking Lever Switch Lock differs only from the foregoing in having a device which permits the switches to open automatically if wrongly set to trailing points. In this arrangement the tongue rails, instead of being joined together by the tie bars in the usual manner, are each of them connected to the projecting part of the rocking lever—which unlike that of the preceding one has this part cross-shape with a longitudinal slot running along the arms—by two tie rods or links whose inner ends with bolts move freely in the slot and the outer ones drop in the ordinary way into eyes on the tongue rail. The arrangement is such that when the rocking lever moves through an angle sufficient to take off and press home the *drivers* the link bolts never come in contact with each other or jam in the slot which is made large enough to provide against. Under this system, as in the former, there can be no danger from wrongly set points, as the moving train or vehicles will automatically adjust them and thereby prevent an accident. We are of opinion that the systems I. and III. are by far better than II., as the switches fitted up therewith may be run over *facing* or *trailing*, even when unheld by a pointsman, with *perfect safety and without injury to either switches or locking gear*. These are advantages which in these days of progress and rapid Railway operation should command the attention and consideration of all Railway owners, agents and managers. The adoption of the Stoney-Winter system of locking points on the Madras and State Railways has, we find, saved many accidents and fully borne out the expectations formed of them by the patentees, who must be congratulated on the usefulness and the importance of their first invention, which has already received recognition at the hands of the Government of India by the honorarium paid by it for the use of the locking apparatus on State Railways.

We may inform our readers that the models of all three systems are open for inspection at the office of Messrs. Burn and Co., Howrah, who are, we believe, the patentees' agents for the sale of them.

PROGRESS IN PHOTOGRAPHY.

A German photographer, Herr Ottomar Anschutz, of Lissa, is creating some sensation in Berlin, by exhibiting an apparatus he has constructed for the Prussian War Ministry, by means of which he reproduces on a screen pictures of moving objects. That of course is no new thing. Her Anschutz's claim to sensation consists in the marvellous quickness of his operations.

Whereas hitherto an average of a hundredth part of a second's exposure has been deemed quick timing for a satisfactory result from sensitized plates, the new method effects the desired object in one five-thousandth of a second. Herr Anschutz has been experimenting for the last five years with a zoo in miniature—wolves, stags, horses, quaggas, pigeons, swallows, storks, &c.—attached to his photographic studio, as a means to the end he has attained. The apparatus used contains, we are told, twenty-four lenses, is perfectly automatic, and so rapid in action that the twenty-four positions into which it disintegrates the leap of a horse are, in favorable cases, read in ·72 of a second. Then there is another apparatus, by means of which the subdivision of motion into component parts is again combined, and reproduced on a screen, so as to show an audience the actual motion of the object that was photographed. The first apparatus is, in principle, similar to the well-known optical toy, where a series of pictures rapidly revolving produces the illusion of actual movement; but the details of the appliance have been greatly improved. The rapidity with which the pictures must be taken necessitates employment of a small lens and hence the photographs are very small, generally only $\frac{7}{16}$ths of an inch in length and breadth. These are enlarged to $1\frac{3}{4}$ inch and transferred to thin glass plates. The rest of the juggle is effected by means of a twenty-four windowed iron disc, revolved rapidly before a Geissler tube bent into a spiral. Four Bunsen elements, and a large induction coil supply the necessary high tension current to render the tube luminous. The disc is revolved at a speed corresponding to that during which the twenty-four photographs were taken. *Industries* writes:—"The usual make and break of the induction coil is replaced by a make and break arrangement, worked from the spindle on which the disc is mounted and the contacts are so arranged that the primary circuit is broken at the moment when a picture comes opposite the Geissler tube, and is again established during the intervening time. In this way only one very brilliant induction spark passes through the Geissler tube at the moment the primary circuit is broken, and as the reproduction of the picture on the screen lasts only an infinitesimal fraction of a second it is exceedingly sharp"—and to the eye of an observer practically continuous.

THE Esquimalt graving-dock, which has been under construction for a great many years, is at length opened; H. M. S. *Cormorant* having been the first vessel to enter. Although there has been no flourish of trumpets over it, this is an event of considerable importance, for it is the only dock of the kind we have available throughout the whole length of the North Pacific. It is of sufficient dimensions to dock most kinds of ships in her Majesty's navy; and as Esquimalt is the naval station for the North Pacific fleet, and our only coaling-station east of Hong-Kong, now that Port Hamilton has been given up, it is to be hoped that the defences of the place will be completed without delay. The Imperial Government has contributed £30,000 for armaments, while the Canadian Government is constructing the earth-works and providing for the permanent garrison.

Notes and Comments.

MINING IN NEW CALEDONIA.—New Caledonian papers report considerable activity in the mining industry, several vessels having sailed direct for Glasgow, with full cargoes of chrome and cobalt.

NEW GUINEA.—The New Guinea exploring party organized by the Special Commissioner, Mr. John Douglas, have returned to Port Moresby in good health and spirits. They report having found magnificent country on the other side of the main range between Mount Obree and Mount Brown—a country which, as the habit of magnificence is, only needs development to become a Golconda.

CIVIL *versus* MILITARY SUBORDINATES, P. W. D.—The old difference has been again revived by the evidence given before the Public Service Commission. There can be no question that at the outset of his career the Civilian Subordinate is heavily handicapped by having to enter the Department in a lower grade and serve on smaller pay than his Military *confrère*. This initial disadvantage, which retards promotion, is certainly mitigated by after concessions and pension prospects; but it is questionable whether, when things are considered as a whole, the advantages counterbalance the disadvantages.

AN ASSOCIATION OF ARCHITECTS AND ENGINEERS FOR INDIA.—The question of an Institution of Civil Engineers for India has been often discussed, and as far back as 1877 was as near becoming accomplished as far as it was possible to be. The scheme fell through from want of unanimity and support, and the period was not opportune. A more modest—some might consider it pretentious—undertaking is now on foot at Bombay, and that is an "Association of Architects and Engineers for India." Judging from the prospectus we are not disposed to favor the scheme. It is too diffuse, lacks weight, and trenches on other domains.

IN RE "MADRAS INDIGO."—A correspondent writes, To the production of good color an immense, an almost impossible amount of personal watchfulness, much practical study of "plates," barometers, and leaf, and friendly terms with the clerk of the weather, are essential. It is given to but few men to fulfil all these conditions. And then, perhaps, when a manager has made himself master of the essentials, and writes to his Calcutta Agents to enquire what color they would like him to make, he is told that they would prefer "pink with a yellow border." That, at any rate, was the answer a youthful and zealous Tirhoot manager of three months' standing got from a leading Calcutta Agency House once upon a time.

RAILWAYS IN JAPAN.—The report of the Railway Bureau with which we are just now concerned is a condensed review of Railway operations in Japan between the years 1869 and 1887. Total mileage 370. Of which 202 miles Government property; 161 miles in possession of private companies. Average cost of construction per mile, on Government roads $79,925 on private roads $26,519. The moral is quite too obvious to stand in need of any commentary. Nevertheless, wise are the words of Viscount Inouye, who says:—"It is unavoidable that, in the beginning, the expenditure in connection with any enterprise should be large in comparison with the profits derived from it, and that the true proportion of the one to the other should only be attained by experience."

ENGINEERS IN AUSTRALIA.—Our English namesake calls attention to the injustice to which those holding responsible positions in the technical departments of the Government railways in our Australian colonies are exposed, owing to the corrupt influences and partisan spirit which too frequently, and as the result of the political forces at work, mark their administration. A correspondent recently drew attention in these columns to the same abuses, and we can speak from personal experience of "party" strife playing not only a prominent part in professional appointments or neutralizing professional action. It is a sad commentary on the motto: "Advance Australia" for a country that will not recognise any professional qualification except one acquired in the Colony.

CUDDAPAH-NELLORE STATE RAILWAY.—The following are some particulars regarding the new line from Tirupati to Nellore, to be opened for public traffic on 1st proximo. This section is 83 miles in length, and runs in a north-easterly direction from Tirupati to Nellore, crossing the Madras Railway by an overbridge at Renigunta, and having ten stations on the line. The country through which the line passes is wavelike in formation and poor in soil, more than $\frac{4}{5}$ths of the railway passing through waste lands and low jungle. Two large valleys, those of Ramdos and Godur, each about 3 miles wide, are crossed by the railway, thus necessitating much bridging and waterway to carry off the large volume of water that accumulates in, and runs down, these valleys. The country is much interspersed with tanks, many of which have to be crossed by the line, thus causing heavy embankments and steep gradients, notably that of the Monobole tank, in which there is more than a mile of railway bank. For the same reason much pitching has to be done. There is a temporary diversion of more than $1\frac{1}{2}$ mile in the Godur valley at the 22nd mile, it having been decided to re-build on wells two of the piers of the 17 forty-feet openings at this spot.

THE AMERICO-CHINESE FINANCIAL INSTITUTE.—History repeats itself; and so does humanity. The spirit of John Law and his Missisippi Bubble would seem now to be animating the booming brain of Count Eugene Stanislow Kosika de Mitkiewicz, a naturalized American citizen who has taken the Empire of China under his financial protection, and with an Americo-Chinese Financial Institute, is going to make everyone in the flowery land as rich as the Rothschilds. His Institute is by way of being a "mammoth" credit mobilier, dealing with nothing but millions, financing the Imperial and Provincial Governments, and built up on monopolies. Monopoly of right to construct and maintain all railways, telegraphs, canals, forts, camps, armies, navies, arsenals, public works, ladies' toe squeezing arrangements, &c., &c. In fact, "its scope is measureless," as a gushing correspondent writes to the *North China Daily News*. Perhaps somewhat too measureless in fact. Random millions are apt to be so. And the heathen Chinee knows how to manufacture bank notes very cleverly; and is not easily induced to part with his real money. We fear we shall not have the pleasure of travelling by the new railway line with which John Law's 19th century avatar is going to connect—*viâ* the Ural Mountains, and in a twelve days' journey—Pekin and Paris.

Current News.

THE Patents Bill will be passed during the ensuing Calcutta Session.

THE Fort at Fulta, in connexion with the Hughli defences, is to be armed with new quick-firing guns.

THE Supreme Government will take no active part in the Melbourne Centennial International Exhibition of 1888.

DR. WATT'S appointment in the Bengal Educational Department, which is now vacant owing to his transfer to the Government of India, will not be filled up.

IT is said that the Secretary of State has declined the Bombay Government's request for permission to publish the report of the Commissioners in the Cambay case.

A CONFERENCE of railway authorities is being summoned to meet during the cold weather in Calcutta for the discussion of matters connected with railway administration.

MR. TOWNSEND, the petroleum expert, has arrived in Simla to consult with the authorities regarding the prospects and progress of the work he has been engaged on during the past two years.

THE continuation of the Bilaspore-Etawah Railway from Umaria is to be proceeded with immediately, and the contractors have received an intimation that the line must be carried to Bilaspore by 1889.

MR. MACKENZIE'S Resolution on the Annual Forest Report of the Central Provinces shews that there are serious shortcomings in the year's work, almost entirely attributable to the fact that the Government expects to get full work out of half establishments.

A REGULATION is published forbidding any persons, not being natives thereof, to reside in the Ruby Mines district in Burma, without special licence, or to dig for precious stones there. Any infringement of the regulation renders the party liable to imprisonment for one month, or fine, or both.

DR. BURGESS, Director-General of the Archæological Survey of India, returns to India to resume charge of his appointment at the end of the current month. We understand that he will proceed to Simla to discuss with the authorities there a programme for placing the department on a more satisfactory footing.

AMONG the reductions already carried out at the instance of the Finance Committee in Madras, is the abolition of the appointments of Joint Secretary and Assistant Secretary in the Irrigation Branch of the Public Works Department, the duties performed by these officers being now performed by the Secretary and Under-Secretary.

THE *Railway Service Gazette* hears that the negotiations between the Government of India and the Cashmere State for the construction of a line of railway between Sialkot and Jummu are progressing very satisfactorily, and that it is not unlikely the undertaking will be commenced at the beginning of next season.

BY order of the Czar the project of extending the Vlady-Caucasian Railway to Pestrosk, a port on the Caspian Sea, will this year be commenced. This railway will connect the Black Sea with the Caspian, as the Vlady-Caucasian Railway to Novorozzisk which has now been under construction for a year, will soon be finished.

LIEUTENANT C. A. BROWNE, R.E., Deputy Examiner of Military Works Accounts, leaves Simla almost immediately to inspect certain account offices in the Punjab. On his return to Simla Lieutentant-Colonel F. J. Oldham, R.E., the Examiner of Military Works Accounts, will then start on a more lengthened tour of inspection, and will visit the Punjab, the North-West Provinces and Oudh and Bengal. The places among others which he will stop at will be Ambala, Mirat, Allahabad, Calcutta, and Barrackpur.

OUR information regarding the appointment of Mr. Alladis as Agent and Manager of the Madras Railway is incorrect. We now learn that the salary of the Agent and Manager has been reduced from Rs. 2,500 to Rs. 1,500, and that as Mr. Robinson, the Chief Engineer, (now acting Agent) draws a salary of Rs. 1,800 as Chief Engineer, he has refused the appointment, and Mr. F. B. Hanna, one of the Engineers, will succeed to the Agency. Mr. Robinson, we further learn, shortly proceeds on three months' privilege leave.

MAJOR MARINDIN and Mr. Farrer, of the British Board of Trade who were sent to Egypt to make inquiry into the working and condition of the railways, have handed to the Egyptian Government a voluminous report. During their stay they have visited every mile of line, inspected every workshop, and examined every department. It is understood that they have found the permanent way in better condition than was anticipated, but that the amount of rolling stock is deficient. They consider 45 per cent. of the receipts sufficient for the maintenance of the line, without any necessity for extra credits.

The repairs to the Bandi Bridge and the placing of the new girder in position have been satisfactorily carried out by the Company's Engineers. The bridge was officially inspected and passed by the Government Consulting Engineer on the 11th instant from which date the restrictions in through booking have been removed. Endeavours are now being made to raise the submerged vehicles, a work of some difficulty, owing to the depth of water, but a party of the Company's divers from Bombay were sent up, and are now engaged in recovering the vehicles. While the break lasted the traffic department successfully coped with transhipment of passengers and mails.

Rapid progress is being made in the defence works at Manora, under the supervision of Major Hayden, Royal Engineers. The battery, which is to receive heavy guns, is in course of construction a mile to the west of the existing battery, and the site is selected with great judgment. The new batteries will be masked from the enemy approaching from the sea. The guns will be mounted on the Moncrieffe system, by which with the aid of hydraulic power they are elevated at the time of firing, the recoil carrying the gun back under shelter for re-loading. The new battery will be finished and ready to receive the guns now on thier way out from England before the close of the year.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

A DICTUM.

Sir,—With reference to your article on "The Adhesion of Cement, &c.," page 158 of Indian Engineering, dated 3rd instant, I would draw your attention to an article on the subject, giving result of very numerous experiments by Mr. Isaac John Mann, page 153 of *Engineering* for 17th August 1883. Mr. Mann's results for adhesion were much less than those quoted in your article ; but evidently he experimented on weaker cements.

M. Inst c. e.

ROOFING MATERIAL.

Sir,—Can you, or any of your correspondents, kindly inform me if there is any kind of material, such as abestos cloth, or any kind of felt, which can be obtained in large sheets and which would be suitable for lining the inside or outside walls and roofs of rooms exposed to the sun, so as to keep them cool ? A kind of cloth is now made of iron slag which is said to be good for jacketing boilers etc. The material if used inside would have to be covered with paper or cloth so as to look respectable : and if outside, it should not be liable to be damaged by rain.

* * *

Please state approximate prices.

THE BLOCK IN THE P. W. D.

Sir,—The rumour that 40 or 50 officers of the Railway Branch are to be compulsorily retired or put on furlough is unfortunately, I believe, true. This will doubtless press very heavily on senior men with large families, but what I wish to point out is that the only sufferers from this unavoidable use of the shears will be the civilians and not the military.

The old argument in favor of the employment of R. Es on civil works, that their presence in India was necessary and that it was cheaper to employ them thus than to let them be doing nothing, does not now hold, because there is their own legitimate branch the "Military Works" which at the present moment is so short of men that it is with the greatest difficulty that any officer of it can get leave, and it is well known that Superintending Engineers of the Military Works have over and over again applied for additional executives and assistants but are told there are none available. A recent *London Gazette* notification concerning the increase of the corps shows how short-handed it is.

Why then are not the Sappers taken out of the Railway Branch which has 30 or 40 more men than they can find employment for ? If every R. E. of and below the rank of a 1st. grade Executive were transferred from the P. W. D. to the M. W. D it would be an advantage to both and these compulsory furloughs and retirements would not become necessary.

I draw the line at 1st. grade executives, because the senior R. Es now serving in the Department joined when it was on a different footing and when the civil element was almost unknown : as they have borne the heat and burden of the day, they should certainly be allowed to enjoy the *otium cum dignitate* which generally comes at the end of a long and honorable career.

The arguments may be enumerated as follows :—

(1.)—That it is an injustice that the only sufferers from the retrenchment scheme should be civilians.

(2.)—That instances are abundant to show that the employment of R Es on railways has not been altogether a success. The fact that they are not admitted as Members of the Inst. C. E. shows they are not recognised by the Profession.

(3.)—That their own corps is in want of them.*

(4.)—That they are more expensive than civilians : each R. E. employed during his whole career on civil works costs the Government some Rs. 70,000 more than a civilian performing indentically the same duties would—

(5.)—That it renders them unavailable for active service, because if an R. E. is employed on an important civil work he cannot be spared at a moment's notice for military duty : in fact General Browne was distinctly told that none of his Sappers on the S. P. S. Railway would be allowed to go on active service should complications arise in Afghanistan.

Hope Deferred.

* [A weak argument. Some of the Medallists and Pryse men of the Inst. are R. Es.—Ed., *I. E.*]

ENGINEERING CONTRACTOR'S ASSOCIATION.

Sir,—I think it is time that Engineering Contractors clubbed together and formed an Association for their mutual benefit and protection. They are an important class of men on Engineering works ; and yet owing to the want of union among them they have no influence and are shewn no consideration. The practice of carrying out works without a contractor—never in much favor with Engineers—has proved a failure. And it stands to reason that it should be so. The Engineer has too much under his charge, burdened as he is with office work, to be able to carry out his works efficiently himself. His men idle or scamp work and although he detects the latter he is obliged to let the thing pass, as he is virtually contractor himself, being expected to get the work done at certain rates. There was a case not long ago of a bridge which was being constructed departmentally, as it is called. Contractors were working on either side of it but they would not take it at the same rate as the other masonry, as it was in an awkward, out-of-the-way spot. They would, however, have been very glad to have taken it up at an advance of 25 per cent. on the standard rates ; but this the Engineer would not allow. He built it himself at a cost of more than double the standard rate for masonry, but did not allow the excess to appear in the books, as he wrote it off to pumping—the bridge having wet foundations. The structure collapsed under the first flood that came down to it. There is a railway in Southern India which has been carried out on the departmental system : and that railway is remarkable for nothing so much as the failures on its works. And it cannot claim to have been constructed cheaply either. But it is unnecessary to multiply proofs of what is really a self-evident proposition. When an Engineer is responsible only for the quality of the work done by him, he will, of course, get better work done than when he is responsible both for the quality and the cost : especially when he has so much to do that he cannot efficiently control both. Yet although the contractor is so useful and important an auxiliary to the Engineer, it is more often the case than not that the Engineer exhibits an antagonism towards him. He generally suspects that the contractor is making a great deal of money—though he would be puzzled to say how—and he addresses himself to the task of minimising his profits. His subordinates taking the cue from him make themselves so disagreeable that the contractor is obliged to pay them black mail to be allowed to get on with his work. For, bound hand and foot as he is by a one-sided agreement, backed by heavy security, he has nothing for it but to submit to anything that is put upon him. Engineers either do not, or will not, see the unwisdom of this policy. Though it is apparent enough that a contractor who loses money by such treatment will take care that the rates he demands the next time will cover such contingencies. There was a home firm of Engineering contractors who built an important railway in this country some years ago. Their instructions to their agents were that they were to assist their sub-contractors to make money by their contracts in every way in their power. No matter if they found that they had given out a work at double the rates they might have got it done at, once having entered into the contract they were to assist the sub-contractor to make as much money as possibly could be made out of it. For, their argument was—and they were sound men of business—"if sub-contractors make money on the works others will be attracted to them, competition will arise, and you will be able to reduce the rates in future contracts." The moral aspect of the question need not be touched upon.

While the Engineer's subordinates do their best to prevent the contractor from doing any work at all—for the simple and sufficient reason that the less he does the less they will have to do—and the Engineer charitably does his best to prevent him from adding any money to his capital through his contract, his own subordinates and workmen are actively engaged in swindling him in every way they can think of—and they can think of many. He thus finds himself between the hammer and the anvil—the Engineer and his subordinates on one side and, his own subordinates and workmen on the other. In all other countries artizans and laborers are honest men. If it were not so they would not follow a laborious handicraft, but would take up the lighter arts, such as pocket-picking, house-breaking, forging and the like. But India is an exception in this as in most other matters. No greater rascal could be produced anywhere than the native workman. It is due to this that works cost so much more in this country than they ought to do considering the little that workmen can be supported on. Whether work is carried out by contract or departmentally swindling is rampant. Men bolting with advances, cheating in measurement, idling, scamping work, stealing materials or else spoiling them through malice. The native workman regards his employer as his natural enemy, for the reason that he expects him to work, and nothing pleases him so much as causing him loss or annoyance. Act XIII. of 1859 he laughs at.

The object of a Contractor's Association would be primarily to improve the position of its members both with regard to the department under which they served and their own subordinates. These objects would be promoted, first by taking no contract in the lump, but simply taking work at schedule rates, undertaking to do a certain minimum quantity periodically, with an understanding that so long as this was done the work could not be taken away. Under this system no money security should be given. The security of the side giving the contract would be that if the work did not go on satisfactorily it could be taken away again. The object of the money security is simply so to bind the contractor that he will afterwards be obliged to submit to anything that may be put upon him. What occasion is there for a money security for any legitimate purpose? The work is not paid for until it is done, and what security can possibly be needed when working on this sound system? If any security should be given at all it is one to the contractor that the work will be paid for when it is done. Cases of not paying contractors their dues are not so rare as to make this proposal an altogether unreasonable one. But the fact is no money security either way is necessary. All contracts should be open ones, carried on under certain conditions, while mutually agreeable. The getting of money security is no advantage to the Government or the principal giving the contract, for the contractor takes it into consideration in determining his rates. It is only an advantage to the agents superintending the working of the contract, for holding this rod *in terrorem* over the contractor they can make him submit to anything they like. There is a general complaint among Engineers and people who want works carried out that they cannot get good contractors. This reminds one of the man who having murdered his father and mother said he hoped the Court would take pity on a poor orphan. It is the treatment most contractors receive which makes them throw up Engineering work in disgust.

The next point is the manner of dealing with workmen. No advances should be given to them on any account. If all contractors and Engineers (when working departmentally) followed this rule, the workmen would have to submit to it, and it would be better for them as well as for their employers. A native usually wants an advance to bolt with it. Gangs of men make a practice of going from work to work getting advances and going off with them. If the giver of the advance be wise he will grin and bear it: for to invoke the aid of that thing called the law is to throw good money after bad and subject onesself to much tribulation into the bargain. In the instances where the men applying for an advance are *bonâ fide* workmen their object is simply to have the whip hand of their employers. They have no real need of it: or, how is it that they manage to do without both advance and employment in those cases where their demands are so exorbitant that no arrangement can be come to with them at all. Having got the whip hand they do not know how to use it. The possession of a little power intoxicates a native of the lower orders. There is nothing too extravagant or outrageous for them to expect or demand when in that position. If contractors would join in promoting merely the two objects abovementioned, they would find their position vastly improved. But there are other desirable ones which might be attained at the same time.

Every case of loss on works sustained by a member of the Association should be reported to the others, with an explanation of how the loss came to be sustained, for their warning and guidance. Large works have been carried out in this country from which one contractor after another has gone off lamenting. Each having taken up the work in ignorance of the experience of his predecessor.

Every case of unfair or sharp practice on the part of the givers of a contract should be reported for the general benefit. There are a great many honorable men in their way who would not stoop to sharp practice to profit directly by it themselves, but who will do so readily enough for their employers, to commend themselves to them. Cases of actual *zulum* should be taken up by the whole Association and redress obtained for the victim if possible. But the general policy of the members of the Association should be so to direct their operations that they shall never need to have recourse to that rotten reed—the law.

ENGINEERING CONTRACTOR.

Literary Notices.

NOTE ON HIGH MASONRY DAMS. *By Guildford L. Molesworth, Consulting Engineer to the Government of India for State Railways.*

THIS note was written by the author in 1883 after having read the observations of M. Bouvier in the previous reports of M. M. Graeff and Delocre on High Masonry Dams which were published in the *Annales des Ponts et Chausées* in 1866, most of our readers are probably acquainted with the simple formula which was framed by Mr. Molesworth in 1873 for calculating approximately the section of a dam according to the theory of M. M. Graeff and Delocre. The object of the present note is to draw attention to that formula which the author has found necessary to modify somewhat to suit the theory of M. Bouvier.

Mr. Molesworth in his note says "that the difference between the results of the formulæ of M. Bouvier and those of his predecessors is a matter of some considerable importance, for in some calculations which he has made, he has found the pressure indicated by the former to be more than 40 per cent. in excess of that indicated by the latter, and there is no doubt that the theory of M. Bouvier is correct according to the present state of experimental science, for there exists some uncertainty in the problem of pressures in structures of this character." M. Bouvier's theory may be briefly stated in his own words:—"In order to obtain the maximum pressure on the down stream face when the reservoir is full, instead of taking the vertical component of the overlying pressure at that joint, the resultant pressure must be taken into account after it has been divided by the cosine of the angle which it makes with the vertical; that is to say, a normal force on the joint of which the resultant is its orthogonal projection."

The following equations will show at a glance the difference between the two theories:—

P=the resultant of the weight of the overlying masonry.

l=the length of the horizontal joint in question.

p'=the maximum pressure upon a given point of the down stream face; the reservoir being full.

u'=the distance of this face, measures in this horizontal joint, from the foot of the resultant of the pressure of the water, and of the weight of the overlying masonry.

πv=the vertical component of the overlying water.

πu=the horizontal component of the same.

R=the greatest pressure that the masonry will bear when the reservoir is full.

$$\text{If } u' > \tfrac{1}{3}l,\ p'=2\left(2-\frac{3u'}{l}\right)\frac{P+\pi v}{l} = < R. \quad (3)$$

$$u' < \tfrac{1}{3}l,\ p'=\tfrac{2}{3}\,\frac{P+\pi v}{u'} = \text{ or } < R. \quad (4)$$

$$\text{If } u' > \tfrac{1}{3}l,\ p'=2\left(2-\frac{3u'}{l}\right)\frac{P+\pi v+\dfrac{\pi u^2}{P+\pi v}}{l} = < R. \quad (6)$$

$$u' < \tfrac{1}{3}l,\ p'=\tfrac{2}{3}\,\frac{P+\pi v+\dfrac{\pi u^2}{P+\pi v}}{u'} = \text{ or } < R. \quad (7)$$

Equations 6 and 7 are M. Bouvier's, and it will be noted that they are exactly the same as equations 3 and 4, except that they contain one additional factor, *viz.*, the horizontal component of the overlying water pressure.

Now we fail to see how the horizontal component of the water pressure can have any effect in exerting a downward pressure on any portion of the joint. So far as we understand the question the horizontal component simply tends to produce sliding on the joint, and to throw the resultant pressure nearer to the down stream face. We are not therefore prepared to accept so readily as Mr. Molesworth seems to have done M. Bouvier's theory, but as the results obtained from his equations are on the side of safety, we commend them on that ground to the notice of the profession, as there is no structure likely to be more productive of damage to property and loss of life than the failure of a high masonry dam. From the numerous sections of dams which are given in the pamphlet, and which have been tested both by the original and modified formulæ, an Engineer will have little difficulty in obtaining the theoretical form of any dam which he may be called upon to design.

General Articles.

THE PEGU MUNICIPAL SCHOOL

Of which we give an Engraving from a photo is a composite building, the lower floor being of brickwork, the upper of timber lath and plaster. In the upper storey the quarterings are framed as for plankwalling, but instead of this expensive description of work, the walls are formed of bamboo laths plastered over.

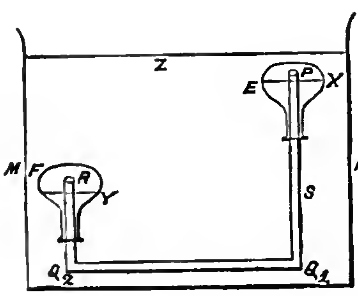
THE COMMON SYPHON.

By A. Ewbank.

III.

This experiment is ideal, as we could not conveniently arrange the pistons, even supposing we did not require one of them at an appropriate moment to vanish. But the mathematical principle that the water will move upward is just as well established by considering an unrealisable experiment as by considering a realisable one. For the piston difficulties have no connection with those laws of liquids that we are studying. If, with a power in our hands to manufacture suitable pistons, the water will rise, there must always—pistons or no pistons—be the same tendency for the water to rise, and this is all that we have to prove. The principle being once established we may perhaps be able to devise some means of dispensing with piston. This is in fact accomplished in the manner shewn in *Fig.* 5.

Fig. 5.

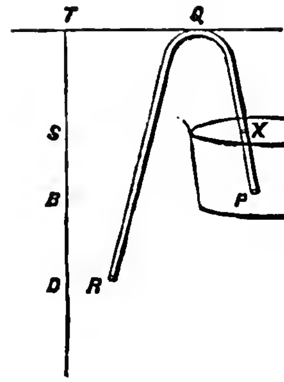


Here we invert the syphon and over the open ends we have placed inverted vessels or bottles E, F. The syphon section is less than the sections of the necks of the bottles. R may be supposed to reach to the top of the inside of F. The position of P in the bottle E is immaterial, but for simplicity of explanation we shall also suppose P at the top of E. The syphon and bottles are placed in a vessel M N which has mercury to a level Z.

F initially is full of water and E of mercury. Then water will pass from F to E. At any moment let the surface of the mercury in F be Y and let X be the mercury surface in E. Then at the level R in the syphon branch R Q_2 we have a downward or inward mercury pressure due to the depth of R below Z. At the level P in the bottle E we have a downward or inward mercury pressure due to the depth of P below Z. The difference of these is a weight of a column of mercury between the levels of S and P. As long as there is water between R and P the tendency of this water to discharge itself at R will be measured by the weight of a column of water S P, which is less than the weight of the same column of mercury. Thus inward pressure M R preponderates and the water empties itself from the syphon through P.

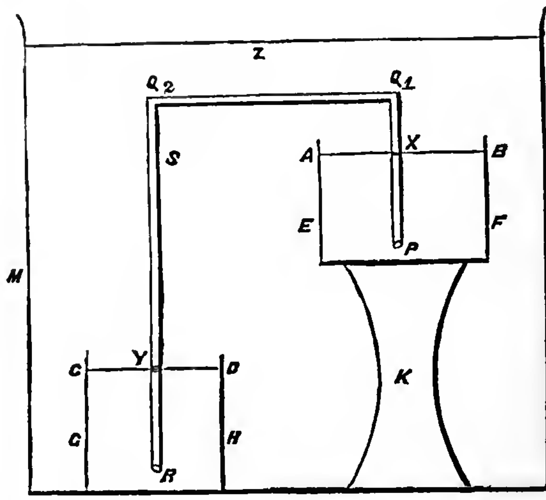
In *Fig.* 1 we had two conditions: The one was that the discharging orifice shal be below X, which we may call the receiving orifice, though the water really enters at P. The second condition was that S T must be less than a certain height. The former condition appears in *Fig.* 4 and *Fig.* 5 in the inverted form—so to say—that

Fig. 1.



the discharging orifice shall be above the receiving orifice. As for the second condition it has apparently vanished.

Fig. 4.



But if in *Fig.* 4 we imagine the vertical branches produced above the level Z so that Q_1 Q_2 is out of the mercury, we might have R Q_2 so high that the depth Z R of mercury could not provide sufficient pressure to lift water from R to Q_2. Here the condition reappears. On the other hand, if in *Fig.* 5 we have the vertical branches produced downwards through apertures just sufficiently large in the base of M N so that Q_1 Q_2 is a horizontal tube outside and below the mercury, we may make the vertical branches as long as we like, but the syphon will always work. If we turn *Fig.* 5 upside down we seem to see an ordinary syphon passing liquid from a higher to a lower vessel. Here the liquid is denser than the circumambient gas or fluid. On restoring *Fig.* 5 to its proper position we have a syphon passing a liquid upwards, but the liquid is lighter than the surrounding fluid. In each case we see two fluids changing place and the heavier fluid taking the lower place. A syphon is merely a fluid connection opened between the two places.

A. Ewbank.

THE ADHESION OF CEMENT AND OF VARIOUS CEMENT MORTARS TO BRICKS,

With Their Application in the Design of Retaining Walls, Arches, and Similar Structures.

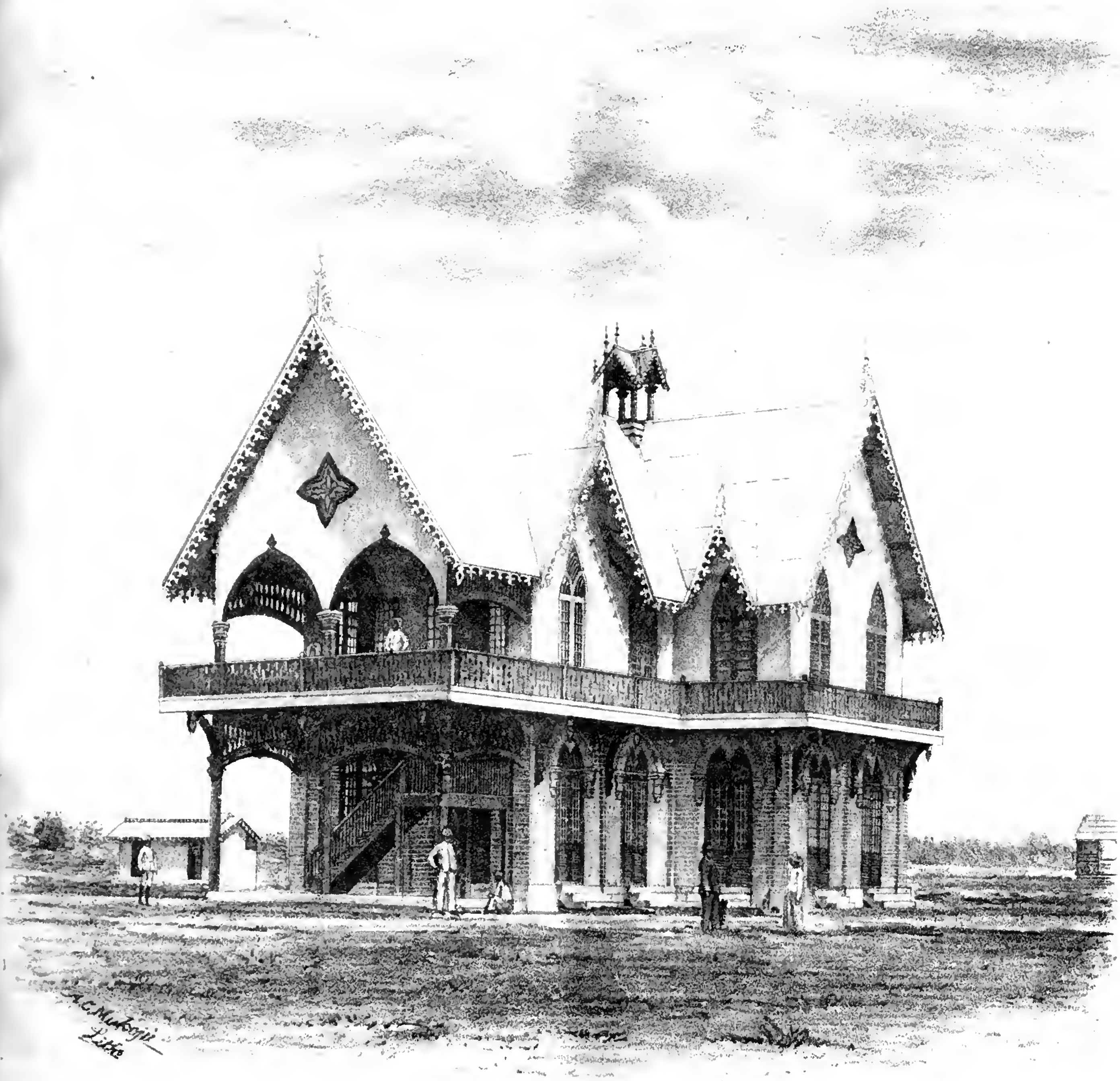
III.

Next investigate the distribution of pressure and tension on the points A and B.

We have seen that the area of the wall was 10 $(x+8)$ and that the weight of the wall was 1400 $(x+8)$—(see *a*). We have also seen that the distance of the centre of gravity of the wall from the point B was

$\frac{2\ (x^2\ +\ 12x\ +\ 24)}{3\ (x+8)}$ (see *b*), and we find that $x = 4$

Then by substituting this value of x in the three expres-



PEGU MUNICIPAL SCHOOL.

The "STAR" Press, 19, Lall Bazar, Calcutta.

sions for the area, weight, and distance of the centre of gravity we have

Area $= 10\ (4+8) = 10 \times 12 = 120$ square feet

Weight $= 1400\ (x+8) = 1400\ (4+8) = 1400 \times 12 =$ 16800lbs.

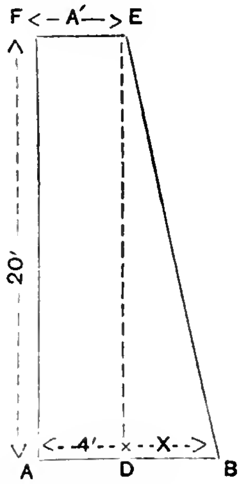
$$X = \frac{2\ (x^2+12x+24)}{3\ (x+8)} = \frac{2\ (4^2+12\times 4+24)}{3\ (4+8)}$$

$$= \frac{2\ (16+48+24)}{3\times 12},$$

whence $X = 4\frac{8}{9}$ or nearly 5 feet.

Therefore, in further calculations let $X = 5$ feet. The distance of the centre of gravity of the wall from A will be A B$-$X, and as A B $= 8$ feet, and X $= 5$ feet, then, calling Y that distance

$$Y = 8 - 5 = 3$$



Let N = normal pressure per lineal foot of length of wall.
" t = thickness of wall at base.
" y = distance of centre of gravity from A.
" n = intensity of pressure at A.
" n^1 = " " " " B.

Then it can be proved that

$$n = \frac{2t-3y}{t} \times \frac{2\ N}{t} \quad \ldots \quad \ldots (e).$$

$$n^1 = \frac{3y-t}{t} \times \frac{2\ N}{t} \quad \ldots \quad \ldots (f).$$

But the nominal pressure per lineal foot of length of wall is evidently the weight of a wall having as section the area A B E F and as length 1 foot, therefore

N = 16,800lbs.

Again we have found that $t=8$ feet and $y=3$ feet. Substituting these values for N, t and y in (e) and (f) we obtain

$$n = \frac{2\times 8 - 3\times 3}{8} \times \frac{2\times 16800}{8} \ldots \quad \ldots (e).$$

$$n^1 = \frac{3\times 3 - 8}{8} \times \frac{2\times 16800}{8} \ldots \quad \ldots (f).$$

whence $n = 3675$lbs. per square foot.

$n^1 = 525$lbs. " " "

The moment of flexure about the section

A B $= \frac{1}{6}\, w\, h^3$ (moment of water).

The moment of resistance about the section

A B $= \frac{1}{6}\, b\, d^2\, f$

when b = length of wall,

d = width of wall at base,

f = force resisting the moment of water.

If equilibrium is to exist, these two forces must be equal.

Therefore $\frac{1}{6}\, w\, h^3 = \frac{1}{6}\, b\, d^2\, f$

whence $w\, h^3 = b\, d^2\, f$ and $f = \dfrac{w\, h^3}{b\, d^2}$

w = weight of a cubic foot of water = 62·5lbs.

h = head of water = 20 feet

b = 1 foot

d = 8 feet

Therefore $w\, h^3 = 62{\cdot}5 \times 8000$

and $b\, d^2 = 1 \times 8 \times 8$.

Substituting these values in the value of f we have

$$f = \frac{62{\cdot}5 \times 8000}{8\times 8} = 7812{\cdot}5\text{lbs.}$$

Therefore the compression at B, together with the pressure n^1 will be

$7812{\cdot}5 + 525 = 8337{\cdot}5$lbs. per square foot

and the tension at A, which is 7812·5lbs. less n, will be

$7812{\cdot}5 - 3675 = 4137{\cdot}5$lbs. per square foot.

Compression at B $= \dfrac{8337{\cdot}5}{144} = 57{\cdot}899$lbs. per square inch.

Tension at A $= \dfrac{4137{\cdot}5}{144} = 28{\cdot}7$lbs. per square inch

On referring to Table I. it will be seen that this tension is not excessive with any of the mortars which consist of cement and sand in the proportion of one to one, and the crushing resistance of good concrete may be taken as 1,000lbs. per square inch.

This system of construction is especially applicable to structures having a rock foundation, but it may be applied in many other cases if the footings be sufficiently spread out to prevent the pressure of the wall on the foundations exceeding the safe limit.

The advantages in uniting the base of a wall built under water to a rock foundation with good cement mortar are obvious, as the water will be prevented from finding its way under the wall and exerting an upward pressure equal to the weight of the water displaced by the wall.

Moreover, since the adhesion of the cement to the rock will allow tensile stresses to be developed at the joint, it follows that the thickness of the wall usually adopted in such cases might be reduced without any risk of danger.

In replying to the discussion which followed the reading of this paper, Professor Warren remarked that he did not wish it to be understood that he recommended the reduction of the thickness of retaining walls to such an extent as to develop the full adhesive resistance of the mortar on the inner toe, but rather that a certain value should be taken as the safe adhesive strength of the mortar used in building the wall, and that the thickness at the base should be such as to insure the tensile stress on the inner toes never exceeding the amount.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

VII.

Coursed Rubble Masonry in thick walls and in Bridge work.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Masons No. ...	3	Variable.	Do.	Do.
Do. " ...	2			
Do. Dressing stones	9			
Coolies No. ...	3			
Do. " ...	2			
Do. " ...	1½			
Bhistie " ...	1			
Grinding mortar, c. ft.	26			
Sundries	...			
Materials.—				
Rubble stone, c. ft. ...	74½			
Throughbonds, c. ft. ...	14			
Lime slaked, dry, c ft...	12½			
Sand " ...	12½			
Surkhi " ...	12½			
Sundries	...			
Scaffolding ...	...			
Petty Establishment ...	...			

Specification.—As for similar work in thin walls, only there is not the same expense in dressing stones, nor the same trouble in laying Masonry.

X.

CALCUTTA PORT IMPROVEMENTS.

MUTLAH CANAL.

IX.

Report of Joint Committee of Port Commissioners and Chamber of Commerce of 1883 and Financial Aspect of the Project.

BUT the above estimates did not include all the works the Committee recommended for the improvement of the Port. They said that the navigation of the Hugli, whether to Diamond Harbor or to Calcutta, must always remain an undertaking of some risk and danger, but whether the voyage terminated at the one place or the other, they were satisfied that it would make no difference in the rates of insurance. If all the risks of the river were to be avoided, it could only be by means of a canal connecting Calcutta with the river Mutlah, and that was the alternative the Committee would recommend. This project had received the careful consideration of the Committee, and all the works they had recommended had been designed with a view to this canal being ultimately constructed. The Mutlah river was free of all obstructions, and if it were connected with the Port of Calcutta there would then be a material and sufficient guarantee that the works constructed there for the accommodation of shipping would always be utilised. Vessels which occupied two, and sometimes three, days in going down the Hugli could almost invariably get to sea by the Mutlah in 24 hours, and without incurring risk from shoals, freshes and eddies. The Port Commissioners had asked Government to appoint them Conservators of the Mutlah, and to sanction a complete survey of it, which was necessary before any definite proposals for the construction of the canal could be made. But they said that meanwhile the following might be taken as a safe approximate estimate of the cost of the work. Plate 6, given with this article, contains the approximate section of the canal, and shows the method of dredging by which the greater part of the excavation would be made.

Assuming that the docks the Committee have recommended at Kidderpore are carried out, no special works would be required at the Calcutta entrance. In fixing the depth of water over the sills at the Mutlah entrance, it has been borne in mind that as vessels could leave for sea from the Mutlah river at all states of the tide, the depth over the sills at the canal entrance must be sufficient to allow vessels drawing 26 feet of water to pass in and out of the canal at the lowest neap tides. The cost of the works at the Mutlah entrance may be taken at Rs. 25,00,000, and there would then only remain the cost of the land and the excavation of the canal. Assuming that the water in the canal is maintained at the same level as in the dock, or at the level of ordinary spring tides, *i.e.*, about 18 feet above datum, the excavation would only have to be carried to a depth of 12 feet below Kidderpore dock sill. A considerable portion of the land that the canal would pass through is very low, most of it only 12 feet above datum. A section of the ground was taken by Mr. Taylor, Executive Engineer, in 1879, and from this section it has been calculated that the total amount of excavation would not exceed 488,550,000 cubic feet. The ground is almost level throughout, but rises slightly towards the Calcutta end. Approximate sections of the canal are given on Plate VI. Of the total quantity to be excavated, it has been assumed that 177,435,688 cubic feet will be taken out dry and the balance by dredgers. For the dry excavation Rs. 10 per 1,000 cubic feet would be an ample allowance, and for the dredged material Rs. 14 should cover every contingency. The total cost of excavation would therefore be—

		Rs.
177,435,688 cubic feet, at Rs. 10 per 1,000	...	17,74,357
313,021,260 cubic feet at Rs. 14 per 1,000	...	43,82,298
Total	...	61,56,655

The land required for the canal and spoil-banks would be on the average 1,000 feet broad for the entire length of 29½ miles. This amounts to 12,885 bighas, which, at Rs. 50 per bigha, would cost Rs. 6,44,280. The spoil from the canal would all be deposited on the banks, and sufficient land has been provided in the estimate for this purpose.

The cost of the canal, including land, would be approximately as follows :—

Mutlah Canal.

			Rs.
Land	...	...	6,44,250
Excavation and dredging	...	...	61,56,655
Pitching ...	...	...	7,34,976
Damming Pialee river	...	...	50,000
Road Bridge, Diamond Harbor Road		...	80,000
Bridges for Diamond Harbor Railway		...	80,000
Ferries	...	...	7,200
Inspection bungalows	...	...	20,000
Huts for subordinates	...	...	5,000
Offices at the Mutlah	...	...	25,000
Residence for Engineer, &c.	...	...	50,000
Entrances at Mutlah	...	...	25,00,000
			1,03,53,081
Contingencies		...	6,46,919
Total		...	1,10,00,000

Ways and means for construction of canal.—In paragraph 52 it has been shewn that the annual surplus which may be expected on the completion of the docks now recommended would be Rs. 8,11,915, but this surplus would not all be available for the reduction of rates or to meet other charges, as Rs. 1,20,000 are now appropriated from jetty revenue to meet a portion of the expenditure incurred on the lighting and buoying of the channels of the Hugli. After deducting this sum, there remains a balance of Rs. 6,91,915 which could be devoted towards meeting the charges on account of the canal to the Mutlah. The cost of that work has been estimated at Rs. 1,10,00,000, the interest on which, at 4½ per cent., would amount to Rs. 4,95,000. There would also be a charge for maintenance, repairs, pumping, dredging, which may be estimated at 2 per cent., on the cost, or, say, Rs. 2,20,000 per annum. The annual charges would therefore amount to—

			Rs.
Interest ...	...	...	4,95,000
Maintenance, &c.	...	...	2,20,000
Total		...	7,15,000

But it would be necessary also to buoy and light the Mutlah. Buoying would cost Rs. 72,560, and the annual maintenance would be Rs. 8,990. Lighting would necessitate three light vessels in addition to the existing Mutlah light, which would cost Rs. 5,00,000, and the annual maintenance cost would be Rs. 90,000. The total annual charge for interest on capital outlay, depreciation and repairs, and maintenance of light ships would be Rs. 1,73,021. Adding this to Rs. 7,15,000, the annual expenditure on accout of the canal,—the total charge for a second entrance to Calcutta, *viâ* the Mutlah and the Canal, would be Rs. 8,88,021 per annum, or nearly 2 lakhs of rupees in excess of the surplus revenue from the docks, which could be met by the dues which the vessels using the canal and the Mutlah could well afford to pay, seeing that they would save one-half of the amount they had to pay for pilotage on the Hugli. There would not be much gained, the Committee said, by a vessel of light draught using the Mutlah in preference to the Hugli, but they believed that if the canal were made every large vessel would use it in preference to the Hugli. But it may be pointed out that the gain in point of safety to even small vessels would be great, as the recent wreck of the steamer *Mahratta* on the James and Mary shoal has strikingly shewn.

CHEAP HORSES.

BROADLY I may say that every Engineer in the country, in the execution of his multifarious duties, must needs ride and drive, and is, in consequence, materially interested, in one way or another, in the breed and condition of horses open to his selection—and in their price. Therefore, without making any pretence to extra-professional knowledge about horseflesh, and the supply of it available in India, I have written the subjoined from a commonsense, general utility standpoint, hoping that my suggestions may call forth others, more suitable to the occasion.

Bret Harte's heathen Chinee is a typical, by no means isolated specimen of the sort of "cuteness" developed,

ty to stand
tomed food
-bred is not
r sorry, does
of grain set
g dyspeptic.
rse Artillery
demanded of
Oxford hack
used to say.
zemindars in
persuaded to
care of stud-
steads. The
Government;
s abound all
r their keep.
nerly to sup-
e now, save at
ose mares are
t—by connec-
ail horseflesh.
lmits of fairly

sion to the old
y with view to
ould afford the
venienced and
rkets.
sidered as ad-
th incomes that
reciated.

)OFS.

ER, P. W. D.

fs can be formed
ng the intervals
oo expensive, by
bular tiles laid
tically unlimit-
Oudh and Rohil-
their permanent
for East Indian
oot run, and for
gnoles 60lb. rails
. Large auction
place in which
ed for half the
e $5\frac{1}{4}$ inches deep,
es and the value
e Wignole's rails
a. and the value
uble-headed rails
tronger than the
ever, present supe-
parts, such as bur-
bearing for slabs
itions their use is
y.
Indian scrap rails
Moore, R.E., late
llahabad, with the
ght of these rails,
5 tons applied in
ternate ressistance

270 tons. The

, a being sectional

$$\frac{70}{) \times 5{\cdot}25} = 6{\cdot}5 \text{ tons.}$$

rails, as given by
, page 53, is 7·35
s factor of safety, M

CAL

Report of Jo.
Chamber of

BUT the ab
the Committ
the Port. Th
whether to Di
remain an un
whether the v
other, they w
ence in the ra
river were to
a canal connec
that was the
mend. This p
tion of the C
ecmmended ha
being ultimate
free of all ob
the Port of Ca
sufficient guar
for the accon
utilised. Vess
three, days in g
variably get to
out incurring ri
Port Commissio
them Conservat
plete survey of
proposals for th
But they said
taken as a safe
work. Plate 6
approximate sec
of dredging by
would be made.

Assuming that
ed at Kidderpore a
quired at the Calcu
over the sills at th
that as vessels coul
states of the tide, t
must be sufficient t
pass in and out of t
the works at the M
and there would th
excavation of the ca
maintained at the s
ordinary spring tide
cavation would on
below Kidderpore d
that the canal woul
feet above datum.
Taylor, Executive E
been calculated that
exceed 488,550,000
throughout, but ris
proximate sections of
quantity to be exca
cubic feet will be tak
For the dry excavati
ample allowance, an
every contingency.
be—

177,435,688 cubi
313,021,260 cubi

The land required
the average 1,000 feet
This amounts to 12,88
cost Rs. 6,44,280. Th
on the banks, and suff
mate for this purpose.

amongst other little considered trifles, by the nineteenth century's jubilant march of progress. On the part of most severely moral and respectable members of society much ingenuity is displayed at times in enforcement of communistic claim to the umbrella another man bought and paid for, people forget to return borrowed books; some gentlemen conceive that they have failed in their bounden duty to themselves, if they fail to "stick" their friend, when selling him a horse. It seems to be a point of honor in the horse trade all over the world, to cheat.

Even Mr. Wilfrid Blunt, whose cardinal article of belief it is that everything pertaining to, or savoring of the West, is bad, even up to the Englishwoman in India, whilst, as a counterpoise, everything Oriental is good—even this hot gospeller of prejudice, is fain to admit that the late Abdul Rahman Minee of Bombay, was the only guileless horse dealer of his acquaintance. This phenomenon is dead; more's the pity; and the *Bombay Gazette* now suggests that the Arab proverb enjoining honesty in dealings with a stranger, is more honored in the breach than in the observance, in the matter of horse dealing. Some two years ago the Turkish Government laid an embargo on the exportation of Arab horses to foreign parts; and since then, I am told, very few at all well bred Arabs have found their way to India.

Nevertheless Mr. Stuart Mill's politico-economic axiom that supply is always commensurate with demand has not been falsified by the action of the Turkish Government: the Indian demand for Arabs has been met by labelling as desert steeds, and selling as such Government bred stock, country-bred "rejections" that is to say. That at least is the conclusion arrived at by Mr. J. K. Grainger, Superintendent of Horse-breeding Operations in the Bombay Presidency, and by Veterinary Surgeon Cooper.

If it is a warrantable conclusion—and I know of no reason why the competency for right judgment, or the local experience of these two gentlemen should be doubted—it is plain that many people, Engineers amongst the number, are paying more than a legitimate price for an indispensable item of field or travelling equipment. Plain also that one of the useful resources of the country is being neglected, to the advantage of rascaldom, and the waste of public money. In these severely economical days of one and fourpenny rupees, and reductions, and revised pension rules, and so forth, there are few of us who can afford to lose the chance of saving an honest penny or two, when opportunity offers. Besides, nobody likes the feeling of being "done."

Fifteen or twenty years ago, any Anglo-Indian not riding over 12 stone, could buy some stud bred "rejection" well up to his weight, and to any amount of work, for Rs. 200 or so. Now-a-days, all that the man posted to Bengal can get out of Poosa and Buxar is country tobacco, made in imitation of American brands; stuff that is hot in the mouth, and sickly tasting; impertinence of apology for the useful hacks and buggy nags that used to be procurable from those erewhile stud centres. It seems to me a great pity that they were summarily abolished. They were very costly certainly. But that was altogether the fault of the wasteful *dillettante* way in which they were mismanaged; not a fault that ought to be saddled on the stud scheme itself. If you put Colonels to do the work of stud grooms, and give them Staff Captains for assistants, and conduct operations generally on a scale regardless of expense, the pecuniary result of such unbusiness-like ordering of affairs must needs point towards bankruptcy. But could there not, with advantage to the State, and to the public, be some sort of return to the broad lines of the old system, accommodated to business-like, economical lines? Now that the Waler is getting dearer every year, it might be worth the while of Government Remount Agents, and others concerned, to think over the suggestion, and *apropos* thereto to take into consideration the Waler's proneness to *kumree*, and bowel complaints; his inability to stand the sun, or to do with short or unaccustomed food allowances, on an emergency. The country-bred is not perversely given to *kumree*, is seldom sick or sorry, does not care for sun, can and will eat any sort of grain set before it, and work on it without getting dyspeptic. Select country-breds are quite up to Horse Artillery work, Light Cavalry work, any other work demanded of them—"in reason," as Mr. Hobson, the Oxford hack stable keeper of "Hobson's choice" fame, used to say. When sufficient inducements are held out, zemindars in many parts of the country can easily be persuaded to keep brood mares of their own, and to take care of stud-bred colts and fillies at their own homesteads. The need is for a few good sires maintained by Government; hardy tight fitted together mares of sorts abound all over the country; and so do facilities for their keep. Good sires the Government studs used formerly to supply; such sires are not to be had for service now, save at prices that are prohibitive for the men whose mares are in consequence getting covered—and spoilt—by connection with promiscuous rag-tag and bobtail horseflesh. This is surely a pity; and a pity that admits of fairly easy remedy.

I should like to see some sort of reversion to the old order of things in the matter of studs, mainly with view to the incidental advantages that reversion would afford the riding public, now being a good deal inconvenienced and cheated by the rascalities of the horse markets.

Meanwhile, my argument may be considered as addressed to the pockets of riding men, with incomes that are from various causes uncomfortably depreciated.

NEW TYPES OF CHEAP ROOFS.

By W. G. Bligh, Executive Engineer, P. W. D.

IV.

Very excellent and economical flat roofs can be formed by using scrap rails for girders and spanning the intervals by stone slabs, or, where these become too expensive, by employing jack arches or Bull's patent tubular tiles laid flat. The rails are obtainable in practically unlimited quantities from the East Indian and Oudh and Rohilkand Railways, who have lately relaid their permanent way with steel rails. The retail price for East Indian double-headed 80lb. rails is annas 8 per foot run, and for Oudh and Rohilkand flat-bottomed Wignoles 60lb. rails Rs. 60 per ton, or annas 8-7 per foot run. Large auction sales of old stores periodically take place in which scrap rails could doubtless be obtained for half the above rates. The East Indian rails are $5\frac{1}{4}$ inches deep, have a sectional area of 7·9 square inches and the value of I, the moment of inertia is 24·7. The Wignole's rails are $4\frac{1}{4}$ inches deep, 5·84 square inches area. and the value of I is 14·4. From this we see that the double-headed rails are not only cheaper, but are much stronger than the others. The flat base of these latter, however, present superior facilities for connection with other parts, such as burgahs or iron purlins, and furnish a wider bearing for slabs or arches. So that under certain conditions their use is preferable to that of the stronger variety.

Experiments on the strength of East Indian scrap rails were made a few years ago by Captain Moore, R.E., late Executive Engineer, Military Works, Allahabad, with the result that the mean breaking weight of these rails, 18ft. between supports, was close upon 5 tons applied in the centre. Thus M,° the moment of alternate ressistance of the section, $= \frac{WL}{4} = \frac{5 \times 18 \times 12}{4} = 270$ tons. The modulus of rupture of a section S is $\frac{M^{\circ}}{a\,d}$, a being sectional area, d depth of beam, whence $S = \frac{270}{7{\cdot}9 \times 5{\cdot}25} = 6{\cdot}5$ tons. The value of S for double-headed 80lb. rails, as given by Bindon-Stoney Theory of Stresses, etc., page 53, is 7·35 tons. Taking a mean between 4 and 5 as factor of safety, M the working moment of resistance $= \frac{270}{4\cdot5} = 60$ tons or 13,440 lbs. The section of beam being fixed, we have now to ascertain by calculation the limiting span with different loading, or with a given loading the proper spacing of the rails. Let $L=$ span in ft.

$b=$ distance of part of rails in ft.

$w=$ distributed load extraneous to that of the rail itself (namely, slabs, concrete and lime load) lbs. per superficial feet, the weight of the rail itself is 80 lbs. per yard or 27 lbs. per foot run, whence weight of rail $=27L$ lbs. We see now that the total distributed load on rail $W=(wb+27)L$. This produces a bending moment on the beam of $\frac{WL}{8}$, or turning the span into inches, $\frac{12(wb+27)L^2}{8}$, equating this expression with M, the ascertained moment of resistance of the beam, we have $\frac{3}{2}(wb+27)L^2 = 1,34,400$ lbs. $\because L=\sqrt{\frac{89600}{wb+27}}$ $L = \frac{300}{\sqrt{wb+27}}$(1)

The next problem is given span L and loading W to find value of b or distance apart of rails. From the foregoing we obtain at once $b=\dfrac{\frac{89600}{L^2}-27}{W}$ (2).

In the experiments made the deflection of the beams varied considerably. As an average the computed value of E, the modulus of elasticity, came to about 30 millions. We may be safe, then, in assuming the recognised figure for rolled beams of wrought-iron, *viz.*, 28,800,000 (Theory of Stresses, page 8). We will now proceed to ascertain the deflection of the rails under the safe condition of stress already given in formulæ (1) and (2). The formula for the value of Δ, *i.e.*, the deflection of uniformly loaded beams of uniform section is $\Delta=\frac{5 W 3Z^3}{384 EI}$.

To take a practical example, let $b=2$ feet and w be compared as follows:—Weight of slabs, 20 lbs.
Conrete, 90 „
Liveload, 20 „

Total 130 lbs.

Whence from (1) the limiting span $\sqrt{}=\frac{300}{\sqrt{287}}=18$ feet nearly. Now $W=287\times18=5{,}166$lbs., whence $\Delta=\frac{5\times5166\times5832\times1728}{384\times28{,}800{,}000\times25}=\cdot94$ inches.

The proportion of $\frac{\Delta}{z}$ then is $\frac{\cdot94}{18\times12}=\frac{1}{230}$. In this extreme case the proportion of $\frac{d}{z}$ cannot be deemed excessive for a dead loading, and we can therefore accept formula (1) as suitable as regards deflection as well as strength. Many examples of the use of rails are in existence in which greater stress has been imposed on them than that allowed in formulæ (1) and (2) without any apparent disadvantage from excessive deflection. The elucidation of formulæ for working out the limiting span, etc., for the other type of rail can only be done in the absence of experimental data by deduction of comparative strength. The moment of resistance of a beam is represented symbolically by $\frac{f}{c}$ I, in which f is the unit stress of any fibre and c the distance of this fibre from the neutral axis, which corresponds with the centre of gravity of the section. Both rails being made of the same material the maximum limit stress should be the same in each. This occurs at the extremest fibre. The value of c in East Indian rails is thus $\frac{d}{z}$ or $2\frac{5}{8}''$ and in the Oudh and Rohilkand section the distance c to the furthest point which is the base of the bottom flange is $2\frac{1}{4}$ inches.

The relative strengths of the two sections are represented by $\frac{f}{c}$ 1 : $\frac{f}{c_1}$ I_1 eliminating f common to both expressions, we have $M : M_1 :: \frac{I}{c} : \frac{I_1}{c_1}$ $\therefore$ $M_1=\frac{M I_1 c}{c_1}$ or substituting actual values.

$M_1 = \frac{60\text{tons}\times14\cdot4\times21}{24\cdot7\times18} = 40\cdot81$ tons or 91,414 lbs.

From this L or limiting span $=\sqrt{\frac{2 M}{3 W}}$

$= \sqrt{\frac{60943}{w\,b+20}}$, 20 being weight of Oudh Rohilkand rails per foot run

$= \frac{247}{\sqrt{w\,b+20}}$ ... ... (3)

and $b = \dfrac{\frac{60943}{L^2}-20}{w}$ ... ... (4)

Taking b as 2 feet and w as 130 lbs., as before, the limiting span $L=\frac{247}{\sqrt{280}}=\frac{247}{16\cdot7} = 15$ feet nearly.

The following table gives values for b worked out, w being taken as 130 lbs. up to 3 feet spacing; 137 to 4 feet and above 4 feet 144 lbs. This is due to increased thickness and weight of slabs:—

E. I. Rails.			O. and R. Rails.		
Span L.	Spacing b.	Thickness of slabs.	Span L.	Spacing b.	Thickness of slabs.
20′	1′-6″	1½″	16′	1′-8″	1¼″
18′	2′-0″	1½″	14′	2′-3″	1½″
16′	2′-6″	1½″	13′	3′-1″	1¾″
14′	3′-2″	1¾″	10′	4′-4″	2½″
12′	4′-4″	2½″	9′	5′-0″	2¾″
11′	5′-0″	2¾″	and under		
and under					

The thickness of slabs $t = \cdot54\ b$ inches as will be shown later on, 1½″ being the minimum thickness, the practical limit of b is 5 feet.

This spacing can be relied on as affording a perfectly safe and watertight roof. In actual practice I have constructed rail girder roofs under severer conditions of stress. For example, the roof of the District Engineer's office at Mirzapore is 20 feet span with East Indian rails 2·6 apart. The value of w in this case would not be more than 100 lbs., excluding the liveload which in reality is merely an additional factor of safety. Then, according to formula (2), the spacing of rails should have been 2 feet. This roof is perfectly watertight. The rails were roughly cambered 2 inches by having been heated in the centre and bent. The deflection appears to be about one inch. In other buildings Oudh and Rohilkand rails, 12 feet span, have been spaced 4 feet in lieu of 3 feet as shewn in our table. All this goes to prove the reliability of the preceding investigations.

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

At a meeting of the Association of Municipal Engineers, recently held at Newcastle-on-Tyne, Mr. Laws, the City Engineer, read a paper on the Floating Hospital on the Tyne which was built from his designs and under his superintendence, for the reception of fever patients and other infectious diseases occurring among the floating population of the river. The hospital deck of creosoted timber is upon seven cylindrical pontoons, upon which are fixed saddles to receive the longitudinal girders, across which are laid baulks to receive the creosoted deck. The hospital buildings, constructed upon this deck, form three sides of a rectangle and are fitted up with all the modern requirements of a first-class establishment, disinfecting apparatus and other sanitary arrangements. The entire construction was completed before being launched and the operation was most successfully performed, longitudinal baulks being for the purpose attached to the under side of the pontoons. The craft admirably answers her purposes and replaces a hulk, an old war-ship, a class of vessel often used for a floating hospital, but found to be most expensive in repairs and maintenance, and steps are already afoot to imitate the Tyne Hospital in other rivers similarly circumstanced.

The next meeting of the Association will be held at West Bromwich, near Birmingham, at which a paper of great consequence will be read and discussed, and it is therefore expected that information of much practical value to the Municipal Engineer will be here adduced with reference to the "*Destructor*." A considerable difference of opinion existing as to whether the process of destroying town refuse in this manner can be done without nuisance. Mr. Jones, of Ealing, for instance, destroys sludge from his precipitating tanks together with town refuse and sweepings without any nuisance, while recent evidence in the Committee Rooms is not so favourable to the Destructor.

Considerable interest attaches to the harbor works now being constructed at St. Helier, Jersey, the principal of the group of the Channel Islands, on account of the peculiar difficulties of the circumstances which are met with here. In the first place, the tidal range is forty feet and the locality lies exposed to the fury of the prevailing west and southwest winds. The breakwater commenced in 1870 is built of concrete blocks and the portion constructed is founded on rocks, the irregularities in the surface thereof having been levelled up with bags of concrete. On these bags blocks of concrete varying from 60 to 80 tons in weight were laid one on the other. On the top of these blocks smaller blocks varying from 8 to 12 tons in weight were bedded in Portland cement. The outer or exposed blocks are faced with a rendering of Portland cement and are battered at the rate of 1 in 12.

The width of the vertical portion or base of the breakwater, namely, from the foundation up to the tops of the 80-ton blocks, or from 50 feet below cope to within 34 feet of the same, is about 44 feet 4 inches; at this level there is an offset or ledge on each side of the breakwater of about 1 foot 4 inches in width. The bottom width of the battered portion of the work is about 41 feet 8 inches, and from this level for 34 feet in height, or up to cope, there is a batter on each side of 1 in 12, making the top width of the breakwater 36 feet.

This work has stood the test of several severe storms, and has not shewn the slightest failure. The new work now commenced consists of an extension of this breakwater, but the section is somewhat altered. The outer and inner faces of the breakwater will be vertical from the foundation layer up to cope and of a width of 42 feet. The base or foundation layer will be 8 feet wider or about 50 feet in all. The average height of the breakwater from the foundation or surface of the rock to cope will be about 65 feet. The blocks forming the new section of the breakwater are to be laid in courses sloping at an angle of about 60 degrees to the horizon. The blocks are formed of granite rubble built with 5 to 1 Portland cement; the outer or facing blocks having a facing of granite ashlar set in 3 to 1 Portland cement.

The space of a letter will not permit a description of the methods adopted in forming the foundations for this work, but I wish briefly to allude to another portion of the work now to be carried out, namely, dredging a portion of the present harbor and the formation of a channelway from the roadstead up to the harbor.

Whether such a channel can be efficiently maintained will be watched with considerable interest. The plan has been adopted only after great opposition, and the use of cement concrete in a granite locality has been severely criticized and the recent experiences at Aberdeen have not tended to allay the fears of those who are opposed to the present works designed.

AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

CONSIDERABLE prominence was given recently in the large advertisements which were placed by the Panama Canal Company in all the Paris newspapers to the fact that subscriptions to the new loan would be received at the office of the American Committee in New York.

The books were closed a short time ago, but no report has been seen of the number of bonds taken here. The Company's receipts here are nothing and its expenses continue to be large. M. Leroy-Beaulieu recently quoted from the Company's annual report a statement shewing the regular annual payment of \$300,000.00 to the American Committee and since the Company was organized the Committee has received \$2,400,000.00. For what service? Presumably for salaries and the privilege of opening loan subscription books in New York City.

M. J. Boulangé, at a meeting of the American Society of Civil Engineers, held in June last, gave the most intelligent and definite information yet received as to the condition and prospects of the work of the Panama Canal. He was one of the French engineers engaged upon the project and has only recently returned from Panama.

He says that as soon as the present supply of funds is exhausted M. De Lesseps will have to quit work for some years, if not to abandon the enterprise altogether.

Only 30,000,000 cubic metres out of 140,000,000 cubic metres have been excavated. Of the great cut, which is to be 318 feet in depth, only 38 feet have been dug out. The engineers are hampered by the lack of adequate maps and profiles of the Canal, a considerable portion of which runs through swamps which have not been surveyed. Nothing has been done in Colon harbor, though about 16 miles of the Canal route thence have been opened up. There is a sliding mountain on the line which gives no end of trouble. The climate is terrible and makes it exceedingly difficult to get common laborers, 60 per cent. of those employed dying annually. The mortality among the whites is 80 per cent. Of 72 engineers, agents, and clerks sent to Panama last year by the Company only 11 are now fit for work. Frequent freshets in a region where it rains during nine months of the year, have made it necessary to rebuild portions of the line.

He speaks of engineering obstacles, but besides these are the financial difficulties, which seem to be insurmountable, despite the infatuation of the Frenchmen. "I have grave doubts that it can be finished," says he, "and if it is, the cost will be three or four times what has already been expended."

The survey of the East river tunnel (between New York and Brooklyn) shews that for the entire distance under the river bed at Blackwell's Island, there is solid rock, with few fissures and no soft bottom or gravel. The construction will consequently be free from the engineering difficulties which impede the progress of the one partly driven under the Hudson. A reorganization of the Company has taken place which puts it in shape to go ahead with the work.

One of the projectors and engineers says that the tunnel will be completed before the Blackwell's Island Bridge is begun. It will be built in eighteen months and will not cost one-fifth the amount necessary to erect a bridge. The line of the tunnel will be under Blackwell's Island diagonally, and work can be carried on from ten different points.

A remarkable new printing press, capable of printing 60,000 copies per hour of either a four or six page paper, and 30,000 copies per hour of either eight, ten or twelve page paper, has just been built for the *New York Mail and Express* by Messrs. R. Hoe and Co., of New York. In each case the papers are delivered in sets and pasted and folded.

To do this at the rate of 1,000 copies per minute from a single machine is a most wonderful achievement and something that heretofore seemed among the impossibilities.

It is stated on very good authority that English lock manufacturers are canvassing our American works to find out what our latest lock improvements are. They have been driven to this by the demand for American style.

The thirty-sixth annual meeting of the American Association for the Advancement of Science will be held during the second week of August at Columbia College, New York City. The Association numbers nearly 2,000, and over one-half of this number is expected to be present. There are nine sections in which eminent professors and scientists will read papers.

The topics which will be discussed in the nine sections are astronony, physics, chemistry, mechanical science, geology, geography, biology, anthropology, economic science and statistics.

The New York and Boston Rapid Transit Company reports between fifty and sixty men in four surveying parties at work in Massachusetts, Connecticut and New York and that a direct line between Boston and New York will be located ready for contracts by 30th August. Negotiations are complete for constructing the line.

A new electric motor is to be tried on the elevated railroads of New York. It will take its power, as have all those which have been previously experimented with, from dynamos in a central station, which is conducted to the motor by a third rail, upon which runs a "traveller," a small wheel from the motor. The motors to be used in actual service will be small and compact, weighing nine tons each, which will take the place of the present trucks under the ordinary cars, one at each end of each car, and can be controlled by a gateman at either end of the car.

It will be exhibited and tested within a few weeks upon a branch of the elevated roads. Besides doing away with the necessity of having a motor separate from the cars, the new machine has various improved devices for regulating and controlling the motor and for prolonging its life and economizing on the expenses of its maintenance. The dynamos are also different in several respects from the ones ordinarily used for generating electricity, and are expected to do much better work than the present style of machine.

CHINA.

(From our own Correspondent.)

The advent of various syndicates of foreign capitalists from various parts of Europe and America, free, willing, and able to give China a lift on its legs once more, in a benevolent sort of manner, has induced the Central Government of late to pay more than passing attention to its famous waterways, the Yellow River and the Grand Canal.

Bearing these facts in mind I have ventured to send you the following information with respect to the latter way, it having recently attracted the greatest attention.

The Grand Canal.

The value, to China, of this famous artificial waterway, has been, and is still, very great. By means of the Grand Canal the produce of the remotest provinces in the south and west, say fourteen provinces, may be safely and economically brought to Peking. In times of war with foreign countries, when the coast is patrolled by the enemy's swift cruizers, the inhabitants of the Imperial capital must rely principally, if not entirely, on the Grand Canal for their supplies of grain, and almost everything else, therefore it is wise to keep the canal in good working order and improve the means of communication through it, in such a manner, as to increase its capacity for larger, and swifter craft, than those that have hitherto navigated its smooth waters. The accommodation for passengers, going through the canal on their way to, or from, Peking, also needs attention, and ought to have it without delay.

The Grand Canal when first cut was most likely the best thing of its kind in existence, and one of the wonders of the world for ages.

It is said to have been commenced by the famous Emperor, Ch'in Shih Huang Ti, the builder of the Great Wall, and that portion of it, connecting the two Great Rivers, *Ta Kiang* and *Huang Ho*, *i.e.*, the Yangtze and Yellow River, was actually finished during the Han Dynasty, two thousand years ago. The canal was, however, subsequently neglected and allowed to silt up in troublous times, and succeeding dynasties, until the latter end of the fifth century of our *era*, when the Emperor *Kao Chu*, founder of the Sui Dynasty, caused its banks to be repaired, and its channel again made navigable. The work of reparation alone, is said to have been a gigantic one, and when we consider that some portions of its bed are twenty feet or more above the surrounding country, and that hundreds of thousands of men were employed on the work, it must be admitted that Chinese historians are somewhat justified in making such an assertion, although less than a third of its present length was then cut. Those portions of the canal that are above the level plains, appear to have been a perpetual or rather constant source of danger to the whole of the inhabitants in its neighbourhood, and it is said, that in troublous times the banks have been cut through, the use of the canal entirely stopped, and the people, millions of them probably, driven from their homes, in order to prevent the advance of the enemy or to prevent supplies being carried to certain places it was desirous to reduce by siege or otherwise.

The Emperors of the Tang Dynasty, A.D. 618 to A.D. 905, are said to have kept the canal in good working order and to have faced some portions of its banks with stone. From the first, a considerable amount of ingenuity appears to have been brought to bear on the construction, in order to save time, labor, and material, as well as to ensure a constant supply of water at all times. Various lakes, ponds, and streams lying some distance from the direct course have been connected together, and numerous cities, towns, and villages, scattered over a very large expanse of country have thus been supplied with water communication between each other for ages, which could not have been possible, except at very much greater expense, had the course of the canal been made to run in a straight line. The southern opening of this section of the canal is at Kua Chou, a city on the northern bank of the Yangtze River, some distance above the present Treaty Port of Chinkiang, and some distance below Nanking—both the latter cities being on the opposite bank. In remote times the most enlightened people in the Chinese Empire, lived in that portion of China lying between the two great rivers. The people living north of the Yellow River, and those living south of the Yangtze are said to have been less civilized than those between the two great rivers and they were called by their more enlightened neighbours, barbarians, savages, heathens, and such like names, and were treated accordingly, until the early part of the twelfth century A.D., when the *Kin* Tartars invaded China, occupied the whole of it up to the borders of the Yangtze, and forced the Imperial Court to fly for safety to Hangchow, where the Emperor Kao Tsung, of Imperial lineage, founded what is known in Chinese history as the Southern Sung Dynasty. The Imperial Court, its loyal adherents, and numerous followers, carried their higher civilization with them, and one of the first cares of State was to cut a canal to connect Hangchow with Suchow, the *Hsi-Hu*, or Western Lake, near the former city, and the *Tai Hu*, or Great Lake, near the latter, ensuring a constant supply of water.

The canal was afterwards extended to the present Treaty Port of Chinkiang, thus forming the Southern, and by far the most successful portion of the present Grand Canal.

In the thirteenth century the Mongol Tartars invaded China, ousted the Kin Tartars, as well as the Chinese, and carried their successful arms to the utmost limits of the Empire. The rude Mongolian Chieftain, Kublai Khan, having, "by the Grace of God and his own mighty power," established himself firmly on the throne, and made Peking his capital, learned men, from all parts of China, flocked to Peking, in search of appointments in the various Government offices, or to serve the invaders in any capacity.

Foreign invaders were thus the means of causing Chinese civilization to spread north and south of its former bounds. This influx of Chinese civilization in the northern plains of Chihli, caused a demand for the Chinese luxuries previously unknown, except by name, to the invaders, and the consequence of this was a resolve on the part of the Kublai, to connect his capital by water, to all the important streams in the Empire, and to the most populous cities, away from waterways, by large roads, on which horses and carts could travel at all seasons of the year. Kublai Khan accordingly directed a canal to be dug from Peking, to a point on the Yellow River near Tung Chang Fu, where the central portion of the Grand Canal ended.

The central portion was also repaired and reopened to navigation as far as Kua Chou, its original terminus on the Yangtze River.

The cutting of the northern section of the canal by Kublai, completed what is now known as the Grand Canal or *Yun Ho*, having a total length of over six hundred and fifty miles, and navigable for vessels of 20 tons or more throughout its whole length.

Tribute of local produce was exacted from all the prefectures throughout the Empire, and the Provincial Governors were directed to forward the same to Peking annually, when the canal was free from ice. By means of the central and southern portions of the canal, it became possible to exchange commodities at all times of the year with the larger portion of the Empire, and during three of the four seasons, it was also possible to forward all the necessaries of life, as well as luxuries, to the inhabitants of Peking. The Emperors of the succeeding Ming Dynasty, and those of the present Tsing dynasty, have all endeavoured to keep the Grand Canal in good repair, until about half a century ago, when foreign wars and native insurrections attracted so much of the attention of the Government that the canal was allowed to become nearly useless. The advent of steamers, and their use in carrying the tribute grain from the provinces to Peking by sea more rapidly and more economically than it could be done by barges through the canal, further detracted from its utility, until the late Franco-Chinese war. Then, the fact that over one million piculs of rice stored at Shanghai could not be safely transported to Peking, owing to the vigilance of swift French cruizers, cutting off all supplies by sea to Tientsin and Peking, caused the Imperial Government to reflect that the Grand Canal was truly a very useful waterway and ought to be kept in a navigable state at all times.

(To be continued.)

NOTES FROM CEYLON.

(From our own Correspondent.)

III.

Kurugam Modera—Namvapana-road. Good progress made considering that the discussion by rival revenue officers which I think was extremely injudicious after the work had been voted in the Supply Bill—regarding at which end the road should begin, occupied several months, resulting in the sanction of the estimate eventually in August.

Aivsawella *Hospital. As usual* the difficulty of obtaining a site after it had been decided on, closed the door to any progress during the year. Anticipated being ready for occupation in October and consists of main ward, attendants' and matrons' rooms, women's ward, kitchen, store-room and dead-house.

Improvement of Bridges.—Four iron bridges were substituted for wooden ones on the Gatiyantolla road, and 268 lineal feet on iron bridging replaced the same length of wood structures of the Ratnapura-Colombo road.

Negombo Kachery.—The enlarged improvements cost Rs. 9,819·83

Then follows statement of other works.	Rs. Cents.
Erection of iron bridge over Kelaniganga at Karana-ella	3,877·98
Addition to cellular block (Welikada) ...	6,455·00
Erecting a rail pile bridge at Demetegodda ...	5,580·00
Do. do. over canal at Kotte ...	5,000·00
Filling fort canal and improvements to York Street	20,000·00
Building divisional walls and other works, new Warehouse, Colombo	1,922 00
Improvements to Queen's House, Colombo ...	1,500·00
Metalling the road from Wellawatta to Galkissa...	2,886·17
Erecting new godown and stable to rest-house at Avisawalla	4,200·00
Improvements Ratnapura Hospital	1,694·90
Additional cells to do. Jail	2,997·46

Then follows a pretty explicit condemnation of the only two irrigation works of importance undertaken in the Western Province in 1886.

The Batugedera Channel near Ratnapura appeared the best of a number of proposals of doubtful utility. Estimate Rs. 11,950 sanctioned late in the year, I presume chiefly to the difficulty in selecting a useful and promising work. Expenditure did not exceed Rs. 7,187·44 with a corresponding progress. Recently especially at Karanadola one of the streams feeders of the channel, serious difficulties have been encountered in regard to the treacherous nature of the foundations. These difficulties will be overcome, but not without a considerable expenditure of time and money, which I trust the expedience of the work will justify.

The Kempe—ela Anicut and Channel were constructed in 1884 and failed in 1885. The failure was due solely to unsuitablity of design and construction. However suitable a solid dam may be across a river with hills, its adoption in low flat country near the coast where the rivers are broad with low banks could not be attended with anything but disaster, and it is to them alone that the failure is due. The work is being reconstructed on an improved plan. Then comes Southern Province.

Udagama Bridge Road.—In the Galle District, the conversion of the Kottawa-Udagama Bridge into a cart road is the only work of any importance and that was given out on contract.

Pettara Channel.—The extension of the Pettara Channel on the Kirima-oya in the Matara District as completed will prove a remunerative and useful irrigation work.

In the Hambantolla District the only works of construction were those having the irrigation of paddy land for their object.

Etpitiya anicut was carried out at a cost of Rs. 7,110·31 and provides for the assured cultivation of a large extent of existing fields in a thickly populated valley of the Kirawa river.

Walawe Anicut.—The progress, especially that of the main anicut, has been very satisfactory in spite of loss of time and money by unprecedented floods. Expenditure for year Rs. 43,866 96 and Rs. 17,092·05 on irrigation channels. Then we are told that these works compare in importance to those of Kalawewa tank scheme, consisting mainly of an anicut for utilising the waters of a first-class river direct. Of course they differ in their nature.

Eastern Province.—5⅝ miles of the natural north and south track have been converted into gravelled roads. 5½ miles of the Badulla-Batticaloa road have been metalled, thus completing the metalling throughout, and also the Karation-Veriyad-road is progressing. Next comes Province of Uva, and under roads and improvements we have nothing but a bridle road on which work was suspended through the proprietor of Rappahanock refusing to give the land, and a hospital at Lunugala costing Rs. 10,000. Coming to the Northern Province we have the metalling of the north road from Vavaniya-Vilan kulam to Palujan kulam, and considering most of the overseers and clerks of the P. W. D. come from this, the Tamil part of the Island, we are told that, coast labor has had to be introduced, because the overseer and coolies had no experience of metalled road work. (Why most of the road up-keep contracts round Kandy were at one time virtually let to Jaffna men.)

Maunar Causeway.—The works designated as improvements to the Maunar causeway cost Rs. 9,996·47 and include two bridges giving a waterway of 160 feet each.

Wells were sunk at Uttiravankai and Nanamadu, 22 feet of water rising in the former and 3 feet in the latter.

The storage capacity of Vavaniya-Vilankulam has been nearly doubled, two new sluices (irrigation) constructed and 400 feet new spill wall built, the old bund which leaked has been stopped with puddle.

The Naporiyakulam Tank, 3 miles west of Vivaniya-Vilankulam has been restored. Mamadu Tank preliminaries only pushed forward, such as a track made and the old bund cleared of trees.

The only item of interest referring to ordinary works in the North-Western Province is that the Rajakadaluwa to Battulu-oya-road may in future be classed as a road formed and gravelled and bridged throughout, 3 of the larger rivers only remaining unbridged, *viz.* the Maha-oya, Dedura-oya and Batulla-oya.

Under irrigation we are told that the Mediyawa Tank was breached and restored and that Maha Uswewa had been completed.

(To be continued.)

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Central Provinces, September 10, 1887.

Rao Sahib Ishwari Pershad, Assistant Engineer, availed himself of the privilege leave granted him in Central Provinces, Public Works Department, Notification dated 19th ultimo on forenoon of the 8th current.

India, September 17, 1887.

Mr. R. T. Mallet, Chief Engineer, 2nd class, *temporary rank,* State Railways, is appointed to officiate as Consulting Engineer to the Government of India for Railways, Central Division, during the absence on privilege leave of Major W. Shepherd, R.E., or until further orders.

Mr. M. H. Jackson, Assistant Engineer, 1st grade, Bengal, is temporarily transferred to the Accounts Branch.

Bengal, September 21, 1887.

Establishment—General.

With reference to the Government of India, Public Works Department, Notification, dated the 10th ultimo, Mr. Sorabji Shavaksha, who has been appointed to the Department as an Assistant Engineer, 3rd grade, is posted to the 2nd Calcutta Division.

N.-W, P. and Oudh, September 12, 1887.
Irrigation Branch.

With reference to Notification dated 8th September 1887, reposting him to the 2nd Circle, Irrigation Works, Babu Jogendro Nath Mukerjee, Rai Bahadur, Executive Engineee, 3rd grade, sub. *pro tem.*, is posted to the Etawah Division, Lower Ganges Canal.

Bombay, 15 September 1887.

Mr. J. E. Whiting, M.A., M. Inst. C.E., is appointed to take charge of the duties of the Chief Engineer for Irrigation and Superintending Engineer, Central Division, in addition to those of Executive Engineer. Nira Canal, pending the arrival of Colonel C. A. Goodfellow, V.C., R.E.

The following reversions will have effect from 1st September 1887 in consequence of the return of Mr. R. B. Joyner, Executive Engineer, 2nd grade, to the effective list:—

Mr. J. Young to revert to Executive Engineer, 3rd grade.

Mr. E. Pinhey to revert to Executive Engineer, 4th Grade.

Mr. T. Summers to revert to Assistant Engineer, 1st grade.

Rao Saheb Parashram Krishna Chitale to revert to Assistant Engineer, 2nd grade.

Burma, September 10, 1887.
Upper Burma.

With reference to *Burma Gazette* Notification dated the 2nd August 1887, Mr. W. E. Muntz, Assistant Engineer, 2nd grade, joined the Mandalay Division, Military Works, on the afternoon of the 29th July 1887.

With reference to *Burma Gazette* Notification dated the 3rd August 1887, Mr. H. J. Richard, Superintendent of Works, Upper Burma, reported his departure on privilege leave on the afternoon of the 16th instant.

Mr. W. E. Muntz, Assistant Engineer, 2nd grade, Mandalay Division, Military Works, is granted one year's leave on medical certificate together with the usual subsidiary leave.

Mr. Muntz availed himself of his subsidiary leave on the forenoon of the 25th instant.

With reference to *Gazette of India* Notification dated the 19th July 1887, Mr. F. W. Morse, Executive Engineer, 3rd grade, is posted to the charge of the Bhamo division, Upper Burma, which he took over from Mr. J. Wallace, Executive Engineer, 4th grade, temporary rank, on the forenoon of the 19th August 1887.

Madras, September 13, 1887.

The following reversions and promotions are made :—

Mr. G. F. Handcock, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 7th July.

Mr. G. F. Handcock, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 26th July.

Colonel H. M. Vibart, R.E., Superintending Engineer, 1st class, temporary rank, to be Superintending Engineer, 2nd class, with effect from 2nd August.

Mr. G. T. Walch, Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 3rd class, with effect from 2nd August.

Mr. G. D. Wybrow, Superintending Engineer, 3rd class, temporary rank, to be Executive Engineer, 1st grade, with effect from 2nd August.

Mr. G. F. Handock, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 2nd August.

Mr. A. T. Mackenzie, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 1st August.

Rai Bahadur S. Gopalakrishna Aiyar, B. C. E., Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 16th August.

Mr. A. T. Mackenzie, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 16th August.

The following intimation, received from the Secretary of State, is published :—

Mr. G. B. Lambert, Assistant Engineer, 1st grade, Madras, permitted to return to duty within period of leave.

The following promotions are made :—

Rai Sahib S. A. Subrahmanya Aiyar, B.A., B.C.E, Assistant, Engineer, 2nd grade, to be Assistant Engineer 1st grade, sub. *pro tem.*, with effect from 11th July.

Mr. S. B. Murray, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, sub. *pro tem.*, with effect from 23rd August.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 12th September 1887.

55 of '87.—Don Clan Alpine Thatcher, Engineer, of 140, Cromwell Road, South Kensington, in the County of Middlesex, England.—*For improvements in type writers.*

89 of '87.—Alfred Henry Death, of Beresford House, Leicester, in the County of Leicester, England, Engineer.—*For an improved feeding apparatus for scutching or fibre-cleaning machines.*

106 of '87.—Percival Everitt, of London, England, Engineer.—*For improvements in, or applicable to, apparatus for indicating the force of a blow.*

152 of '87.—Thomas Seale, of No. 2739, California Street, in the City and County of San Francisco, State of California, United States of America, temporarily residing at Melbourne, in the Colony of Victoria, Railway Superintendent.—*For improvements in apparatus for heating and purifying water for steam boilers.*

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong. Shanghai,* and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, OCTOBER 1, 1887.

INDIAN UNCOVENANTED CIVIL SERVICE ASSOCIATION.

THE large meeting of Uncovenanted Civil Servants, held at the Dalhousie Institute, has started the ball rolling in Bengal. Another meeting will shortly be held in Darjeeling, at which the same resolutions will, in all probability, be adopted. For obvious reasons reporters were excluded from the Calcutta meeting, but a copy of the resolutions has been placed at our disposal, and we are informed that no less than 60 gentlemen were present. It is to be hoped that the Secretary of State will give some attention to this question, which is causing the gravest dissatisfaction throughout almost every branch of the Service. The resolutions adopted in Calcutta were as follows:—

The following series of Resolutions, passed at Bellary, on the 30th July 1887, which are concise and to the point, were proposed at the meeting :—

(1.)—That the thanks of the Meeting be conveyed to Mr. H. S. King, M.P., and the Committee of the Indian Unconvenanted Civil Service, for the efforts they are making on behalf of the Uncovenanted Civil Service.

(2.)—That a Local Committee be formed to collect subscriptions in Calcutta and adjacent districts, and to communicate with the Central and Local Committees.

(3.)—That all officers be asked to subscribe Rs. 10 towards the Indian Uncovenanted Civil Service Association, and that the subscriptions, after paying expenses, be remitted through Messrs. Henry S. King & Co. to the London Committee, with the assurance that further remittances will be forthcoming if required.

(4.)—That it is highly desirable that meetings of this kind should be held wherever possible, as being calculated to promote concerted action, as well as stimulate independent effort.

(5.)—That this meeting is of opinion that the serious grievances of the Service are clearly and ably set forth at page 10 of the "Statement of the Uncovenanted Civil Service in India," prepared by the Committee of the Uncovenanted Civil Service Association, London, that it is unnecessary to recapitulate them here, and that each of the 12 grievances therein specially detailed urgently calls for redress.

(6.)—That the Members present engage to exert their influence at home to support the action of the Central Committee of the I. U. C. S. A., and strengthen the hands of Members of Parliament who are interesting themselves in this subject.

(7.)—That copies of these Proceedings be sent to the Secretary of the Central Committee, London.

AURIFEROUS TRACTS IN MYSORE.

In May last Mr. Foote, Superintendent, Geological Survey of India, was deputed by Government to examine and report on the auriferous tracts in Mysore, which had previously been visited and reported upon by Messrs. Lavelle and Marsh, and the result of his three months' investigations having been submitted to the Mysore Government, it has now appeared in the shape of Selections from the Records of that Government, together with the reports of the other two gentlemen named. Mr. Lavelle's report appeared *in extenso* in this Journal and will be referred to incidentally during the progress of examination of Mr. Foote's report, which, being in the nature of an oracular utterance, will naturally carry considerable weight with it and perhaps influence minds predisposed to accept all he says *re* the gold-producing regions of Mysore as gospel truth. With the above preface we will now proceed with the consideration of Mr. Foote's report. On the onset he divides and arranges in a tabulated form the several groups of auriferous rocks, to which he gives the contra-distinguishing names "Central," "West Central" and "Western" groups, the Eastern group being formed by the Kolar, which he was not required to visit and report upon. By this arrangement of the three groups, the Central group appears to belong to the Dharwar Schistose series, to which the name *Dhambal Chiknayakanahalli* was given by Mr. Foote in his first paper on the geology of Mysore; the second or Western group to the Schistose band called by him the Dharwar-Shimoga band; and the *third* or West Central comprises some unimportant strips of Schistose rocks, some of which, if not all, is alleged to belong to the same geological age as the great schist band lying to the West and East.

Commencing with the Central group he enters into the consideration of the geological features of the country he had traversed, carefully noting down the manner and method of his arriving at results, which in many instances appear to be divergent from, if not diametrically opposed to, those attained by Messrs. Lavelle and Marsh, to the first of which gentlemen must be conceded the palm of being the pioneer of modern gold mining industry in Mysore. At *Halgere* workings washings were made by Mr. Foote's party, the results of all which were very disappointing, the gold shews being *middling* at best. He holds out no hopes for the field, nor does he give sufficiently convincing reasons for doing so.

With regard to this particular field Mr. Lavelle declares that he found what miners would call a *very fair shew* of gold; and, in fact, what might be called a *very good* prospect. Mr. Foote is next of opinion that the small shew of gold which yielded to Mr. Lavelle from the washings in the *Kadkole* nullah *must* have come from veins too small in size to be worth mining, and this opinion, be it noted, is expressed with a degree of seriousness which passes understanding, despite Mr. Lavelle's distinct statement to the contrary. Let us see what he says in respect to the gold taken by him from *Kadkole*. "In almost every test I found gold. *The tests were not made in the bed of the river nor in the deposits of the river, but from the high ground, and principally from where the country rock was laid bare at various distances from the stream, being most careful that there was no chance of the gold being carried by storm floods and deposited where found!* We are induced to italicise the foregoing to shew how superficially *Kadkole* must have been treated by Mr. Foote, who at the very threshold of this important auric exploration misquotes Mr. Lavelle, and himself indulges in the conjectural inference that the gold so found *must have come from veins too small in size to be worth mining;* while he thus *obliquely* admits the existence of small auriferous reefs, he is unwilling, on the other hand, to confirm the finds of Mr. Lavelle, nor does he (Mr. Foote) speak of any washings having been made by himself to be able to speak as positively of the gold bearing capabilities of the locality as Mr. Lavelle, who, it must be allowed, appears to have been more careful and less conjectural in his forecast for this field.

Passing over certain villages or gold bearing sites, regarding some of which the two opinions are divergent and convergent geologically and mineralogically, we come to an inconsistency which characterises in an unmistakable manner the shallowness, or shall we say the unreliability, of the conclusions arrived at by Mr. Foote in regard to the workings at *Chiknayakanahalli.* "It is possible" he writes "that Mr. Prideaux, who had previously reported on them, may have made things look too much *couleur de rose,* " and thinks that Mr. Lavelle " has erred in the opposite direction and depreciated the gold yielding capacity of the tract *unduly.*" He then adds by way of relief to his attentive and interested readers, "I do not recommend it to the attention of investors, but neither would I condemn it." This at least is the opinion of the scientist to whom the Government of Mysore, the investors and adventurers were anxiously looking for advice and guidance. The inconsistency becomes less inexplicable and more overwhelming when it is stated that it emanates from no less a personage than the head of the Geological Survey of India!

In the examination of the *Belligudda* mines reputed for copper ore in the form of malachite or carbonate, he is opposed to the opinion of Mr. Lavelle in thinking that antimony and silver had been mined there in times long gone by, and is unable to understand on what ground he bases that opinion. We will allow Mr. Lavelle to speak for himself. He says: "Judging from a small quantity of mineral collected by us, these pits appear to have been worked for the extraction of a mixed mineral, antimony and copper, and no doubt upon assay a small quantity of silver. We got some slag from these (reducing) furnaces which will undergo assay. No doubt," says he, "the *kancha* (antimony) ornaments and household utensils used in and about *Chitaldroog* in ancient days were taken from these mines." This explanatory quotation should, we think, set Mr. Foote's misgivings at rest. With the report before his eyes, and the remarks just quoted, he could have easily satisfied himself as to the character or composition of the mineral taken and the ground upon which Mr. Lavelle based his conclusions. A procedure like that suggested by us would have placed the question beyond the shadow of any doubt. Does Mr. Foote really pretend to doubt the accidence or occurrence of silver with antimony or copper, or does he not believe that either of the two minerals last named was taken from the locality? This latter cannot be the case, as he bears testimony to the fact of *pockets* of copper having been mined, but is doubtful whether any silver had been mined! We are aware that silver is often associated with copper, antimony and other metals, and even with gold. We are then informed by the same authority, in a most unqualified and positive manner, that the pockets of copper ore have been completely exhausted, and that there remains nothing to tempt the enterprise of speculators or capitalists. We are thankful for this information, but disagree with him in thinking that the copper ore could have been quite exhausted by primitive mining and appliances.

Kotemaradi and *Gudda Rangavanahalli* were next visited by Mr. Foote, who found gold in relatively large quantities and excellent in the workings of the extensive *talas* covering the quartz reefs which are of rare occurrence at these sites. Speaking of this tract, Mr. Foote is of opinion that it is one of the most promising he had visited and deserves to be closely tested by *costeaning* and deep prospecting. With reference to Honnamaradi he quite agrees with Mr. Lavelle, that it is one of *very great promise* and worthy of all attention from mining capitalists.

Halikalgudda, which gave a *shew* of moderately coarse gold, and which, according to Mr. Foote, merits closest investigation, closes the prospective operations of the first or Central group.

Turning to the second or the West Central group, we find it stated that the localities included in this group occur in small patches of schistose rocks—remnants of the Dharwar system—scattered over the older gneissic series.

At the little gold field of *Sannahalli* numerous workings, extending about 2½ miles north and south, were found, but none were of very great size. The premises proposed by him, and the favorable conclusions drawn therefrom in regard to this field, are nullified by Mr. Foote's inability to form an opinion as to the value of this property. Although the washings of the scrapings from the walls of the old workings yielded at best but very small shews of gold and the country *favorable* to the prospects of gold, yet he is not prepared to place the same value on this locality as Mr. Lavelle, who refers to it in the following manner:—"*Judging from what I have seen, I deem this a most valuable property, although we found but very little gold in our washings, a fact which does not reduce the value of the property in my estimation, as the debris from the old workings—in Kolar and other places that I examined shewed much less gold in the pan than an equal quantity from these workings.*" What a marked contrast between the reasonings of a scientifically trained individual and an experienced miner! Mr. Foote is equally disposed to question Mr. Lavelle's opinion, which is based on the examination of the existing *debris*, that large quantities of gold and silver were raised from the *Sonnahalli* workings in the shape of chloride or in any other shape. As to the latter, Mr. Foote could not find the *slightest ground* for accepting his views, and this, be it noted, despite his own admission that in the short time at his command he could not attempt making a survey of the area—hence it is only reasonable to infer that his investigations and generalisations were hastily made, or they were of a very shallow character. Alluding to this identical field, Mr. Lavelle is of opinion that "immense quantities of auriferous quartz and chloride containing silver must have been taken from this lode, as, *comparatively speaking, very little now remains in the debris of these old workings.*" Mr. Foote does not attempt to convince his readers as to how he came to the conclusion that Mr. Lavelle's views are wrong. We have already referred to the occurrence of silver in combination with other metals, and here again draw the attention of our readers to our remarks, as being equally applicable to his (Mr. Foote's) observation in regard to the occurrence of *silver in any shape.*

The next field to the above which concludes the survey of the auriferous tracts South of the *Cauvery* belonging to the West Central group is that known as the *Bellibetta* or Silver Hill gold field, which contains a considerable number of large and well defined reefs, to which it would appear a large amount of attention had been paid by the old native miners and which now is worthy of the closest examination. After describing the geonostic situations of the reefs, the sites of the workings, and the various results obtained from workings, he once more takes up the cudgels against Mr. Lavelle, whose description of *Bellibetta* as composing, or having been composed of, alternate courses of *carbonate of silver* he utterly discredits and holds it up to ridicule! "No such mineral as *carbonate of silver*" says Mr. Foote, "is known to science!" We, it must be clearly understood, do not hold with Mr. Lavelle that the particular hill or locality contains or contained such a mineral or not, but what we are concerned with at present is whether Mr. Foote is correct in announcing that such a mineral as the carbonate of silver is not known to science. This assertion must either have been made in innocence or inadvertently, as the occurrence of such a mineral under certain mineralogical conditions, physical and chemical operations, have been reported upon and turned to profitable account. We remember reading some years ago a description of what is generally known of the Silver Fahlerz or Argentiferous Gray Copper ore found in the Reese River. There were two lodes contra-distinguished by the names "Comet" and "Sheba." The former, or the Comet lode, was set forth as being a metamorphosed silver *fahlerz, the sulphur being represented by carbonic acid so that almost all copper and silver was a carbonate* containing silver a little over 22 per cent., the rest being made up of other minerals such as copper, antimony and lead. Mr. Foote next indulges in the supposition—for his assertions are not founded on fact—"that Mr. Marsh, who accompanied Mr. Lavelle when examining *Bellibetta*, evidently discredits the wonderful discovery." Now we, in all seriousness, ask Mr. Foote to tell us how came he to make *this startling statement*—to quote his own words—in the face of Mr. Marsh's statement to the contrary. What this gentleman declares is, that he was *unable to accompany* the prospecting *party and had subsequently* no opportunity of examining this *(Bellibetta)* District! *Verb. sap.!* How different is this from the cool affirmation of Mr. Foote, who in his zeal to set Mr. Lavelle right has drawn largely on his own imagination and himself fallen into error.

The place next visited—passing over others—is *Kempinkote*, where washings resulted variously in 'no' gold, 'very poor' and 'very rich' shews of gold being fine grained and of excellent quality. Here he was unable to find the mine yielding sulphide of silver as stated by Mr. Lavelle in his report, not even on close examination; but in the very next following paragraph, he declares it *impossible to offer any positive opinion* as to this, and the gold prospects of the place, notwithstanding the presence of the extensive workings which the old miners found then *worth their attention for a long period.* As against this expression of opinion we have the declaration of Mr. Lavelle who *took samples* which could easily have been called for and tested by Mr. Foote, if he was earnest in his search after the truth.

'Traces,' 'small,' 'fair' and moderate shews of gold were obtained from the washings made at *Nuggihalli, Taggadurbetta, Jalyaranhalli, Belgumba, Gallarahalli Yellavari*, and *Karadihalli* workings. The great wealth in gold, says Mr. Foote, in his concluding paragraph, relative to the West Cental group, which Mr. Lavelle ascribes to this part of the country has yet to be proven.

The report on the Auriferous Tracts in Mysore closes with the survey of the third or Western group. Some old workings known to Mr. A. G. Lock, and unknown to Mr. Foote and the native gentleman who accompanied him and Messrs. Lavelle and Marsh, were not visited by the Foote party as the authority was sufficiently reliable to dispense with their identification and examination. Evidently Mr. Foote knows his foe, or he would have labored to shew that the facts which he is pleased to term as 'probably correct' are not facts at all.

Chiranhalli possesses geological features favorable to the occurrence of gold; *Mahebennur* gave very good shew of gold; *Davangere*, whose source of gold is believed to be in the high ground to the south, gave, from a working of the red soil exposed in the shallow bed of a small stream, a small shew of gold, and the whole of the auriferous area requires very close survey.

A very faint shew of gold characterises the capabilities of *Saladamaradi*, while Honnehatti workings appeared, from the fine shews of gold obtained by Messrs. Lavelle and Foote, deserving very marked attention from earnest prospectors. *Palvanhalli*, well-known auriferous tract visited by Mr. Foote in 1881, was not in operation to enable him to conduct his investigations; and at *Kudrikonda* the Turnbull reef is still considered worth further development and expense before practically abandoning it, as the geological inferences drawn by Mr. Foote have, as far as circumstances have permitted him to judge, proved correct. Mr. Lavelle is in accord with Mr. Foote in this respect, as the results obtained by him confirmed his previously formed opinion, that a very rich mine could be opened up on this—Turnbull—reef. Without entering into the consideration of other metals found by the survey parties, we think enough has been placed before our readers to enable them to see the addition of another instance of the many that have gone before, wherein theory has arrayed itself against practice. While, however, admitting the geological discrepancies, exaggerations and other imperfections of the three reports now before us, and the results achieved by the two survey parties, we cannot help expressing our disappointment at the performance of Mr. Foote, whose reports at best may be characterised as poor, hasty, indefinite and misleading—a conclusion which we have arrived at on the testimony of his (Mr. F.'s) own words. The country he traversed consisted of a 'series of flying visits,' some places were not visited, and there was hardly a single gold field he would not have greatly preferred examining far more closely than his time allowed; his cursory examination meriting closer investigation and his unwillingness to commit himself to anything definite, makes our conclusion more pertinent. We are aware of errors possible in course of a hasty and cursory inspection of a field—errors into which even the best trained geologists are known to fall—and in the case of Mr. Lavelle the possibilities are multiplied, if not made more possible.

In the realm of geology Mr. Foote must be regarded an authority, but while doing so, we can scarcely disregard the decision or identification of a well trained eye and long practice. Mr. Lavelle though confident is apparently a careful man and zealous in the promotion of the gold mining industry of Mysore. The perusal of the three reports has left on us the impression that Mysore is rich in the king of metals and had the surveys been conducted with a more elaborate system of exploration than has been the case, the result would have been more satisfactory and less speculative.

We would strongly advise the Mysore Government to set aside an annual grant for the systematic and thorough examination of the various fields, dealing first with the most probable localities.

ECONOMY, AND MR. MOLESWORTH'S OFFICE.

For a Government, as well as for private persons with limited means, there could be no better watchword, no more serviceable aid to efficiency and general well doing than economy. But then, if any serviceableness is to be got out of it, one must not regard it as a mere shibboleth; it is needful to understand what the word really means, and wherein its efficacies consist. Too often there is disposition to lose sight of utilities that are worthy of being striven for in mere worship of the name, of the shadow instead of the substance. It is a truism; but it cannot be too often repeated that a penny-wise-and-pound-foolish policy is as far removed from real economy as palpable extravagance is. When the Government of India, for instance, is seized with one of its periodical savings-box fits, it makes great outcry about waste of stationery; it abandons, for a time, construction of some urgently needed public work, and allows the material collected for it to go to waste; it discharges sundry subordinate employés, who probably have to be taken on again a few months afterwards, when probably the market rate for labor is higher than it was when they were discharged. It never seriously assails the overgrown Home charges, the *fons et origo* of more than half the mischief. It does not concern itself with sinecures—such, for instance, as the Director-Generalship of Stores at the India Office. It is by way of soothing Cerberus with some sop, often as useless, sometimes as mischievous, as it is infinitesimal from an Imperially financial point of view.

We hear now that it is in contemplation, on Mr. Molesworth's retirement, to do away with the office of Consulting Engineer for State Railways, and that it is proposed to replace his functions and services by periodical Railway Conferences. To substitute, that is to say, civilian fads for professional acumen, talk for action, crudities of uninformed opinion for trained judgment. Where will the economy be? Does anyone with his head screwed on tight and some experience of the country, suppose that these periodical railway conversaziones will not, in one way and another, cost a deal more than the up-keep of Mr. Molesworth's office does? *Credat Judæus.* The conversaziones will cost more; and moreover they will, in the nature of human nature, be discordant; the element of assurance and finality will be lacking. They will be like the House of Commons without a Speaker; and without the sanctions that pertain to Parliamentary polling of votes. Lately the English public has shewn some dawnings of inclination to come forward with its money in support of Indian Railways. But it is a public cautious even to timidity in the matter of investments; it knows nothing about India; it takes its opinion about things Indian from men in whose capability to give a sound opinion it has gained faith; and it is on the strength of such opinion that it invests its money, if it invests at all. This is more a matter of sentiment than of reason. If the *imprimatur* of an experienced and trusted English authority on Indian Railways is to be quashed, English capital will fight shy of those Railways—which would mean eventually a higher rate of interest on Government borrowings. As to the opinions of a Conference it is ten to one that they will be of Tower of Babel character and unlikely to inspire any confidence, if only because of their want of coherency. Did anything *practical*, anything *real*, ever eventuate from Conference, Committee, Commission, or any other parliament of words, sitting in confabulation on any Indian affairs whatsoever?

COOPER'S HILL.

THE Duke of Wellington used to say that the motto "Floreat Etona" had won him a good many battle-fields. Had he lived in our days of almost obsolete bayonet charges, and the triumphs of artillery and science in war, he would probably have been inclined to say:—"Floreat Cooper's Hill." For he would not have known how to put Cooper's Hill into Latin any more than we do, and would not have minded any more than we do. Meanwhile, Cooper's Hill prize days are pleasantly green spots in the memory of many an Indian Engineer and awaken memories one would not willingly let die. The 16th College Commemoration, lately solemnized, when judged by English newspaper reports, must be deemed as thoroughly satisfactory a searching of the conduct of collegiate affairs, and exemplar of a tale of good work done. The calendar of successes achieved by collegiate students is from every point of view gratifying and satisfactory. Over and above that, it shewed a steady yearly developing tale of increased and increasing spheres of usefulness, gradually being opened out for the alumni of Cooper's Hill. Such developments must needs be very welcome to India. At first, Cooper's Hill was requisitioned by advancing demand on English educational supplies for the adequate recruitment of the Indian Public Works Department. But the time has long gone by since that economic function ceased to be the limit of its functions; and it is now required to supply fit recruits for the Forest and Telegraph Departments as well as for Engineering pure and simple.

We have before us the College Calendar for 1885-86, containing a syllabus of the courses of study pursued during the period under review, and other matters which, although most appropriate to the neat red covers in which they are bound up, we need not presently concern ourselves with. It suffices to say that at the late celebration, the President gave it as his opinion that during the year under review students had worked with commendable diligence, and competition had been "sufficiently keen." But this Jubilee gingerbread folly, of which every sensible man in India is so heartily sick, played the fool, even at Cooper's Hill.

In the course of his speech Sir Alexander Taylor said:—"In regard to our studies I have to report, that, upon the whole, a satisfactory share of good work has been done. The best judges on this head are the professors who have had charge of the different classes. From long experience they can speak with confidence, and they are not disposed to take optimist views; so when they say that the year's work has been satisfactory, their judgment may be accepted with confidence. At the same time I feel that the Jubilee distractions during the last term, and an application that was made to us in the Spring, to supply Assistant Engineers for a Railway under construction in India, unsettled men's minds, and have to some extent checked progress." By way of parenthesis we may remark that this said application "in the Spring" was a distinct compliment to Cooper's Hill; and one that may not be gainsaid.

With but four exceptions the senior students who completed their Cooper's Hill course on the 29th July 1887 all qualified for the public services. They entered the College, fifty strong, in 1884. Besides these three others won commissions in the Royal Engineers and the Royal Artillery, at a public competitive examination held in London last year. The quantity of work, said the President, "done by the students of this year, is undoubtedly less than in previous years, but *the best judges do not think that it has fallen off in quality.*" The italics are ours, and are suggested by thorough-going belief in the old saw that all work and no play makes Jack a dull boy. We are glad to hear that football, and cricket and athletic sports have flourished, helped thereto by the encouragements of Colonel Courtney, of the Royal Engineers, Professor of Surveying at the College. Professor Reilly is President of the Boat Club. Mr. Heath is prime organizer of lawn-tennis tournaments. Several of the College professors, over and above being teachers and disciplinarians, are organizers of recreations and do in that way, what the president calls, "a great deal of most useful work."

About students of the first and second years we are told that in both years the great majority have worked very well, while in the second year they form a class which may fairly be ranked as one of the best ever domiciled in the College. Six new scholarships were competed for last year, and a prize of £15 given by the members of the Indian Public Works Account Department. It was won by Mr. M. G. Simpson. The President took occasion to suggest, in the course of his speech at the commemoration, that the College is as yet endowed with no scholarship for forestry students, and would be thankful to get one.

It would be a very little matter for concerted action on the part of the department to bring about; it would be a praiseworthy undertaking; and we feel sure that as soon as it is brought to the notice of the men concerned they will be glad to do in the matter what is needful, and what will seem on their parts a graceful tribute to Alma Mater.

With reference to immediate practicalities the President said:—"A few years ago, a considerable expansion of our laboratories took place, and our present mechanical laboratory and testing machine were established with the primary object of enabling our senior students to study the behavior of iron, steel, and other substances used in construction, under straining actions of various kinds; and so to acquire a correct practical acquaintance with their more important physical properties."

At the conclusion of his speech the President said to the Chairman:—"I hope you will think I have made good the three points I wished to bring out, namely, that there is reason to be satisfied with the past year's work, whether with reference to conduct, to study, or to success out of doors." It seems to us that the President has as good a right as ever Strafford had to claim "Thorough" for the motto of the College. The year's record is in effect a record of work admirably well done; we rejoice to find that dryasdust and bookworms have not dominated the collegiate roost; that room and appreciation have been found for manly sports as well, for the truest education; combination of *mens sana in corpore sano.* It appears to us that this year's Cooper's Hill men have done very well indeed in the class lists, and we rejoice to hear that they can hold their own in the playgrounds too. These are just the sort of men India wants.

INCANDESCENT GASLIGHT.

Among the various methods now employed in obtaining the greatest possible light from gas, that connected with the Welsbach light is about the best. The invention has for its object improvement in the manufacture and application of *mantles* in incandescent gas lighting and in packing such *mantles.* The *mantles* are conoidal or conical in shape and made of looped or knitted or woven fabrics and suspended above the flame with either the large or the pointed end downward, so that the flame acting centrally will in the one case be within and in the other without or at the apex of the *mantle.* In both cases the materials employed are more or less destructive and refractory and are rendered incandescent by the gas flame acting upon the same. It is very important that the *mantle* should be kept during and after the incineration in as true a shape as possible in order that the heat of the gas may impinge equally upon all its parts, as any departure from the definite shape will lead to unequal results. To accomplish this object a wire ring is employed above and below the conoid *mantle* and a variety of other devices are adopted having for their object the maintenance of true shape and equal incineration of the *mantle.* The incineration or carbonisation of the *mantle* is effected by a *mandrel* of hollow glass of the required shape being placed vertically as a suitable burner or flame, in such a manner that the top of the burner stands level with the top end of the *mandrel* which surrounds it. On this is then placed the *mantle* whose bottom edge corresponds with the top edge of the *mandrel* and the flame when the burner is lighted. This done, the burner is lighted and the top edge of the *mantle*—previously damped by steam after carefully drying it—carbonised or cinerated in a regular and uniform manner and if the *mantle* happens to be of the proper degree of dampness the process of incineration will proceed in a regular and uniform manner from top to bottom of the *mantle.* The *mantle,* by the intervention of manual or mechanical means is made either to lift gradually or remain upon the mould or *mandrel* until the carbonisation is perfected. This is an improvement which should commend itself to all users of that commodity in this country. Mr. Arthur Paget, of Loughborough, Leicestershire, is the patentee and we would refer all enquirers to that gentleman.

In order to facilitate the landing of heavy railway materials the Harbour Trust Authorities, Madras, have constructed three railway lines within their yard, opposite the High Court. On each of these lines will be placed a crane, and as the trucks which are laden with the materials on the Pier are brought opposite to these lines, the cranes will be pushed forward, and used in lifting the materials from the trucks.

THE CHANNEL TUNNEL.

Sir E. Watkin's Channel Tunnel Bill came on for second reading in the Commons on the 3rd of last month, and was thrown out by a majority of 46, in a House made up of 260 members. Of course, the Chairman of the South-Eastern Railway had a certain *ex-officio* backing, and the guild of promoters can always command some votes. But, on the sense of the House, the arguments brought forward in support of the Channel Tunnel scheme,—and incidentally of the Railway Company whose yearly dividends Sir E. Watkin would like to see increased at the expense of the nation—seem to have fallen flat. The sense of the House inclined to believe rather in strengthening national defences than in substituting for them a sentimental *entente cordiale.* As to which matters the commonsense of the House of Commons opines that too much familiarity is apt to breed contempt. Another proverb, the one affirming that circumstances alter cases is held to dispose of the contention that certain city personages who are dead approved of the scheme when they were alive. They would not approve, in the fuller light let in upon the subject now, it is maintained; and even if they did, their favoring breath of favor must be blown to Limbo by the many competent authorities, Civil and Military, who have unhesitatingly given judgment against the idea, and given adequate reason for their adverse opinion. Sir E. Watkin wanted to make out that for lack of this tunnel, England is isolated and in danger of losing her foreign trade. To which suggestion reply is made that England's insular position has been a material factor in building up her enviable condition of independence, and constituting her sea carrier of the world's merchandize. Sir E. Watkin's benevolent desire to do away with the miseries of sea-sickness between Dover and Calais, by means of his tunnel is laughed at, as on dry land allusions to *mal de mer* always are. The gist of the opposition's contention is that the public welfare should not be made to give way to private interests, even though the object aimed at is, as the *Railway Times* puts it, "doing a good turn to the Channel Tunnel and South-Eastern Railway Companies combined."

Notes and Comments.

The Site of the Damuda Bridge.—We understand the position of the bridge will not be where it was originally intended, but about a mile to the West of that place, where boring operations will commence almost immediately to prove the nature of the river bed.

The Grievances of the Telegraph Department :—Mr. Buckley, of the P. W. D. Secretariat, has, we are informed, been entrusted with the enquiry touching the grievances of this Department, and before long it is expected some scheme will be formulated which will ameliorate the position of the department.

The Bengal-Nagpur Line.—We hear that Mr. F. I. E. Spring will not join the Bengal-Nagpur line, but will probably go home on leave. The Simla wiseacres call this line the "Chokras' Line." We hope the "Chokras" will shew that they are made of good stuff, and above all that they will not exceed their estimates threefold.

A Sensible Ruling.—A native of the Public Works Department, who was cited to give evidence before the Public Service Commission, having applied for allowance while so engaged, the Government has ruled that those who were required to attend before the Commission must be considered as on duty and are entitled to travelling allowances, &c.; but those only permitted to attend, are only entitled to their official salary.

Railway Fencing as a Protection against Accidents.—We see a suggestion in a daily paper that Legislative interference is imperative in this direction with a view to lessen accidents on railways. Any provision of this description can be of little avail, for we have often witnessed cattle trespassing on fenced lines with impunity. An endeavour is made by the same paper to connect the recent serious accident on the Rajputana State Railway with the absence of a fencing, but we are unable to agree with the views expressed by the contemporary.

Flood Havoc at Goalundo.—The recent floods have done serious damage at Goalundo and the removal of the terminus to Rajbari was only just in time. The site of the old Railway station is now nearly a mile from the river bank, and nearly half a mile has been cut away this year up to date. The telegraph cable was in imminent danger, and had to be lengthened inland about two miles. It was also found necessary to take up a considerable length of the existing telegraph lines, which would otherwise have disappeared into the river.

Uncovenanted Service Pension Rules.—The Government of India have just passed an important Resolution in the matter of the Uncovenanted Service Pension Rules, under which invalid and compensation pensions are to be given on from ten to twenty-four completed years of qualifying service at ten-sixteenths to twenty-four sixtieths of average emoluments, with certain limits in the case of the highest pension of Rs. 5,000 per annum. Below and above those years the rules remain unchanged, but the limit of Rs. 4,000 is removed. The new rules come into force from the 17th instant, but officers now in India and retiring under section 114, Pension Code, may elect within three months of the date of the Resolution for the old or new rules, and officers on leave out of India within six months.

Mining Statistics.—The total number of persons employed in and about the mines of Great Britain in 1886 amounted to 561,092, of whom 519,970 were working under the Mines Regulation Acts and 41,122 under the Coal Mines Regulation Act, as compared with 41,044 under the latter and 520,632 under the former, making a total of 561,676 in the preceding year. The mineral outturn in 1886 amounted to tons 170,006,959, of which 157,518,482 were coal and 8,862,648 iron stone, as compared with tons 159,931,418 coal and 10,188,612 iron stone or an aggregate of tons 173,223,960 in 1885. Fatal accidents aggregated 869 causing 1,018 deaths, of which 807 accidents and 953 deaths occurred in coal mines, as compared with the same number of accidents causing 1,018 deaths, and an aggregate of 866 accidents resulting in 1,214 deaths in 1885.

More Railways Wanted.—The Secretary of State not long ago addressed some of the Indian Governments, inviting information as to what lines of railway might still be constructed within their territories of sufficiently lucrative promise to tempt home capitalists to undertake them without a guarantee. We venture to say that no such lines exist. No railway without a guarantee is practicable. The solitary exception is, perhaps, the case of the Bengal and North-Western Company which, we believe, is ready, on what should be reasonable terms to Government, to continue its present system to Calcutta. But the Government are said to be indisposed to countenance any competition with their own East India line; or, in other words, consider a large dividend of more importance to the country than a large principle exemplified in their mode of dealing with its railway system generally.

Oudh and Rohilkhand Railway.—What we lately predicted would be the fate of the present Oudh and Rohilkhand Railway Company is now an accomplished fact. The State takes it over in terms of the contract. With the Home and Indian Governments in accord in objecting to treat with the Company, they have no chance of retaining the management of the line on any terms. The proposals of the East India Company, decidedly discouraged as they are on the Indian side, are not likely to find favor, notwithstanding the powerful combination working on their behalf at Whitehall. Nor is the Bengal and North-Western Company likely to prevail. It will be determined, we believe, that the Secretary of State settles with the Oudh and Rohilkhand Proprietors, and that the Government of India works the system for a year or two at any rate. That a new company may eventually arise to take it over is not impossible.

Government Inspection of Mines in the United Kingdom.—From the discussions that have been carried on in the Home papers in connection with this subject in relation to mining legislation the following would appear to be the conclusions arrived at with reference to the extent to which the diminution of accidents in mines might be ascribed to the system of Government inspection:—

1. That it is a mistake to suppose that the falling off in the number and gravity of accidents is entirely due to inspection appointed under the mining law.

2. That the diminution is partly due to a relatively large number of hands employed and the extensiveness of the operations as compared with 1886.

3. That improvements in ventilation, roads, lamps, machinery and blasting agents and the advancement of mining science amongst miners and managers must have exercised favorable influence on the ratio of mortality and accidents during the last thirty or more years.

Another Civil Engineer Doomed.—We hear with great regret that the Government of India have refused to recognize the appointment of one of the Civil Engineers on the staff of the Bengal-Nagpur Railway. The grounds of the refusal appear to be that the gentleman in question was until recently employed as a temporary engineer on a certain frontier line, to which we have of late frequently referred in our columns. It appeared that in the enquiry, which was held not long ago in reference to the terrible extravagance which has taken place on this line, blame was attached to the gentleman we are referring to on account of exceeding his estimates. In our opinion this blame was not deserved, inasmuch as he had distinct orders from his Chief to complete his work at any cost within a certain time, and his successful efforts to carry out these instructions met with the Engineer-in-Chief's cordial approval. However, somebody had to be hanged, and the due wrath of the Government of India has fallen on this officer's head, with the result that orders are said to have been issued not to employ him on the Bengal-Nagpur line. This action somewhat reminds us of a story told of a former Chief Engineer of Bengal who went by the name of "Smiling Billy." Travelling down the Grand Trunk Road accompanied by the Superintending Engineer, the Executive Engineer, the Assistant Engineer and the Overseer, the Chief was brought to a halt, owing to the horse he was driving putting his foot through the rotten planking of a bridge. [Be it noted he had refused applications for money to repair the same for four years running]. Billy looked reproachfully at the Superintending Engineer, who promptly called on the Executive Engineer to explain. With a severe frown the latter said to his Assistant: "Mr.——, be good enough to let General——know why this bridge is in such a disgraceful state." The Assistant looked helplessly at the Overseer, (a tall Irish Sergeant of Engineers,) and remarked, "Sergeant——, this OUGHT to have been seen to." The Overseer who had his road peon with him, replied with great emphasis, and pointing to the trembling culprit, "Sorr, sure I tould this blagyard to have the rotten planks put right, but it sames he hasn't done it, divil take him." "Then let him be fined eight annas" said the Chief loftily, and went on his way. The same process of selection appears to have been adopted in the case of the gentleman we have referred to above, but the waste of money having amounted to several millions in this instance, the Government of India have thought fit to stop at a temporary Engineer this time, and make an example of him. If they would only go for the men who are really responsible, they would meet with the approval of the whole of the Public Works Department.

Current News.

It is believed that the Patents Bill will be passed during the ensuing Calcutta season.

It is rumored that Colonel Luard, R.E., will succeed Sir Bradford Leslie as Agent of the East Indian Railway.

Major-General Æneas Perkins, on return from leave, has resumed the duties of Chief Engineer in the Punjab.

The Viceroy opens the Benares Bridge in the middle of December, arriving at Calcutta on Saturday, December 17th.

The Supreme Government will take no active part in the Melbourne Centennial International Exhibition of 1888.

The floor of the Sanctuary at St. Mary's Cathedral, Madras, is being paved with Shahabad stones, one foot square, which when completed promises to have a fine effect.

A Conference of Railway Authorities is being summoned to meet during the cold weather in Calcutta for the discussion of matters connected with railway administration.

There is one Bengali gentleman now prosecuting his studies at the Cooper's Hill College. He stood thirteenth in order in general merit at the last annual examination of the College.

It is stated that the reductions and re-arrangements that have been carried out in the Bombay Public Works Department are expected to result in a saving of about a lakh of rupees per annum.

We hear that the Board of Directors in England have sanctioned Rs. 23,000 towards the construction of a Loop Line of Railway from the Hoosain Saugor Junction to Secunderabad.

Sir Charles Elliott leaves England by the steamer of the 2nd December, arriving at Calcutta towards the end of the month, when he takes over the Public Works Department from Sir Theodore Hope.

We are informed that the Hannumconda station on the new line of His Highness the Nizam's State Railway has undergone very great improvements of late, owing to the untiring exertions of the Taluqdar, Mr. Framjee, who also acts as District Engineer.

Colonel Jopp, R.E., the Senior Deputy Consulting Engineer for Railways, has just returned from Bangalore, whence he proceeded for a few days to look into the state of the work to be completed in the office of the Engineer-in-Chief, Madras State Railway Surveys, in view to its being closed.

On and after this date the B. B. & C. I. Railway Company announce that they will accelerate the train service between Bombay and the Punjab, by the running of a fast mail train daily in each direction between Rewari and Ferozepore on the Rewari-Ferozepore section of the Rajputana-Malwa Railway.

Among the reductions already carried out at the instance of the Finance Committee in Madras, is the abolition of the appointments of Joint Secretary and Assistant Secretary in the Irrigation Branch of the Public Works Department, the duties performed by these officers being now performed by the Secretary and Under-Secretary.

On Monday, 12th ultimo, a native Gunner Guard, after coupling the wagons of the train he was marshalling, was trying to make his way out; not being sharp enough, the shunting engine knocked him over, when a few wagons of the train ran across him, separating his body in two from the hips. The unfortunate man expired immediately.

The Government of India have, it is said, decided that a sum of ninety lakhs is to be sanctioned under the heading of Provincial expenditure for some of the lines of railways lately surveyed in the Madras Presidency, and for which estimates had been sanctioned. The first line to be undertaken will be that from Vellore to Villapuram, 135 miles in length, which is to be constructed in three divisions.

An accident attended with fatal results, occurred lately near Asulpura, beyond Jeypore, on the Rajputana-Malwa Railway. Two girders and a pier of a bridge subsided and a goods train that was passing at the time was precipitated into the river. The two guards and two pointsmen escaped, but the European driver and native fireman were killed.

A new invention, which will undoubtedly play an important part in any future war, was lately exhibited at the Kensington Town Hall. The apparatus is an electrical war balloon, adapted to the requirements of aërial signalling. The interior contains a frame capable of holding six incandescent lamps of the Edison and Swan type, of 25 volts, the power being conveyed to the frame by a double cable of extreme lightness and flexibility. The lamps are controlled from a switch board placed on the earth, the contacts being of carbon, and the balloon is held captive by a line of Italian hemp capable of bearing a breaking strain of 25 tons. The apparatus is worked with E. P. S. battery of 25 cells, enclosed in teak boxes, the whole being capable of being stowed in a very small space. The apparatus exhibited has been made for the Belgian Government.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

ARCH ROOFS.

Sir,—In the articles now appearing in your paper the writer assumes that a rise of ⅛th the span is best, and most economical; in this he is, I think, mistaken.

The linear arch rib for a uniform load, which is that borne by arched roofs is a "Parabola," hence this is the proper figure for such an arch rib, in order that it may be uniformly deep, and that the line of resistance may correspond with its axis for a uniform load. Now a segment of a circle, whose rise is equal to ⅛th span, and of such length as used for arched roofs, practically coincides with a "Parabola," therefore I have chosen this ratio of rise to span for all arched roofs designed by me.

If a greater rise be taken the arch must be made thicker at the haunches, so as to keep the line of pressure within the arch, this makes the quantity of material, and therefore the thrust greater than would be caused by an arch ring such as I use, as all these are of uniform depth, *i.e.*, 4½" up to 15' span, and 9" from 15' to 30' span.

I may also add that the greater the rise the larger the arch ring and consequently the more material in it. Reverberation is also lessened by keeping the roof as flat as possible.

E. W. Stoney.

AN EXPLANATION.

Sir,—While you are on the subject of grievances will you permit me to quote the following extract from the Administration Report of the Madras Government for the past official year:—

"Consulting Architect to Government.

"During Mr. R. F. Chisholm's incumbency of this appointment a special and consolidated rate of salary was attached to it, but after the retirement of that gentleman, the Secretary of State for India sanctioned the continuance of the appointment as a permanent measure on the following conditions: That the appointment shall be open to an officer of any rank below that of Chief Engineer, and should the officer be a Superintending Engineer, or should he rise during such employment to the rank of Superintending Engineer, he shall be treated as a supernumerary and receive promotion in his turn. On those conditions Lieutenant-Colonel J. L. L. Morant, R.E., was gazetted to the permanent appointment on the 16th July 1886."

As the above paragraph, though accurate, is incomplete, I would suggest its being rewritten thus: "Mr. R. F. Chisholm, who held the appointment of Consulting Architect to Government for a period of 22 years, solicited the Government of Sir Elphinstone Grant Duff to give him one step of promotion, as many men had been promoted over his head. The Government of Sir Elphinstone Grant Duff declared their inability to comply with his request, in consequence of which Mr. Chisholm thought it to his advantage to retire. Before he did so, the Government of Sir Elphinstone Grant Duff received from the Government of India full powers to accede to Mr. Chisholm's request, but did not make the matter known until after that gentleman had retired, when they at once conferred on Major Morant, R.E., the boon denied to Mr. Chisholm after 22 years' service."

The above, Sir, is the truth of the matter. I may mention that I submitted a respectful memorial to the Government of India on the subject—it is needless to say with what result.

R. F. Chisholm.

THE INDIAN ENGINEERING COLLEGES.

Sir,—The leader which appeared under the heading "The Reason Why," in your issue of 17th instant, must be disappointing to every impartial reader of your Journal. Without sifting both sides of the question and adducing reasons and arguments such as the gravity of your inferences demands, you make the sweeping announcement that a native will never make a good engineer because of his "natural defects which no amount of teaching will rectify"; and you proceed to question the necessity of maintaining the Engineering Colleges in India on their present scale.

To go as directly as may be to the point, I agree with you that the instruction available in India is scarcely of a character to make an all-round professional man; and, this fact has been reported over and over again by competent witnesses before the Public Service Commission. It is equally true that the heads of institutions are picked men. But the reason why the colleges do not turn out properly qualified men must be sought for, not so much in the men that are trained, but in the men that train, and chiefly in the system of recruitment in vogue.

The teaching staff in our colleges, with the exception of the Principal and perhaps an assistant, is notoriously deficient both in number and quality. However eminent an educationist the Principal may be, he can do little, single-handed, by the part he personally takes in teaching. He hardly finds time to teach all the classes in a single subject, and must of necessity entrust the teaching almost entirely to his subordinate staff. If the head of an institution applies for an able and expensive teaching staff, Government say, as the Madras Government said not long ago, that the college should restrict its operations to train men for the subordinate grades and that additional expenditure is not justified when the college is intended to furnish only one or two recruits annually for the higher grades.

The system of recruitment does not attract the best men, and the prospects held out are not inviting. One or two appointments are annually open for competition. The prospect that an aspiring native youth sees before him is a Government appointment—or nothing. If he fails to secure a guaranteed appointment, his professional training is thrown away; and if he is in need of employment, he must seek it outside the engineering profession.

The best solution in my opinion is the one quoted on page 121 of your Journal of 20th August last. Four high class colleges are really not required. With the expenditure at present incurred two large engineering colleges may be established; one for Northern India and Bengal and one for Bombay and Madras, and an able staff of professors may be maintained in each. The remaining two may be reduced to schools for subordinates.

To the proposed colleges a decent number of appointments, say 8 or 10, should be offered for annual competition. In this way high scientific training can be ensured, and there will be a fair competition in which really intelligent men will take part. Thus an efficient staff of native engineers may be trained for the public service.

Your voice was expected on the side of reason and progress. But you propose the exclusion of natives from the higher grades, and to abolish even the semblance of higher education at present maintained. You would have done some service to the public had you called attention to the anomalous condition of the engineering colleges with a view to their reorganisation. Instead of this you inveigh against the men and have thus, perhaps involuntarily, imported a partisan character to your advocacy. You seem to hold that R. E's. are interlopers, that native engineers are unfit and out of the reckoning, and that the interests of the C. Es. are all supreme in the Department.

September 20th, 1887. Scrutiny.

A VOICE FROM TENASSERIM.

Sir,—Perhaps a little news from this neglected town may not be uninteresting to many of your readers. Our Chief Commissioner is expected, and it is to be hoped the visit will materially benefit the place. It is a well known circumstance that water is to be had with great difficulty during the hot weather in Moulmein, and although there was some tall talk of constructing water-works some time ago, nothing has come of it. The late Municipal Engineer, I believe, submitted a scheme for bringing the water from the Ewer Attacan, but this was found to be too expensive I suppose, so it was pigeon-holed. Another project was for building a reservoir upon a hill near the town and conducting the water down under an enormous head of pressure, but all came to nothing, and here we are *in statu quo.* That Moulmein is sadly in need of good potable water is a verity, but when we shall get water-works constructed is, to say the least, an uncertainty. Cholera generally breaks out during the time there is this scarcity of water, and out of shere humanity at least something ought to be done to give the poor good water and thereby eliminate one of the chief causes of the disease.

Writing of cholera, bye-the-bye it seems strange that this epidemic should have favored the Jail more than other localities. Cases occurred in the Jail when there was not a single one in any other part of the town, and they occurred during the monsoons, too, altogether an unprecedented circumstance, as one of our local papers had it. There must be something wrong about the site of the Jail, and as advocated by the Press, it should be removed to a healthier spot, but, perhaps, if this was suggested "no funds" would be the reply.

A year ago, I think, the Municipality asked the Public Works Department to send in an estimate for a Steam Tramway, and this was done, but that was all. The expenses of the preliminary survey, and levelling, &c., were cheerfully paid, but *ne plus ultra.* The residents I daresay do not care much whether they have a Tramway or not, but by all means give them "Water-works." This is an imperative necessity and Government should take this matter up for, as I say, humanity's sake at least. We lately had a new wharf constructed, but, *mirabile dictu,* when it was completed the Captain of the Steamer for whose special benefit it was erected refused to come alongside, on account of the presence of a rock about 50 feet away from the wharf. A vessel of less draught, however, was put upon the line and things now go on as "merrily as a marriage bell."

Endeavors were made to blow up this sunken rock. Executive Engineers, Port Officers, Custom House Clerks, &c., all went prodding about the place to discover its hidden "habitat," and rumour says found it too, but *bus,* nothing else was done. However, as one sunken enemy is not likely to give us any trouble now, we will "leave him alone in his glory," not, however, without giving him this intimation, that the vessel for whose safety he was so diligently looked for and prodded is now no more, having come to a wreck on the James and Mary sandbank in the Hooghly. A new jetty and swing bridge is to be erected on the site of an old wharf, and then, I think, the people will not have any reason to complain of not having wharves enough. It is to be hoped that the Steamer *Tavoy* that runs between Tavoy and Moulmein will use this new wharf and so prevent the great inconvenience that now exists in landing from her from mid-stream.

Nothing has been done with regard to the "Victoria" Park that was to be laid out in commemoration of the "Jubilee"—oh! that word. I have had enough of it. Everything taken on hand, everything newly invented has "Jubilee" for its front name. At Thatone (a district near Moulmein) however, I hear a start has been made with the "Empress" Park there, but how much has been done I cannot tell. Bye-the-bye, the Assistant Commissioner of that place (Thatone), while superintending the laying out of the work in this Empress Park came across an alleged precious stone weighing over 35lbs. Experts, if you can call the Burmese lapidaries by that name, have given it as their opinion that the stone is an amethyst. Don't let your readers be surprised; but all are of opinion that it is really one, though one cautious gentleman modified his opinion by adding that it was an "undeveloped" one, as it has not as yet separated itself from the matrix, or rather that the matrix has not as yet passed into its last stage. Another gentleman is of opinion that it is nothing but pure felspar or felspathic porphyry and that having no *intrinsic* value it has a very large *local* one, since the stone can be cut up into pieces and sold to the Burmese for use in their jewelry. The stone is about 10″×6″×8″ roughly and is laminated, the strata being clearly discernible and of a light pink or flesh color, with a metallic lustre. I am told that a piece of the stone about as big as a hazel nut was given to a well-known gentleman of Moulmein and in return a present of a drinking fountain valued Rs. 1,000 was given for the Park. What glorious benevolence! I must say. The Burmese I hear worshipped the stone when it was exhibited and even made offerings to it. Poor ignorant people, they really believe that a "Nat" (Burmese for spirit) sent it to the Assistant Commissioner, and for this reason are reluctant to value it for fear of incurring the just anger of this spirit if they depreciated this (or "her," for I don't know whether this spirit is male or female) gift. I forgot to state that the stone was found on the surface and covered over with calcareous clay which took some hours' soaking to wash off. The lowest value of the stone as rumoured is *nil,* its highest value 6 lacs. If the Assistant Commissioner gets the mean of the *sum* of the two, why all I can say is, that he is deuced lucky, but if he gets the mean of the *product* of the two values, why then he is not lucky. I have spun out this letter to an inordinate length, so *au revoir* till my next.

Moulmein 20, 1887. DEXTER.

General Articles.

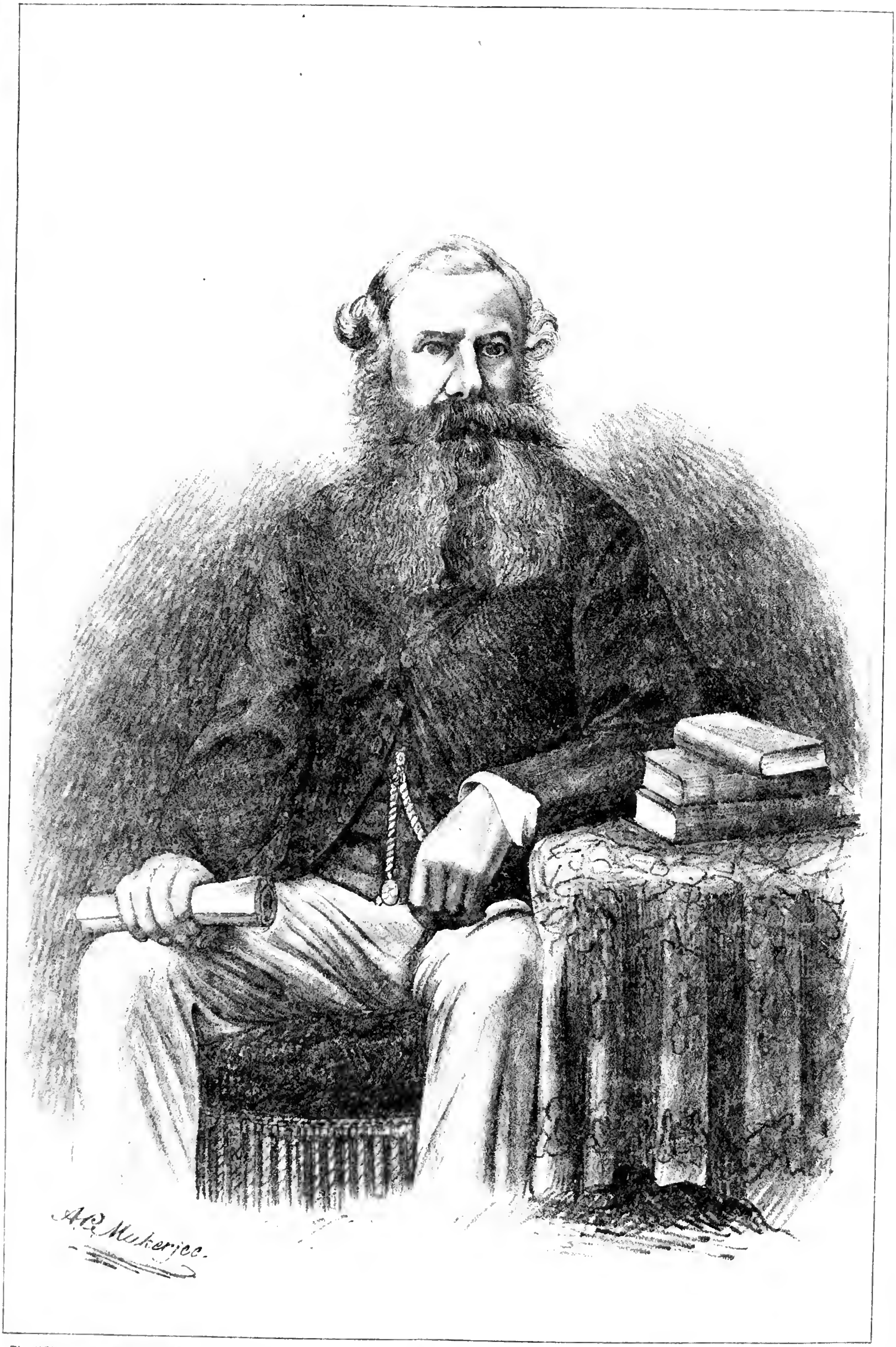
GUILDFORD L. MOLESWORTH, C. E.

On the eve of his retirement, we present our readers with a likeness of the senior Civil Engineer in the country. We extract the following memoir from "Men of the Time":—

Molesworth, Guilford Lindsay, civil engineer, son of the Rev. John Edward Nassau Molesworth, D.D., vicar of Rochdale, was born at Millbrook, Hants, in 1828; educated at the college of Civil Engineers, Putney, afterwards served an apprenticeship to civil engineering under Mr. Dockray on the London and North Western Railway, and also in mechanical engineering under Sir William Fairbairn at Manchester. Subsequently he was employed in various railway and other engineering works in connection with iron-works in South Wales. In 1852 he was chief assistant-engineer on the London Brighton and South Coast Railway, which he left in order to superintend the construction of buildings and machinery in the Royal Arsenal at Woolwich during the Crimean War. Afterwards he practised as a Consulting Engineer in London for some years. In 1858 the Institution of Civil Engineers awarded to him the "Watt" Medal and the "Manby" premium, for a paper read before the institution on the subject of "Conversion of Wood by Machinery." In 1859 he went out to the Ceylon railway as mechanical and locomotive engineer, and he was appointed Chief Engineer of the Ceylon Government railway in 1862; Director-General of the railway in 1865; Director of Public Works in 1867; and Consulting Engineer to the Government of India in 1871. His "Pocket-book of Engineering Formulæ" passed through six editions in the first year, and is now a standard work in the profession.

H. H. THE NIZAM'S STATE RAILWAYS.

We learn that the Secretary to Government of H. H. the Nizam's Home Department (Railways), has been instructed by the Board of Directors of the above Company to execute certain works on the section of line between Wadi and Secunderabad. In some instances the works are absolutely necessary. The Board of the Company has recommened that nearly all improvements shall be deferred, but Mr. Furnivall is of opinion that most of these improvements will tend to decrease working expenses. The following are the works proposed to be carried out:—The loop siding at the Hoosain Sagar junction: this is for the direct connexion at the junction between the Wadi and Secunderabad lines which will be needed now that the mineral traffic will shortly commence. This work was included in a schedule of works submitted with the proposals of the Agent and Chief Engineer in September 1885, and was sanctioned by the Board and by the Government of His Highness the Nizam in December 1885 as a work to be taken in hand that year, but on re-considering the matter it seemed to Mr. Furnivall that more was needed than he at first contemplated. The embankment originally constructed is narrow for the formation of the line, and instead of being 20 feet wide is only 12, the bridge in the centre, to drain the triangle formed by the other two lines leading up to Hyderabad is too narrow, and the signals require re-arrangement to make them efficient, so that the cost will be raised to Rs. 23,300 in place of the sanction accorded of Rs. 7,630 in 1885; no expenditure has been incurred on this work up to the present time. This work is obviously to the advantage of the Company, because it will cut off seven miles extra running of mineral trains. The Board has sanctioned this undertaking as a reappropriation of the saving on the Secunderabad-Warangal section. The second proposal is to improve the Mulkaid station, situated at the 15th mile between the stations of Chittapur and Seram. Mr. Warden, the late Agent, moved in this matter some years ago and strongly advocated the interpolation of the station on the ground that it would



The "STAR" Press, 19, Lall Bazar, Calcutta.

GUILDFORD L. MOLESWORTH, C.E.

facilitate the working of the line by enabling trains to be crossed, and because there was good evidence that the station would attract traffic from the town of Mulkaid and prevent goods being carted to the stations of Chitapur on the Wadi side and Seram on the Hyderabad side. Mr. Pendlebury concurs in this view and advocates the construction of a station with sidings and telegraph office, but without watering arrangements. A flag station has been established at this point to begin with but a flag station does not permit of goods being loaded in trucks, and passengers seem to prefer booking from the adjacent stations where they have a greater choice of trains. Mr. Furnivall therefore thinks it will be best to construct a new station at a cost of Rs. 38,813. As at present situated, the Company loses by want of inducements to traffic to come to the line and also by the carts going to the station which is nearest to the town eastward and westward of Mulkaid. This new station will be situated in one of the most richly cultivated districts of that section of the Railway. The Board of Directors are of opinion that this question should be left to the Government of H. H. the Nizam. If it can be avoided, the Board are adverse to the expenditure at present on financial grounds, although Mr. Dunlop gives good reasons for the station being built. The next proposal made is for lengthening the platform at Shankerpalli station at a cost of Rs. 3,078. The existing platform at this station is not sufficiently long to comply with the standard dimensions of the Government of India, and should be lengthened. The Board remarks that this platform has stood a long time as it is. There are doubtless sufficient reasons for extending it, and if the Inspecting Officer of the line insists on it, there will be no recourse but to do it. It has also been proposed to extend the goods sheds at Secunderabad and Hyderabad at an estimate of Rs. 1,500 each. These are for increased goods accommodation at these two principal stations, which is required by the increase in goods traffic. The necessity for these extensions has been noticed by the Government Inspecting Officer on several occasions. The Board of Directors are of opinion that the necessity for increasing these sheds has arisen from the extension of the line, and might be sanctioned as against the saving on the estimate for the Secunderbad-Warangal section. It is also proposed to construct a goods shed at Dharur at a cost of Rs. 3,929, the need of which is shewn by increased traffic at the station. This the Board thinks should, if possible, be postponed, although the District Engineer's reasons for recommending the work are good. The next proposal made is to construct a latrine at Gullaguda station at a cost of Rs. 1,335. This requirement has also been noticed by the Inspecting Officer and is really necessary both for the station staff and for the public.

REPORT ON THE WATER-SUPPLY SCHEME PROVIDED FOR THE CITY OF JUBBULPORE.

By J. G. H. Glass, M. Inst. C.E., Executive Engineer.

The population of the City and Cantonments of Jubbulpore aggregates 75,705 souls. The City generally is built in a basin of granitic rock, and previous to the introduction of the scheme now to be described it obtained its water-supply from shallow wells, the greater number of which are in this granitic rock, affording an uncertain supply, not usually of good quality. In years of short rainfall many of the wells ran dry, and generally the yield in such seasons was scanty and impure.

There were in all 1,058 wells in the City proper, but of these, only 187 afforded water fit for drinking. During the hot season of 1869, in consequence of the failure of the previous year's monsoon, 142 of these wells failed, and even in years of average rainfall no less than 82 ran dry. The population of the part of the City in which these wells are situated is 48,500 souls. Thus under the most favourable circumstances there was only one well to every 254 inhabitants, and annually in the hot season the proportion was one well to 448 inhabitants.

In the hot season of 1869 matters were very much worse, the proportion then being one well to 1,055 persons. In 1878 there was a short rainfall, and the water-supply from the wells was again deficient. Some considerable expenditure was then incurred in cleaning out and deepening such of them as it was thought would by these means afford an increased supply. But notwithstanding these efforts great scarcity prevailed, and it was not unusual for water to be sold in the City during that time at from 2 to 4 annas per *ghurra* of about two gallons. Excepting in years of heavy rainfall this was the customary experience every hot season. Again, of all the wells which afforded palatable, not always pure, drinking water, one-half were situated within a short distance of tanks filled entirely by surface drainage from the streets. The Sanitary Commissioner of the Central Provinces, writing in 1872 on the condition of the water supply of Jubbulpore, states that it is generally impure and scanty, and attributes the fact that only one-eighth of the wells yielded what is called by the natives "sweet water" to the saturation of the soil with the urine of the inhabitants, and of the large number of cattle kept within the City. It is evident, therefore, that the necessity for an improved water-supply was urgent.

So far back as 1872 an Officer of the Public Works Department was deputed to examine and report on sites in the immediate vicinity, and others within a reasonable distance of the City which afforded facilities for the storage of water. He reported on no less than ten sites, but all were found on closer examination to be unsuited, either on account of expense, insufficiency or impurity of gathering ground, or other inherent fault. Towards the end of 1873 Mr. J. H. Wilson, C.E., then Executive Engineer of the Jubbulpore Division, was called upon to make proposals for a water-supply scheme, and he accordingly submitted shortly afterwards an outline sketch of two schemes for the supply of water to the City by gravitation. The first was to throw an earthen dam of moderate height across the Pachperi nalla, situated some three miles to the east of the City, and owing to the insufficiency of the gathering ground, to supplement it by constructing a second dam across another nalla some three miles further away, and leading the water thus stored in an open channel to the first reservoir. The second proposal was to construct a reservoir on the Khandari nalla at a favorable site, distant about 7 miles from the City, and to convey the water in pipes the whole away. This would necessitate the construction of a high dam if the whole supply was to be held in a single reservoir, and to obviate this Mr. Wilson recommended the construction of two small dams on the same nalla.

The objections to the first proposal lay, as Mr. Wilson pointed out, in the small difference of level between the reservoir and the City, the head available being only 13 feet, and it would thus have been impossible to command the Cantonments, and Barracks, the Railway Stations, and shops, or even the higher parts of the City. The second scheme would, however, command with an effective pressure all parts of the Cantonments and City, and its construction in preference to the other was advocated by Mr. Wilson. The cost of this scheme was roughly estimated by him at 5 lakhs in round numbers.

The finances of the Municipality would not, however, then admit of a scheme involving so large an outlay being undertaken, and the matter was allowed to drop for some years. The short rainfall of 1878, and the privations undergone by the City population in consequence, brought the question of an improved water-supply again prominently to notice, and the manner in which funds could be raised for the purpose received the earnest attention of the then Commissioner of Jubbulpore, Mr. C. H. T. Crosthwaite, C.S.

When the question of funds was settled, orders were issued by Colonel J. O. Mayne, R.E., Secretary to the Chief Commissioner, Public Works Department, to commence the necessary surveys, and to prepare a scheme; and work was first started on the surveys in the cold weather of 1879. By the end of 1880 all the required information had been collected, and the preparation of the scheme was then taken up. Early in the following year a full detailed scheme was submitted with drawings and estimate to the Chief Engineer, but it was found from the Census taken in that year, the returns of which had just been compiled, that the population on which the design was based, had been considerably under-stated, and it was therefore necessary to draw up a revised scheme providing for the supply of 100,000 persons. Orders to this effect were issued in April, and early in August the second scheme, with complete drawings, calculations, &c., was submitted to the Chief Engineer's office, and was returned sanctioned in the following October.

Before then, however, orders had been received to commence the work in anticipation of sanction to the estimate, and early in April 1881 the excavation of the foundations for the masonry dam was put in hand. The construction of a road from one of the Cantonment roads to the Reservoir, a distance of 5 miles, and of a bungalow at the site of dam for the residence of the Sub-Engineer in immediate charge of the work, were commenced at the same time, and completed in November following. Arrangements were made for the storage of water close to the head works, to meet the requirements of the work-people and of the work, as none was available during the hot season within a distance of two miles. With this object a small tank within the Reservoir area was commenced in August 1881, and by the end of October an embankment 30 feet in height at the deepest part, and about 300 feet in length, had been thrown up, and a considerable quantity of water impounded.

A convenient site was chosen beyond the Reservoir catchment area for the location of the laborers to be employed on the works, and lines of huts for their occupation were laid out and erected. A temporary hospital and a better description of hut for the Native Doctor were also constructed in the immediate vicinity of the lines. Arrangements were also made to ensure strict attention to conservancy matters, and for this purpose a small establishment of sweepers was organized, temporary latrines constructed, and a quantity of dry earth stored. It will be sufficient to remark, that throughout the progress of the works, the sanitary condition of the coolies' lines was at all times satisfactory, and that, notwithstanding the large number congregated there nearly 3,000 persons, no epidemic occurred.

Stone quarries were opened out as close to the site of dam as was expedient; iron rails, wagon wheels and platforms were obtained from the Kanhan and Hoshangabad Divisions, and a tramway with sidings from the quarries to the dam was laid down. Lime kilns of the ordinary running kind were constructed in an advantageous position; arrangements were made for the supply of lime stone from the quarries, some four miles distant, and for procuring the necessary quantity of coal from Lametta on the Nerbudda, a distance of about 18 miles, for manufacturing lime; and successful search was made in the neighbourhood of the works for a clay suitable for surki. Two portable engines were obtained for unwatering foundations and driving mortar mills, cranes and winches were erected at the quarries for loading wagons. Gangs of coolies were engaged in the removal of jungle and uprooting trees growing within the Reservoir area—an important work, and one that occupied a considerable time.

In the meanwhile the excavation of foundations for the dam was proceeded with, stone for building was collected, and gittee for concrete broken at site. In December 1881 these preliminary operations were sufficiently advanced to permit of the construction of the dam being commenced, and on the 19th of that month the first stone was laid. By the 9th of June 1882, when the monsoon of that year commenced, the dam had been built to an average height of 23 feet above nalla bed, representing 343,000 cubic feet of masonry; the tower and walls of strained water chamber had been raised some 26 feet above the same datum, and the tunnel culvert was well advanced. It was fortunate that the monsoon broke early, as towards the end of April the water stored in the temporary tank was exhausted, and all the requirements had then to be carried on water-carts, bullocks and by bhisties, from a deep pool in the nalla, two miles distant. Water was also supplied to the work-people in the same way.

During the rains of 1882 the work was carried on vigorously, and on their cessation the dam had reached a height of 28 feet, and water was stored to that depth in the Reservoir.

A contract for the supply of the necessary iron piping, sluice valves, hydrants, &c., the pipes, including special castings for the tower tunnel, and inlet arrangement, aggregating 2,185 tons, was entered into early in 1882, with the firm of Messrs. Richardson and Cruddas of Bombay, and in April of the same year the first consignment reached Jubbulpore. By the end of the year, 1,500 tons had been delivered and laid down, and in the early part of 1883 the pipe distribution in the City was connected with the Reservoir.

In the original report submitted with the estimate, it is stated that water would probably be laid on in the City within three years of the commencement of the works. Owing, however, to the very satisfactory and punctual manner in which the pipe contractors, Messrs. Richardson and Cruddas, fulfilled the terms of their agreement, and to the rapid progress made on the head works, it was found possible to do so somewhat sooner. The late Chief Commissioner, Sir John Morris, K.C.S.I., who had from the first evinced great interest in the scheme, was desirous that the opening ceremony should be performed by him, and every effort was made to meet his wishes in this respect. He was informed in January 1883 that it was hoped everything would be ready for a formal opening about the end of February. A more definite promise could not be given, as the last consignment of 16″ pipes had not then arrived in India, and without them it was not possible to connect the City distribution and the Reservoir. Early in February intimation was telegraphed of the arrival of the pipes at Bombay, and on the 15th of that month they reached Jubbulpore. The connection was soon made, and on the 26th of February, the Water-works were formally opened by Sir John Morris.

Before the rains of 1883 the Dam was raised to the 1434·67 level, or 45 feet above bed of nalla, the strained water chamber and tower were built to a somewhat higher level, and all the iron work in connection with the tower and tunnel fittings and the pipe distribution in the City was completed. During this season the benefits of the water-supply were extended to the whole of the City, and also to the Great Indian Peninsula Railway, the Central Jail and Police Lines.

By the end of the official year 1883-84, *i.e.*, the 31st March 1884, the whole of the Dam masonry, amounting to 1,111,216 cubic feet, was completed, the S. W. Chamber tower and tunnel were all but finished, and the new arrangement for the escape was well in hand. Practically, therefore, the Dam and subsidiary works were completed in a little over two years from their commencement.

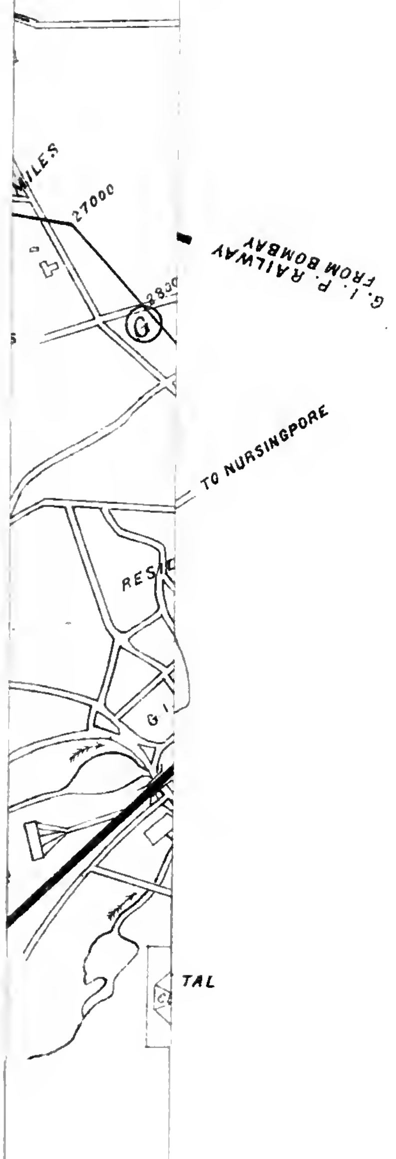
In the original report the provision for flood escape is thus described. "It is, however, I consider prudent to arrange for the escape of the flow due to a fall of 4

ING.

LPORE WATER WOKRS.

Plan Showing

VOIR AND PIPE ALIGNMENT TO AND IN CITY.



NOTE.—Letters in circles represent pipe line from Reservoir and City.

...st to it.

occupied a considerable time.

In the meanwhile the excavation of foundations for

to arrange for the escape of the flow due to a fall of 4 inches (in an hour) over the whole catchment, of which two-fifths will reach the escape. The quantity will be 5,909 cubic feet per second. This is done by allowing a depth of 2 feet to pass over the length of 560 feet from the right flank guard wall and 6 inches over the additional length of 400 feet, as shewn in the longitudinal section of Dam. In other words, for a length of 560 feet the crest of Dam from right flank will be at the 1450·92 level (top of stored water), which length forms the escape proper, and for a further length of 400 feet at the 1451.42 level. The total discharge due to the combined lengths and depths is 5,700 cubic feet per second."

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

IMPROVEMENTS at Calais Harbour of a very important nature are now in course of construction. The works of the new harbour comprise a tidal basin 15 acres in extent with 890 yards of tidal wall. A depth of 13 feet at low water is to be maintained here and the entrance is to be widened from 111 to 140 yards. The channel steamers will thus be able to enter the harbour at all states of wind and tide without the least difficulty. There is to be a floating dock, the superficial area of which is 27 acres; a graving loch 70 feet by 340 feet. Railway accommodation will also be greatly improved and a loop line is in course of construction to unite the Calais line to that from Boulogne to Amiens without entering Boulogne, and by this means it is believed that the journey from London to Paris *viâ* Calais will be performed in less than 8 hours.

With reference to the failure of cement at the Aberdeen works, to which I have alluded in former letters, it is satisfactory to note that the Harbour Trustees have not rested satisfied with the explanation offered by their Engineer and Professor Brazier, but have asked Mr. Messent, the Engineer of the Tyne Piers, to report on the matter. A more searching inquiry will thus be insured and the engineering world will await with anxious interest the result of his investigation on this most important matter.

The swinging girder on the new bridge over the Dee will be 287 feet long at a height of 16 feet above the water, the clear opening span being 140 feet long. This bridge will be longer by 35 feet than any existing opening bridge spanning a navigable river in the United Kingdom. The piers are to be constructed on the Indian system of brick wells, by which the employment of iron between wind and water will be avoided. The girders are to be of mild steel, and consequently the moving mass, when the bridge is being opened or closed, will not exceed 850 tons. Hydraulic power wlll open or close the bridge in 40 seconds, and the estimated cost of the work is from £70,000 to £80,000.

In connection with Mr. Baber's descriptive articles on bridging the Forth, *Engineering* publishes a series of photographs, which give valuable graphic information of the present state and the methods of construction of this mighty work. In the last issue was given a photograph of the wrecked caisson and of the methods adopted to remedy this expensive accident. Mr. Baber gives some account in this last article of the unfortunate accidents that have occurred among the army of 3,500 workmen employed in carrying out the work of the Forth Bridge.

Through passenger trains are now being run in the Severn Tunnel, and it appears from the statement of the Chairman of the Great Western Railway that the new traffic seems to be passing through the tunnel to the extent of £75,000 per annum.

It appears from the Engineer's Report at the recently held half-yearly meeting of the Barry Docks and Railway Company, that the works are making satisfactory progress, and it was anticipated that the contractor would experience no difficulty in completing his contract within the prescribed time, namely, 1st September 1888.

The steel water-pipes laid along the Tay Bridge have been subjected to several very severe tests, with very satisfactory results. It appears that these tests were carried out while trains were passing along the bridge, but the vibration seems to have had no effect on the pipes.

The Electric Lighthouse on the Isle of May was the subject of a paper read at the Institution of Mechanical Engineers at Edinburgh, by Mr. David Stevenson. This lighthouse, which is situated at the entrance of the Firth of Forth, has recently been lighted with electricity. is the most powerful in the world and possesses several novel features. The lamps—of which there are three, one in use and two spare—are of the Serrin-Bergot type. The power of the arc is estimated at 12,000 to 16,000 candles when one machine only is running. The cost of the new buildings, engines, electric machines, &c., is put down at £15,835. Some interesting comparisons are made with what the cost would have been if oil were the illuminant.

The first part of the Birmingham Compressed Air Power Supply Works is nearly finished. In connection with this, experiments were recently made for the Birmingham Corporation on small steam engines, from which we find that the average annual cost per indicated horse-power of steam engines up to 25 nominal horse-power is over £17, while the Company expect to be able to supply power on their system at the rate of £13 per indicated horse-power per annum, thus affording a considerable saving to their customers.

The Institution of Civil Engineers have been granted a supplemental Charter enabling them to acquire and hold lands up to £8,000 annual value. The Privy Council has refused the grant of a Charter of Incorporation to the Sanitary Institute of Great Britain.

CHINA.

(From our own Correspondent.)

II.

THE various Provincial Governments, through whose provinces the canal passes, have thus been called upon to devise means for making the canal navigable throughout its entire length, for vessels of large tonnage. After lots of useless debate and arguments on the subject, the Committee of Viceroys and Governors concerned have decided to employ a foreigner to survey the canal, and make estimates of the probable cost to make it as useful as possible, or as the exigencies of the case demand. The foreign expert will probably decide or declare that the canal must be deepened throughout its entire length and furnished with lock-gates, and sluices, according to foreign modern works of the kind. Such an undertaking will necessitate very heavy expenses, and the result will probably be that nothing will be done. Having travelled on it for about two-thirds of its length, I know pretty much the state it is in, and I believe the Government will not be willing to expend the money necessary to repair it on foreign methods, in order to make it truly a first-class canal. Its numerous sluices and flood-gates are simple wooden doors, sliding in grooved stone buttresses, and its movable lock-gates are just as simple and inexpensive. Baulks of timber, with a cord attached at each end, are let down by hand, one after another in the grooves of the buttresses, in such a manner, that by pulling out what appears to be a key piece, the whole of the bars are swept aside by the rush of water, when started to let the barges down from a high to a lower level. The bars being retained by the cords at one end, are again at hand for further use whenever necessary. Of course, there is a large amount of water allowed to escape between the bars, a fact which probably prevents or saves them from breaking with the weight of water accumulating against them. In some places where the flow of water is slow and limited, coarse mats, made of millet stalks, crushed flat, are put down in front of the lock bars, and that reduces the leakage considerably, and saves time.

The plan is simple and cheap, and I doubt very much whether the Chinese Government is prepared to replace these simple and inexpensive contrivances by costly locks and gates of foreign, or even native construction.

There being no locks or basins with gates, properly speaking, the operation of going from a lower to a higher level, is a very different operation, though quite as simple, and inexpensive as the other, and is performed as follows, *viz.*, barges going up stream are taken to inclined plane against the bank of the canal, by a sort of side channel. On the top of the bank, some distance from the edge, are too rudely constructed capstans, and a gang of men, always in attendance, as long as the canal is navigable at least. On the arrival of a barge these men, assisted by the crew, pass a stout hempen rope around the stern of the barge and run each end of the rope to the capstan on the side nearest to it.

The men then heave away at both capstans, the barge ascends the incline easily and safely, though slowly. When the barge has reached the top of the incline the crew go forward and she gradually tilts over on a bed of soft mud until on a level keel, the crew then go aft, as quick as possible, the capstans continuing to work until the barge passes between them, when she rushes, of her own accord, down an easy plane into the water on the other side. If the crew are not smart enough in going aft, the barge being down by the head may ship a little water on plunging into the canal, especially if the water in the higher level is low. The job is all done in a few minutes. Whether going from the higher to a low level, or *vice versâ*, a small *fee* is charged by the petty officer in charge of the lock, from all private barges or boats, but all Government boats pass *free*. Officials travelling in private boats are asked to give the men a little tea money, the amount being left entirely to their own liberality.

Of course, there is a limit to the size of all barges and boats, whether private or Government property. The lock-gates or passages being only four or five yards wide, if I remember rightly, although the canal itself is about fifty or sixty yards wide in most places. Barges exceeding six yards in width I believe would be unable to pass through the locks. There is also a limit to the length, as if too long the barges would very likely break in two, on the top of the inclines when passing from a low to a high level. There are some barges, however, built in two or three sections, which are easily joined together, end on, when travelling on level portions of the canal, or down stream. The sections are detached from each other when being hauled up over an incline. Each of these barges is probably the property of a single family who thus manage to economize, by having but one mess or cook's galley for the whole lot, and the barges being joined together the crews may afford each other protection against thieves or pirates. Then again the combined crews may assist each other in working one section at a time, in some difficult part of the canal. There is no doubt a very good reason for this sort of thing, but I have either not been able to learn it or have forgotten it. No doubt when sailing through the different lakes connected with each other by the Grand Canal, or belated, or becalmed, whilst crossing them, it is safer to have *three* crews together than *one*, and it is not always possible for several barges or boats to keep together unless lashed to each other.

Thousands of barges built especially for the transportation service, besides thousands of private barges and boats are always afloat on the Grand Canal, or in the lakes, at all seasons; but the canal is so long, and some of the lakes so large, that one might be days without seeing another sail in sight at times.

The management of the navigation, and grain transportation on the Grand Canal is under the control of a Governor-General, called the Ts'ao Yun Tsung-Tu. This officer has a regular staff of officers and men under him called the Ts'ao Piao, or transport staff division. He is stationed at Ts'ing Chiang Pu, some distance from Yong Chou Fu, where navigation on the Grand Canal frequently becomes impossible, in winter, on account of ice. This naval force or transport division is divided into various first and second class stations called *Wei*, and *so* respectively, and distributed along the whole line of the central and northern sections of the canal, under a number of special officers, who are all responsible to the Governor-General for the proper management of the grain transport service in their various and respective stations. The southern section of the canal, that is, from Hang Chew to Chinkiang, is not supplied with such a staff of men, because there are few, if any, locks or barriers in the canal excepting at Chinkiang.

In conclusion, I may say that, although the Grand Canal has a well organized transport service corps, there is much room for improvement in its organization, as well as in the canal itself. It is possible that reorganization of the service will soon be undertaken, but I doubt very much if the canal will be thoroughly refitted.

The barges in readiness at the lock-gate are then allowed to shoot through the opening at a tremendous rate, their sides being protected from damage against the stone buttresses by rope fenders and the attendance of the boatmen The wooden bars being replaced when all the barges have passed through the lock.

MINING IN GREAT BRITAIN.

Great disappointment has been felt at the rumoured refusal of the Government to insert clauses in the New Mines Bill to sanction the searching of workmen to prevent matches being taken down into the mine. There is strong evidence that (in spite of screw locks) the workmen do manage to relight their lamps, in spite of the risk of explosion consequent upon this dangerous practice: thus in France at a certain colliery with the screw lock, one per cent. of the lamps in use were relighted at the lamp stations which increased to eight per cent. when a more perfect system of locking the safety lamps was introduced. There is power to search workmen employed in factories for the manufacture of explosives, notwithstanding which explosions are said to be caused in them by matches. Colonel A. Ford, one of H. M. Inspectors of Explosives, reporting upon the explosion at the Hounslow Gunpowder Factory, on 3rd May last, says that matches placed maliciously upon the platform may have been the cause, and adds that the circumstances were of "so highly suspicious a character that he is forced most reluctantly to attach considerable force to it." Matches have been maliciously placed also in coal mines, and it would have been a small concession to have given coal owners the same powers as are exercised in powder and other factories.

Mr. Ellis Lever has offered to place £1,000 in the hands of the Home Secretary to be awarded in two premiums of £500 each, one for an efficient system of blasting in mines without the use of gunpowder, and the second for a safe system of an electric lighting in mines. As he, however, stipulates that the Government must undertake the necessary tests and make the awards, it is possible that the offer will be declined.

Mr. Joseph Routledge, of Ryhope Colliery, has lately introduced a handy and convenient form of safety blasting cartridge, which it is claimed will arrest all flames and sparks at the seat of the explosion and prevent the ignition of either inflammable or coal dust. The case is cylindrical and consists of two parts, the outer case to hold water and the inner case to contain powder. Both of the cases are made of thin metal or water-proof

and incombustible paper, and of suitable sizes for the work required of them. In preparing the cartridge for use, water is put in at the open end of the outer case, and the inner case, having been previously charged with powder, is inserted into the inner case, making a water-tight joint. It will be seen that the powder is almost entirely surrounded by water. The firing cord of an electric machine is placed in the powder and the cartridge placed in the bore-hole with the powder at the far end.

An electrical locomotive has been applied at the Wiconisco Mines, Pennsylvania. The current is conducted by a 25-pound T-iron, insulated and carried about 20 inches above the tramway by posts, except at certain points where it rises to $5\frac{1}{2}$ feet at crossing in the mine, and on the surface. The current returns through the tram rails being connected by copper leads to the dynamo. The line is about a mile long, of varying inclination and many curves of small radius. The steam engine develops 130 horse-power, the dynamo is a 50 horse-power machine, and the motor upon the locomotive is a 25 horse-power machine. No details are given of the intensity and amount of electric current employed. But if the motor develops 25 horse-power, the useful effect is less than 20 per cent. As total weight of ten wagons, about 50 tons, is brought out in about eight minutes, it is somewhat certain that the inclination is in favor of the full wagons.

The official report upon the Udston colliery explosion in June last has been issued. The accident is attributed to the use of defective safety lamps or the proved practice of the men of using lights for smoking, and is a strong argument in favor of the searching of men alluded to in a preceding paragraph.

It is said that some thousands of the Swan electric mining lamp are about to be introduced into "the mines of the principality" of Wales. The lamps are provided with an indicator for testing the presence of gas. If these lamps perform all that is claimed, they will have the advantage of absolute safety against gas, but their economy can only be ascertained after use for a lengthened period.

Some valuable experiments have been made at Koenig Colliery, in Germany, to utilize the firedamp. A spare air compressor was arranged to act as an exhauster and by means of pipes was connected with the working places of a district producing about 100 tons of coal per day, aired by from 7,000 to 8,000 cubic feet of air per minute, containing about 25 per cent. of firedamp. The exhausted mixture was found (on analysis) to contain from 6 to 8 per cent. of gas. About 360 feet of mixed air and gas was exhausted per minute, containing from 21 to 28 cubic feet of firedamp. It was applied to the firing of two boilers and evaporated 15 pounds of water per pound of fire-damp. The gas was stored in gasometers, care being taken by the use of water-locks and wire gauze in the pipes to prevent the ignition of the gas extending into the mains or gasometers. The question is worthy of very careful consideration, more especially as it furnishes a means of removing a dangerous enemy to the miner and renders it a source of profit. It is suggested that the exhausted mixture, containing from 8 to 10 per cent. of gas, would be very suitable for use in gas engines, &c.

NOTES FROM CEYLON.

(From our own Correspondent.)

IV.

In North-Central Province.—18 miles of Anuradhapura-Trincomalie road had been completed for Rs. 37,304 and the remaining 14 was in hand, also a diversion of the Anuradhapura-Pattulum road at Tisserwewa completed at a cost of Rs. 2,092·84. Kala-oya Bridge, an unusually high flood, floated the main span (150 ft.) of this bridge off the piers. 200 tanks were said to have been breached and found discharge into the Kala-oya on this occasion. Delay in repairing damage caused by the difficulty in procuring a small portion of the angle iron of the bottom boom, the size not being procurable locally, nor could it have been made, while the quantity was so small that English firms refused to supply it, because its manufacture would entail special work and involve disarrangement of their workshops. Finally, after considerable difficulty, Belgium supplied the article required.

The new rest-house, Anuradhapura, delayed for want of bricks, while the new association ward in the Jail progresses with prison labor, for which there is a demand. Yodi-ela is completed and handed over to the Government Agent. Works at Kaluwewa progressing at expenditure rate of Rs. 2,07,417.65, while 8 to 10-year-old village tank sluices, require renewing.

Restoration of Ruins.—Comes the Yapahu, an account of which I forwarded, costing Rs. 1,449·42.

Abayagiri Dagoba.—The collapsed west face of which has been restored and the south side repaired. Residents of the district found Rs. 1,300 and Government the balance Rs. 1,300. Mihintah Dagoba is also under repair and is expected, even with aid of prison labor, to cost twice the sum estimated.

Some important questions are started by the Director under the Head of Road Ordinance funds.

Return shewing contributions in labor (and its estimated money-value) and money to principal roads, canals and rest-houses and the amounts appropriated to minor roads collection and establishments in the several Provinces for 1883-84-85.

Province.		Expenditure on roads, rest-houses for 3 years.		Expenditure on minor roads, collection and establishment.		Total Expenditure.	
		Rs.	c.	Rs.	c.	Rs.	c.
		2,57,476	00	7,15,176	16	9.72,652	16
Western ...	...	1,30,351	98	1,17,369	28	2,37,721	26
North-Western	...	42,901	95	1,53,144	44	1,96,046	39
Southern ...	...	47,272	63	1,39,808	49	1,87,081	12
Eastern ...	...	1,01,480	95	1,15,582	68	2,17,063	63
Northern ...	...	79,101	71	2,12,369	06	2,91,470	77
Central ...	...	32,099	45	74,587	00	1,06,686	45
Uva ...	...	29,913	34	42,709	53	72,622	87
North-Central	...						
		7,10,598	01	1,570,746	64	2,281,344	65

During the 3 years to which the return refers, the Western Province contributed Rs. 2,57,476 to principal roads, canals and rest-houses and spent Rs. 2,06,957·23 on minor roads and canals and a further sum of Rs. 5,08,218·73 in collecting the tax and paying cost of establishment, total contribution to principal roads being Rs. 2,57,476, and minor works and establishment Rs. 7,15,276·16, and he finds that with the exception of the Northern, the other Provinces, through their Road Committees, have been administered upon lines discordant with the spirit of the Road Ordinance No. 10 of 1861, which fixes $\frac{2}{3}$rds of the collection as the sum to be appropriated to principal roads, and he naturally wants to know why the sums for minor works exceed that handed over to him for principal. He suggests the funding of the balances in hands of committee, so that it may meet the want of provision to cover unforeseen works such as flood damages, slips &c.

With an improved system of administrative detail, the collections under the Road Ordinance, *plus* amounts realized by sale of tolls, would be sufficient to cover all cost of maintenance to principal and minor roads, provided the latter were transferred to the P. W. Department, involving the abolition of the executive power these Committees now possess, and relieve revenue officers of an immense responsibility, intensified by a lack of training in works of construction and maintenance. And he believes that if the collections under the Road Ordinance were paid into the Treasury and all public works whatsoever now executed by minor road officers under the supervision of the revenue officers only were transferred to my department, in a few years the result would meet with public approbation.

Then under road maintenance he wrote, assuming that the votes of 1884 were enough for the efficient maintenance of the roads on the old system (which is a matter of great doubt, strengthened into almost absolute certainty, because of the deterioration of their condition, due to previous ruthless cutting down of estimates), the gain to the Colony since the introduction of the system now so well known as "The MacBride System" has been considerable.

In 1885, when but partially applied, the saving of expenditure was Rs. 2,30,430·48, in 1886 Rs. 2,94,269·85, and the estimated saving in 1887 Rs. 3,10,739·79, or a total in 3 years of Rs. 8,32,440·12.

Then he compares upkeep in the different Provinces: Western Province from Rs. 4,00,000 in 1880 to Rs. 2,09,000 in 1886.

N.-W.	"	"	1,37,000	"	56,000
Southern	"	"	1,54,000	"	75,000
Eastern	"	"	1,66,000	"	45,000
Northern	"	"	1,19,000	"	58.000
Central	"	"	7,65,000	"	173,000
N.-Central	"	"	40,000	"	40,000

Uva as a separate province cost Rs. 1,06,000 in 1886, but was down to Rs. 95,000 for 1887, and as to the defence of his system he goes on to say the general condition of the principal roads leaves nothing to be desired. Improvement is visible wherever there has been no departure from the rule laid down for the guidance of the officers in charge. The agitation against the system has appeared to have dwindled down to occasional outbursts of chagrin. Impersonal criticism has ministered to the greatest enemies of the system,—the road overseers,—after a fashion which says but little for its discretion and not much for its knowledge of road repair, and admits that these 11 miles of Haputale and 10 miles of Lamastolla shewed cause for complaint, but reminds Government that these sections represent only $\frac{1}{10}$. of the outlets from Haputale and the remaining $\frac{9}{10}$th are in good order.

"With reference to the non-observance of details, the treatment the roads named received last year deeply discouraged me. The work was performed without a thought of the object for which the responsible officers were laboring. Notwithstanding my vigilance either through ignorance, or wilfulness, my orders were disregarded, and by passive obstruction made to appear impracticable. But what has been good for Dimbulla, Dik-oya, Newara Eliya and other hill districts must be good also for Haputale, and for the future it is to the local officers that the Government and the public must look for results, although there was not a single detail that escaped my notice in the Haputale District. The unavoidably long intervals between my visits of inspection rendered impossible that supervision and inspection of everything which must have resulted in checkmating obstruction. My instructions were not openly disregarded; they were followed with an awful awkwardness which would make the best planned system abortive. More than once in 1886 such nonsense has been mentioned as that of putting tappal runners on the Ratnapura and Jaffna roads; but anyone with commonsense can understand that native coach contractors are only too glad for some excuse for their wretched ill-treated horses, while the bullock coach drivers to the north take advantage of the rain to dawdle at all the stations and then report 'bad roads—' a cry which everyone takes up with pleasure, and no enquiries are made as to the time wasted."

Survey.—Designs and estimates for proposed new works were prepared to an estimated cost of Rs. 30,00,000, all officers working at high pressure.

The Wellawaya Monaragala trace was completed by a private Engineer (Mr. Thomson). At the Government factory works of every description were turned out, including a lattice girder bridge of 100ft. clear span and several others, pipe sluices for village tanks and Molesworth sluices for Government tanks, besides assistance being rendered to the Colombo W. W. and Harbour. The department lost 4 officers and 2 overseers by retirement or resignation, and one by death. The department was brought up to its full strength of 51 officers 8 inspectors and 9 head overseers by the appointment of 6 District Engineers by Secretary of State, and 3 by His Excellency the Governor.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Punjab, September 22, 1887.

His Honor the Lieutenant-Governor is pleased to sanction the following temporary promotions and reversion in the amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against each :—

Mr. F. Farley, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Jeffery, proceeded on furlough, with effect from 21st June 1887.

Rai Sahib Kanhaya Lal, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, *vice* Mr. Chanter, proceeded on furlough, with effect from 23rd July 1887.

Rái Sáhib Kanhaya Lál, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, *vice* Mr. Tufnell, returned from Simla Imperial Circle, with effect from 16th August 1887.

His Honor the Lieutenant-Governor is pleased to sanction the following sub. *pro tem.* promotions in the amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the date specified against each, *vice* Mr. Reid, on deputation :—

From Assistant Engineer, 1st grade, to Executive Engineer, 4th grade—Mr. A. Hicks, from 1st August 1887.

From Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade—Mr. H. W. V. Colebrook, from 9th August 1887.

Bombay, September 22, 1887.

Mr. J. H. E. Hart, M.Inst. C.E., Secretary to Government, Public Works Department, is allowed furlough to Europe on medical certificate, for ten and a half months, with effect from 30th September 1887.

His Excellency the Governor in Council is pleased to make the following appointments during the absence of Mr J. H. E. Hart, M.Inst C.E., Secretary to Government, Public Works Department, on furlough on medical certificate, or until further orders :—

Mr. W. S. Howard, M.Inst. C.E., to act as Secretary to Government, Public Works Department.

Mr. J. E. Whiting, M A., M.Inst. C.E., to act as Superintending Engineer, Southern Division, with temporary rank as Superintending Engineer, 1st class, *vice* Mr. Howard.

Mr. A. Hill to officiate as Executive Engineer, Nira Canal, *vice* Mr. Whiting.

Assam, September 17, 1887.

Mr. Bolinarayan Borah, Assistant Engineer, 1st grade, and District Engineer, Nowgong, who was granted privilege leave for seventeen days in orders dated the 19th August 1887, made over charge of his office to the Deputy Commissioner of Nowgong on the afternoon of the 7th September 1887, and availed himself of the leave on the same date.

Central Provinces, September 24, 1887.

The following transfers in the Engineering Establishment are ordered :—

Rao Sahib D. S. Sathye, Assistant Engineer, 1st grade, from the Hoshangabad to the Jubbulpore Division.

Mr. P. W. Gillilsnd, from the Jubbulpore to the Hoshangabad Division.

Colonel D. Ward, R.E., Chief Engineer, and Secretary to Chief Commissioner, Public Works Department, Central Provinces, is granted two months' privilege leave, with effect from the 16th current.

Colonel Ward, R.E., Chief Engineer, Central Provinces, availed himself of the above leave on the forenoon of the same date, making over charge of the current duties to Mr. M. Leslie, Assistant Secretary to Chief Commissionerer, Public Works Department, Central Provinces.

Mr. M. Leslie, Assistant Secretary to Chief Commissioner, Public Works Department, Central Provinces, will, until further, orders, take charge of the current duties of office of Chief Engineer and Secretary to Chief Commissioner, Public Works Department, Central Provinces, with effect from the 16th current.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "Star Press," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E. *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India ...	Rs. 12 ...	Rs. 7 ...	Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—Street & Co., 30, *Cornhill, E.C.*
NEW YORK.—The Scientific Publishing Co., 27, *Park Place.*
ROME.—Loescher & Co.
STRAITS SETTLEMENTS.—"The Straits Times," *Singapore.*
CHINA and JAPAN.—Lane, Crawford & Co., *Hong-Kong. Shanghai*, and *Yokohama.*
JAVA.—G. Kolff & Co., *Batavia.*
AUSTRALIA.—Gordon & Gotch, *Melbourne, Sydney*, and *Brisbane.*

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, OCTOBER 8, 1887.

FIRST DESERVE, THEN DESIRE.

In our last issue we published a communication from a correspondent subscribing himself "Scrutiny" on the subject of Indian Engineering Colleges. The writer takes exception to the spirit of our leader which appeared on the 17th ultimo entitled "The Reason Why," and has either missed our meaning altogether, or attempts, rather disingenuously, to evade the points at issue. He quotes merely a portion of a sentence in the article referred to above, and reads us a homily on what *would* be the result of the training imparted in our technical institutions if certain conditions were satisfied. Even here he is not happy in his choice. The writer agrees with us in thinking "that the instruction available in India is scarcely of a character to make an all-round professional man; and this fact has been reported over and over again by competent witnesses before the Public Service Commission. It is equally true that the heads of institutions are picked men." This is strictly true, and the confession coming from an accomplished professional carries great weight, but when he says that "the reason why the Colleges do not turn out properly qualified men, must be sought for, not so much in the men that are trained, but in the men that train, and chiefly in the system of recruitment in vogue," we are compelled to offer an emphatic protest to the position he has taken. Surely our correspondent does not mean seriously to imply that besides "the principal and perhaps an assistant, the teaching staff in our Engineering Colleges are deficient in number and quality." We speak from personal experience in the matter and could say without fear of contradiction that in very few places throughout the civilised world will there be found such competent and practical men as are to be met with in the centres of technical instruction in this country. If, however, our correspondent had taken his stand on the broad ground that the *system* of education here, whether technical or general, was defective to the very core, there would be a consensus of opinion in favour of this view. There is universal complaint that the young men turned out in thousands by our Universities every year, are so many automata or machines for quoting stereotyped phrases from standard authors and nothing more. Out of this large number so sedulously manufactured periodically at a heavy outlay, those who have carved a name for themselves might be conveniently counted at one's fingers' ends. It cannot be alleged with any shew of reasoning that the agency employed to educate these young men is either deficient in quality or number, care being taken to secure the services of the best men available for the work, at any cost. Why then are the results so deplorable? There is only one and a simple answer to the query. The little boy who enters the last standard of a village school has been taught to believe in the formula that Government is the *Ma-Bap.* He need have no concern with any thought for the morrow. If he succeeds in passing an examination (the entrance is the be-all and the end-all of his existence), the Government is in duty bound to provide him with a berth of at least Rs. 15 a month, to keep body and soul together. Should he be so fortunate as to add to his laurels by the acquisition of an F. A. degree his claim is still more enhanced, and when, unfortunately, he finds that he is left to his own resources to shift for himself, and the Government will have nothing to do with him, the disappointment overwhelms him and his position is embarrassing. What then is the cause of all this discontent and heartburning among the rising generation of undergraduates and graduates? It is this. Their creed is a total stranger to the old and valued saying, "God helps those who help themselves." Their entire faith is centred in Government, and when this fails them, the sheet-anchor of their hopes is gone. Our correspondent suggests that "a decent number of appointments, say 8 or 10, should be offered for annual competition." Why confine the loaves and fishes of the service to a limited number? Those who have successfully passed the examination, but are not so high up in the list, will still have a grievance to complain of, and rightly too. They will certainly object to be classed with subordinates who have passed a lower standard, and certainly there is reason in all this. Next, the appointments under district and local Boards have been thrown open to the alumni of our Colleges and their services ought to be utilized to a great extent. If their claims are not recognized by their own countrymen, it is useless railing at Government for not providing them with fat berths. "SCRUTINY" must first prove that the young men whose cause he advocates are on a par with the importations from England, not only in book-work, but in the general standard of excellence, and especially in that 'resourcefulness' of mind which should be a distinguishing characteristic of an Engineer, and which is generally brought into play in the face of a sudden catastrophe, such as every now and again overtakes engineering projects in India. When our correspondent is in a position to show an equality in the two sets of men, he should then, come forward to vindicate the cause of those who clamour for higher appointments, but whose claim to such honor is doubtful, at least for the present.

MR. J. E. HART, M. INST. C.E.

VERY few of our readers on this side of India are probably aware that in the retirement of Mr. John Eustace Hart, late of the Bombay Secretariat, the country has lost one of its most brilliant practical Engineers who, whether in the inception or carrying out of large works of public utility, has shown himself capable of being ranked with the best professionals that have ever come out to India. And that too without blazoning his deeds from the tops of houses or trumpeting them forth in the corners of streets. Who could for a moment imagine that the genial, kind, charitable, and accomplished Private Secretary to two Governors of Bombay in succession was a man in possession of such sterling useful talents. But so it has been. Truth is strange, stranger than fiction. A short account of the man who has just retired, after a service of 34 years, leaving memories of great deeds behind him will not be out of place here. He finished his scholastic career at the Engineering School of Trinity College, Dublin, and after working on several railway projects and canals came out to this country in 1854. Shortly after his arrival he was nominated to an appointment in the P. W. Department, and from that time to the day of resigning the service he has been a true and faithful servant of the Bombay Government. He had his usual turn of office, running through the several subordinate grades in the Mofussil, till he was called to take charge of the Government Reclamation Works in Bombay at Mody Bay and the extension of the Apollo Bunder. Although an uncovenanted officer in the sense of distributing patronage, his talents could not be wrapped up in a napkin or hid under a bushel. He rose by slow, but sure degrees, to be acting Executive and Superintending Engineer, Presidency, and the active part he took in the erection of the public buildings that grace the Western capital of India, testify to his abilities as a man of energy and resources. His acquirements were varied and he was elected member of the Drainage Commission, on which his special qualifications came into full play. Here he made a mark for himself, for after being employed for a time in charge of the Karachi Harbor Works, he succeeded General Merriman as Chief Engineer for Irrigation. Ten years' hard work in this responsible office resulted in his "being the adviser of Government in connection with all projects for Bombay and other localities and also for the great schemes in the Deccan, which, originally projected by his distinguished predecessor, General Fyfe, were either commenced during the famine of 1877-78 or have since been undertaken with a view to protect those tracts of the Deccan which are periodically liable to famine." Some monuments of his labour in grand engineering works exist to this day in the Nira Canal schemes and the large tanks in the Sattara, Kolhapore and Sholapore districts, and the Gokak Canal in Belgaum. In recognition of the eminent services rendered by him, he rose to the highest appointment in the service, an appointment which was successively filled by Royal Engineers alone; with this difference, that whereas his appointment did not carry the imprimatur of a covenant, he is obliged to be satisfied with a pension nearly half of what an R. E. would have been entitled to, only as the consequence of those two talismanic letters after his name. We do not grudge any man his position in office or the emoluments it carries with it, but when an invidious distinction is made between two men performing similar duties, simply because one is armed with a covenant and the other is an outsider, we believe it conduces to the destruction of that *esprit de corps* which is a *sine quâ non* of respectability in the services. The remarks made by the *Times of India* are so apposite and to the point that we cannot help quoting them here. It says:— "It seems hard, to say the least of it, that rules should be so framed that for the same services and for the same work, two classes of men in the same department should receive such very dissimilar pensions."

"STRIKE BUT HEAR."

We are sorry to find that the *Pioneer* and the *C. and M. Gazette* are both very unhappy over the remarks we made a short time back in connection with the proposed Umballa-Kalka Railway. Far be it from us to throw cold water on any scheme which has for its object the improvement of inter-communication in India, or to deprecate any project merely as an obstructionist. What we have all along maintained is that there should be no deviation from the accepted principles enunciated by Government in regard to the extension of the railway system. It would hardly be consistent to put its veto on the prosecution of a line in one part of the country which does not hold out prospect of being remunerative, and in the same breath to sanction the construction of another line which has barely any consideration to recommend it, save that it will facilitate the progress of the annual exodus to the Hills. Even here the facility seems highly problematic as, on the admission of Mr. Morris himself, owing to the gradients being abnormally steep, a tonga of ordinary speed would perform the journey within the same period as a mountain train. But this is indeed a small matter and may well be left out in a consideration of the question. The principal point at issue is whether the traffic returns shew the probability of any adequate return for the invested capital. We have patiently waited to see if any fresh light could be thrown on the subject, so as to suggest hopes of a satisfactory solution. But none whatever has been forthcoming. On the contrary the details that have been discussed from time to time irresistibly point to the conclusion that nothing by way of an adequate dividend may reasonably be expected. As we pointed out in one of our late issues, it is more than useless to compare the proposed Umballa-Kalka Railway with the Darjeeling-Himalayan line. The conditions are not the same, and beyond both coming under the appellation of 'mountain trains' there is nothing in common between them; unless those two talismanic words are suggestive of bringing grist to the investors' mill. On the contrary all facts subsequently brought to light shew that the chances of its yielding a good revenue are as far off as ever, and the traffic statistics will not help us. As the statist thinks so the bell clinks; distort the figures as we may, there is no gainsaying the fact that the Punjab Government has arrived at very sound conclusions, for a good reason, that having once burnt its fingers in the Pathankote Railway business in relying on 'statistical figures,' it is nothing but natural that it should dread the sight of fire. Who will find fault with Sir Charles Aitchison's Government when it declined to go upon any other data but what were before it. We are, however, glad to observe that one of our contemporaries is beginning to take a more sober view of the case. It says:—

On the other hand it must not be forgotten that the Government had only to deal with the recorded paying traffic, and had no authority either to discount developments or to take into consideration probable Imperial savings on the postal and passenger services that have now to be kept up at an annual loss. Although a line to Simla might undoubtedly enable the Government of India to save its half or three-quarter lakh on the dâk and tonga service, not to mention the time and travelling allowance of its officers, it does not follow that this sum would be credited to the railway, any more than the East Indian is credited with the savings on the up-keep of the Grand Trunk Road and its former accessories.

The most satisfactory test of the feasibility of the scheme is to place it before the public, and the public who is the best judge of its own interests will then decide whether it is safe for investments. If it is, the project should be taken up at once, if not, let it be consigned to the limbo of oblivion. No amount of ingenious sophistry can prove that one and one make three, neither could a bushel load of smart editorial writing prove white to be black, or make the worse appear the better cause. The only *rôle* the Imperial Government could possibly play in the matter is to "offer substantial inducements and liberal concessions" to capitalists and investors in the prosecution of their work. To go beyond this or to adopt the proposed line as its own offspring would be a clear violation of public duty.

DEHRA DUN RAILWAY.

When, within memory of some of us, and for the delectation of growing generations, Hosea Biglow gave it out that

"John C. Robinson, he,
Said they didn't know everything down in Judee'

new gospel lights on commonplace enough subjects opened out for a good many people; and a good many people began to conceive that the tradition of the elders is not always, or necessarily, correct as to facts. And this sceptical tendency has gone on increasing, until at this last, we find people prepared to assail the infallibilty of Mr. Guildford Molesworth, Consulting Engineer to the Government of India, for State Railways. Lately, to wit, in the matter of the proposed Dehra Dun Railway.

At a meeting of the Dehra Dun Railway Association, held at Mussoorie, on the 10th September, a Resolution was adopted which proves arithmetically to the satisfaction of its framers that Mr. Molesworth's "Note" on the Association's concerns is "so inaccurate both in statement and calculation that it may altogether be disregarded by them as a factor in the determination of their future course, especially as Government has declined all responsibility for the opinions expressed in it." It is noteworthy, surely, that the Consulting Engineer has decreased his mileage estimate of the cost of the line from Rs. 1,00,000 to Rs. 84,000 and has lowered his estimate of the cost of working it from Rs. 2,91,130 to Rs. 2,00,000. These figures mark the difference between 0·9 per cent., his former estimate of profit on working, and 4·33 per cent., his present estimate. *Apropos*, we quote from the *Mufasilite*:—

In estimating the cost of working, Mr. Molesworth has taken no notice of the elaborate printed calculations and arguments of the Association which have on several occasions been placed before Government and himself and has contented himself with saying that according to the most favorable estimate, Major Gracey's, "the traffic receipts will amount to Rs. 3,25,000 per annum, whilst the working expenses of such a traffic on this line, as now modified, would probably be in round numbers about Rs. 2,00,000, leaving a net profit of Rs. 1,25,000, or about $4\frac{1}{2}$ per cent. on a capital of $28\frac{3}{4}$ lakhs of rupees." Rs. 2,00,000 are $61\frac{1}{2}$ per cent. on Rs. 3,25,000, but that is the gross revenue to be earned from charging higher rates and fares than are charged on lines on which 60 per cent. is a common rate of working expenses. If "such a traffic" (Mr. Molesworth should have said "such a gross revenue") were recalculated at the rates and fares earned on the Oudh and Rohilkhand Railway, the gross revenue would amount to only Rs. 1,41,509, and Mr. Molesworth's 2 lakhs are 141 per cent. of that amount! This is a *reductio ad absurdum* of his guess at the cost of working the Dehra Dun Railway.

Members of the Dehra Dun Railway Association we are told, adhere to their own estimate of working expenses, which has been made on the basis of the train-mileage necessary to carry the expected traffic; but—as the difference between the estimates of the cost of construction is so trifling, while the margin of net revenue is so great—they are prepared to accept Mr. Molesworth's estimate of cost, Rs. 84,000 a mile, or a total of $28\frac{3}{4}$ lakhs of rupees, and their final estimate of profit is, therefore,—

Gross earnings (Major Gracey's estimate) ...	Rs. 3,25,000
Deduct working expenses	„ 1,12,343
Net revenue ...	Rs. 2,12,657

Which will yield a return of nearly 7·4 per cent. on $28\frac{3}{4}$ lakhs.

Here are the three rival estimates of cost per mile:—

Association's revised Estimate.	Mr. Hunt's Estimate.	Mr. Molesworth's Estimate.
Rs. 80,565	Rs. 79,182	Rs. 83,794
TOTAL COST FOR 34·3 MILES.		
Rs. 27,63,379	Rs. 27,15,942	Rs. 28,75,000

There seems but little room for doubt—even taking the most unfavorable estimate as a basis of calculation—that this line has every chance of proving a remunerative commercial venture. It has been played battledore and shuttlecock with, and shelved and postponed,—now in deference to Tweedledum, now to Tweedledee,—often enough, and more than often enough during the last ten years. We should be glad to see a commencement made on it. We can see no valid reason why commencement should not be made.

Notes and Comments.

COMPLICATIONS.—The military authorities at Rangoon have protested against the outlet for Shone and Ault's sewage scheme having its site near Monkey point.

THE RAMISSARAM CANAL SCHEME.—It is stated that the capital of this undertaking, large as it is, is all underwritten. If nothing intervenes between this and the next two months the company will be floated. What have sceptics to say to this?

AN AMALGAMATION.—Sir Albert Cappel's term of service in India is likely to be extended, as a proposal is under consideration to amalgamate the management of the Persian lines of the Indo-European Telegraph with that of the Government of India Telegraph Department.

A QUESTION OF THE DAY:—The cause of "cremation" *versus* "burial" continues to gain adherents in Germany, and a big crematorium is to be erected in Berlin, in the Municipal cemetery at Friedrich's felde. All over the world the opinion that it is as unfair as it is unwise to allow the unsentient dead to poison the sentient living is gaining strength and consistency.

BENGAL-NAGPUR RAILWAY.—Borings are now being put down in the bed of the Damuda on the site selected by Mr. Way for the bridge. Mr. Way's site is lower down than that selected by Mr. Whitty and has the advantage of a much smaller width of waterway, but disadvantage of the absence of rock foundations. It is an open question therefore, whether the advantage will counterbalance the disadvantage.

CUDDAPAH WATER-SUPPLY PROJECT.—Application having been made by the Municipality to Government for permission to raise debenture loans for carrying out the sanctioned scheme for bringing Bugga water into town, and the Council having been authorised to raise the said loans, the work will soon be undertaken, and may be expected to effect considerable improvement in the health of the town.

SHIP-BUILDING IN BOMBAY.—The *Bombay Gazette* seems to have been hoaxed into publishing a minute account of the building of nine steel steam vessels in the Government Dock-yard there. A contemporary contradicts the statement, but adds that the steamers answering the description are being constructed in Calcutta, and that the only share Bombay has in the arrangements is that the engines are being made there.

A GASEOUS MINE IN THE BENGAL COALFIELDS.—We have heard of an outburst of gas in Sanktoria in one of the pits owned by the B. C. C. Nothing happened as the occurrence was expected, and every precaution was taken to avoid a catastrophe. We believe that this is the only coal pit in Bengal that has safety lamps in use, and it should be incidentally mentioned that the seam of coal is considered to be the deepest and best gas-making coal in India.

SURVEY IN BURMAH.—*On dit* that a party will be told off during the ensuing cold weather to carry on survey operations in the newly conquered province, in connection with land communication between India and Burmah. It will commence in the You country lying to the east of Lushai and the Arracan hills. A body of troops will work up from the Irrawaddy and when they arrive at the foot of the hills, a survey column will likely be sent across them.

Public Competition and Private Trade.—The Inspector of Local Fund Accounts, Madras, thus refers to the Nellore Workshops:—It is very questionable indeed, I think, whether there is any real necessity for a workshop; the necessity for it having, as far as I am aware, never yet been demonstrated either by the Engineer or the President of the District Board, the inability to procure articles of the kind manufactured in the workshop, that is, in the open market, having never been proved. Government have ordered that the workshop is to be closed at once.

An Acknowledgment.—We have received from the Under-Secretary, C. W. Branch, Government of India Secretariat, D. P. W., Simla, plans of Police Buildings, Burma, in 11 sheets; Hospitals, in 3 sheets; District Court Houses in 4 sheets, being designs made by Mr. H. J. Richard, when Superintendent of Works, Upper Burma, and whose name has not been unfamiliar to our readers. We have already commenced the issue of a series of the best specimen of architecture in Burma and we fear that the pressure on our space will preclude us from reproducing any of the above-mentioned drawings.

More Extravagance.—The workshop of the Burma State Railway at Insein has not yet hit on an economical plan of building carriages as other Indian workshops have successfully done. About 500 tons of teak timber in round logs have been purchased for conversion into scantling at the workshop for rolling stock for the Mandalay extension. It is reported that the rates paid for these logs are the same at which first class converted timber according to specification could be delivered at any of the saw mills in Rangoon. It is not therefore clear whysuch extravagant waste should be allowed and does not reflect credit on the management.

Telegrarh Communication with Mauritius.—A Bombay paper learns that one result of the recent difficulty in Mauritius will be the connecting of the island with Europe by telegraph. For several years this step has been pressed on the attention of the Colonial Office, and its importance has been acknowledged on all hands. Still, nothing was done; but during the last twelve months, owing to the isolation of Mauritius, difficulties have arisen and mistakes have been made which might have been avoided had there been an opportunity for ascertaining the views of the Colonial Office. At present, telegrams have to be sent to Natal by steamer and are then despatched from Durban, a delay of a month being frequently the consequence.

Telegraph in China.—The conservativeness of the Chinese has once more succumbed to the seductive influences of the West. By our latest China papers to hand we learn that an arrangement is reported to have been made between the Government of the Celestial Empire and the Great Northern Telegraph Company, working in conjunction with the Eastern Extension Company, for the extension of the Imperial Telegraphs to Kalgan and Kiachta, which will give a direct telegraph route from China to the continent of Europe and Great Britain. For this concession the Chinese Goverment are to receive Tls. 100,000 on condition that the Chinese charge the same rate per word as the two Companies *viz.* dollars 2. The arrangement is to continue in force for sixteen years.

Southern Mahratta Railway.—Mr. Wm. Lind Buyers, Superintending Engineer of the Mysore Extension of the Southern Mahratta Railway, goes back to the P. W. D. from 1st October 1887 at his own request. Mr. Peter Scott, Executive Engineer, Hubli Division, goes to Bangalore as Superintending Engineer of the Mysore Extension, and Mr. A. Stephens, Assistant Engineer, Castle Rock Sub-Division, succeeds Mr. Scott as Executive Engineer. These latter promotions and transfers have given universal pleasure and delight in the Department, especially among the subordinate staff, to whom Messrs. Scott and Stephens have endeared themselves so much owing to their extreme kindness, courtesy and consideration. The Company has lost a most hardworking and energetic Assistant Engineer by the resignation of Mr. H. S. Davies.

Coconada Port Improvements.—It having been suggested that two additional dredgers should be indented for use on the river bar, the present Priestman's dredger being retained for use in the river alongside of wharves &c., the Chief Engineer, Madras, does not anticipate that the effect of the proposed arrangement would be to give a greater depth of water on the bar or to lessen the work which must be done in dredging. He records it as his opinion that the Priestman's dredger at Coconada works satisfactorily. The cost of one of these dredgers, we may add, is Rs. 20,000. The following remarks by the Port Officer in Madras in connection with the subject are worthy of note. "The construction and gradual extension of these parallel groynes, with the object of obtaining deeper water on the bar, has only resulted in the bar obstruction backing seaward from the training walls. In extending these walls, I would observe that the natural river has been transferred into an artificial one, with the groynes for its two banks, the bar backing and forming to seaward of its mouth, as with every Indian river." These views would appear to be supported by the experience gained at Madras.

Kidderpore Docks.—We glean from the Report on the progress made on the Kidderpore Dock Works up to end of June 1887, that the proportion that the work done up to date bears to the whole is not very great, and if no better progress were to be made for the future than has been achieved during the past year the completion of the Docks would be a matter of many years; but if it be considered that work was first seriously begun during the past season and that, with the exception of a short length of dock wall founded last year, not a brick was laid until late in March, and that for a considerable time the work was of an experimental nature and very much hampered by want of sufficient wagons to remove the spoil, and partial failure in the lime supply and a deficiency of appliances generally, which have now been rectified, the Superintending Engineer considers that the progress made during the last four months may be considered as most satisfactory, and he is fully satisfied that during next working season at least three times as much brickwork will be done daily as was effected during the past. Further, it is found that, contrary to expectation, the work is not brought to a standstill by the rains, but that steady progress will be made from July to December though not of course as rapid as what can be achieved from December to July. From December next it is believed that it will be possible to average 23,000 cubic feet of brickwork per diem during the dry season and 11,000 during the rains, giving a mean for the whole year of 17,000, and if the year be taken as containing 300 working days, the annual outturn of brickwork will be 51 lakhs of cubic feet. But the balance of brickwork remaining to be done, including the Boat Canal, is not quite 150 lakhs, so there should be no difficulty in opening the Docks some time in 1891.

Current News.

Messrs. Macneill and Co. have purchased the Assam Railways and Trading Co.'s Flotilla for close upon £60,000.

Major Carter, R.E., Director of Submarine Defences, is now in Simla, where defence projects are being very completely threshed out.

The construction of a line of railway from Sialkote to Jummoo has been finally decided upon and that work will commence next season.

Eight Italian miners from Venice, who have been engaged by Messrs. Best & Co., for the Mysore Gold Mines, arrived in Madras by the P. and O. Steamer *Bengal*.

Colonel Lang, R.E., Secretary of the Public Works Department, North Western Provinces, retires next month under the fifty-five years' rule. He will probably be succeeded by Lieutenant-Colonel Forbes, R.E.

The Municipality have been requested by the Commissioner in Sind to draw up a report on the sewerage scheme for Karachi prepared by Mr. Strachan, stating that the subject appears to require the earnest attention of the Municipality in the interest of the town and Bazars.

A sharp shock of earthquake was felt at Dhurmsala at 4-20 A.M. on the 22nd September, followed by two slighter shocks, one at 2 P.M. and the other at 4 P.M., the third exactly 12 hours after the first. The two latter were accompanied with a decided "bang, like the boom of a distant gun."

Near Harvangi Abad, a few miles below Canning, a portion of an upper deck, with brass fittings, of a large steamer, has been found, and a little further down some planks, canvas purdahs, &c. The articles are believed to have belonged to either the ill-fated *Sir John Lawrence* or the *Retriever*.

Mr. Furnivall, Agent and Chief Engineer, Nizam's State Railway, has called upon the District Engineer to erect loading boards at various station, on the new line between Secunderabad and Warrangal. Owing to the increase of traffic of horses on the line, that Department found it very inconvenient to land them without proper platforms.

A meeting was held on Wednesday, at the office of the Agent and Manager of the Madras Railway, to take into consideration the question of gratuities to employés of the establishment on retirement from service. These have become so alarmingly frequent as to attract the attention of Government in view to limiting the gratuities for the future, and to granting them under more restricted conditions than at present obtain.

Having successfully passed through the district boards, the Howrah-Sekhola Tramway now awaits sanction from the Municipal authorities of Howrah. The terms proposed are in course of settlement. The municipal requirements of the Howrah and Ampta Tramways have been made identical. They will have one line of rails for a length of 2 miles from the starting point (Telkulghat to Bantra), and then they follow two different routes.

Mr. Coode, who was the Executive Engineer of the Secunderabad Division prior to his leaving the station, issued orders that certain contractors, who were then working, must cease to be contractors, and that their works in progress were to be stopped. Mr. Coode was then served with notices by a few contractors calling upon him to settle up their accounts before his departure. Major Fox, the present incumbent, prior to his taking over charge of his office, made his predecessor to understand that he stood in a delicate position, and that unless he withdrew his orders, he might be prevented from leaving the station. Mr. Coode did accordingly withdraw them and the contractors are free again to work.

As No. 10 down mixed train was entering Phulbari station, Northern Bengal State Railway, at 2 A.M. on the 28th instant, the tender and five wagons became derailed at the north facing points. The three leading wagons were upset, and the body of the driver was found under the front wagon, completely crushed. The fireman was slightly injured. The line was blocked for about six hours, during which time the up mail, which left Sealdah on Tuesday afternoon, was detained, the passengers being transhipped to another train. Lieutenant-Colonel Engledue, R.E., of the Consulting Engineer's Department, and the railway officials, held an enquiry into the accident on the 29th, the District Sub-Divisional Officer from Nilphamari being also present.

A serious trolly accident occurred at noon on Friday, 30th September, on the Himalayan Railway, half a mile below Kurseong. A trolly, carrying Mr. Prestage, an official of the Railway, Mr. Martin and Mr. Warren with three natives, was proceeding down the line towards Silliguri, when it unexpectedly met the up-mail train for Darjeeling. Every one on the trolly jumped off before the collision occurred, Mr. Prestage and one native escaping unhurt; Mr. Martin, however, sustained a severe cut on the back of the head, besides another contusion; Mr. Warren injured his leg, and two of the natives were seriously hurt, one of these men broke his collar-bone and leg, and was also dangerously cut about the face. The trolly was completely smashed up by the engine of the mail train.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

STRENGTH OF OLD RAILS.

Sir,—Many thanks to your correspondent for the information about iron rails, which will be most useful.

A. M. B.

THE KLITOMETER.

Sir,—Your correspondent "A.M.B." describes, in your issue of the 17th September, what he claims to be a simpler instrument than the Klitometer described in your pages by "J. P. S." The writer forgets that "J. P. S." intends his graduated T square only for laymen, and claims simplicity for it on the grounds

(*a*) that a layman can construct it,

(*b*) and that he can then use it and know at once that if his instrument shews 1 in 25 or 1 in 30 he is making his road at an easy incline.

These elements of simplicity are entirely absent from "A. M. B.'s" quadrant. A junglee-walla planter or Collector could not construct it himself, and having it he could bring it to no practical use. The quadrant would tell him the angle of inclination, but this would convey no meaning to him. He is supposed to know nothing of angles, to have no surveying instruments, and to be out of reach of professional assistance. The Klitometer is *the* instrument for

A Jungle Planter.

PUNKAHS.

Sir,—I am putting up a few punkahs on the principles advocated by J. Wallace, Esq., of Bombay (whose lectures appeared in your issues of March last), but am at a loss to find out the proper length of line for suspending them, as the lectures are very meagre in information regarding this. Could you, therefore, or any of your readers, inform me what length I should adopt for a punkah 7½ feet long. Perhaps Mr. Wallace may himself be able to give me this information. I should further be much obliged with information on the following :—

(1). Does the length of suspension line vary with the length and weight of punkah, or is there a standard length for all punkahs, and if so, what is this proper length?

(2). What weight of shot should be used and how is the shot to be arranged, to prevent them moving about inside of the seam or fold at end of punkah? I have had the shot enclosed in a long narrow canvas bag and then thrust into the fold.

The swan shot are placed *singly* and side by side, but whether this is correct or not I do not know. I should, therefore, be extremely obliged to Mr. Wallace, or any other of your readers, if I am set right on this point. Trusting you would be good enough to give the above a corner in your next issue.

Thatone; *September* 19, 1887. Mag.

P.S.—I should also like to know if the pulling rope is to be attached to the centre of the iron rod or two points equi-distant from the centre.

PUBLIC SERVICE SUB-COMMITTEE, MADRAS.

Sir,—Now that the last reports have been published in connection with the Public Service Committee's investigations in the Southern Presidency, it may not be amiss to consider the matter and manner of enquiry, and the results that may flow therefrom.

The Madras Government very wisely, as we think, selected two Engineers that hail from Cooper's Hill, two natives educated in the local College, and one R. E. to represent the Department—men of all nearly equal rank, and left it to the Committee by a carefully studied system of cross examination, to elicit which was the fittest set of men to maintain and develope the mighty resources of this great empire. The Committee, it is known, was headed by an astute Anglo-Indian lawyer and judge, with three other gentlemen of this country to help, all of whom were well conversant with the workings of Government Departments. It would have been expected, when these met as a Committee of Enquiry, with not only the men, but also all the Government records thrown open to them, that they would not have found it difficult to ascertain how each set of Engineers had been employed, the importance or otherwise of the works entrusted to them, and the manner in which they had met and overcome difficulties, and from this to have themselves concluded, beyond any possibility of mistake, how each set of men best commanded the confidence of Government, and suited the requirements of the country when works of importance had to be executed, works which are said to require all those high qualifications—"resourcefulness," "fearlessness of responsibility" as well as a "specialized technical training" to successfully carry out. If both European and native were alike employed on such works, and from the Government records gave equal satisfaction, then it would be fair to conclude that they were men of equal calibre. But if one set of men were invariably sent to the more difficult works, and more frequently had to bear the heavier end of the burden, it would be at once premised that these were the best men. It would no doubt have required a good deal of address and management to sift and ascertain facts, and it was doubtless for this reason that an astute lawyer was selected as the head of the Commission. But once these facts were obtained, they would have formed a safe foundation on which to build either the most radical changes, or to let well alone. Instead of the drift of the cross examination being directed mainly to the elucidation of the importance of the works executed by each set of Engineers, from which any impartial Committee could have easily drawn conclusions of its fitness for real work, and ascertained who were the ornamental drones, and who the busy workers, the vein of enquiry was directed principally to elicit the *opinion* of the European Engineer on the fitness or otherwise of natives for the higher Engineer grades, and if they made as good administrative officers as themselves. Under such a system of interrogation, the European could not be expected to cry "stinking fish" about himself, but on the contrary was forced to praise his wares to the highest. He stated that his mental, moral, technical, physical, and practical training, was beyond comparison with anything in this country; yea, that if this country tried, and mustered up all its resources, it could not produce the material to give such an education. This perhaps was tolerable so far as it went, but it did not end here. He next condemned without reservation the college, school, and even home, life and education of the youth of India. One was even allowed to go into hysterics on the ethnology of the native and the European as a reason against the former, as if Sir C. Turner did not know as much on that subject as this young Engineer, or could not have studied the ethnology of races as well at Simla or even London without coming all the way to Madras. The surprising thing is how the expression of such impolitic reasons and arguments was allowed into what must be considered a specialized enquiry into one specific subject.

When the innings of the Engineers educated in this country came about, the same system of enquiry was adopted. He was asked his *opinions* about himself and the European Engineers, and who can blame him if he allowed his own lips to praise himself? He extolied his acquaintance with the vernaculars of this country, by which he could at once communicate his technical knowledge without any fear of error to the work-people. If his training was not so complete as the European, and he was not going to admit even this, he was yet able to apply what he knew to greater advantage by being able to communicate it to his work-people. The Indian next plumed himself on his knowledge of the ways, means, habits, and peculiarities, of the work of the different craftsmen of the country, as each different craft formed a different caste with observances and methods of work peculiar to itself. The Indian Engineer having a perfect knowledge of all this, is able to manage the work-people better than a foreigner who has no sympathy for the observances peculiar to each caste of work-people, and who very seldom thinks it necessary to acquire a knowledge of these things. The Indian Engineer went still further, and pointed out that as England may be considered a nation of merchants and manufacturers, so the people of India may be classed as a nation of cultivators, and as the operations of the P. W. D. are confined almost entirely to works of irrigation for agricultural purposes, the youths of this country, as cultivators, take a direct interest in, and acquire a practical knowledge of, these works from childhood, and know everything about their uses, requirements, and best methods of construction. When these same youths elect the Profession of Engineers, they can at once apply their technical knowledge to the best development of such works, whereas the European-trained Engineer, having no irrigation works in his own country, never does acquire that familiarity with the subject, by which he can apply his technical knowledge to the best advantage. For years he often goes messing about, often causing very serious and sometimes irreparable loss to the Government and the country; the Government gets some plausible explanation and the ryots suffer and are silent.

With such conflicting opinions so forcibly expressed, Sir C. Turner, smart lawyer and judge though he is, felt somewhat straitened. Had he been on the bench, he would probably have abused the Police, that great butt for the irate lawyer or judge, but being neither on the bench nor at the bar, and having no policemen to abuse, he was in sore dilemma. Instead of travelling back and altering his system of examination, to ascertain not the opinions, but the works carried out by the different sets of Engineers, and make this the proof of their fitness or otherwise, he erroneously conceived that it must be some fault in the men themselves whom he had been examining, and so sent a telegram to the Government complaining that the P. W. D. was badly represented, and requesting the examination of senior Superintending Engineers. Had there been both natives and Europeans holding this rank, the request would be fair enough, and the public would have had an opportunity of knowing what the two classes of men of this high position thought of each other, but it so happens that no native has been sufficiently long in the higher ranks to have risen to the grade of Superintending Engineer, so that this examination would be confined only to Europeans and at best would be considered *ex-parte*. The Madras Government evidently foresaw this, and therefore selected their men for enquiry from both natives and Europeans of equal rank and numbers. They, however, ordered two of the nearest Superintending Engineers before Sir C. Turner for examination, and the manner and result of this further enquiry I will give in another communication.

VERITAS.

New Books and Reprints.

ART AND ARCHÆOLOGY.

ELEMENTARY Flower Painting. With 8 Coloured Plates. Old. roy. 8vo, pp. 47. *Cassell.* ... 3/

CRITICAL Notices of the Pictures and Water Colour Drawings in the Royal Jubilee Exhibition, Manchester, 1887. 8vo, sd, pp. 71. *John Heywood.* ... 6*d*.

MILLER (L. W.) The Essentials of Perspective. With Illusts. drawn by the Author. 4to, pp. 108. *L. U. Gill.* ... 6/6

ASTRONOMY AND METEOROLOGY.

SYMONS (C. J.) British Rainfall, 1886: On the Distribution of Rain over the British Isles during the year 1876, as Observed at nearly 3,500 Stations in Great Britain and Ireland; with Articles upon various Branches of Rainfall Work. 8vo, pp. 217. *Stanford* 18/

CHEMISTRY AND PHYSICS.

FRESENIUS (C. R.) Qualitative Chemical Analysis. 10th ed., trans from the 15th German ed., and Edit. by Chas. E. Groves. 8vo, pp. 496. *Churchill.* ... 15/

ELECTRICITY.

ELECTRICITY and Health: Being an Exposition of the most Scientific and Rational Methods of Applying Medical Electricity in the Cure of Acute and Chronic Disease. Cr. 8vo, pp. 100. *G. Cohen* (Blackpool) 3/6

KENNEDY (Rankin) Electrical Distribution by alternating Currents and Transformers. 8vo, pp. 60. *Alabaster. Gatehouse and Co.*... 2/

LARDEN (W.) Electricity for Public Schools and Colleges. Post 8vo. pp. 496. *Longmans* ... 6/

ENGINEERING AND MECHANICS.

ABHANDLUNGEN aus dem Gebiete des Gesammten Tchiff banwesens. Heft 1. Ueber Reserve-Schwimmkraft und Freibord aus Eisen oder Stahl erbante Dampf und Segelschiffe. Heftz, Ueber Spannungen in den Langsverbanden Eisener Schiffe. Von C. F. Steinhaus. 4to, sd. *L. Friederichsen and Co.* (Hamburg).

LEANING (J.) The Duties of a Clerk of Works. 18mo, pp. 50. *Batsford.* ... 1/6

RANKINE (William John Macquorn) A Manual of Civil Engineering. With numerous Diagrams. 16th ed., thoroughly revised by W. J. Millar, C.E. Cr. 8vo, pp. 828. *C. Griffin and Co.* ... 16/

GEOLOGY, MINERALOGY, MINING.

HULL (E.) A Sketch of Geological History: Being the Natural History of the Earth and of its Pre-Human Inhabitants. With an Illustrative Diagram drawn by the Author. Post 8vo, pp. 194. *Deacon.* ... 3/6

SKINNER (W.) Mining Manual for 1887. 8vo. *Skinner.* ... 5/

MATHEMATICS.

TARN (H. C.) The Difficulties of Algebra Made Easy: A Book for Beginners. New ed. Post 8vo, pp. 91. *Moffatt and Paige* 1/

TRADE, COMMERCE AND MANUFACTURE.

DAY (L. F.) The Anatomy of Pattern. Illust. Post 8vo, pp. 52. *Batsford.* ... 3/6

GEDDES (P.) Industrial Exhibitions and Modern Progress. Reprinted from *Industries*. 12mo, sd., pp. 58. *Douglas* (Edinburgh). *Hamilton* 1/

LUNGE (George) Coal Tar and Ammonia: Being the Second and Enlarged Edition of a Treatise on the Distillation of Coal Tar and Ammonical Liquor. 8vo, pp. 756. *Gurney and Jackson* ... 31/6

MURRAY (Kenric B.) Commercial Geography Considered in its Relation to New Markets and Fields of Production for British Trade. Cr. 8vo, pp. 206. *F. C. Jack.* ... 2/6

ANNOUNCEMENTS.

By Messrs. HENRY CAREY BAIRD & Co. (Philadelphia)—A Practical Treatise on Animal and Vegetable Fats and Oils. Comprising both Fixed and Volatile Oils, their Physical and Chemical Properties, the Manner of Extracting and Refining Them, and Practical Rules for Testing Them; as well as the Manufacture of Artificial Butter, Lubricants, &c. Edited chiefly from the German of Drs Karl Schaedler, G. W. Askinson, and Richard Brunner. With Additions. By William T. Brannt. Illust. 8vo.

A Practical Treaties on the Manufacture of Soap and Candles. Based upon the most Recent Experiences in the Practice and Science. Comprising the Chemistry, Raw Materials, Machinery and Utensils and Various Processes of Manufacture. Edited from the German of Dr. C. Deite, A. Engelhardt, Dr. C. Schaedler, and others. By William T. Brannt. Illust. 8vo.

A Practical Manual of Minerals, Mines, and Mining. By—Osborn. 8vo.

General Articles.

NILGIRI RAILWAY.

YOUR number of the 13th September gives as certain that the Nilgiri will at last get a line of Railway. This is "welcome news" and the sooner this line will be opened the better.

I think that some of your readers may be glad to know something of the several schemes originated for constructing a Railway linking the Plains to the Table Land of the Nilgiris—the more so, as these projects will before long become things of the past.

The first attempt was made by myself in 1867, having applied to Government and obtained sanction to construct a "self-acting incline"—the motive power of which was to be provided by filling with water some waggons at the top of the line, their weight acting upon a cable so as to haul up; the ascending over the total length was to be divided in seven stages.

This plan, however, was considered as too complicated for the traffic available, and, instead, a line with heavy gradient was proposed, but the scheme was not successful and was abandoned.

A few years afterwards the Madras Government proposed to construct the line themselves, but their proposal was not granted by the Supreme Government. At last, about 1880, Messrs. Stanes & Co., of Coonoor, started a company for constructing a line of railway, upon the "Rigi" principle.

Mr. Rigenback, the inventor, was asked to come and see the "Hills," and after a brief sojourn, having made a flying survey, he declared the scheme very practicable. The projectors, Messrs. Stanes & Co., applied then to Major Morant, R.E., so as to have his aid; this Engineer caused a trace to be cut through the jungle and forwarded a favorable report. It was then decided to have a definitive survey made. I was entrusted with the same and began in January 1880, with orders to follow the "trace" and not to introduce curves of a radius less than 6 chains and a gradient of 1 in 6.

This survey was done, but there were many objections to the project, as the line had to cross six times the main road, and Colonel Shaw Stewart objected. Therefore Messrs. Stanes & Co. resolved to have another line surveyed, and requested me to find another tract above the new ghaut road if possible, and with the same conditions as were binding heretofore. After a great deal of trouble the survey was made, and adopted, the new line crossing the high road only once. I have the pleasure of sending you a plan and a longitudinal section of this project.

Owing to the necessity of conforming to the Secretary of State's orders, that is, that the capital was to be subscribed in India, the company could not be floated and the scheme was abandoned.

The estimate of this line was from 20 to 25 lacs of rupees. There were to be 25 iron viaducts, some very high; such a large number was owing to curves of 6 chains radius and the standing order that no tunnel was to be designed. It is to be observed, that if my recommendation of introducing curves of even 2 chains radius had been acted upon, the cost would not have exceeded 10 or 11 lacs and with a narrow gauge 8 or 9 lacs of rupees.

Since then Mr. A. Woolley asked Mr. Prestage to come and see whether a line on the adhesive principle could not be constructed, and upon the favourable opinion expressed by Mr. Prestage, Mr. Woolley started for England where, we understand, he has been successful in securing the means of accomplishing this most desired line.

As far as could be presumed from the nature of the way teh new line will be about 24 miles in length from Mateepollium to Coonoor.

A. PIERRES DE CLOSETT, C.E.

THE NEWCASTLE-UPON-TYNE EXHIBITION.

THE exhibits at the Royal Exhibition at Newcastle-upon-Tyne are most interesting to those connected with the mining and engineering industries. The Exhibition is in many respects a striking instance of the manner in which such enterprises can be made instructive, attractive and entertaining. It is not a collection of the products of various countries, but a complete exposition of mining and engineering, two departments of industry in which this district has taken a leading part for many years.

The leading idea has been, to shew the number and extent of the industries connected with mining and engineering, and includes the various means of converting into gold the coal and other raw products by which the Newcastle district has become wealthy and renowned.

The exhibits of mining produce form a unique collection and undoubtedly surpass in interest anything of the kind contained in other exhibitions in this or any other country. In connection with these exhibits, nearly every appliance and invention is to be seen for securing greater safety to the workmen. There are numerous exhibits of safety mining lamps which form an admirable historical collection, shewing the various descriptions of lamps invented by Clanny, Davy, and Stephenson, and improved by other inventors, together with, probably, the most complete exhibit of electric mining lamps ever seen at one time.

The various stages of the manufacture of iron and steel are amply developed from the raw material to the finished articles of all sizes and descriptions. The exhibits of iron and steel rails, sleepers, and various systems employed in connecting rails and sleepers, are numerous and instructive. The chemical industries are largely represented by samples of their products including specimens of the Durham or Tees-side salt.

The machinery includes appliances used for nearly every purpose, and produces a most effective sight when seen at work. Amongst them are to be found numerous examples of marine and locomotive engines, ordnance from the works of Armstrong, Mitchell and Co., Ld., &c., &c.

Naval architecture is made attractive by the number of fine models of merchant and war vessels from the leading ship-yards of the district, together with the historical collections of the Board of Trade, Lloyds, and the Italian Government. There are also interesting models of the harbours of the district, and of the mammoth cranes, dredgers, &c., employed in their maintenance.

Other sections of the Exhibition are devoted to building materials, sanitary appliances, telegraphs, telephones, electric signals, electric lighting and transmission of power, iron and hemp ropes, coach building, &c., &c.

The reproduction of a coal mine (lighted throughout by electricity) covers a large area, and exhibits the modes of working in the district, known as "bord and pillar," "long wall," and "post and stall." The illusion is very complete, with shaft, hauling engine, moving tubs, ventilating fan, and all the accessories to be found in a well appointed colliery. On returning to the surface, after a journey of about 2,000 feet, it is difficult for the visitor to remember that he has not been in the bowels of the earth.

The lead mine shews the modes of mining practised in the Weardale and Alston districts. The lode is soon reached by one of the adits, the shaft is shewn in this and the upper levels, fitted with cages, pumps and a ladder-way. A horse track or inclined drift, for the passage of horses, is used by visitors as an access to the upper levels. The ore from the higher workings is drawn at the shaft or allowed to fall through hoppers or shoots to the adit level, whence it is conveyed to the surface by means of wagons drawn by manual labour or horses.

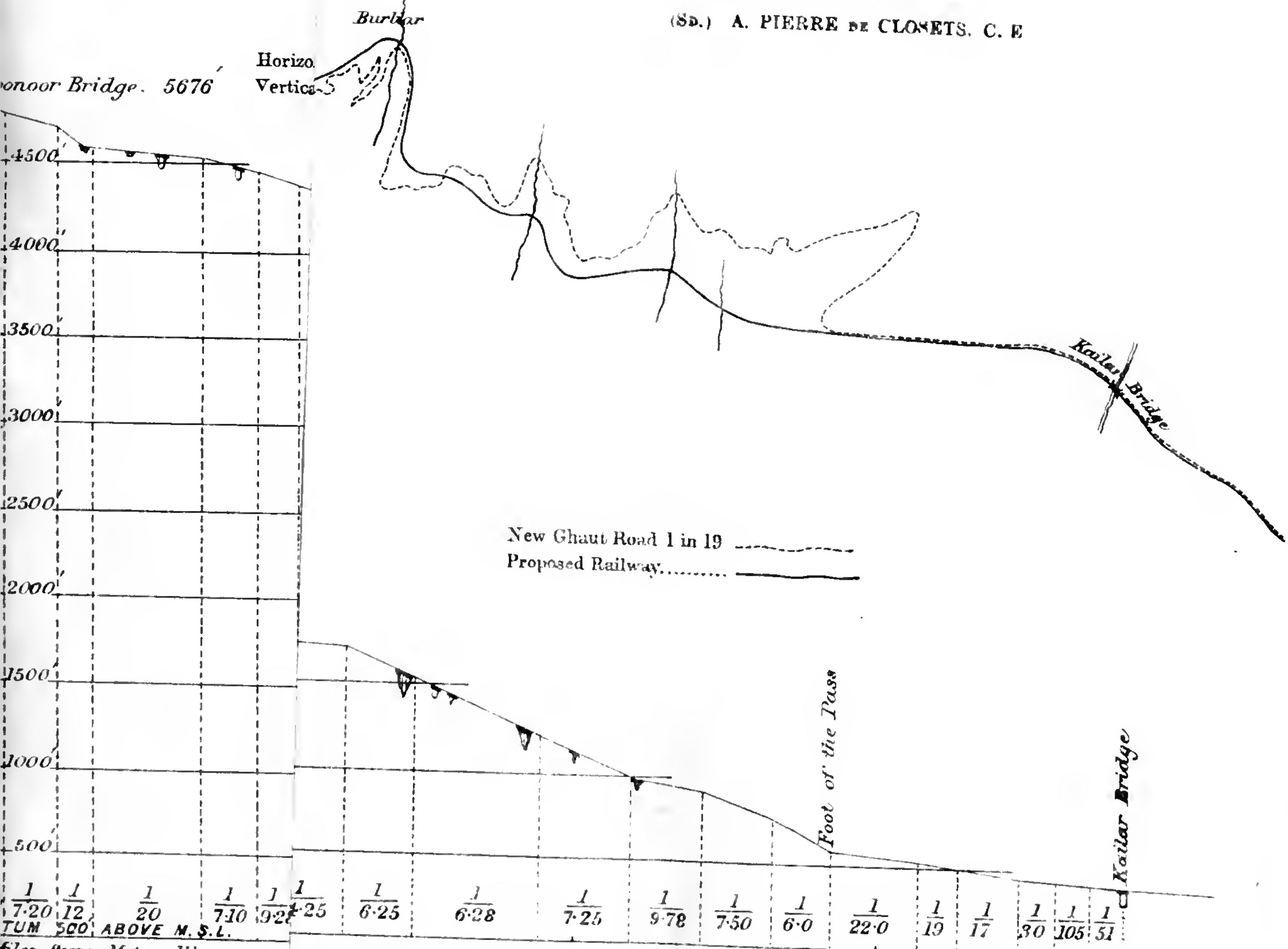
The leading idea in the inception of the Exhibition was to secure exhibits of the most useful appliances in connection with mining. This idea is practically de-

PLA]

THE NILGI

Madras, 25th August 1883.

(SD.) A. PIERRE DE CLOSETS, C. E



The "STAR" Press, 19, Lall Bazar Street, Calcutta.

monstrated by the installation of the leading systems of haulage employed in mines in Scotland, Wales and England (especially in Northumberland and Durham). Thirteen systems of haulage are shewn *at work, viz.*, main and tail rope, endless chain, various modes of applying endless ropes, and locomotive engines driven by compressed air. Most of the systems are driven by steam power, but one of them is worked by an electro-motor, the current being derived from a dynamo at a distance of about 1,000 yards.

An overhead tramway is shewn at work consisting of a pair of wire-ropes used as rails to carry the skips, and a smaller and endless wire-rope employed to draw them.

An electric railway about 2,000 feet long is employed to convey visitors around the grounds, and is a successful instance of the application of an electric locomotive upon a railway.

Another notable structure in the grounds is the reproduction of the Old Bridge over the river Tyne at Newcastle, built about 1250 and partially destroyed by the great flood of November 1771.

I propose to supplement this with an account of the various systems of haulage shewn at the Exhibition, which will, I believe, prove somewhat instructive to your readers.

September 8, 1887. T. W. B.

REPORT ON THE WATER-SUPPLY SCHEME PROVIDED FOR THE CITY OF JUBBULPORE.

By J. G. H. Glass, M. Inst. C.E., Executive Engineer.

II.

The drainage area is about $5\frac{1}{4}$ square miles above site of Dam. Deducting the water spread, the area is about 5 square miles. Applying to this the formula for maximum discharge known as Dickens' Formula, and which is ordinarily used in these Provinces, we get—

$$D = 825 \sqrt[4]{5^3}$$
$$= 2{,}760 \text{ cubic feet per second.}$$

This is equivalent to (very nearly) $\frac{3}{7}$ths of a fall of 2 inches in an hour flowing at a uniform rate from the catchment. Considerably heavier falls of rain are not however unfrequent, as the following extracts from the Observatory records of Jubbulpore shew :—

Extreme rainfall in 24 hours.

Abnormal falls of rain.		Fall in inches.
September 1873	...	... 6·40
July 1874 ...	...	... 7·50
August 1874 ...	...	... 10·20
August 1874 ...	...	... 5·30
June 1877 ...	...	... 12·49
August 1879 ...	...	... 5·43
September 1883	...	.. 6·91

The recorded fall of 12·49 inches on 28th June 1877 was distributed thus—

			inches.
6 to 7 P. M.	...	...	... 2·05
7 to 8 „	...	...	... 3·95
8 to 9 „	...	..	... 4·20
9 to 10 „	...	...	... 0·15
10 to 11 „	...	...	... 1·65
11 to 12 „	...	...	... 0·11
12 to 6 A. M	...	...	... 0·38
		Total ...	12·49

This abnormal fall occurred at the first break of the monsoon when the ground was very dry, and the flow off would not therefore be so great as it would have been had it fallen on a previously saturated soil. But the records shew that very heavy rain fell in 1874, in the height of the monsoon, and it was therefore considered prudent to give the waste weir a much larger capacity of discharge than that arrived at from Dickens' formula. Unless accurate and systematic observations extending over a number of seasons are taken of the rainfall on a catchment, and the proportion which the surface discharge bears to it, the dimensions necessary for flood escapes cannot be determined with any exactness. No general rules can be laid down for adoption with any pretensions to accuracy, as so much depends on the circumstances of the locality of the catchment, its geological formation and the configuration of the ground, that each case requires special and separate consideration. In this particular case the highest recorded rainfall in any hour the whole of which would have to pass the escape has been taken as the discharge to be provided for, the Reservoir being considered full at the time. This necessitated a considerable alteration in the escape. For a fall of $4\frac{1}{5}$ inches in the hour, such, as has been observed, the whole of which has to pass the escape, the rate of flow would be—

$$\frac{5{\cdot}26 \times 640 \times 43560 \times 4{\cdot}20}{60 \times 60 \times 12} = 14{,}230 \text{ cubic feet per second.}$$

This seems an enormous discharge for a catchment of $5\frac{1}{4}$ square miles, but so also was the rainfall recorded enormous, and as an equally heavy fall may again occur prudence demands that all possible risks should be provided for.

The escape has accordingly been constructed as follows :—

For a length (A) of 300 feet (*vide* drawing of Dam to be produced in a succeeding issue) on the right flank (distant about 100 feet from the termination of Dam) is what may be called the normal escape, the cill of which is placed at the 1450·92 level, that of stored water : immediately on the left is anadditional length (B) of 437 feet, the cill of which is 1453·92, or 3 feet above the cill of normal escape; and again in continuation a third length (C) of 628 feet, the cill being one foot higher, that is 1454·92. The top level of the Dam at the flanks is 1455·92. With the flood-water on a level with the top of Dam at flanks, *viz.*, at the 1455·92 level, the combined discharging power of the escape would be—

$$D = (3{\cdot}5 \times 300 \sqrt[2]{5^3}) + (3{\cdot}5 \times 457 \sqrt{2^3}) + (3{\cdot}5 \times 628 \sqrt{1^3})$$
$$= 11739 + 4512 + 2198$$
$$= 18{,}450 \text{ cubic feet per second.}$$

This is equivalent to a rainfall of 5·44 inches in an hour, the whole of which reaches the escape at a uniform rate in the hour. The formula used for the discharge from the waste weir is that given in Downing's practical hydraulics. In addition to the theoretical reduction of taking the discharge at two-thirds of the area of the water-way into the velocity, there is the further reduction due to multiplying by the co-efficient C=0·667. The discharge is therefore practically about one-third of the area of water-way into the velocity.

The greatest observed depth of water that passed over the weir last rains was 2' 6", equivalent to a discharge of 4,147 cubic feet per second. Rain had been falling off and on for some days before this reading was taken, and the catchment was thoroughly saturated. A heavy burst of rain, which gauged 4·59 inches, then fell, and within an hour of its commencement its effects were seen by a considerable rise in the water passing over the weir. From the threatening appearance of the clouds, I had anticipated there would be a heavy fall of rain, and as I was anxious to see a high flood at the Reservoir I went there and was present when the depth of $2\frac{1}{2}$ feet was passing over the cill of weir. At the time I left it was quite dark, and although heavy rain continued falling for nearly an hour afterwards no greater depth over the weir was recorded. It is probable, however, that a greater depth did pass, though it was not observed. The recorded depth of $2\frac{1}{2}$ feet represents a discharge considerably in excess of the maximum given by Dickens' formula, and although some difference is to be expected from the rainfall over the spread of water in the Reservoir, yet that does not account for all. A reservoir of this kind presents very favorable opportunity for observing the relation between rainfall and surface discharge, as by a simple arrangement of automatic recorders, the quantity and duration of rainfall could be observed, and the discharge over the weir due to that fall ascertained. The Ambajeri Reservoir at Nagpur also affords facilities for similar observations.

(To be continued.)

PHILLIPPS' IMPROVED COMBINATION "COLLAR AND THIMBLE" JUTE THROSTLE SPINDLE.

Figure I. represents the sectional view of the ordinary spindle now in use. The footstep and neck rails are fixed, and the conical bush A, is the only contrivance intended to keep the spindle steady.

Figure II. represents the sectional view of my combination "Collar and Thimble" spindle; the result of many years of patient thought and labor; which has been found, from actual working in the mills at which I was Manager, to possess many advantages over the ordinary spindle.

The construction of the ordinary throstle spinning frame being left undisturbed, it will be found that all other arrangements in the working of my spindle differ entirely.

The spindle, marked S, works in the collar C, which is of an entire piece of cast-iron, rigidly fixed to the neck rail by the nut N; and it is furnished at its top with a bush B, and at its bottom with another of a conical shape marked D; the latter being adjustable by the nut G. The flange of the collar C has two set pins for convenience.

Now, it will be observed, the spindle blade is almost entirely encased in the collar C, and held there in perfect steadiness by the top and bottom bushes B and D. But, as it is apparent to all professionals, the mere advantage of steadiness gained, in this particular way, does not suffice for jute spinning operations to be commenced with, for experience shews that the rigid surface of the collar C, would be affording so much friction to the bobbin Y, as to snap the yarn every time a start was made to spin. It would also be found that the introduction of revolving rings round the collar C, or otherwise arranged, would not overcome the difficulty, and the only means for the object desired would be a contrivance that would virtually restore to the bobbin Y a continuous revolving surface to work upon, that would rather help than impede its motion. The desideratum is found, in the application of my "Thimble" PV. It consists of a tube marked P and a cap V, turned and bored true and added to the tube; and allowed to rest upon the spindle shoulder perpendicularly and in such a manner as to never interfere with the rest of the parts of the spindle; and also, so arranged as to admit of the flyer M screwing on top of it and carrying it round with it and the spindle, and at the same number of revolutions as the spindle.

With the necessary holes for lubrication of the bushes B and D, the bobbin Y can now be dropped over the revolving "Thimble" PV and spinning commenced with perfect confidence in the attainment of good results.

The advantages of my spindle may be thus summarized:—

High speed, accompanied with perfect steadiness of motion to the spindle, thereby producing larger and better quality of yarn. Being about half the weight of an ordinary spindle, requiring less power to drive, $\frac{1}{2}''$ or $\frac{3}{4}''$ listing band being sufficient for the purpose.

Admittingof a longer lift being given to the bobbin.

The bobbin working in contact with my revolving "Thimble," its working is necessarily perfect.

By the "Thimble" dropping over the exposed working parts and effectually covering them, dust and flying fibres find no place therein to cause the untimely wear and tear of parts.

The speed of the ordinary spindle being from 2,500 to 2,700 revolutions per minute; my spindle, under the improved conditions, can be driven from 4,000 to 5,000 revolutions per minute, attended with satisfactory results.

The undersigned is prepared to submit his spindle for trial on condition of an order for them being ensured, when found successful.

C. L. PHILLIPPS,
Late Manager,
The Bombay Hemp and Jute Mills,
Colaba, Bombay,

SITARAMPORE; *September* 18, 1887.

NEW TYPES OF CHEAP ROOFS.

BY W. G. BLIGH, EXECUTIVE ENGINEER, P. W. D.

IV.

ERRATA:

Wignoles *read* Vignoles, page 207, lines 10 and 16.

Alternate *read* ultimate, page 207, line 30.

13,440 *read* 1,34,400, page 208, line 2.

Lime *read* live, page 208, line 8.

$L = \sqrt{} \frac{89600}{w\, b+27} L$ *read* $L = \sqrt{\frac{89600}{w\, b+27}}$, page 208, line 16.

$b = \frac{89600}{\frac{L^2 - 27}{W}}$ (2) *read* $b = \frac{89600}{\frac{L^2}{W}} - 27$ (2) page 208, line 20.

$\Delta = \frac{5W\ 3Z^3}{384\ E\ I}$ *read* $\frac{5W\ L^3}{384\ E\ I}$, page 208, line 30.

$\sqrt{} = \frac{300}{\sqrt{287}} = 18$ft. *read* $= \frac{300}{\sqrt{289}} = 18$ft., page 208, line 36.

$\frac{\Delta}{z}$ *read* $\frac{\Delta}{L}$, page 208, line 39.

$\frac{d}{z}$ *read* $\frac{d}{L}$, page 208, line 40.

$\frac{d}{z}$ or $z\frac{5}{8}''$ *read* $\frac{d}{2}$ or $2\frac{5}{8}'$, line 57.

$= 247$ *read*, $\sqrt{\frac{247}{Wb+20}}$ line 67.

4ft. 144lbs, *read* 4ft. as 144lbs., line 73.

$1\frac{1}{4}''$ *read* $1\frac{1}{2}''$, within rule in last column, 1st line.

13′ *read* 12′ ,, ,, 4th ,, 3rd line.

ROLLED IRON BEAMS.

BY LALA GANGA RAM, A.M.I.C.E., M.I.M.E., EXECUTIVE ENGINEER, P. W. D., PUNJAB.

Now that the network of Railways has brought down the cost of iron-work within reasonable figures, the use of rolled iron beams in place of wooden beams is fast drawing the attention of Engineers in all works of construction. Indeed, at the current market rates, it is cheaper to use iron beams for spans of about 16 feet and over.

In order to ascertain the size of these beams to carry a certain load, I believe the common practice is to refer to catalogues of several firms, but if one takes the trouble to compare the figures given in these catalogues, he would find that hardly two of them agree, except in a *foot note,* which one and all have added to disclaim all responsibility as to the accuracy of these figures. Under the circumstantes, I don't know what value can an Engineer attach to the so-called useful and handy information obtainable from these catalogues. There is no other alternative for an Engineer but to go into mathematical calculations for the size of each beam, which is a very laborious task and involves tedious arithmetical calculations, liable to lead to error.

I have, therefore, compiled a few tables, based on a method hereafter shewn, which I have great pleasure in offering to the Profession through the medium of your

Fig. I.

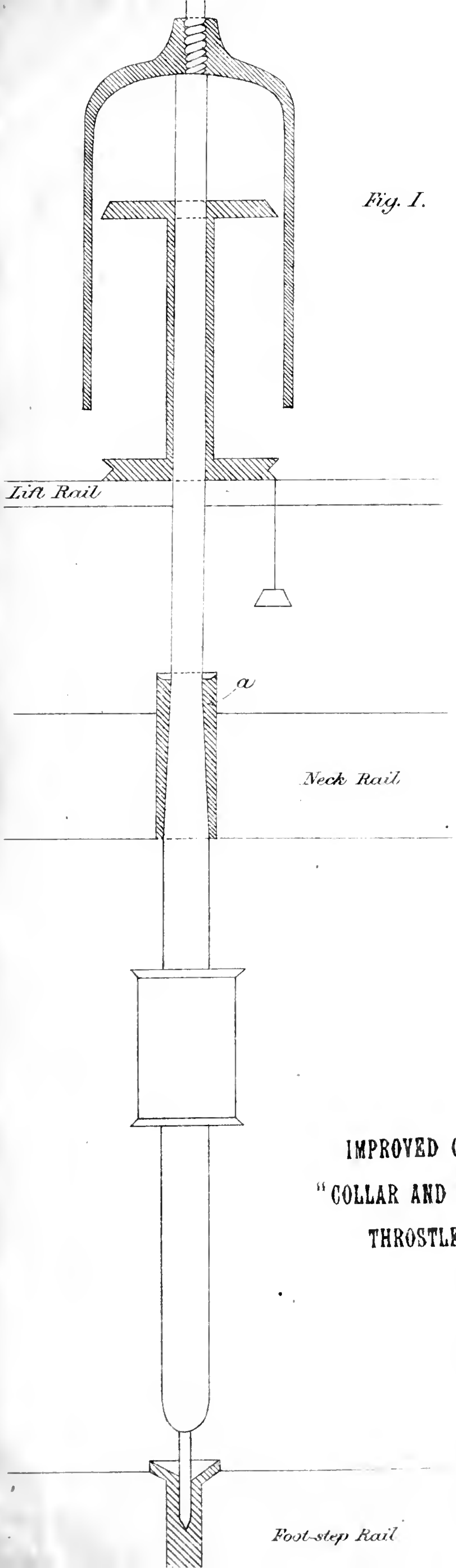
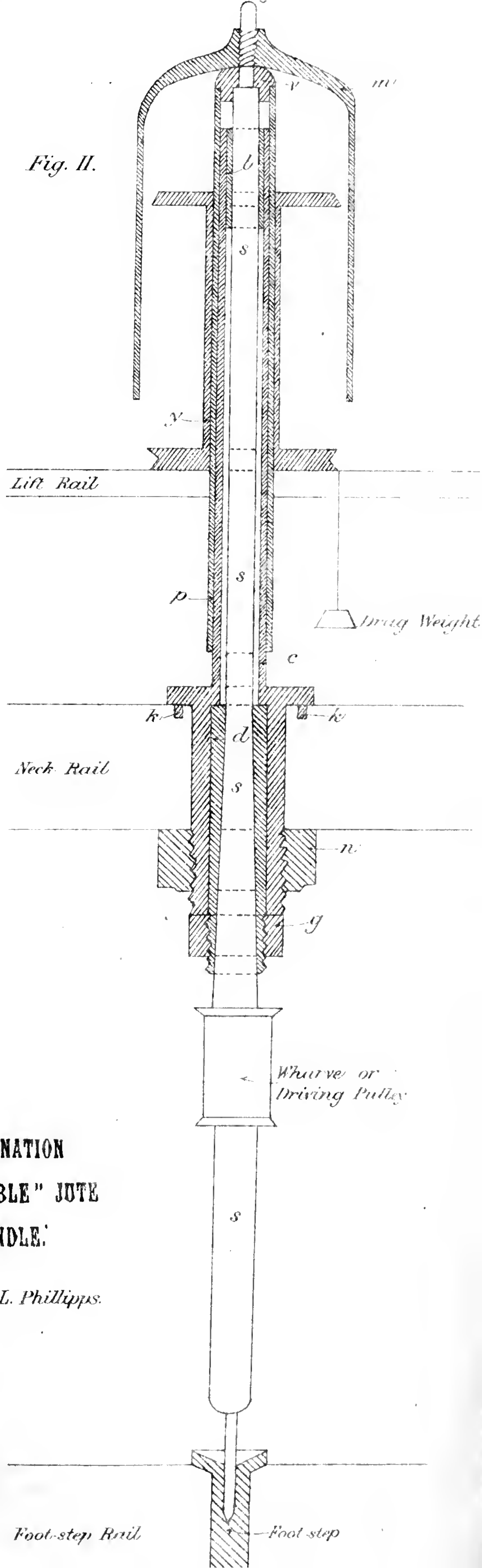


Fig. II.



IMPROVED COMBINATION "COLLAR AND THIMBLE" JUTE THROSTLE SPINDLE.

C.L. Phillipps.

interesting Journal. I hope these tables would be found handy and lead to considerable saving of time and trouble.

Following are some of the several methods of calculating the strength of rolled iron beams.

I.—Find the moment of inertia and then use the formula given in Molesworth's Pocket Book, 23rd Edition, page 132.

$$a = \frac{5}{384} \; \frac{W\,L^3}{E.\ I.}$$

where a=deflection in inches.
W=weight in lbs. distributed.
L=span in feet.
E=modulus of elasticity.
I=moment of Inertia.

II.—Formula given in Molesworth's Pocket Book, 23rd Edition, page 122.

$$\text{Breaking weight} = \frac{8K\ BD^2}{L}$$

Substituting for BD^2, the value of V given in page 123. Note that L in this case=span in inches.

III.—Ordinary bending moment formula.

$$\text{Bending strain} = \frac{W \times L}{8D}$$

where W=weight in lbs. distributed.
L=span in feet.
D=depth in feet.

IV.—Deflection formula given in Trautwine's Pocket Book, 25th Edition, page 521.

$$\text{Deflection in inches} = \frac{\text{Load in lbs. (distributed)} \times \text{span}^3}{\text{weight of beam in lbs. per yard} \times \text{square of depth in inches} \times 18000}$$

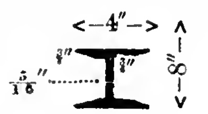
Now I shall assume the following values of different notations, which, I believe, agree with the general practice, and prove by an illustration that the four methods above-mentioned give almost identical results.

Let safe deflection in inches be taken at $\frac{1}{40}$th of an inch per foot of span.

Let safe modulus of elasticity for wrought-iron be taken at 5 tons.

And let the factor of safety be taken at 4.

In order to illustrate that the above methods do give identical results, I shall give an illustration.



22lbs. per ft.

Let us find the strength of this section for a span of 16ft.

I.—

$$a = \frac{5}{384} \times \frac{W \times L^3}{E.\ I.}$$

Assuming some of the values.

$$\frac{L}{40} = \frac{5}{384} \times \frac{W \times L^3}{5 \times I}$$

$$W = \frac{9{\cdot}6\ I}{L^2}$$

Value of I for the section above given is 86 (by formula in Molesworth, page 123).

$\therefore$ W = 3·2 tons ... ... (1).

II.—

$$\text{Beaking weight} = \frac{8\ K\ BD^2}{L}, \text{ but L = span}$$

in inches. K is given in Molesworth, page 122, at 68 cwt. for wrought-iron.

$$\because \quad \text{Safe load} = \frac{\text{Breaking load}}{4}$$

$$\therefore\ 4\ \text{Safe load} = \frac{8 \times 68 \times BD^2}{L}$$

$$\therefore\ \text{Safe load} = \frac{136 \times BD^2}{L}\ \text{cwt.}$$

$$= \frac{136}{20} \times \frac{BD^2}{L}\ \text{tons}$$

$$= 6{\cdot}8\frac{BD^2}{L}$$

Value of BD^2 for this section, found by formula in Molesworth, page 123, is 100

$$\therefore\ \text{Safe load} = \frac{6{\cdot}8 \times 76}{L} = \frac{6{\cdot}8 \times 100}{16 \times 12} = 3{\cdot}5$$

III.—

$$\text{Bending strain} = \frac{W \times L}{8D}$$

Let 4 tons per square inch be taken as safe figure.

$$\therefore\ \frac{\text{Bending Strain}}{4} = \text{area.}$$

Area of the top part in this section $= 4'' \times \frac{9}{16}'' = 2{\cdot}25$

$$\therefore\ 4 \times 2{\cdot}25 = \frac{W \times 16}{8 \times \frac{8}{12}},\quad \therefore\ W = 3\ \text{tons.}$$

IV.—Trautwine's method.

$$\text{Deflection} = \frac{\text{Load} \times \text{span}^3}{\text{weight per yd.} \times \text{square of depth} \times 18000}$$

$\therefore$ Assuming some of these values as above explained

$$\frac{l}{40} = \frac{\text{Load} \times l^3}{\text{weight per ft.} \times 3 \times d^2 \times 18000}$$

$$\therefore\ \text{Safe load (distributed in lbs.)} = \frac{\text{weight per ft.} \times 3 \times d^2 \times 18000 \times l}{40 \times l^3}$$

(a = weight per foot run of beam in lbs.)

$$= \frac{1350 \times a \times d^2}{l^2}$$

For the section under reference,

$$\text{Safe load} = \frac{1350 \times 22 \times 8^2}{16^2}$$

= 7425 lbs.
= 3·3 tons.

The results, it will appear, very closely agree by whichever method calculations are made, but Trautwine's formula No. 4 is much the simplest.

In practice the problem to determine is the strength of a certain section to carry a certain load per foot run. As above deduced, Trautwine's formula is

$$\text{Safe distributed load in lbs.} = \frac{1350\ d^2}{l^2} \times \text{weight per foot in lbs.}$$

where d = depth in inches.
l = span in feet

And let safe distributed load in lbs. = W
Weight per foot run = w
And let weight of beam in lbs. per foot run } = a

$$\therefore\quad W = w\ l = \frac{1350 d^2}{l^2} \times a$$

$$\therefore\quad w = \frac{1350 d^2}{l^3} \times a$$

Tables annexed are based on this formula.

Use $w = k\ a$, and $a = \frac{w}{k}$.

For value of k see tables.

Example:—Take the illustration above given

Opposite 8, in the column of 16, read 21

$\therefore$ weight per foot run that this section will carry = 21 × 22 = 462lbs.

If the load of the roof=100lbs. per sq. ft., these girders should be 4·62 ft. apart.

The depth of the beam should of course be first assumed, and *ordinarily* half the span would be the proper depth, that is to say, for a span of 16 ft. take 8 inches, for a span of 24 ft. take 12 inches, and so on.

G. R.

GUNGA RAM'S TABLES FOR ROLLED IRON BEAMS.

Let w = Safe load in lbs per foot run
a = weight of beam per foot run in lbs.
k = co-efficient (see table below.)

$w = k.a.$ $\therefore a = \frac{w}{k}$

N.B.—For any other depths than those given the required co-efficient may be found by interpolation.

Depth in inches. / Span in feet.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
3	190	97	56	35	24	16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¼	...	114	66	41	28	19	14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
½	...	132	77	48	32	22	16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¾	...	...	88	55	37	26	19	14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	...	...	100	63	42	30	22	16	13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¼	...	...	113	71	48	34	24	18	14	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
½	...	...	...	80	54	38	27	21	16	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¾	...	...	...	89	60	42	30	23	18	14	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
5	...	...	...	...	66	46	34	25	20	15	12	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¼	...	...	...	...	...	51	37	27	22	16	13	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
½	...	...	...	...	...	56	41	30	24	18	14	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¾	...	...	...	...	...	61	45	33	26	20	16	13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6	...	...	...	...	...	67	49	36	28	22	18	14	12	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¼	...	...	...	...	...	72	53	40	30	24	19	16	13	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
½	...	...	...	...	...	78	57	43	33	26	21	17	14	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¾	...	...	...	...	...	84	61	46	36	28	22	18	15	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7	...	...	...	...	...	...	66	50	38	30	24	20	16	13	10	8	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¼	...	...	...	...	...	...	71	53	41	32	26	21	17	14	11	9	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
½	...	...	...	...	...	...	76	57	44	34	28	23	18	15	12	11	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¾	...	...	...	...	...	...	81	61	47	37	30	24	20	16	13	12	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8	...	...	...	...	...	...	...	...	50	39	32	26	21	18	15	13	11	9	8	7	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¼	...	...	...	...	...	...	...	...	...	...	34	27	23	19	16	14	12	10	8	7	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
½	...	...	...	...	...	...	...	...	...	...	36	29	24	20	17	15	13	11	9	8	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
¾	...	...	...	...	...	...	...	...	...	...	38	30	26	21	18	16	13	12	10	9	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9	...	...	...	...	...	...	...	...	...	...	40	32	27	22	19	16	14	12	10	9	8	7	6	5	...	...	...	...	...	...	...	...	...	...	...	...	...
¼	...	...	...	...	...	...	...	...	...	...	...	34	28	23	20	17	15	13	11	9	9	8	7	6	...	...	...	...	...	...	...	...	...	...	...	...	...
½	...	...	...	...	...	...	...	...	...	...	...	36	30	25	21	18	16	14	12	10	9	8	7	6	...	...	...	...	...	...	...	...	...	...	...	...	...
¾	...	...	...	...	...	...	...	...	...	...	...	38	31	26	22	19	17	15	13	11	10	9	8	7	...	...	...	...	...	...	...	...	...	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...	.	40	33	28	23	20	17	15	13	11	10	9	8	7	6	5	5	...	...	...	...	...	...	...	...	...	...
¼	...	...	...	...	...	...	...	...	...	...	...	...	35	29	25	21	18	16	14	12	11	9	9	7	6	5	5	...	...	...	...	...	...	...	...	...	...
½	...	...	...	...	...	...	...	...	...	...	...	...	37	31	26	22	19	17	14	12	11	10	9	8	6	6	5	...	...	...	...	...	...	...	...	...	...
¾	...	...	...	...	...	...	...	...	...	...	...	...	39	32	27	23	20	17	15	13	12	10	9	8	7	6	6	...	...	...	...	...	...	...	...	...	...

Depth in inches. / Span in feet.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
11	...	...	...	...	...	...	...	...	...	...	...	...	40	33	28	24	20	18	15	13	12	10	9	8	7	7	6	6	5	4	...	...	...	...	...	...	...
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	29	25	21	19	16	14	12	10	9	8	7	7	6	6	5	4	...	...	...	...	...	...	...
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30	26	22	19	17	15	13	11	10	9	8	7	7	6	6	5	...	...	...	...	...	...	...
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	32	27	23	20	17	15	13	11	10	9	8	7	7	6	6	5	...	...	...	...	...	...	...
12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	28	24	21	18	16	14	12	11	10	9	8	7	6	6	5	5	4	4	...	...	...	...
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	22	19	17	14	13	11	10	9	8	7	7	7	5	5	5	4	...	...	...	...
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	23	19	17	15	14	12	11	9	8	8	7	7	6	5	5	5	...	...	...	...
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	27	24	20	18	15	14	12	11	10	9	8	8	7	6	6	5	5	...	...	...	...
13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	28	25	21	19	16	15	13	12	10	9	8	8	7	6	6	5	5	4	...	...	...
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	22	19	17	16	13	12	11	9	8	8	7	6	6	5	5	4	...	...	...
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	23	20	17	17	14	12	12	10	9	8	8	7	6	5	5	4	...	...	...
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	27	24	21	18	17	15	13	12	10	9	9	8	7	6	6	5	5	...	...	...
14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	28	25	22	19	17	15	13	13	10	10	9	8	7	7	6	6	5	5	4	4
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	29	25	23	20	18	15	13	13	10	10	9	8	8	7	6	6	5	5	5	4
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30	26	24	21	18	16	14	13	11	10	9	9	8	7	7	6	5	5	5	4
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	32	27	24	21	18	16	14	13	12	11	10	9	8	8	7	6	5	5	5	4
15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	28	25	22	19	17	15	14	12	11	10	9	8	8	7	6	6	5	5	5
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	23	20	18	16	14	12	11	10	10	9	8	7	6	6	5	5	5
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	23	20	19	17	15	13	12	11	10	9	9	8	7	6	5	5	5
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	24	21	19	18	15	14	13	12	11	10	9	8	7	6	5	5	5
16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	22	20	18	16	14	13	12	11	10	9	8	7	7	6	6	5
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	18	16	15	14	12	11	10	10	9	8	7	6	6	5
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	19	17	15	14	13	12	11	10	9	8	7	6	6	5
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	19	17	16	14	13	12	11	10	9	8	8	7	6	5
17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	22	20	18	16	14	13	12	11	10	9	8	8	7	6	6
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	19	16	14	13	13	12	11	10	9	8	7	6	6
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	19	17	15	14	13	12	11	10	9	8	7	6	6
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	22	20	18	15	14	13	12	11	10	9	9	8	7	6
18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	22	20	18	16	15	13	12	11	10	9	9	8	7	7
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	15	14	12	11	10	10	9	8	7	7
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17	15	14	13	12	11	10	9	8	7	7
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17	16	14	13	12	11	10	10	9	7	7
19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	16	15	13	12	11	10	10	9	8	8
¼	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	16	15	13	12	11	10	10	9	8	8
½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19	17	15	14	13	12	11	10	9	8	8
¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19	17	16	14	13	13	12	11	10	9	8
20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	18	16	15	14	13	12	11	10	9	8

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

VIII.

Coursed Rubble Archwork in Buildings.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—		Variable.	Do.	Do.
Masons No. ...	3			
Do. " ...	4			
Do. " ...	1			
Coolies " ...	3			
Do. " ...	2½			
Do. " ...	3			
Bhistie " ...	1¼			
Masons dressing stones	16			
Grinding mortar, c. ft.	25			
Sundries	...			
Materials.—				
Rubble stone, c. ft. ...	85			
Lime slaked, dry, c. ft...	12			
Sand " ...	12			
Surkhi " ...	12			
Sundries	...			
Scaffolding ...	...			
Centreing	...			
Petty Establishment ...	...			

Specification.—The stones as received from quarry to be fairly hammer-squared and not wedge-shaped. In thicknesses up to one foot single stones covering whole thickness of arch to be used. In thicker arches up to 18 or 21 inches every alternate stone to be a thorough stone covering thickness of arch. The stones to be rough chisel picked on all faces and along the courses to be dressed to the required radiation.

X.

NOTES FROM HOME.

(From our own Correspondent.)

The fifty-seventh meeting of the British Association has lately been held in Manchester. Professor Osborne Reynolds, the President of the Mechanical Section, in his address remarked that it was 26 years since the last meeting of the section was held in Manchester and took for the text of his address the achievements in mechanical science accomplished in the interval. The introduction of the telephone was first referred to as one of the great distinguishing features of the period. The preservation of food by means of the tin can—the freezing process—the gas engine were all important matters to be included. Amongst the works of the past year the commencement of the Manchester Ship Canal would ever make the year memorable, and the completion of the Tay Bridge, the Severn Tunnel, and the progress of the Forth Bridge shewed there was no lack of enterprise or falling off in heroic undertakings. He next referred to the progress recently made towards a higher training in that branch of science which most directly relates to mechanical progress, and considered that this movement had been brought about by the conviction of the necessity of an education which in its subjects and methods of teaching was much more closely related than was the old system of the Universities to the actual work which the student might eventually be called upon to undertake. The introduction of laboratories was, he said, to be hailed as one of the greatest inducements to keeping alive in engineering schools a real scientific interest in the practical work that was going on around.

Mr. Shelford read a paper on the improvements of the access to the Mersey ports in which special consideration was given to a description of the bar now existing and the action of the present currents. Mr. Shelford maintains that the great volume of the local tidal flow is sufficient, if properly directed, to maintain a navigable channel at the bar. In the course of the discussion it was stated that if works similar to those which are constructed at the mouths of the Danube and of the Mississippi were carried out in the case of the Mersey, the bar would be permanently removed and the same results would follow.

Mr. Leader Williams read a paper on the Manchester Ship Canal scheme, and in course of the discussion which followed it was stated that it would take vessels about 8 hours to pass from Eastham to Manchester, Eastham being the point of deep water at Liverpool where the Canal starts. It was also stated that the Canal would have beneficial sanitary effects on the neighbourhood of Manchester and Salford. A paper on the Forth Bridge was read by Mr. Biggart, the Assistant Engineer of the Works.

The British Association will next year meet at Bath, commencing on the 5th September. Sir Frederick Brammell has been elected President for the ensuing year. The meeting for 1889 will be held at Newcastle-on-Tyne. It will be remembered that last year the New South Wales Government invited the Association to visit Sydney next January. The invitation has now been withdrawn.

The autumn meeting of the Iron and Steel Institute is announced to commence on the 14th instant in Manchester. The meeting will be held in Owen's College. This will be the second time the Institute has met in Manchester.

The Railway receipts from goods and passengers shew that the passenger traffic is at its lowest point about the middle of February and from that date it gradually increases until the end of August when the maximum of the year is reached. This on the principal lines is rather more than double the winter minimum. The goods traffic does not shew such variations. The Great Western fluctuates between £10,000 daily in August to about £13,000 in the last month of the year. Whilst the passenger traffic is rising the goods traffic is falling, thus evidently forming a valuable counterbalance in the revenues of the companies.

According to the Report of the Water Engineer of Liverpool, the operation for the suppression of water waste has for several years been carried on most persistently, since 1873, through the adoption of Deacon's Waste Water Metre system. Had it not been for the most careful watching and stopping waste Liverpool would have suffered severely from shortness of water. But notwithstanding the prolonged drought, an almost constant supply has been maintained.

A method of cooling the air in Railway carriages during hot weather was tried recently on the Magdeburg Railway in the presence of the chief officers of the line. The experiment was made with a composite carriage with 1st and 2nd class compartments. On the top of the carriage is fixed a tank or box contaning ice, through which the air for ventilation is made to pass--the trial was regarded as satisfactory, and the temperature throughout the journey was kept at about 16° Fahr. below that of the surrounding air.

At the meeting of the American Association for the Advancement of Science, the Nicaraguan Canal came up for much discussion, and the result seems to be that in the general opinion it will be a success, while the Panama scheme and the Tchuantipec Ship Railway will be failures.

M. Jovis is to make his balloon voyage from New York to Europe, that is France, some time between October and January. He hopes to find a suitable wind in that time. The balloon is to be named "La France" and will have a capacity of 8,500 yards. M. Jovis estimates that the time occupied in the transit will range from 48 to 60 hours, but the balloon is calculated to keep aloft for four days.

THE METEOROLOGY OF CEYLON.

(From our own Correspondent.)

Colonel Clarke's report on the Meteorology of Ceylon for 1886 is comprehensive and interesting.

"In comparing the records since 1882, we see that there has been an undoubted fall in temperature throughout the Island until the present year. In the Indian Meteorological report for 1884 it was stated that the temperature had been observed to be gradually increasing until the year 1878, the year of minimum sun spots and that since then it had been decreasing. In 1884 the temperature was from one to one-third of a degree lower than in 1878."

Whether or not solar spots influence terrestial rainfall, it would seem to be certain that they modify, to some extent, the amount of heat rays which reach the earth from the sun. The subject deserves, and will doubtless receive, careful investigation. Other observations are thus stated : *Atmospheric Pressure.* In examining Table XIV. it will be seen that the results for the year are remarkably below the average. Last year on the other hand, the exact reverse was noted, the barometric pressure for 1885 having been generally high throughout the year.

Hygrometry. During this year the vapour tension and mean relative humidity at the low country stations is below the average, but at the hill stations the average is generally higher. This perhaps is partly due to greater carefulness on the part of the observers in keeping the wet bulb moist and well exposed. From a table of monthly mean temperature and that of the whole year at various stations in the island we find that (a striking contrast to continental India) nowhere did the mean temperature for the year reach 82° F. If we eliminate the exceptional figures 57·6° F. for Nuwera-Eliya (the lowest of all) 61·1° F. for Hakgala (the two mountain stations), 71·3° F. for the Eastern hill station of Badulla and 75·4° F. for Kandy, the range is from 81·5° F. opposite Mannar (the hottest place in the island, for 1886 at least) down only to 79·2° F. in the case of Vaduniya-Vilankulam. The highest monthly mean we can find in the table is 85·3° F, for Jaffna in April. April, May, and June appear to be the hottest months everywhere.

At the 4 hottest stations the means were—

	April.	May.	June.
Mannar	84·6° F	84·7° F	83·6° F
Jaffna	85·3 ,,	84·9 ,,	83·5 ,,
Trincomalie	82·7 ,,	83·3 ,,	83·1 ,,
Batticaloa	82·5 ,,	83·4 ,,	83 0 ,,

We give the annual means for the different stations in the list from the hottest to the coldest as follows:—

Mannar 81·5° F; Jaffna 81·4° F; Colombo 80·7° F; Batticaloa 80·6° F; Trincomalie 80·5° F; Puttalam 80·2° F; Hambantolla and Anuradhapura 80·0° F each; Galle 79·6° F; Vaduniya-Vilankulam 79·2° F; Ratnapura 78·9° F; all the above are only a few feet above sea level, Ratnapura alone attaining to 109 ft. The hill and mountain stations are as follows:—

Kandy (1,696 ft.) 75·4° F; Badulla (2,225 ft.) 72·3° F; Hakgala (5,581 ft.) 61·10 F and our Sanitarium Nuwera-Eliya (6,240 ft.) 57 6° F. For Kurunegala the reliable observations appear only to have just commenced being taken.

Besides the sixteen stations which extend so far west as Mannar 79° 55′ (4 minutes west of Colombo) and from 6° 1′ N Latitude at Galle to 9° 40′ at Jaffna, there are 67 rain-gauge stations reporting their observations to the Surveyor-General's Office, of which one only is in the dry zone under 60 inches There are maps shewing by colour the regions of varying rainfall from under 50 inches up to 50 inches and more, 75 and more; and 100 inches and more; 150 and more; 200 inches and more.

Average excess of Isolation over the corresponding maximum shade temperature is interesting to note, if for nothing else, just by way of warning, being 62°F in Nuwera-Eliya for 1886, and attaining as much as 72·3° F in the dry clear month of May so that with the temperature in the shade at 65° F the temperature in the sun would be 137°F. At Colombo again the temperature in the shade exceeds 90° F in April and adding only 58°F for excess of isolation we have 148°F in the sun.

It may be of interest to know that the fortifications at Trincomalie are being pushed on evidently as Mr. T. D. Mitchell has contracted for the earthwork and to provide labor to construct a battery on Osenburg Ridge and to rebuild there now known as the Portuguese, the Eastern Battery and the citadel at Fort Frederick for which the water-works coolies and staff have been sent round.

CEYLON GOVERNMENT RAILWAY.

Abstract and tonnage of goods forwarded by Rail for week ending 31st July 1887 :—

		Revenue.			
1887.		Rs.	1886.		
Passengers	...	15,992 54	Total	...	44,063·39
Horses	...	168·79			
Carriages	...	47·58			
Dogs	...	56·25			
Live stock	...	60·57			
Mails	...	425·56			
Parcels	...	995·47			
Merchandise	...	31,369·85			
Total	...	48,516·61			Rs. 44,063·39
Increase	...	4,453·22			

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, September 24, 1887.

Upper Burma.

Mr. W. B. Campbell, Assistant Engineer, 1st grade, is granted one year's leave without pay, with effect from this date.

Punjab, September 29, 1887.

Irrigation Branch.

With reference to Irrigation Branch Notification, dated 22nd August 1887, Mr. E. S. Bellasis, Executive Engineer, 5th Division, Sirhind Canal, took over charge of the Canal Agency Office, Patiala, from Major S. L. Jacob, R.E., Executive Engineer, on the afternoon of the 27th July 1887.

Mr. W. Smith, Executive Engineer, 4th grade, from the Chenab Canal Division to the 2nd Division, Bari Doab Canal, which he joined on return from the one month's privilege leave granted in Irrigation Branch memo. dated 18th July 1887, on the forenoon of the 5th September 1887.

The transfer was made in the interests of the public service.

Madras, September 20, 1887.

The Governor-General in Council is pleased to order the following promotion and reversion, with effect from the 3rd August 1887:—

Colonel K. A. Jopp, R.E., Executive Engineer, 1st grade, to Superintending Engineer, 3rd class, temporary rank.

Mr. T. H. LeMesurier, Temporary Assistant Engineer, Madras State Railway Surveys, is placed in charge of the current duties of the Office of the Engineer-in-Chief, Madras State Railway Surveys, with effect from the afternoon of the 2nd September 1887.

Central Provinces, September 24, 1887.

The following transfers in the Engineer Establishment are ordered :—

Rao Sahib D. S. Sathye, Assistant Engineer, 1st grade, from the Hoshangabad to the Jubbulpore Division.

Mr. P. W. Gilliland, from the Jubbulpore to the Hoshangabad Division.

Colonel D. Ward, R.E., Chief Engineer, and Secretary to Chief Commissioner, Public Works Department, Central Provinces, is granted two months' privilege leave, with effect from the 16th current.

Colonel Ward, R.E., Chief Engineer, Central Provinces, availed himself of the above leave on the forenoon of the same date, making over charge of the current duties to Mr. M. Leslie, Assistant Secretary to Chief Commissioner, Public Works Department, Central Provinces.

Mr. M. Leslie, Assistant Secretary to Chief Commissioner, Public Works Department, Central Provinces, will, until further orders, take charge of the current duties of office of Chief Enginser, the Secretary to Chief Commissioner, Public Works Department, Central Provinces, with effect from the 16th current.

October 1, 1887.

The services of Mr. G. Moyle, Executive Engineer, 3rd grad sub. *pro tem.*, State Railways, on his return from furlough, are placed at the disposal of the Bengal-Nagpur Railway Company.

The services of Mr. G. A. Anderson, Executive Engineer, 3rd grade, sub. *pro tem.*, State Railways, on his return from furlough, are placed at the disposal of the Bengal-Nagpur Railway Company.

Hyderabad, September 15, 1887.

Establishment,

Mr. J. H. Handley, Assistant Engineer, the 1st grade, is transferred from the West Berar Division to Secunderabad Division.

Mr. H. R. F. Ash, Assistant Engineer, 1st grade, is transferred from East Berar Division to West Berar Division.

These transfers are in the interests of the public service.

Mr. R. A. W. Swinnerton, Executive Engineer, 4th grade, is appointed to take charge of the East Berar Division with effect from the date of Mr. J. Craig, Executive Engineer's departure on furlough to Europe.

Mr. M. J. Scobie, Executive Engineer, 4th grade, is transferred from the South Berar Division to the Melghat Roads Sub-Division, *vice* Mr. Swinnerton, transferred to East Berar Division.

Mr. D. M. Scobeie, Assistant Engineer of the 1st Grade, is transferred from the Melghat Roads Sub-Division to the South Berar Division.

These transfers are in the interests of the public service.

India, October 1, 1887.

Mr. St. J. Hewitt, Assistant Engineer, 1st grade, Rajputana, is, on return from furlough, temporarily transferred to State Railways, and his services placed at the disposal of the Chief Commissioner, Burma.

Mr. A. Sprenger, Executive Engineer, 1st grade, Assam, has been granted by the Secretary of State for India furlough for three months, in extension of the furlough for eighteen months granted to him by the Director-General of Railways.

Mr. H. F. White, Superintending Engineer, 3rd class, temporary rank, is promoted to Superintending Engineer, 2nd class, temporary rank, with effect from the 13th August 1887.

The Right Honorable the Secretary of State for India has been pleased to appoint the undermentioned passed Students of the Royal Indian Engineering College to the Telegraph Department in India, as Assistant Superintendents, 4th grade:

Mr. M. G. Simpson.
Mr. G. Mahon.

Mr. J. S. Beresford, Executive Engineer, 1st grade, North-Western Provinces and Oudh, is appointed to officiate as Superintending Engineer, with temporary rank in the 3rd class, during the absence on special leave of Major F. V. Corbett, R.E., or until further orders.

Mysore, September 24, 1887.

The following transfer is ordered in the interests of the public service:—

Mr. D. Ranga Rao, Assistant Engineer, from the Hassan Sub-Division to the Chitaldroog Division, of which he will assume charge as Officiating Executive Engineer.

To join with the least practicable delay.

The following promotions are made in the Engineer Establishment of the Mysore Public Works Department, Local, with effect from the date specified:—

Mr. Y. Srinivasa Rao, B.A., Assistant Engineer, 1st grade, to be Executive Engineer, 3rd grade, permanent, with effect from 1st October 1887.

Mr. D. Sitaram Rao, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent, with effect from 1st October 1887.

Mr. A. Govindacharlu, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent, with effect from 1st October 1887.

Mr. C. Halagaiya Gauda, L.C.E. Apprentice Engineer, to be Assistant Engineer, 3rd grade, permanent, with effect from 1st October 1887.

Mr. K. Prahlada Rao, Assistant Engineer attached to the Kolar Division, is granted privilege leave for 10 days from the 20th instant or date of departure.

N. W. P. and Oudh September 24, 1887.

Buildings and Roads Branch.

Babu Mohan Lal Katcha, Rai Sahib, Assistant Engineer, 1st grade, 1st Circle, Provincial Works, is appointed to officiate as District Engineer of Jalaun, *vice* Babu Puran Chandra Chakravarti, Sub-Engineer, 3rd grade.

Irrigation Branch

Mr. C. Hill, Executive Engineer, 4th grade, sub. *pro tem*, is, on return from furlough, posted to the 3rd Circle, Irrigation Works.

Mr. J. H. I. Ivens, Assistant Engineer, 1st grade, is, on return from furlough, posted to the 1st Circle, Irrigation Works.

October 1, 1887.

Irrigation Branch.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner of Oudh, is pleased to order the following promotion, with effect from the date specified:—

Mr. J. H. William, Executive Engineer, 4th grade, to be Executive Engineer 3rd grade, sub. *pro tem.*, *vice* Major Macpherson, R.E., retransferred to Military Department.

Bengal, October 5, 1887.

Establishment—General.

Mr. L. R. Fraser, Assistant Engineer, is placed on special duty under the orders of the Inspector of Local Works in the Patna Division.

Assam, October 1, 1887.

Mr. A. B. Gatherer, Executive Engineer, 1st grade, Khasi and Jaintia Hills Division, who was transferred to Burma in Government of India Public Works Department Notification, dated the 9th September 1887, made over charge of his duties as Executive Engineer to Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, on the afternoon of the 16th September 1887.

Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, took over temporary charge of the Khasi and Jaintia Hills Division, from Mr. A. B. Gatherer, Executive Engineer, 1st grade, on the afternoon of the 16th September 1887.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong. Shanghai*, and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

NOTICE.

SHOULD a sufficient demand arise, we shall be glad to reprint Ganga Ram's Tables for Rolled Iron Beams on paper of the size of Molesworth's Pocket Book, so that Engineers may paste them in their Pocket Books.

CONTENTS.

Obituary.

McDERMAID.—On 29th September, at Cossipore, N. B. McDermaid Superintendent, Tallah Water-Works (late Chief Engineer, B. I. S. N. Co.), aged 40 years.

INDIAN ENGINEERING.

SATURDAY, OCTOBER 15, 1887.

THE BOMBAY P. W. D. SECRETARYSHIP.

THE appointment of Mr. W. S. Howard, M.I.C.E., as Secretary in the Public Works Department, Bombay, in succession to Mr. J. E. Hart, M.I.C.E., is likely to give rise to further complications between the Government of Bombay and the Government of India. The orders passed, after the late controversy between the two Governments, were, that no officer below the rank of Chief Engineer should be appointed Secretary. Now, Mr. Howard has not attained that rank yet, whereas Colonel Goodfellow, V.C.,R.E., has. The recent appointment, therefore, shows Lord Reay's final determination not to have a Royal Engineer Secretary on any terms whatever. It is not difficult to divine the *raison d'être* of this, as Lord Reay has in all probability learnt that the support and thorough *esprit de corps* of what is irreverently termed the Simla gang carry enough weight to make a Royal Engineer Secretary take up a far less subordinate attitude on departmental questions than the Governor could hope to force a Civil Engineer to occupy. Whether this be so or not, there can be no question as to the right and wrong of the case. It will be generally admitted that this journal has always upheld the cause of the Civil Engineers in the Service, and it is in their cause that we emphatically protest against the injustice with which Colonel Goodfellow has been treated in this matter. We take it that an officer is absolutely entitled to his promotion in turn, so long as he has shewn that he is capable of administering the post to which he aspires, and to which he is entitled by rank and seniority. Any proof of incapacity would no doubt be sufficient to disqualify him, but we never even heard this asserted against Colonel Goodfellow; and until this be shewn, the treatment meted out to him is glaring injustice.

These episodes in the history of the Department have always a comic side, and the present instance is no exception to the rule. The two Governments are now at a complete deadlock, and somewhat resemble a couple of angry dogs snarling at each other over a bone. The sequence of the events as they have actually occurred is nothing more or less than laughable. Lord Reay, who is evidently a man of autocratic temperament, at first attempts to "ram in" a Covenanted Civilian *protégé*, Mr. Lee-Warner, as Secretary in the Public Works Department. The above expression is, we admit, not an elegant one, but it expresses our meaning adequately enough. The Government of India promptly put a stop to Lord Reay's action, and inform him that he must appoint an Engineer, whether Civil or Military, to the post; blandly adding that if the Government of Bombay feel that they have no Engineer sufficiently distinguished to occupy that position, the Government of India will be only too glad to help them out of the difficulty, by sending them a man so qualified. At the same time the Bombay

Government get a patronising pat on the back, and are told to select the best man they have got in the Presidency.

Lord Reay now committed an act which can only be described as that of a blundering *farceur*. Mr. Hughes, the Under-Secretary, a 2nd grade Executive Engineer, was hereupon appointed Chief Engineer and Secretary, we presume on the ground that he was the senior fittest man for the post. This was really too much for Sir Theodore Hope, and the Bombay Government were again ordered to appoint an Engineer, but were reminded that only a Chief Engineer was eligible for the post of Secretary. Lord Reay then gazetted Mr. J. E. Hart, M.I.C.E., who was about to retire from the Service in another fortnight, obviously an absurd appointment, intended only to stave off the evil day when he would be compelled to gazette Colonel Goodfellow. When that day arrived, Mr. Howard, who has only attained the rank of Superintending Engineer, was appointed to the coveted post. Thus the Government of India and of Bombay are in the following position. The former have given distinct orders that only a Chief Engineer could be considered eligible for the Secretaryship, the Bombay Government first laugh at, then evade, and finally disobey these orders. The onus now lies on Lord Reay of proving that Colonel Goodfellow is unfit for the appointment, and if he can do so a Chief Engineer will have to be appointed from another province by the Government of India. We trust that this will be done, if it be finally decided that Colonel Goodfellow is to be superseded, as it is perfectly ridiculous that the Central Government should be flouted and set at defiance in a matter of this kind. If Lord Reay had been in the right we would have been the first to support him; or if the Government of India had attempted to force a *persona ingrata* upon him,—there being at the same time a suitable man available in Bombay,—the Governor would have deserved sympathy; but we fail to see in his action anything more than the "*Zidd*" of an autocratic man, whose object throughout has been merely to "sit upon" a gentleman, whose only fault is to belong to a corps to whom Lord Reay appears to have a rooted dislike. The Government of India may get the reputation of having tried to force Lord Reay to accept Colonel Goodfellow against his better judgment if they compel him to obey their deliberate orders; but their backs are quite broad enough to bear such an imputation. It is possible, that amongst a small section of the Service, there may be an outcry of this being only another job done for the Royal Engineers; but we feel certain, that the good feeling and sense of justice of the great majority of the Civil Engineers will not take this view. They have only to put themselves in the same position, or think of what their feelings would have been, if similar treatment had been accorded to a Civil Engineer, instead of to a Royal Engineer. No doubt much injustice has been done in the past, but we are now beginning to hope for a better state of things. We also hope that the Government of India will insist on their orders being obeyed, and that Lord Reay may be made to eat the leek down to the very last quarter of an inch.

THE HEALTH OF THE BOMBAY PRESIDENCY.

The difficulty of procuring reliable statistics in India, in connection with any subject affecting important public questions, especially in the matter of vital returns, is amply verified by the memorandum of the Army Sanitary Commissioner on the Administration Report of the Municipal Commissioner for Bombay, for 1885-86. The paper is highly interesting from a general point of view, but from the standpoint of a professional, it is of exceptional value, relating as it does to the engineering works constructed there within the last few years, which have an immediate bearing on the health of the town. The initial impediments in the way of securing correct information are the social customs in the East, which have the sanction of religion. Take, for example, the census of 1881; no one who has lived for any length of time in the country will dispute the fact that, as a rule, natives are loth to communicate to the public the internal economy of their household—the number of inmates, male or female, single or married—and similar information necessary for the purpose. However elaborate the preparations made by Government to secure reliable returns might have been, it was a foregone conclusion that their efforts would be defeated. The evening of the census was a remarkable occasion, an incubus hung over the country as if we were preparing for a final struggle for life or death. Everything, however, passed off quietly, with this exception that the object of all these costly preparations was not attained. The Army Sanitary Commissioner will not accept the figures of births and deaths as given in the latest returns and he has very good reasons for doing so. The population of Bombay has been estimated at 773,196, leaving out of calculation the considerable increase since then, like Calcutta, by a large changing and migratory population. Now, let us come to actual figures. The recorded births for the last three years vary from 15,182 in 1883 to 14,964 in 1885; it therefore follows that the birth-rate on the census population would be 19·35 per 1,000, but on the calculated increase since 1881 the rate would fall to 17·72 per 1,000, or about half the birth-rate in London. This is no doubt due to defective registration for reasons given above. Let us now turn to the death-rates, and we find the same inaccurate results. There is a total of 25·88 per 1,000 for the population of both sexes, a ratio, which, considering what has been the past sanitary history of Bombay, the Commissioner would not be warranted in accepting.

Similar haziness surrounds the figures relating to the cholera. It is generally supposed that water is a main medium for the conduct of the germs of the disease into the human system. But this theory seems to have received a rude shock, as will appear from the following:—In the report of the Officer of Health the following facts are given on the relation of the disease to the water-supply. Of the people using water from the Vehar and Tulsi lakes 589 were attacked and 465 died, and of the well-water drinkers, 94 were attacked and 17 died. This clearly proves that of the lake-water drinkers 78·8 per cent. died, and of the well-water drinkers 75·5 died—"results," says the Army Sanitary Commissioner, "in direct contradiction to the presumed specification of cholera-polluted water in spreading the disease."

During the past official year main sewerage works had been extended and there was a general desire expressed for making connections with the houses along the sewer lines; but those lines which are intended for house drainage are to be separate from those intended to receive or carry storm water, for which other provisions are being made.

From a report of the Municipal Commissioner for 1883-84 it would appear that the 'dry' system of removing night soil is much in vogue in Bombay and accords with the customs and ideas of the inhabitants. The Army Sanitary Commissioner draws attention to this and remarks :—" In a large densely-peopled city, such as we have shown Bombay to be, any attempt at 'dry' removal of house filth would most certainly end in a state of matters by no means likely to improve the public health, and that wherever there is water at hand, together with house connections, drains, sewers, and a suitable outlet, there is no alternative, for all the means are at hand for the immediate cleansing of houses. This must be a continuous operation at a rate of not less than 3 feet per second." He quotes the engineering arrangements of Frankfort-on-the-Maine, where the sewers and drains for 60,000 people discharge the excreta and foul water from the most distant point to the outlet within one and a half hour, the fall for half a mile being 1 in 1,000.

In the period covered by the report, water was supplied from the Vehar and Tulsi lakes by 14,448 connections, 46 dipping wells, 56 drinking fountains, 24 stand pipes, 14 large ornamental fountains, and 17 cattle troughs. A new 24-inch iron main had been laid from the Vehar lake, and the filter beds at Vehar had been completed. Bhandarwada Water Works appear to have been completed, and also the reservoir and filter works on Malabar Hill. The subject of additional water-supply from Tansa was under consideration. Concurrently with all these improvements the Army Sanitary Commissioner recommends better house construction, so as to give more breathing space to each individual, and thus decrease the risk of air stagnation, which is as inimical to health as defective drainage or water-supply.

MADRAS SCHOOL OF ARTS.

PESSIMISTS who view with disfavor the establishment of technical schools in this country would do well to ponder over the annual report submitted to Government by the Director of Public Instruction, Madras, on the progress and position of the local School of Arts for the past official year. We are ourselves no advocates of an indiscriminate founding of such institutions all over the country, whether the circumstances warrant such a step or not. The conditions operating in each locality must form an important factor in determining the question of feasibility; and when the former are favorable a consideration of finances should form no obstacle to the promotion of the good work.

There are some points in the report that call for special notice. Notwithstanding the popularity of the School, it seems strange that out of a total of 265 pupils (boys and girls) there were only four of the Brahmin caste. This shews the strong desire that section of the community entertain for purely literary pursuits, and the Director expresses a hope " that, with the growing demand for technically qualified men for art and industrial schools, a large number of Brahmin youths will adopt an art or industrial career, a career which ere long should prove as remunerative as the ordinary callings, and much more conducive to independence of character and happiness." For the past four years the number of students has been steadily increasing, together with a marked improvement in their prospects. Although the School is yet in its infancy, it has succeeded in finding appointments for four apprentices during the period under review. One a five years' engagement as drawing teacher to H. H. the Prince of Pudukota, one as drawing teacher in the Black Town Industrial School, and another a similar appointment in the Industrial School at Nazareth, Tinnevelly. One was appointed assistant draughtsman in the Government Central Museum, besides whom several other applications have been received for the appointment of apprentices as teachers.

The defect in the general educational attainments of most of the apprentices, that has stood in the way of their successfully passing the prescribed examinations, has to a great extent been removed by the establishment of an English class, which most of the students attend on Saturdays. It is even hinted that the system might profitably be extended to the general students.

Some admirable works—terra-cotta balustrading for Wellington church, ornamental flooring tiles for churches at Berhampur, Ganjam, and St Thomé, Madras, &c., stained glass windows for a church at Jubbulpore—were executed during the year.

In the department of experiments very little was done and the results of the trials with the kaolin from Katgudy shew that it is not suitable for fine porcelain, at the same time the report says that the elaborate efforts in this direction are of very little utility, without the assistance of a pottery manager combining a thorough practical and scientific training.

Apparently the statement of accounts shew very indifferent results. The receipts on sales decreased by Rs. 6,794. But this need not cause any alarm in connection with the stability of the School. It is as might have been expected. The work done for the Indian and Colonial Exhibition in 1885-86 brought in over Rs. 6,000, and the falling off in orders for terra-cotta and stained glass has been considerable, whereas on the other hand the charge for contingencies decreased by Rs. 3,093, and the fees shewed an increase.

Out of 265 pupils as mentioned above, no less than 182 were of the poorer classes, that is, whose parents drew an annual income of less than Rs. 200. This is a healthy sign, as it indicates a laudable desire on the part of their parents to prepare their children for an honorable pursuit in life. Of the girl students, 34 in number, all are of European or Eurasian parentage.

PETROLEUM.

"Palm and whale oils are dead : long live Petroleum !" In such fashion, and in capital letters, Mr. Marvin thus headed a *brochure* he put forth some twelve months ago, entitled *England as a Petroleum Power.* There can be no doubt, we take it, as to the more than moribund condition of the palm and whale oil trades, and scientific investigations in the Indian Empire *in re* petroleum assuredly promise well for the dominion of England, as a petroleum power. We need not say much about Burma, beyond that the deepest wells there have not hitherto found it needful to penetrate lower than 400 feet, and that that is a depth petroleum experts consider child's play. In America nothing is thought of boring down 2,000 feet.

It is with India proper in its relation to the petroleum trade that we are concerned to-day, rather than with Burma; for all Anglo-Indians have heard more or less of the Burmese earth oils and know that they are abundant, and that their cardinal excellence consists in the fact that they are "heavy," and, in proportion to their heaviness, safe. India is as yet a comparatively untried petroleum field, although it is well enough known that the oil is to be found in parts of Assam, the Punjab, and Beloochistan. Some years ago the Director of the Geological Survey of India wrote in an official report:—"It is, I think, a safe prophecy that the oil measures of Eastern India may be supplying half the world with light, within a measureable time, when the American oil-pools have run dry." Our present concern, however, is with Beloochistan rather than Assam. Mr. Townsend, the petroleum expert, who has secured the confidence of the Government of India will, in a few days, commence deep borings at Kattan, about 50 miles from Sibi. Borings that have not been deep from the expert point of view—only 2,500 feet to wit—have led to a conclusion that an annual yield of fifty thousand barrels of oil can safely be reckoned on, when once the live oil has been reached.

A special providence sitting up aloft specially devoted to the interests of frontier railways could not have arranged the economics of supply and demand more commodiously and satisfactorily. They have now to pay, on an average, Rs. 25 a ton for the coal they stoke with. It is estimated that there will be a saving of at least Rs. 4,00,000 per annum as a result of the substitution of kerosine for coal as motive power. It was intended at first to convey the Kattan oil in pipes along the slopes of the hills, to the nearest railway station. But, as happily happens with some proposed makeshifts, this notion was soon discovered to be an impracticable one, and now it has been decided to construct a light, narrow gauge railway to bring the oil traffic into connection with the Sind-Pishin line, at an estimated outlay of twenty lakhs of rupees. This initial outlay notwithstanding, and in some quarters it is held to be an over estimate, it is calculated that, after paying interest on cost of construction, and working expenses, a profit of two lakhs of rupees a year at least will be derived. Only preliminaries have as yet been discussed. We are told that Sir Theodore Hope will go to Kattan next month, with a view to personal investigation, and that then everything will be in a fair way to be decided on without delay.

The American Railways find that petroleum gets up steam better than coal and moreover that the supply of oil can be adjusted exactly to the amount of work done by the engine, whereby is avoided wastage due to the necessity of keeping coal burning in the furnace whilst an engine is under stoppage. On the London and Brighton line in England trials with petroleum in lieu of coal as a motive have been decidedly satisfactory. In Russia, we are told, "the petroleum refuse used has double the heating power of coal, and the wear and tear of the furnaces is reduced by two-thirds. Besides, there is great economy in the stoking, which is reduced almost to *nil.*" The steamers plying on the Caspian Sea are worked altogether by means of petroleum. Some enthusiasts are sanguine enough to believe that petroleum, as a motive power, bids fair to supersede in time, not only coal, but steam. Putting that hope on one side, in favor of assurances, we think the march of facts and experience gives warrantable hope for many most valuable utilitarian results from development of the petroleum trade. And it is, we take it, a matter for sincere congratulation that India is likely to share largely in the manifold benefits that must accrue from such results. The Indian output of kerosine is at present, of course, insignificant as compared with America's yield of 310,000,000 barrels. But there had to be a beginning to that development. There is no reason apparent why India may not surpass it. Meanwhile here is a suggestive quotation from Mr. Marvin's pamphlet, with a reference to which we commenced this article: "To-day, London finds capital to open up the oil fields; to-morrow Glasgow has to provide the boring tubes and pipe lines; the next day Newcastle is called upon to furnish tank steamers and tank barges; and the day after Birmingham tens of thousands of lamps and stoves. Thus the development of the oil fields within the Empire means briskness of trade at home, and if the mission be not a brilliant one, I can conceive none more useful in these depressed times than the publicity which a writer can give to so promising a field of enterprize.

America and Russia 'struck oil' long ago, and the exportation of petroleum is now the most flourishing industry of the two countries. England, in turn, has her chance. She has successfully struck corn in India : now let her strike oil in Burma."

THE ADMINISTRATION REPORT, N.-W. P. AND OUDH, 1885-86.

I.

Reading the Administration Report of the N.-W. P. and Oudh for 1885-86 leads one to think that if the people of those Provinces are not for the present, at any rate, contented with their lot, it must be beyond the resources of any Administration to make them so.

During the rainy season they got a rainfall exceeding the annual average by 33 per cent., and afterwards a sufficiency of cold weather showers. In consequence, all crops throve; the condition of horned stock improved greatly; pasturage and fodder supplies were abundant. There was a fall in the price of food grains. Wage rates advanced, in consequence of the demand for labor created by the railway works in progress in various parts of the Provinces.

There was no unusual mortality in any part of them and the condition of the mass of the population was, we are told, "on the whole decidedly satisfactory."

Again, there was great development of trade; a result of low prices, a low rate of exchange, and low freights both by land and sea. These aids to all persons interested in the grain business—to the bulk of the population that is to say—combined to place a ton of wheat in the English market, at a price less by 11 shillings than what it had cost in the previous year.

The export of wheat increased from 38 to nearly 82 lakhs of maunds; the total exports rose from 186 to 260 lakhs of maunds. Imports rose, during the year under review, from 1,89,52,022 maunds to 2,02,82,401 maunds; a rise very satisfactorily accounted for by coal and railway material. *Apropos*, we are reminded that during the four years of Sir Alfred Lyall's satrapy, up to the end of which the Report carries us, great progress was made in Railway construction in the North-Western Provinces. The Oudh and Rohilkhand Railway Company opened an extension 135 miles long from Moradabad to Saharanpur with a branch to Hardwar; the Bengal and North-Western Company constructed 270 miles of line, opening out the fertile tracts of country lying north-east of the Gogra; the Indian Midland Railway Company was busied on 310 miles of line, and the great bridge over the Jumna at Kalpi; the Rohilkhand and Kumaun Company opened a line 55 miles long, connecting Bareilly with the hills below Naini Tâl, thus giving easy access to that hill station, and the Military cantonments beyond. Moreover, whilst the Railway Companies were thus pushing on their work, there was considerable extension of lines constructed from provincial revenues. In addition to 140 miles from Cawnpore to Jhansi, the Cawnpore-Achneyra Railway was completed by the construction of 100 miles of new line, and a bridge over the Jumna at Muttra, which cost sixty lakhs of rupees; a railway was constructed connecting Philibit with Bareilly and the railway systems of India; and 36 lakhs of rupees have been spent on a line from Lucknow northwards, opening out the rich districts and productive forests of the Sitapur Division. The total length of railways under construction during the past four years, in the United Provinces, was 1,030 miles. 109 lakhs of rupees have been expended on them. The Report points out with justifiable pride that, before the end of the year 1887, 2,510 miles of railway will be open for traffic in the Provinces—"A mileage considerably greater than that of any other part of India, and no village except in the Himalayas, and hill tracts south of the Mirzapur district, will be more than 40 miles from a railway station."

The Betwa Canal claims notice as a successful engineering work. A masonry weir 3,114 feet in length, with a maximum height of 51 feet, was built across the river Betwa, advantage being taken of an unbroken section of hard gneiss rock extending across the bed of the stream.

On the left flank of the weir are the sluices and canal head. The channel itself is constructed to carry a maximum volume of 1,000 cubic feet per second; capable of irrigating 100,000 acres during *kharif*, when the September rain fails. The main canal, with a bottom width of 20 feet and a maximum depth of 10 feet, enters the high bank in 39 feet of digging, diminishing to 10 feet in the fourteenth mile. In the twentieth mile it divides into two channels, named the Kataund and Hamerpur branches.

The aggregate length of main line and branches is 180 miles, to which must be added 377 miles of distributaries. For the Lower Ganges Canal, on the east Kali Nadi at Nadrai, a new aqueduct has been designed to replace the work which was destroyed by the floods of October 1884 and July 1885. The new aqueduct, estimated to cost over 45 lakhs of rupees, will have 15 spans of 60 feet, and a clear waterway for the river of 23,000 square feet, capable of discharging a flood volume of 150,000 cubic feet per second without apprehension of serious scour. The total length of canal channel of all kinds in actual use in the North-Western Provinces, on the 1st April 1886, was 9,397 miles, exhibiting an increase, as compared with the length in use on the same date of 1882, of 1,098 miles, or 13 per cent. Main canal and branches shew an increase of 183 miles; distributaries shew an increase of 714 miles, of which the Lower Ganges Canal contributes 344 miles, the Agra Canal 153 miles, and the Betwa Canal 131 miles. Tried and proved by severe floods the drainage works have done their work efficiently; and they have exercised a beneficial influence on the surrounding country in reducing swamped areas, and enabling damaged land to be brought under cultivation.

Railways and canals bulk largely in popular view as prominent and grand triumphs of industrial enterprize and engineering skill, which appeal to the imagination. Road-making, on the other hand, is common-place, though of course every schoolboy knows (and some grown up men are apt to forget) that without well bridged roads to act as railway feeders, railways can do comparatively little for the trade of a province. We are glad to find in the report before us record of good work on roads as well as railroads, work that has been carried on *pari passu* with them. We are told that:—"during the past four years a total sum of Rs. 13,37,000 has been spent on original works of communication by provincial and Rs. 27,00,000 by local agency, or a total of Rs. 40,37,000. The greater part of this sum was devoted to the construction of—(1) first and second-class new roads; (2) 50 large bridges; and (3) the metalling, raising, and improving of several hundred miles of existing roads. Of the new first-class roads constructed the greater portion have been short lengths of feeder roads, connecting the provincial roads with the railway lines." Amongst the important bridges which have been constructed may be mentioned the combined road and railway bridge over the Kitcha river, on the Bareilly and Naini Tâl road, costing Rs. 1,79,000, and the combined road and railway bridge over the Deoha river on the Bareilly-Philibit road, which cost Rs. 2,00,000.

Notes and Comments.

THE DIRECTOR OF PUBLIC WORKS, CEYLON.—Mr. R. MacBride is expected back in Colombo during the first week in November, shortly after which Mr. R. D. Ormsby will probably go on leave.

RAILWAY APPOINTMENT.—Mr. W. H. Parker, Superintending Engineer, has been appointed to the charge of the Pattiala-Bhawalpur Railway, the construction of which has just been sanctioned.

ANOTHER RETIREMENT.—Mr. J. C. Vertannes, Superintending Engineer of the South-Western Circle, has succeeded in obtaining two years' special leave, preparatory to retirement from service, and will probably leave India for good shortly.

THE IRRIGATION SECRETARYSHIP, P. W. D., MADRAS.—We are glad to learn that the excerpt given in our issue under the heading of "Current News" of the 24th September regarding the abolition of the appointment of Joint and Assistant Secretary, Irrigation Branch, Madras, is without foundation. Colonel Mead, the Joint Secretary, and his Assistant, Mr. Davidson, are very much in request, and no one in the South of India has heard any hint to abolish either of them.

A SUGGESTION.—*Apropos* of the Bombay imbroglio, we might suggest that if the Bombay Government cannot appoint a Chief Engineer to the Secretaryship, the Bengal Government could possibly manage to provide them with one. For nearly twenty years only two Bengal Civil Engineers have been promoted to the rank of Superintending Engineer, in the Provincial Branch—Messrs. Anley and Wickes—so that Bengal has not very much reason to be grateful to the Government of India for an excess of the good things of this life.

AN APPROVED DEPARTURE.—The acceptance of the loan of the services of State Engineers by Railway Companies being found to be costly, involving, as it does, besides high salaries, costly pensionary contributions, Mr. Robinson, the Acting Agent of the Madras Railway Company, has applied to his Board of Directors for the services of two Assistant Engineers to take the place of Mr. Shelbourne,—whose services with the Company have been terminated,—and of Mr. Bullmore, deceased. The Government have approved of the application.

THE LATE BABU SHIV DAYAL, B.A.—We regret to record the death of Babu Shiv Dayal, Executive Engineer, Bellary-Kistna State Railway, who died at Rungapuram in the Guntakal Division on the 9th ultimo. The deceased was a graduate of the Government College, Lahore, and passed out of Roorkee in 1874 under the emergency of the Bengal Famine Works. He attained the 35th year of his age, having served in the Department upwards of 13 years. His brother is the well-known Rai Malraj, M.A., Subordinate-Judge, Rawal Pindi, Punjab.

RAILWAYS IN PERSIA.—Persian contractors are reported to have been buying rails and railway plant in France and Belgium for the first important line to be constructed in Persia with Persian capital. It was said some time ago that an attempt would be made to raise a Persian loan of £8,000,000. A Teheran correspondent says that this is not so. He doubts whether the Shah has absolutely given away any railway concessions, but he says that if he has done so the entire work will be done by the concessionaires, who are Frenchmen, at their own expense.

SWARNAMURKY BRIDGE, MADRAS RAILWAY.—The two out of the nine thirty feet arches of the Swarnamurky bridge at the eighty-first mile, N. W. Line, Madras Railway, which fell in November 1886 on account of floods in the river, having been rebuilt, they were recently inspected by Colonel K. A. Jopp, R.E., the Senior Deputy Consulting Engineer for Railways, and passed for public traffic. The cost of reconstruction is Rs. 42,000, and, as the failure of the old arches is attributed to their having had brick foundations, the present piers have been founded on rock.

THE CHIEF ENGINEERSHIP, BENGAL.—We are glad to hear that Mr. E. J. Martin, M.I.C.E., F.R.I.B.A., is on his way from England to rejoin the Public Works Department, and that his health is completely restored. As there is every probability of a Chief Engineership falling vacant next month, Mr. Martin may hope to obtain it, as he is qualified for it in every way, and is the senior officer available. Mr. Martin's experience on Railway work and his well known ability as an Architect, mark him out for the appointment in question, which is in Provincial Work.

THE TELEGRAPH DEPARTMENT:—It is said that a despatch from the Secretary of State regarding the block in promotion in the Telegraph Department authorizes the Government of India, with a view to facilitating promotion, to offer exceptional pensions to a large number of officers, as an inducement to retire before the time when, under existing rules, they become entitled to pension. The officers chiefly affected by this offer are those who came out in the years 1869, 1870 and 1871, A reorganization of existing grades in the Department. is also believed to have been ordered, and it is hoped that it will afford immediate promotion to several officers.

A COMPULSORY PRIVILEGE.—It is rumoured that another circular is about to emanate from the India Secretariat, granting special leave (to count as service) for two years on half pay to a certain number of Engineers in the Public Works Department. A condition will be attached to the effect, that if the services of such gentlemen as wish to avail themselves of this privilege are required they must return to India on due notice being given to them, and come out again within one year of their taking leave. If, on the other hand, a sufficient number of officers do not go on leave, names will be selected by the various Administrations, and the lucky owners of the same will be compelled to go, whether they like it or not.

ANOTHER AMERICAN NOTION.—Colonel John H. Pierce, of Plantsville, Connecticut, has a notion of connecting the old and new worlds by means of submarine pneumatic tubes, of large proportions, and laid after the manner of the Atlantic cables. They are to be laid exactly straight, "or as near straight as the surface of the globe will permit," and are to be operated on by propelling currents of air, which the sanguine Colonel deems it will not be difficult to secure, by means of a great number of steam fans, on the principle of those used in blast furnaces. Friction would be prevented by call bearings. A speed of 1,000 miles an hour the idealist considers by no means impossible with a polished steel surface for tube lining. The speed, we are told, "owing to the curvature of the earth's surface will tend to overcome all weights, and make the pressure greatest on the upper portion of the tube, when running at maximum speed."

THE SUKKUR BRIDGE.—An American paper commenting on the scaffolding used for erecting the iron work of the Sukkur Bridge before sending it out to India, says that this proceeding either indicates that British corporations have more money to spend than others upon what would elsewhere be considered a very unnecessary and wasteful precaution; or, they have less faith in the skill and honesty of their bridge builders. The Sukkur Bridge will be 820ft. long between main posts and is quite a cantilever. But even with these dimensions American workmen would consider a steel-tape quite as efficient and more economical, in securing mechanical accuracy, than the "24 lineal miles" of timber here wasted in false works. It dilates on the folly of such an expensive method of testing the theories of a bridge designer, and adds that the better plan would have been to have originally secured the services of an Engineer whose ideas on bridge construction did not require "24 lineal miles of false works" to prop them up.

A Hopper Dredger for Bombay.—There was successfully launched on 3rd September from the shipbuilding yard of Messrs. Wm. Simons and Co., of Renfrew, one of their patent hopper dredgers. This vessel has been constructed to the order of the Bombay Port Trust, and built from designs revised by Mr. George E. Ormiston, C.E. This vessel, which is one of the largest and most complete of its type yet constructed, is of the following dimensions:—Length, 222ft.; breadth, 40ft.; depth, 15ft.; and the hopper, which is situated near the centre of the vessel, is capable of containing 1,000 tons of dredged material. There are two pairs of compound surface-condensing engines, of 1,100 I.H.P. collectively, and working independently of each other—one pair only being required for dredging; two steel boilers, with corrugated steel furnaces, having a working pressure of 95lbs. per square inch; centrifugal pump, auxiliary engine for driving the hoisting gear, hopper door winches, steam steering gear, and turning lathes.

Fires in Theatres.—These are chronic, heartrending, terrible corollaries on our vaunted 19th century of progress. The horror has lately been accentuated in England by the sad disaster at Exeter. *Ex Oriente lux*, the old proverb runs. Cannot some Indian Engineer, unprejudiced by the stuffiness tradition has taught English architects to regard as an integral, indispensable part of English theatres, devise some plan by means of which exit may be made easy, and protection and ventilation secured at one and the same time? There would of course be opposition at first to any departure from old fashioned, suicidal designs; but assurance of protection from fire would, we venture to think, prove more potent in the long run. And we think that an Anglo-Indian architect, not having the fear of a draught always before his eyes, is far more likely to hit upon a scheme for a patent safety theatre, *à la* Bryant and May's matches, than their stay at home, cold and cough wedded compeers in England. That there are draughts and draughts is an axiomatic fact, with the sense of which the average Englishman who has never travelled, has yet to be indoctrinated.

Ancient Wells.—Mr. Baldwin Latham, says that as the art of well-sinking developed itself at an extremely early period, and long anterior to the commencement of history, no very great advance has been made in it; indeed, the mode usually adopted at the present day when sinking wells to a great depth in loose strata—by first forming a curb on which the ordinary steining is placed, and which settles down as the work of excavation is carried on within, and thereby preventing the loose soil falling into the well—was practised ages ago in sinking wells in the East, and from them we have copied the mode in more modern times. Wells of excellent construction abound in Hindustan, China, Japan, Tartary, Egypt, and elsewhere. When the British took possession of Hindustan, the number of wells in use in that country was estimated at 50,000. Many of the ancient wells were of great depth. The wells of Cabul are from 300ft. to 350ft. deep, and many of them are but 3ft. in diameter. The famous well at Tyre is said to be 630 fathoms in depth. Jacob's well at Samaria is 105ft. deep and 9ft. diameter. The well Zem-Zem, at Mecca, is 210 ft. deep, and that of Jacob's, at Cairo, 300ft. deep.

The Inspector-General of Stores.—The vacancy caused by the death of Major-General Hyde, R.E., the Inspector-General of Stores at the India Office, the *C. and M. Gazette* thinks, may possibly not be filled up at once; but if the appointment is to be continued, it is to be hoped that claims of the Civil Engineers in the Public Works Department will not be ignored. Nearly all, if not actually the whole, of the appointments in connection with the Public Works Department at home have been held hitherto by retired Engineer Officers. A correspondent points out that we have General Strachey, R.E., in the Council; Sir Alexander Taylor, R.E., at Cooper's Hill; Colonel Williams, R.E., as Deputy Secretary; Colonel Jopp, R.E., (now Mr. Jopp,) as Director of Contracts; and there was General Hyde in the Stores Branch, besides one other Royal Engineer officer. If there is any special pleasant bit of work to be done from the India Office, the R. E. seems to fall into it. We have Colonel Luard at Milan; Colonel Shepherd in Mexico; Colonel Wallace, in Germany, and so on; but the C.E. seems to be "out of it." The jealousy between the two elements in the service is not surprising under these and other irritating conditions. If there is one person more fitted than any one else to fill General Hyde's place it would seem to be Mr. G. L. Molesworth, who, we believe, is about to retire shortly, and would, probably, gladly take up the duty.

Retirement of Officers of the Public Works Department.—The Governor-General in Council is pleased to rule, that any Civil Engineer of the Public Works Department, who on reaching the age of 50 years has not attained the rank of Superintending Engineer, will be liable to be called upon to retire, provided—(I.)—That no officer having less than 25 years' service to his credit for pension shall be called upon to retire under this order within two years of the present date. (II.)—That no officer having less than 20 years' service to his credit for pension shall be called upon to retire under this order within three years of the present date. (III.)—That an officer called upon to retire under this order shall be allowed to take any furlough admissible under the rules before his final retirement, subject to the condition of Section 110, Rule 9A, Civil Pension Code, in regard to retirement on attaining the age of 55 years. This rule to be in force for five years from the date of this Resolution. A Military officer in the Public Works or Military Works Department, who on reaching the age of 50 years has not attained the rank of Superintending Engineer will be liable to be called upon to vacate his appointment, provided that before finally quitting the department under this order, he be allowed to take any furlough admissible, under the rules and allowances of the Public Works Department applicable to him. This last proviso to be in force for five years from date of this Resolution.

KARRACHI AND ITS FUTURE.—Reuter says that the *Times*, commenting, in a leading article, on the present position of Karrachi, holds that its decline in prosperity is only too apparent, and demands prompt and serious attention to the matter, on the part of the Government of India. Speedy construction of a line of railway between Hyderabad and Pachbadra, and the Meywar States is insisted on, as a necessity alike on commercial and military grounds. It is a fashion in jealous journalistic circles to decry and minimize the power of the *Times* on public opinion. It is a cant without reasonable basis, and with which *Indian Engineering* does not hold; and we look upon the *imprimatur* of the leading, more or less inspired, London journal as an augury for good. It will satisfy doubting stay-at-home English hearts as to the feasibility and utility of the project—and that much given, all the rest will be easy sailing enough. In these days of telegraphs, and globe-trotters in search of a sensation the Government of India is too much afraid of the Parliament at Westminster to do what it knows to be good for the country under its governance. Lord Dalhousie was the last great Indian Proconsul who had courage enough to stake his reputation on the well informed opinion of himself and his Council against dillettante, uninformed Parliamentary fads. He was the father of Indian Railways. We would fain hope that his mantle has fallen now on the *Times*, and that its efforts will be crowned with commensurate success. At any rate we incline to accept its advocacy gratefully, as a good omen; and a signpost likely to be followed by the commercial world.

ALTERATIONS IN THE UNCOVENANTED SERVICE PENSION RULES.—The Right Honorable the Secretary of State sanctions the grant of invalid and compensation pensions to members of the Uncovenanted Service on the following scale, *viz.*, $\frac{10}{60}$ths of the officer's average emoluments after 10 years' qualifying service, and thereafter an additional $\frac{1}{60}$th of average emoluments for each additional year's service up to 24. $\frac{30}{60}$ths of average emoluments after 25 years' qualifying service. The maximum limit for half-pay pensions will be Rs. 5,000, and the maximum for the pensions for 10 to 24 years' service will be 10 to 24 twenty-fifths of that amount. The Governor-General in Council directs that from the 17th August 1887, the date of the receipt of the above quoted Despatch, the new scale of invalid, compensation, and superannuation pensions be substituted for that stated in section 113 of the Civil Pension Code. Officers now in service, who may, within six months from the date of this Resolution, retire from the service of Government under circumstances which entitle them to a pension for service of 15 years and not exceeding 20 years, may be allowed pensions calculated under the old scale, if it is the more favourable to them; otherwise the new scale will be applied to all officers retiring on or after 17th August 1887. Invalid, compensation, and superannuation gratuties for service under 10 years and for inferior service will be calculated as at present. The provisions of Section 124, Civil Pension Code, for condonation of deficiencies of service do not apply to pensions granted on the graduated scale now sanctioned.

Current News.

GOOD results have been achieved by the Government in Burma in training Burmans and Karens in survey work.

A RESOLUTION will be issued shortly giving the results of the final detailed surveys for the Umballa-Kalka Railway.

GENERAL CHESNEY and Sir T. Hope will make a frontier tour about the same time as Sir Frederick Roberts and Lord Dufferin.

THE total area irrigated in the Punjab last year was 940,507 acres, being an increase of 78,400 acres as compared with the previous year.

THE total rainfall at Cherapunji from the commencement of this year up to the 22nd of September has been 423·25 inches, as compared with 444·18 inches during the corresponding period of last year.

THE railway bridge over the Chinee Creek, near the Custom House at Karachi, is fast approaching completion, and the Railway authorities hope to be able to convey the Viceroy over it from the camp to Keamari during his visit there in November.

ORDERS have been issued sanctioning deep borings, up to 1,300 feet, to test the full capacity of the petroleum oil fields near Sibi. All the necessary machinery is now on the spot, and the question of the capacities of the supply should be soon put at rest.

THE Behar paper states that lands are being taken up on each side of the river for the defences of the Sone Bridge, and that it has been decided to erect defensive works at all the large bridges on railways in India as a part of the internal line of the defences of the country.

THE Secretary of State for India has allowed the Government of Bengal to use its own discretion in the matter of the discontinuance temporarily of the scholarships awarded to distinguished graduates of the Calcutta University to go through a course of study at the Royal Agricultural College at Cirencester.

THE Bombay Government has again pressed on the Government of India the urgent necessity there is for some legal enactment regarding land within cantonment limits. When it is considered that this matter has been under discussion for the past twenty years, we think that it is time some decision was come to.

A PROPOSITION has been made to the Government of the Punjab by Mr. Noble, a petroleum mine-owner in Canada, to prospect for oil in the noth-west corner of the Punjab, in respect to which a favorable report has been submitted by Mr. Townsend, the Superintendent of the Petroleum Operations in Biluchistan.

UNDER instructions from Army Head-Quarters the following movements of the Royal Engineer officers have been ordered:—Lieutenants Huleatt and Percival to join the Bengal Sappers and Miners at Roorkee; Lieutenant Wright to join the Madras Sappers and Miners at Bangalore; and Lieutenant Duff to join the Madras Sapper Company at Mandalay.

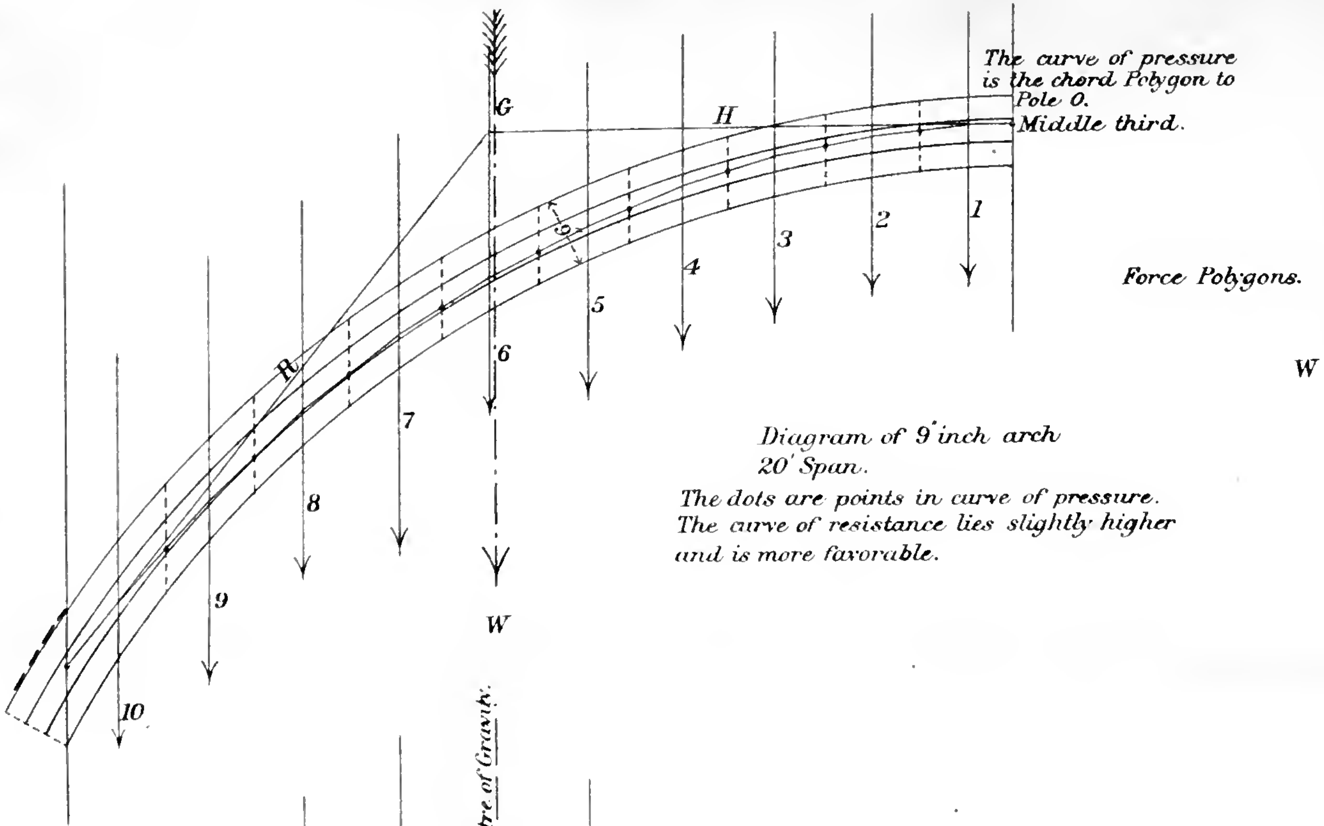
MR. RUNDALL, the Superintending Engineer, 2nd Circle, including the Bezwada District, Madras, has submitted plans and estimates amounting to Rs. 51,000 for the construction of a Boat Dock at Bezwada on the Ellore Canal. The excavated soil is to be utilized in raising the site of the Bezwada station, which has arranged to carry it free. The Public Works Department will supply the coolie labor.

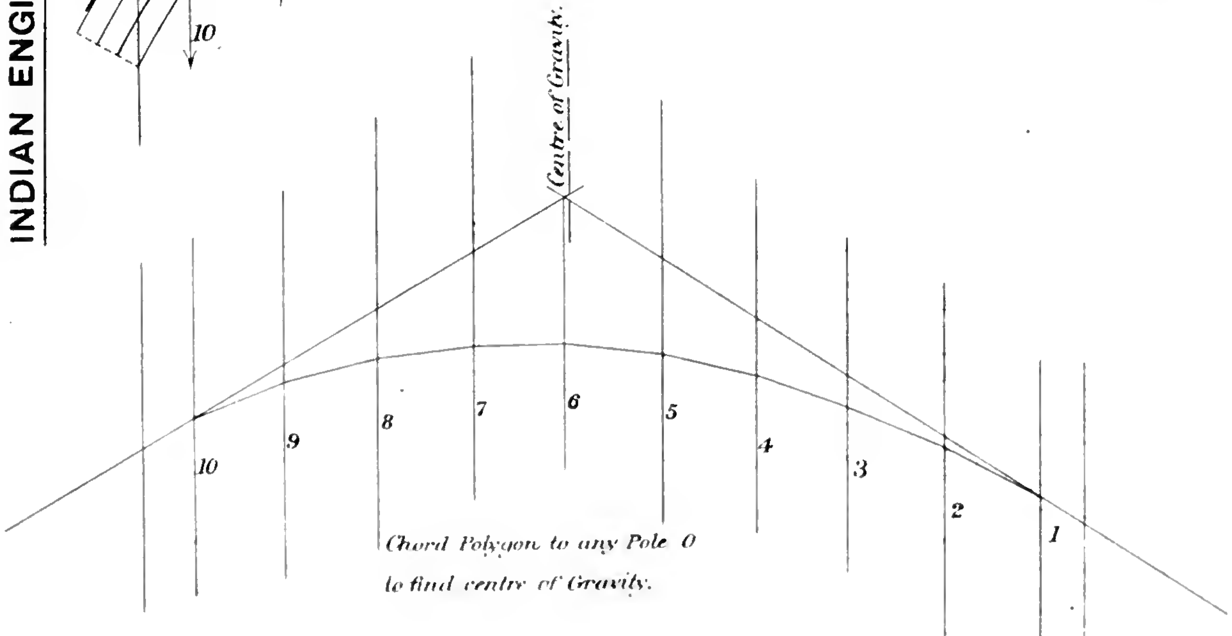
THE name of the Guntakal station on the Madras Railway is to be changed to Timmancherla, as verified by the Revenue Department, instead of Timmicherla, as suggested by the Railway authorities,—the former being the name of the village near the Railway station. The change has been found necessary in view to prevent confusion in the address of parcels, &c., to the Guntakal station, and to the Guntakal Junction station.

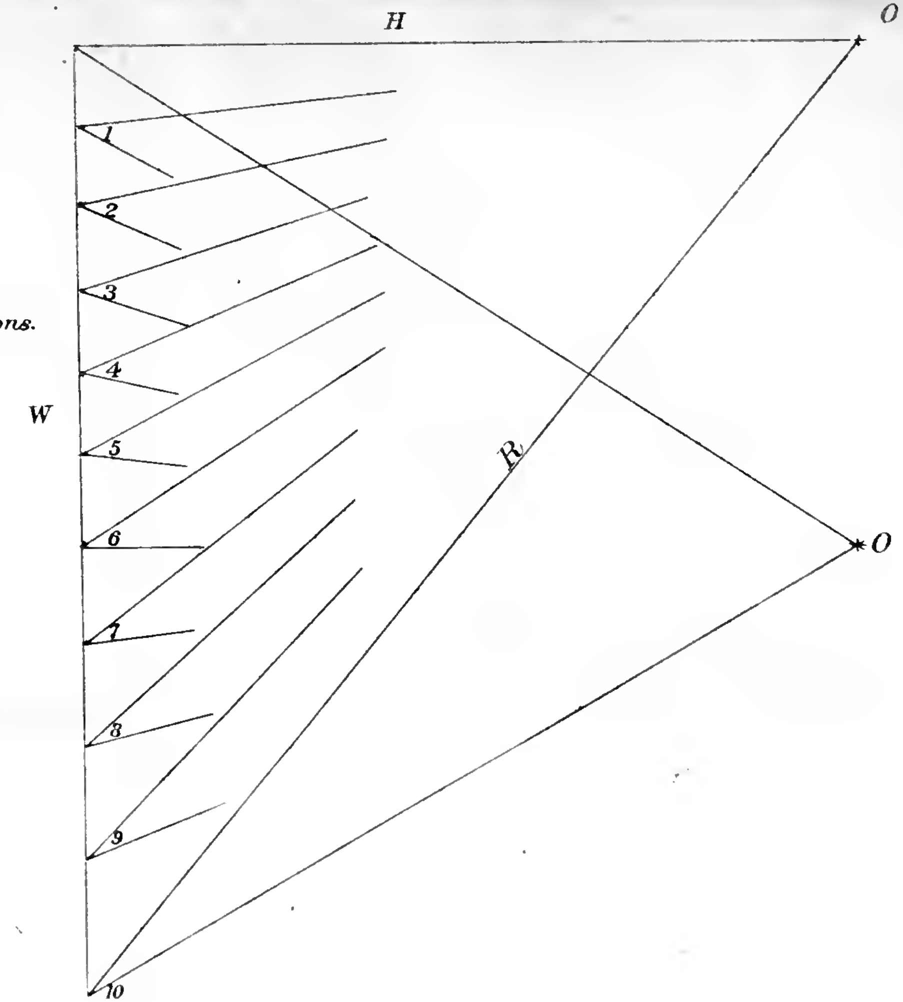
THE vacancy caused by the retirement of Sir Bradford Leslie has been filled by the appointment of Mr. D. W. Campbell, C.I.E., as Agent. Mr. Campbell has been in the service of the East Indian Railway for nearly thirty years, during the greater period of which he served as Locomotive Superintendent. He was recently created a Companion of the Indian Empire, is Colonel of the E. I. R. Volunteers and Honorary Aide-de-Camp to his Excellency the Viceroy.

Two contributory causes to the recent fatal accident on the North-Western Railway were, that the amount of waterway provided for in the embankment was only a third of what would be adequate for such a flood, and only the alternate "pot" sleepers were tied transversely. The sinking or softening of the earthwork allowed the united sleepers to part when the weight of the engine came upon them, and that led directly to the wreck of the train. The sanction of Government has been accorded to a proposal to tie all the sleepers, and, in reconstructing the line, to make an addition of some three-fourths to the waterway.

A PROPOSAL is afoot, and is being well supported, for the construction of a broad gauge line of Railway from Delhi, *viâ* Rohtak, Bhivani, Bikanir and Jessulmere, to Hyderabad and Kotree. This would be about six hundred miles in all, with a continuation through Kurnaul to Umballa and Kalka. This *route* saves one hundred and sixty miles in distance between the North-West and the seaboard; four hundred miles on the present line of communication with Karachi, *viâ* Lahore, and it is believed that it would







ARCH ROOFS

BY

W. G. BLIGH,
Ex. Engineer.

The "STAR" Press, 19, Lall Bazar, Calcutta.

also prove of great strategic value. The cost of making would be low, and the traffic prospects are considered good.

THIS year the Kistna has had high floods and the Canals are reported to be all full. Cargo is plentiful for the boats, and so also is discomfort for passengers. The offices of the Bezwada Anicut Superintendent and the Executive Engineer are close to the place where all boats land, but these officials do not enforce strict obedience to the rules. The Railway works are not progressing rapidly on account of the rains. The Vijayavada Sabha is making great preparations to celebrate the anniversary. Colonel Olcott is expected at the festivities. The Railway officials seem to know nothing of the buried Yogee, but the Sabha, to all appearance, is exerting itself in the matter.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

NEW TYPES OF CHEAP ROOFS.

SIR,—Will Mr. Bligh, the author of "New Types of Cheap Roofs," kindly inform us why he has used two different formulæ, *a.d* for finding the modulus of rupture of the rail section and $\frac{I}{c}$ for finding the strength of 60lb. rail.

Do they represent the modulus of one and same section? If so, how can the results obtained from them be made to agree with each other.

DORABJEE B. RABADINA.

BOMBAY; *October* 6, 1887.

A PROBLEM.

SIR,—A locomotive travelling at the rate of 30 miles an hour has her big connecting-rod snapped in two in the middle of her stroke. The questions arising therefrom are whether (1)—will the piston in connection with same connecting-rod halt within the cylinder—at the moment the accident occurs? or will it travel in the direction assigned to it by the valve (before the accident) towards the cylinder cover facing it? And (2)—will the piston come in contact with this cover and blow it away or will a cushioning be formed as is usually allowed? All other parts of the Engine are supposed to remain perfect.

A great many contradictions having been entered by many parties in reply to the above, I beg to refer the matter to you and the public (interested) through the medium of your Journal for the better satisfaction of one and all.

The reply may be based either on theory or practice.

ENQUIRER.

THE BENGAL NAGPUR RAILWAY AND THE BENGAL COAL-FIELDS.

SIR,—If the Bengal-Nagpur Railway is to run from Rughunathpur to Asansol, who is to pay for all the work that has been done, and pay the rent for the last four years for the land that has been taken up between Rughunathpur and Sitarampur?

The Government cannot take up land, cut it up with cuttings and embankments, and hold it from rayyats and companies for four years, then give it up on the plea they do not want it or of heavy claims. We know the coal companies that allowed their lands to be taken up are willing to accept any reasonable offer for compensation. Government asked the different companies to send in their claims for land compensation for surface and minerals, which they did, but up to date they have received no reply; yet we are given to understand by some of the "knowing ones" that the line is to be diverted, because of the coal companies' heavy claims.

Government have got an Act passed to enable them to take up mineral lands for railways; why is this not adopted to work the screw on the colliery pioneers?

We understand that seven lakhs of rupees has already been spent on the line between Rughunathpur and Sitarampur.

October 3, 1887. IRON.

P.S.—Other people are only waiting to make this line, if Government take their hands off the work.

ARCH ROOFS.

SIR,—In your issue of 1st October some strictures were passed on my article on arched roofs, which I wish to reply to categorically.

1st.—It is easy to prove, that the quadrant form of arc is more economical than the flat $\frac{1}{8}$ rise which is recommended by Mr. Stoney.

The length of the 2 arcs are approximately as 12 : 13.

In the flat arc, concrete packing, which is necessary to flatten the slope of the exterior of the roof, is dispensed with. Hence we have in the flat arc a saving of $\frac{1}{12}$th of the arching and all the concrete. Against this the horizontal thrust of the flatter arch is $2\frac{1}{2}$ times that of the quadrant, or, allowing for the less weight carried, we may put it at twice. Hence the sectional area of ties will have to be just double, and in addition to this, owing to the low inclination of the thrust, a rail backing plate behind the skewbacks is absolutely necessary. Mr. Stoney admits this and always uses one.

Take a 3ft. length of 20ft. span, 9in. arch.

Comparing the two arcs we have—

In favor of $\frac{1}{8}$ rise arc—

	Rs.	As.	P.
Saving in arch work $3 \times 2 \times \frac{3}{4} = 2\frac{1}{2}$ c. ft. @ Rs. 25 ...	0	9	6
Saving in concrete — 36 „ @ „ 12 ...	4	3	0
Total ... Rs.	4	12	6
or per foot run ... „	1	10 nearly.	

2ndly.—In favor of the quadrant—

Excess in Tie rods

(Two $\frac{7}{8}''$ rods being required instead of one)

	Rs.	As.
lbs. $\frac{1 \times 23' \times 9{\cdot}3}{112}$ = 2 cwt. @ Rs. 10 ...	20	0
Excess in rail backing plate $2 \times 3 \times$ = 6 feet run @ Rs. 0-11...	4	2
Total ... Rs.	24	2
or per foot run ... „	8	1 nearly

Thus we have conclusively proved that the quadrant arc of 20ft. span is cheaper than the half quadrant by no less than Rs. 6-7 per foot run and this would apply in a more or less degree to all spans.

2ndly.—The curve of pressure in an arch of uniform thickness is *not* a parabola as stated by your correspondent. The load is *not* a uniform vertical one, but gradually increases from the crown towards the springing.

A glance at diagram in Plate annexed will show that the height of section 10 is more than of section 1. Under these conditions of loading the curve is a *catenary*. This curve approximates to the parabola, but is less dissimilar from the segment of a circle.

3rd.—Mr. Stoney is quite mistaken when he states that if a greater rise than $\frac{1}{8}$ be given the arch must be thickened at haunches to contain the line of pressure within. It has been proved by experiments made by Perronet, and others, that the point of rupture of all segmental arcs of less magnitude than 120° is at the springing. Now, the quadrant has a magnitude of 106° only. A quadrant arch without any backing can be safely struck as the line of pressures passes well within. I lately struck a quadrant bridge arch of 60ft. span without any spandrel backing or filling, and it certainly did not collapse, as it should have done, if Mr. Stoney's statement is to be believed. To further settle this matter the Plate annexed shews a diagram of a 9-inch 20ft. span quadrant arch ring unloaded externally. An arch is in equilibrium provided a line of pressures can be drawn within the *middle* third. No tension is then produced and the arch would stand even without cementing material. The curve (adopted after two or three trials) falls everywhere within the middle third and is an admissible line of pressures. The conditions are not so favorable as in a flatter arch, in which the curve of pressure goes nearly through the centre of the arch ring, but it fulfils all requirements of stability. Of all admissible curves of pressure, "the true line of pressure is that which is nearest the axial line." The curve drawn, apparently approximates more than other possible ones to this condition.

4th.—The real object of thickening segmental arches in bridges, etc., towards the haunches is to produce a uniform unit pressure on each section of the arch ring—the pressure on arch stones at the springing being much greater than at the crown, where it is a minimum.

I have no doubt but that a quadrant arch of 30ft. span might be constructed safely with only one 9-inch ring; but considering concrete backing is used, the cost of the addition of an extra half inch at the haunches is merely the difference between the cost of the brickwork and the concrete. I find that Mr. Stoney contributed in 1884 a very valuable Paper an Arch Roofs to the now defunct Roorkee Professional Papers. He uses wooden portable centreing of an exceedingly neat and ingenious design. In isolated buildings, such as we have in the P. W. D., it would not pay to use made centreing. The only disadvantage it possesses is that the arch has to be built in separate lengths. This must produce unevenness, and the connecting bond is wanting. Then, again, the mortar has not been given time to set properly. In my large span roofs I have left the centreing up for 2 or 3 weeks, when absolutely no settlement takes place. The weight of the spandrel filling and backing undoubtedly improves the curve of pressure in a quadrant up to a certain extent. Of course hollow bricks as designed by Mr. Stoney are a great improvement and reduce the cost of roofing immensely. They cannot be used in isolated buildings.

W. G. BLIGH.

"STEEL AND IRON BRIDGES FOR DISTRICT ROADS."

SIR,—Referring to the letter under the above heading signed "W. F.," which appeared in your issue of 20th August, I have to offer a few remarks, but before doing so I wish to make a personal explanation.

From the position which I hold in Messrs. Main & Co.'s Works it is only fair to myself to say that as I have been temporarily absent in the Australasian Colonies, and only returned two months ago to resume my position as Chief Engineer to the firm, I am in no way responsible for the designs, &c., of bridges which have appeared in your Journal, or for any of the correspondence which has been published in connection with them; nor do I feel called upon to uphold any work which has been done during my absence and without my advice, unless personally satisfied with it. I may say, however, that I am instructed by Messrs. Main & Co. to revise all designs in bridge work before having the work executed, and to rectify any errors that may exist in the strength or arrangement of the members forming the same, at whatever cost to themselves. Apologising for the space I have taken up with a personal matter, I return to the letter by your correspondent "W. F.," and while agreeing generally with the conclusions he comes to, I must take exception to the formula $a = \frac{W}{2} + \cdot0003\ W\left(\frac{l}{d}\right)^2$ employed by him in calculating the strength of struts. It would be interesting to know whence it has been derived; it certainly has the appearance of having been resuscitated from the pages of some obsolete "Engineer's Pocket Book." A glance suffices to shew that it is quite irrational, for we notice that whatever the length of strut, the sectional area required $= \frac{W}{2} + \ldots\ldots\ldots$ which means that for an infinitely short strut $a = \frac{W}{2}$, or in other words, that the working stress of wrought-iron in very short struts must not exceed two tons per square inch. But perhaps it is scarcely fair to push the formula too far; it might possibly be applicable to the case of struts of moderate length. Let us examine the case of the strut for which your correspondent "W. F." has furnished a calculation, *viz.*, that which has to bear a stress of 14 tons, ends rivetted, ratio $\frac{l}{d} = \frac{72}{3}$. He finds that a sectional area of 9 square inches would be necessary.

Compare with this the results given by formulæ commonly in use which possess the advantage of having a rational foundation in theory and for which the constants have been derived from careful experiments in recent times.

Take, *e.g.*, Gordon's formula $$P = \frac{f \times A}{1 + b\left(\frac{l}{d}\right)^2}$$

$$\text{or } A = \frac{P\left\{1 + b\left(\frac{l}{d}\right)^2\right\}}{f}$$

for which the constants b and f have been determined from experiments by Professor Unwin to be for angle and tee-sections in wrought-iron $b = \frac{1}{900}$ and $f = 19$ tons per square inch, giving a formula

$$A = \frac{P\left\{1 + \frac{1}{900}\left(\frac{l}{d}\right)^2\right\}}{19}$$

In the case of the strut above referred to, using factor of safety 5.

$$A = \frac{14\left\{1 + \frac{1}{900} \times \left(\frac{72}{3}\right)^2\right\} \times 5}{19}$$

$$= 6\cdot04 \text{ sq. in.}$$

or to employ a formula commonly used in American practice for railway bridges, the design of which especially in the case of truss bridges has been brought to a high state of excellence largely from the fact of their having been made a speciality by the manufacturers themselves, who are really in a much better position, if properly qualified Engineers, to design efficient and economical structures than a Civil Engineer in ordinary practice can be.

$$\text{It is } P = \frac{37{\cdot}800 \times A}{1 + \frac{1}{1900} \times \left(\frac{l}{d}\right)^2} \div \left(4 + \frac{6\frac{l}{d}}{100}\right)$$

$$\text{or } A = P\left\{1 + \frac{1}{1900} \times \left(\frac{l}{d}\right)^2\right\} \times \left(4 + \frac{6\frac{l}{d}}{100}\right)$$

in which it will be observed the factor of safety is made to depend partly on the ratio $\frac{l}{d}$

$$A = \frac{14\left\{1 + \frac{1}{1900} \times \left(\frac{72}{3}\right)^2\right\}}{17} \times \left(4 + \frac{6\left(\frac{72}{3}\right)^2}{100}\right)$$

$$= 5\cdot84 \text{ sq. in.}$$

The results given by these two formulæ are tolerably close and may be accepted as correct; the difference from the result obtained by the other formula need scarcely be wondered at. It must not be supposed that I defend the form of strut employed in this case, the absurdity of which is obvious.

The next bar which your correspondent "W. F." takes up is a tension one, stress 13·8 tons, form of bar $2\frac{1}{4}'' \times 2\frac{1}{4}'' \times \frac{1}{2}''$ ∠I and he hews that in it the iron will have a stress of 7 tons per square inch, thus assuming that the stress is uniformly distributed throughout its section: this, however, is far from being the case, as the stress is non-axial and will therefore produce a much greater intensity of stress on the fibres of the thin edge on the flat. Probably without much error the bar might be supposed to be in the condition of a flat bar 4 inches wide with the axis of stress at a distance of 1 inch from the edge.

$$\text{This would give a maximum of stress} = \frac{P}{A} + \frac{P x_2}{I} . x_1$$

$$= \frac{13{\cdot}8}{2} + \frac{13{\cdot}8 \times 1}{2{\cdot}66} \times 2$$

$$= 6{\cdot}9 + 10{\cdot}4$$

$$= 17{\cdot}3 \text{ tons per sq. in.}$$

And this too without making any allowance for fastenings.

The same remark about the stress being non-axial, of course, applies to the case of the strut, but as I was concerned only with the formula used by your correspondent "W. F." I have not entered into any calculations in connection with it.

GEO. GARSON, B.Sc.

PUBLIC SERVICE SUB-COMMITTEE, MADRAS.

SIR,—In my last I stated that at Sir Charles Turner's request two European Superintending Engineers were sent to him for examination, but that there were no natives of equal rank who could also have been sent to represent both sides of the question. In a country with so many jarring interests, and where natives have an inbred natural suspicion of foreigners, it seems unfortunate that the enquiry should have been allowed to extend so far, as to preclude the equal representation of both races. Englishmen rightly believe in their own integrity, and natives have also in a measure learned to respect and trust it. But in an unbiassed investigation, where every part should be, like Cæsar's wife above suspicion, and where nothing ought to have been taken on trust, the better method appears to me, would have been, to limit the enquiry within such bounds, where evidence could have been adduced equally from both European and native alike. The Madras Government apparently thought so too, when they failed to order Superintending Engineers before the Commission, till requested by Sir C. Turner to do so.

But with even all this against it, the Sub-Committee had now a last chance to retrieve past mistakes, by changing their method of eliciting opinions, for something more substantial, which would be a correct description of the works executed by European and native Engineers. It so happens that the two sets of men have been working side by side, so that nothing was easier than to ascertain the quality and quantity of work done by each, but instead of this only fair method of gauging their ability, the old system of ascertaining the opinions of the Superintending Engineers on the natives and Europeans who worked under them was again resorted to. No one will attempt to impeach the statements made by these high officers, but the natives know that they are English, and that all their sympathies, national, social, and religious, and these form nearly the whole compass of one's existence, are also English. The European Executive and Superintending Engineers dine, drink, tennis and cricket together. Their families visit each other, and they are constantly in each other's company. Often even living together. Over the walnuts and wine, official matters are re-discussed with greater gusto, and the Superintending Engineer learns all about the difficulties, disappointments and successes of the European Executive, and thus takes the amplest measure of his character and ability. But it is not so with the native. The only intercourse with the Superintending Engineer is official, there is no sympathetic explanation of difficulties, disappointments, or successes. Except what he can see on the surface and on the works, the Superintending Engineer knows very little indeed of the man. When therefore both knowledge and sympathy are on one side, is it possible to form an unbiassed opinion? I think not. On what are all opinions based? Are they not on one's knowledge and sympathies or prejudices. When these are all for the European and against the native, one's opinions must also perforce run in the same groove. However honest the individual, if he looks through green spectacles, everything will be green to him. His honesty will not change the color of the glasses through which he looks, and so it would be in this case. Sir Charles Turner as an old Anglo-Indian should have known this and adopted a system of enquiry in which personal opinion should have had no place whatever. Would he as a Judge condemn a criminal on the opinions of others, however high in rank they may be. I know he would not. The law will have nothing whatever to say to opinions, but will call for facts and acts. Would more care be given in weighing the merits of an individual than in that of a nation. What is required is an overboard judicial enquiry or none at all. When these Superintending Engineers were summoned, the natives who worked under them and whom they so fulsomely condemned ought also to have been summoned. All public records should have been produced, and the works on which these men were employed and where they failed or succeeded should have been fully discussed, and opportunities of explanation given on both sides. A few cases thus thoroughly threshed out, would be of more value than any quantity of mere opinion.

I have tried to look at this subject as disinterestedly as, and on the broadest lines, possible. I feel jealous for our English reputation for honest fair-dealing. It is our character in this respect that is enabling a mere handful of Englishmen to govern two hundred and fifty millions of aliens to the astonishment of all the civilized world. Our valor and our justice have gone hand in hand in making us the greatest nation of modern or ancient history. How every English heart wherever the English tongue is spoken throbs when English valor is tarnished. Do not we in India all recollect "Maiwand" and how readily every Englishman in the country would have buckled on and gone and wiped away that stain. I feel very much like that now when we see our English sense of justice being trailed on the ground. Nothing has excited the mind of the educated classes in India for a long time so much as the enquiries of this Commission. It was no doubt intended to give India an open proof of our desire to deal fairly by her sons, and thus to draw closer, the bonds of good feeling between the two nations, whereas now so far as it has gone it is having just the opposite effect. It appeared to me a most pitiable and degrading sight when not only in Madras, but all over India, Royal Engineers and Cooper's Hill men were asked their opinion of Roorkee and other Indian College men, and almost invariably condemned them, and then these latter rose up and condemned Royal Engineers and Cooper's Hill men. The Commission was sent forth on a mission of peace and good will, why then hath it brought forth a sword? Does it mean nothing when two educated classes of men, representing two mighty nations are urged on to rail against each other, with all the hideous feelings of caste and nationality roused up. Such feelings are easily raised, but afterwards so difficult to control, and have often been quenched only in oceans of blood, as was the case in the last French Commune.

Before the Commission went forth on its errand of opinion collection, did it attempt to dig down and examine the foundations of self-seeking, prejudice, want of knowledge, or imperfect knowledge, and a hundred other cognate reasons that go to form correct or erroneous opinions? It is surprising how very little Englishmen in India know of the people among whom they spend the best years of their lives. Sir Madava Row in writing on this subject says, and his words will be listened to with respect all over India:—"The English who are in India greatly isolate themselves from the natives. They seldom take any trouble to understand native life, feelings and sentiments. Regarding these they have very hazy ideas. Their ideas are often wrong. They see too much of their faults and too little of their virtues." Under these circumstances we would say, that if in this enquiry anything ill has been said of a man, European or native, he should be told of it, and given an opportunity of explanation, and every particle of evidence should be rejected which has not been thus judicially sifted, and there should be no place whatever for mere opinion, however high the officer giving it. The mass of information collected by the Commission is so great, that after even such a weeding out, enough will remain on which to found correct conclusions. We have every confidence that the result of this enquiry will be another triumph of English justice, which Englishmen all over the world will be proud to point to. There is, I believe, plenty room yet in this country for both European and native, and no necessity for this feud of opinions. If natives have a pre-imbibed practical knowledge of irrigation, and know something of building, the European has a similar leaning towards railways, and these have been lately developing in India at a most rapid rate. Where one door of industry in the peculiar sea-saw of time naturally closes to the Englishman, a hundred others as naturally open out to him, so that there is no necessity to try and niggardly force nature or to gag the developments of native talent. The more quickly these expand and energize, the larger the avenues of work and industry they will open out to Englishmen both in this country and at home. Even if it were not so, and if every means of employment were closed to the English in India, which I do not believe will take place for at least another thousand years, there is yet no cause for alarm. The young Englishman of to-day stands in the proud position of Milton's Adam and "Has all the world before him, where to choose his place of rest, with Providence his guide." Australia, the Dark Continent, and the isles of the sea, are beckoning to him on all sides, and will give him, and the Light he brings, a hearty welcome, so that he need shed no "natural tears" at leaving India.

This country appears to me to be moving more quickly than many suppose. It is only about twenty years ago that I heard one of the old Haileybury Civil Servants, who afterwards rose to the top of the ladder in the Madras Presidency, on opening a *Gazette*, anathematising the plebeian sounding names of the new appointments to his service. He swore against the idea that low-born and low-bred men simply by passing an examination can be made into good administrators. He said that however difficult the test passed, their whole school and home life and education were against them. The predictions have happily proved false, but, strange to say, these very same objections are now taken up by the competition men, against another set who has since risen up. History verily repeats itself both in big and little matters, and will doubtless continue to do so. We hail all these things, however, as healthy signs of motion and progress. India after lying still for ages is evidently waking up and moving rapidly when such changes can take place in the comparatively short space of twenty years. England has learnt lessons how to help such natural movements, and we have full confidence in her helping India heartily.

In conclusion, I must very sincerely thank Sir Charles Turner for the invariable courtesy he has shown throughout all this trying enquiry. He must have known that much of the matter laid before him was irrelavent, but rather than give offence, and at much trouble to himself, he has allowed it all to pass. He is not infallible and may have made some mistakes, which I have tried to point out with a desire to help him to the best of my ability. I know that whatever may be the results of this Commission they cannot please every body, but I feel sure, that he will carefully pick out the grains of gold from the mass of information collected, and build from it something that will meet the present wants of this reviving country and may God bless him and his work.

VERITAS.

Literary Notices.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS. Volume XV.

THIS volume reminds us of the recent proposal made at Newcastle-upon-Tyne to amalgamate all the Provincial Societies of Mining Engineers and to form one National Institute like that of the United States of America. The advantage of such a procedure is apparent in the volume before us, which contains no less than 63 Papers in all departments of mining, metallurgy, and geology, with allied subjects. The American Institute possesses nearly 1,600 members, distributed not only over the Union, but throughout America and the world at large. Its object is to promote the arts and sciences connected with the economical production of the useful minerals and metals, and the analytical index to Volumes I.—XV., about to be published, will doubtless prove that its aims have been more than accomplished. It would be impossible in a cursory notice to do justice to a fraction of the Papers that make up the volume under review, but it will suffice for us to say that the Transactions from May 1886 to February 1887 inclusive will bear comparison with the publications of any other professional or scientific body, whether in Europe or America.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE, 1887

WE have to acknowledge receipt of No. I. of the Volumes, for the current year of this well-known publication. The contents of the present volume are both varied and instructive; some of the Papers being of an eminently practical character and others of scientific interest. Basic slag, as would be expected, occupies a large share in the matter, but Dr. Sorby's investigations into the microscopical structure of iron and steel and the illustrations that accompany clear up some of the most complicated and difficult questions in metallurgy. Mr. Bennett Brough's Paper on the use of the magnetic needle for exploring iron ore, shews admirably how the principles of terrestrial magnetism may be applied for purposes of great economic importance. The value of the improved method given by him for the exploration and development of iron and ore cannot be over estimated. The notes on the Progress of Iron and Steel are as full as ever; while the Presidential Address shows a deviation from the beaten track in dealing, with the question of Royalties. We have only to add that the Report of the Council is very satisfactory both as regards the accession of new members and financial affairs generally.

JOURNAL OF THE UNITED SERVICE INSTITUTION OF INDIA. Vol. XV.—1887. No. 68.

THE September issue of this serial contains but little of interest to the Indian Engineer. Captain Winston's lecture on Japan, published in part, is a graphic account of the land of the rising sun. Colonel Luckhardt's article on sheltered trenches and entrenchment tools might afford hints to civil members of the profession to provide against contingencies always likely to occur, and for which it is as well they should be prepared against. Some of the other articles, notably those on Small Arm Ammunition and Boots, abound with technical details in every way worthy of the attention of the inventor. The Chart and Compass Competition of the Calcutta Mounted Rifles was an admirable scheme to develope a knowledge of reconnaissance or map reading and eye for the country. We are glad to find that the Institution has been affiliated to the R. U. S. I., London, and that its prospects are all that could be desired.

General Articles.

JUBILEE BRIDGE, BARA BANKI.

THE district of Bara Banki, in Oudh, has not been behind others in the expression of their loyalty; among other things they have constructed an iron bridge across a small river and made a road over it to the railway station from the town, the making of which will shorten the distance for carts and passengers between the station and the town by 1 mile nearly, in a length of 2½ miles; we give plans of the bridge in this issue.

The total cost of the bridge was Rs. 6,000 only, and it was completed in four months from date of its commencement.

The design is, as can be seen, a braced wrought-iron arch, of 50 feet span and 16 feet roadway between the wheel guards.

The whole of the work in bending the rolled iron forming the arch and in fitting other work and rivetting, &c., &c., was done by inhabitants of Bara Banki district, and most of the raw material was obtained from Messrs. Burn and Co. of Calcutta.

The ceremony of driving the last rivet was performed by Rajah Tassaduk Rasul Khan, of the Bara Banki district, in the presence of some 2,000 spectators, and in the evening the bridge was illuminated and there was a display of fireworks, but an unfortunate downpour of rain came on about half an hour after dark and gave one but a very short glimpse of them.

The Jubilee Committee also propose to build a clock-tower in the town, and we shall give a copy of the design in a future issue.

The bridge was designed by Mr. H. W. Hughes, District Engineer of Bara Banki, and the work was carried out under his direct supervision without the intervention of contractors, and to this latter may be greatly attributed the low cost.

SANDALWOOD CARVING IN MYSORE.

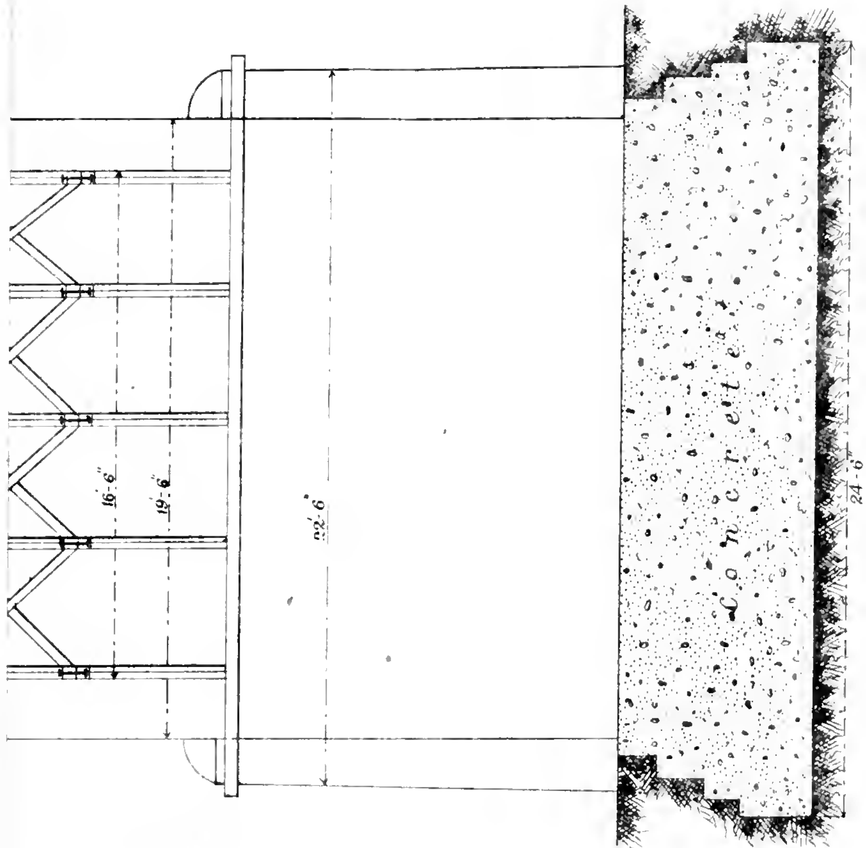
By Lieut.-Colonel C. Bowen, R.E.

THE tendency of indigenous Indian industries to localise themselves within narrow circles is well exemplified in the case of sandalwood carving in Mysore, an art which is almost entirely confined to a few towns in the north-western corner of the Province and in the adjoining taluks of Bombay. Saugor is the headquarters of the few families that practise this art and who have apparently handed it down for generations from father to son; it has never extended beyond this locality. Caste prejudices may have contributed to some extent to the retention of the craft in this particular district, but it is likely that the demand for the articles manufactured was always very limited, and there was no inducement to outsiders to intrude on the demesne of the few who were, so to speak, born and bred to the trade, more especially as the skill and delicacy of touch required could only be acquired by training from early boyhood. Under these circumstances, it is perhaps strange that the art did not die out altogether during the centuries of chronic disturbance under the Pallegar Chiefs; stranger still that it survived the period of Mahomedan supremacy. It is probable that it was kept alive by the bounty and liberality of a few wealthy local magnates, with a taste for the æsthetic, and although the policy of Hyder Ali and Tippu Sultan aimed at the extirpation of Hindu customs and traditions which invariably find expression in Hindu sculpture and carving, Mahomedan influence never extended to the remoter districts of the Province.

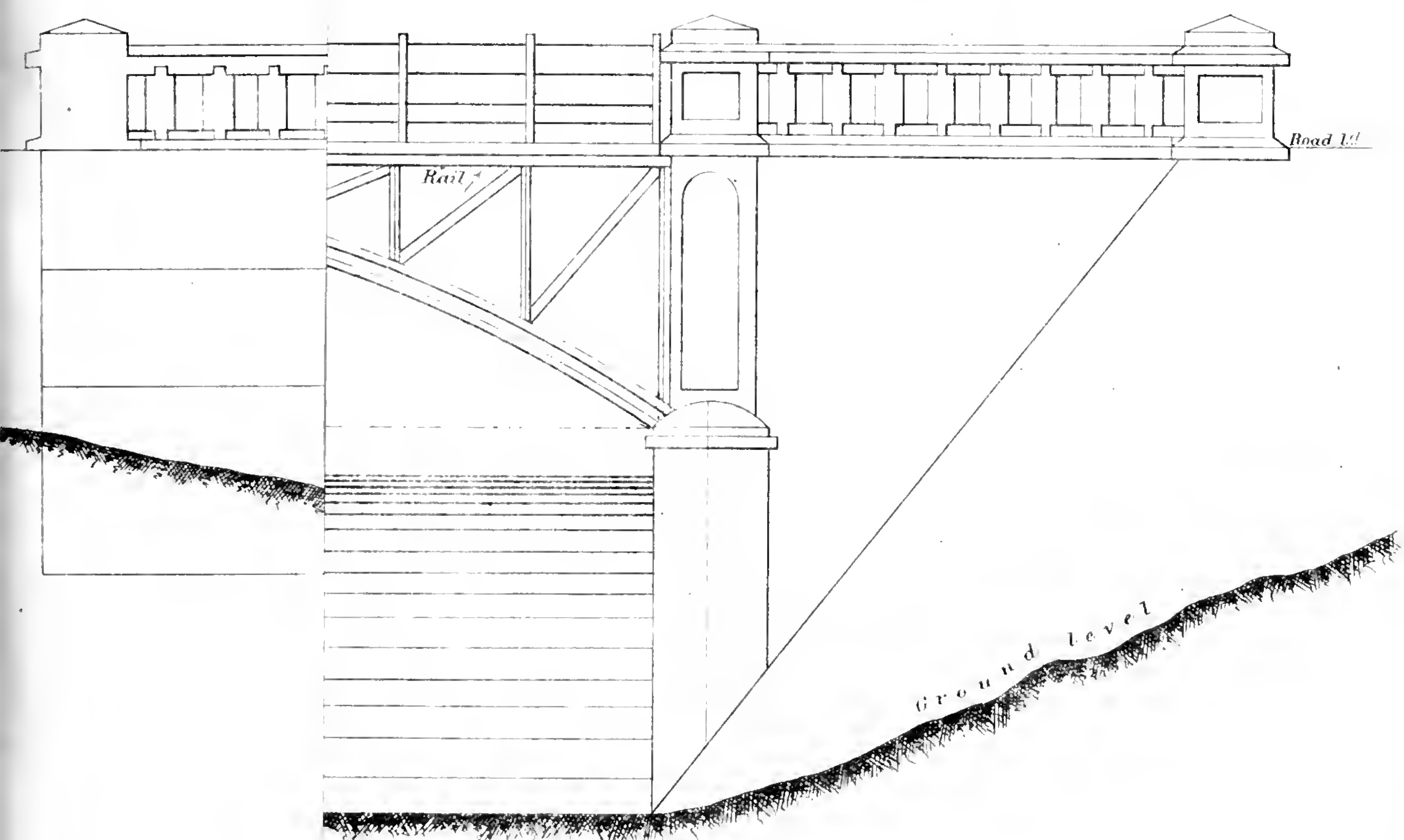
It is not known with any certainty when sandalwood carving was first introduced in Mysore, but there is a tradition amongst the Gudigars, as the carvers are called, that their ancestors came from Saptakoti, Narway, and other places in the Goa country, and that their original language was Konkani. They believe themselves to be descendants of Kshatriyas; that to escape the wrath of Parsu Rama in the 6th incarnation of Vishnu, who had vowed to destroy every Kshatriyas in the world, they adopted the profession of carvers and "Rath" or car builders, and that ever since they have been following that avocation. It is a fact worthy of notice here that "Chitragars" or painters, toy-makers, workers in lace and followers of other refined arts which administer to the luxury of man, have a similar tradition that they are Kshatriyas. They may not be descended from the old Aryan Kshatriyas, but as it has been usual for every ruling caste or class to assume the name of Kshatriya, it is not improbable that these artizans once belonged to the dominant class, but were compelled by conquest and subjugation to adopt some profession for their livelihood, and that they took to these fine arts as more in keeping with their previous habits and delicate breeding. This would imply that those Kshatriyas found the trade ready to hand, that they had only to master its technicalities, and that they ousted in course of time those who originally introduced and pursued it; it gives no hint as to its origin or early development. We must then imagine that the beauty and fragrance of the wood, the ease with which it is wrought, and the wide distribution of the insignificant tree from which it is derived, led in the first instance to its use for domestic articles. The ornamentation of these articles and of the beads, amulets, and articles of personal adornment also probably wrought from the wood in the earliest times, followed in natural sequence, just as the primitive rough-hewn temples of the ancient priests developed in course of time with the growth of the natural artistic instincts of the people into the elaborate and profusely decorated temples of a later period.

In India, as elsewhere, the art instinct of the people first found expression in the decoration of its temples, and when the instinct grew into the desire for the decoration of dwellings or of articles in ordinary use, the figures, columns, and carvings of the temples were naturally adapted for purposes altogether outside of religion. So we find that from the beginning the sandalwood carvers followed the models before them on the walls of their shrines. Unfortunately after the architects and sculptors who elaborated the walls of Belgavi and Halebid had disappeared, a period of distinct art-decadence appears to have set in, and has lasted down to the present day; no original artist arose to treat the subjects of the Hindu Pantheon with entire originality, or to effect improvements on the designs of his predecessors, and the wood carvers have slavishly adhered to the same original models with the result of establishing in their work a purely conventional style. In every article that we have seen, unless in the few cases when the copy of a European picture or print has been attempted, there is to be found the same ever recurring type of Hindu god or demon, of flower and foliage, of tracery and border. There may be diversity in the arrangements or juxtaposition of each conventional part, but the art-impression conveyed on the mind by one carved article, whatever it be, is exactly that conveyed by any other.

In mediæval Christian art we find that pictorial teachings in painting and sculpture, were the medium of propagating a knowledge of Christian facts and doctrines, and of profane and romantic history. A traditional way of treating those subjects was adhered to by artists of all kinds, and the same mode of treatment was maintained for centuries, yet we find that the mediæval artists were not mere slavish copyists, and though they retained the traditional elements of the subjects and the conventional arrangement of them with curious fidelity, the style of art varied from time to time and the artist told his story in the art vernacular of his own day. He worked very freely in the details of his picture, translating the customs and architecture, and other accessories into the fashions of his own time. In ancient Greece the same course had obtained, and it produced the greatest artists and the greatest works of art.



ELEVATION.



H. W. HUGHES, C.E.

The "STAR" Press, 19, Lall Bazar, Calcutta.

Between these and Eastern art, as embodied at least in Mysore architecture, sculpture, and carving, a parallel may be drawn as regards the adoption of traditional subjects and modes of treatment, but the parallel stops abruptly when we come to variety in expression and to modifications, or improvements of the original examples. Centuries ago in Mysore a few beautiful types were created, for a time perhaps slight variations on these were introduced, but stagnation soon followed, and artists in stone and wood degenerated rapidly into mere copyists, and copyists pure and simple they have remained to the present day.

When we come to the "technique" of his art, we find that the tools of the sandalwood carver are simple and rude, all locally manufactured; his modes of working primitive in the extreme. He works exactly as his forefathers worked, his method and means are precisely those of centuries ago. Although the number of tools employed is considerable, many sizes being required at the various stages of each operation, they may be classified simply as the chisel, the curved chisel, the graver, the gouge, the mallet, in addition to which the ordinary carpenter's drill, square and lines are employed. The carver having selected a strong-scented and fine grained log which he himself saws into slabs of $\frac{1}{2}$ to $\frac{3}{4}$ inches thick, cuts and planes it into panels of the sizes required for the article to be manufactured. He next sketches in pencil the outline of the design on the wood itself, when the design is not very elaborate; when intricate carvings are required, the drawing is made on thin paper which is pasted on to the panel. He then proceeds to cut and engrave the pattern into the wood, working out the outlines roughly at first, following up the first rough stage by a finer one with a finer tool, until by degrees the bold relief and deep undercutting are patiently attained, and the finishing touch given with the most delicate of his chisels. It may seem absurd, more especially when we examine closely the best samples of his work, but it is a fact that the net result to the first-class carver of all his patience and skill is for a carved slab, at the ruling prices, the equivalent of a wage of Re. $1\frac{1}{2}$ a day. The apprentice, always a member of the family, begins by simply watching continuously and with close attention the various stages in the work of the master, then he is put to practise on pieces of waste wood, after which he is promoted to the actual carving of inferior articles. He never actually assists the master, who never even guides his boyish hand or shews him how to select and handle the tools; he learns simply from patient watching and imitation.

Such is briefly the history and description of this interesting industrial art, in which Mysore claims a distinct pre-eminence. But what is to be done to raise the carver's work, hitherto confined to mere copyism, to the true level of an art-manufacture? Selected specimens of their work have recently been exhibited at the Calcutta and Indian and Colonial Exhibitions. These have been much admired and a stimulus to the demand for sandalwood articles may be thereby created. The number of good carvers is however very limited; a few of them have recently migrated to Cashmere to take service under the Maharaja of that Province, and some have obtained permanent employ under the Maharaja of Mysore, who takes an enlightened interest in their work, which it is his desire to foster and encourage. An enhanced demand is more likely to result in a deterioration of workmanship than in any advancement in style and design; we will have quantity, not quality. The present families of carvers being so few and apprenticeship having to commence at a very early age in order that the necessary delicacy of touch and manipulative skill may be acquired, it would seem impossible to expect any extension of the best class of work or the attainment of any originality or variety in style without the direct intervention of the State. What shape State help should take is the problem. There is no Art-School in Mysore, nor can recourse well be had to the Art-Schools of the Presidency towns, for what would be gained as regards designing by youths attending these institutions would be lost to them as regards the essential manual skill acquired by early and constant practice. The distribution amongst the families of carvers, of suitable modern designs and patterns, periodical local exhibitions, and money prizes may do something; but it is doubtful whether anything short of the endowment of a school to be devoted entirely to this purpose, with the best of the carvers selected as masters and with liberal scholarships, will effect the revival of what appears to be a fast-decaying industry.

REPORT ON THE WATER-SUPPLY SCHEME PROVIDED FOR THE CITY OF JUBBULPORE.

By J. G. H. Glass, M. Inst. C.E., Executive Engineer.

III.

In the original design the flood water after leaving the Reservoir was to have passed along a flight of steps to the ground below, and as there is a considerable fall from the right towards the left flank below the Dam, it was decided to build a guard wall to divert the flood water to a channel some short distance below the Dam. The cill of the lowest part of the weir is 1450·92 and the level of sound rock immediately below is 1428—a difference of 23 feet. It was, as I have mentioned, originally intended to have a flight of steps between the two, over which the flood waters would pass, but this arrangement was not considered altogether satisfactory. It necessitated high flanking walls and a considerable quantity of dressed stone, and a large expenditure comparatively was therefore involved. The estimated cost for the complete Waste Weir was Rs. 16,620. A second proposal was to give a long slope of roughly packed large rubble stone from the crest of weir to the rock beneath, the stone being retained in position by nucleus walls of masonry. In this case also high flanking walls would be required, and although it is a perfectly safe arrangement it is an expensive one. Further consideration of the subject and careful observation of the action on the rock of flood water discharged by the temporary weir during the construction of the Dam, led to the proposal that floods should be allowed to fall direct on to the rock beneath without the intervention of steps or protection of any kind. This proposal was approved by Colonel Brownlow, R.E., Inspector-General of Irrigation, and by the Chief Engineer, Central Provinces (Colonel C. M. Browne, R.E.) and has accordingly been carried out.

As will be seen from the longitudinal section of the Dam which accompanies this report, there is a considerable fall from the right towards the left flank, and in consequence it was necessary to construct a long guard wall on the left of the normal escape (A), to conduct the flood waters away from the toe of Dam, and divert them to a small nala some 330 feet below which ultimately joins the main nala about 1,000 feet beyond. There is also a short guard wall on the right of the escape to prevent injury from the falling water to the soil of the hill which slopes up from it. Both guard walls are set back 8 feet from the extremities of the escape, so that flood water does not fall on them. The right guard wall has a total length of 80 feet and terminates at the base of the hill on which the right flank of the Dam abuts; and the left guard wall is 326 feet in length, and ends at the small nala into which, as previously mentioned, the flood waters are diverted. The arrangement is fully shewn in the drawings which accompany.

The weir is constructed in the manner shewn in the detailed drawing. There is no novelty in its construction whatsoever, the only departure from ordinary practice being that concrete is substituted at the crest for dressed stone masonry. This has been found to answer very well, and has the advantage of being considerably cheaper than dressed stone. The gittee used in the preparation of the concrete was made from a tough basalt broken up into cubes of less than ½ an inch on the longest diagonal, and it was well washed before being added to the mortar. The top two inches of the crest was covered with Portland cement concrete, composed of four parts cement, four parts sand and sixteen parts very fine gittee, all intimately mixed and well rammed with light wooden beaters. No surface plastering was permitted.

The waste weir arrangement was completed before the commencement of last year's rains, and during their continuance it was subjected to a considerable trial, as the rainfall was unprecedentedly heavy. The average rainfall during the monsoon season from 1850 to 1884, a period of 35 years, is 51·42 inches, whereas in last year it reached the abnormal total of 91·27 inches. From the time the Reservoir filled till the end of the rains, about three months, water was continually running over the escape, the maximum observed depth being 2'-6", and no damage worth mentioning was occasioned. To the rock, on which when the water reaches a certain depth on the weir it falls direct, no injury whatever was done, and to the masonry the only harm done was that the mortar from some of the side joints of the face stones in the footings of the Dam was washed out by the action of the falling water. The side joints have since been filled in with fine Portland cement concrete, and it is not expected the water will have any effect on this material. It is improbable that so prolonged a trial as was experienced last rains will occur for many years to come; and judging from the insignificant amount of the injury done by that trial, I think it may safely be asserted that the arrangements for passing floods is satisfactory, and that it is an improvement on the original design.

During the construction of the head works it was necessary to throw up a flood bank from the temporary escape to divert the flood waters from the quarries, as they would otherwise have been swamped and the work in consequence retarded. The bank has been made use of in the completed scheme for the purpose of diverting water passing over the second part of the escape (B) from following the natural slope of the ground, and thus causing probable injury to the pipe line some short distance lower down.

The original design for the Tower has been generally adhered to, the few departures that have occurred being chiefly in the class of work employed. The Tower is circular on plan, has an internal diameter at bottom of 6 feet, and external diameter throughout of 18 feet; the internal diameter at top is 11 feet, and extreme height from bottom scour pipe to top of floor grating is 59 feet. The work was intended to be of rubble stone in hydraulic mortar throughout, with the exception of the outer two feet, which were to be of dressed blocks set in Portland cement mortar. It was, however, considered advisable to build a better class of masonry than this, and accordingly the outer and inner stones of the circle were dressed on their sides and beds, the former joints being truly summered, and all face stones dressed to the curvature of the circle. The beds and side joints of all face stones were set in Portland cement mortar. The hearting was of specially picked basalt stone set in a superior hydraulic mortar. The greatest care was taken to obtain a satisfactory bond in the work, and this was secured by tailing the stones of each face well into the hearting. In no case were the beds of the face stones inside and out on the same level, the height of the inner course of face stones being always so arranged as to be from three to six inches higher than the same course of stones on the outer course. This was with the object of there being no through joint. This hearting besides being of uncoursed rubble almost prevented the possibility of there being any through joints, but the other arrangement made it certain that there could be none. This work was carried on uniformly and at a slow rate of progress, so as to guard against unequal settlement.

(To be continued.)

BUILDING CONSTRUCTION.

Domes and Vaults.

Arched roofs appear to have been first introduced into this country about 600 years ago by the Mahomedan conquerors of India, who built mosques for their religious worship and tombs in the memory of their distinguished dead. Some of these works, which are to be found in the seats of their former rule and prosperity, are magnificent and exquisite in design and admired to the present day for their beauty and excellent workmanship, and also as testifying to the patience and determination with which they were carried on for many years, with the immense resources of the country spent on them, while their strength and durability have been more than proved by the long test of time extending over centuries.

There is no doubt that their remarkable durability is due to a great extent to the strength and permanency of their arched roofs, generally domes and vaults, and the absence of any wood or iron in their construction. It is therefore worthy of consideration whether the principles involved in their construction cannot, with advantage, be brought into use in common buildings, with a view to make them more permanent than at present, without at the same time increasing their cost to a prohibitive extent.

The idea, it may be stated, is not a new one, as examples of domed and vaulted roofs are to be found in some palaces and court-houses handed down to us by the Mahomedan rulers, as also in a few Hindoo temples of later period and dhurumsallas attached to them. Their style is, however, too costly for adoption in common buildings, although much can be learnt from their study.

Under these circumstances it is satisfactory to know that of late years, owing chiefly to the scarcity of good building timber, an attempt has been made in some districts to introduce domed and vaulted roofs in ordinary buildings, and it is to be hoped that the same construction may be adopted in other places also where materials required for the arch are abundant. A somewhat higher cost on their account in the first instance, compared with the cost of flat or tiled roofs, may often be warranted by the greater safety and permanency of the structure and the advantages offered by the necessarily increased cubic space afforded by them. At the same time it seems probable that their present high cost will admit of considerable reduction by making their construction light and cheap and by training the work-people to carry out the work with ease and facility.

Hemispherical domes of brick or stone need no centre, as their work can be carried on, on scaffolds inside. They are often made unnecessarily thick with very thick walls to support them, making the whole work needlessly expensive. The same remark applies to vaults also and there is much room for improvement in this respect.

With good mortar and thin bricks gauged to answer a certain number of courses, 6 to 9 inches thickness of dome work, will in practice be found sufficient for rooms up to 20 feet square and the thickness of walls need not then exceed 2¼ feet. If properly dressed stones, strengthened with wooden dovetail joining pieces outside be used 3" to 4" inches thickness of the arch will be ample under similar circumstances. The cost of such construction will be found to compare favorably with other kinds of roofs.

The semi-circular form is the best for vaults as exerting the least thrust on walls and there is no advantage in making them segmental when they run longitudinally over a room. Segmental form is, however, used with advantage, when instead of one longitudinal vault several cross vaults supported on what are called carrying arches, are used as shewn in *Figs.* 1 to 4, Plate I. In this case the long wall will be free of any thrust, but the two end walls will have to bear the thrust of the two end-vaults and they are consequently made thicker than the former. The construction will thus be comparatively safer and cheaper.

G. R. T.

(To be continued.)

PLATE I.

FIG. I.

PLA SEGMENTAL CROSS VAULTS.

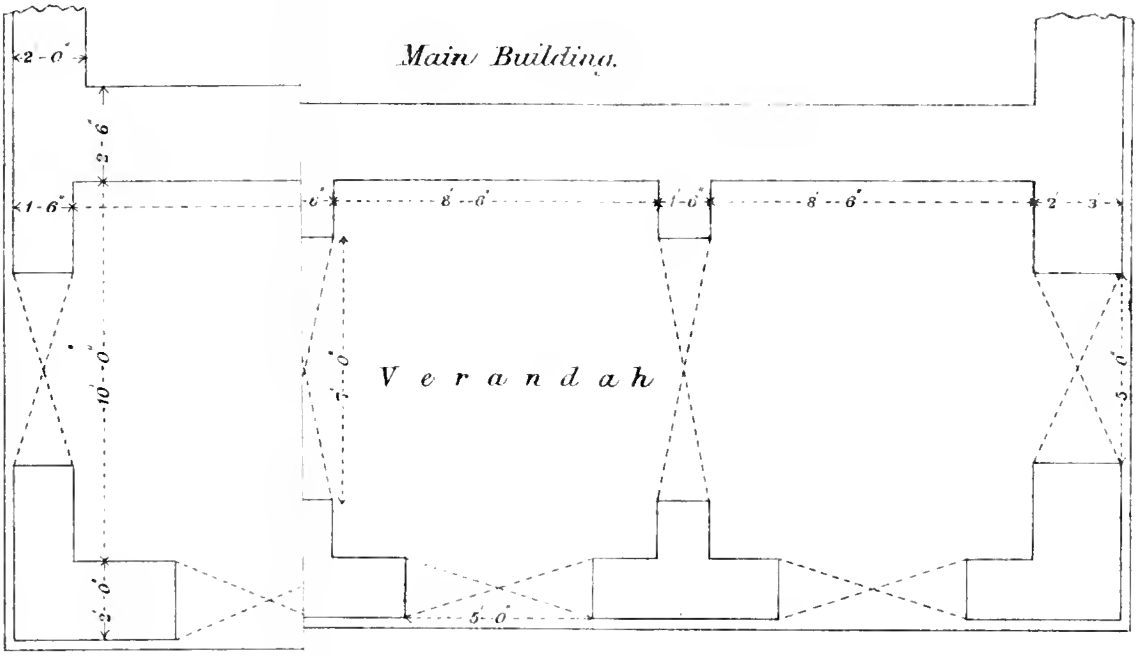
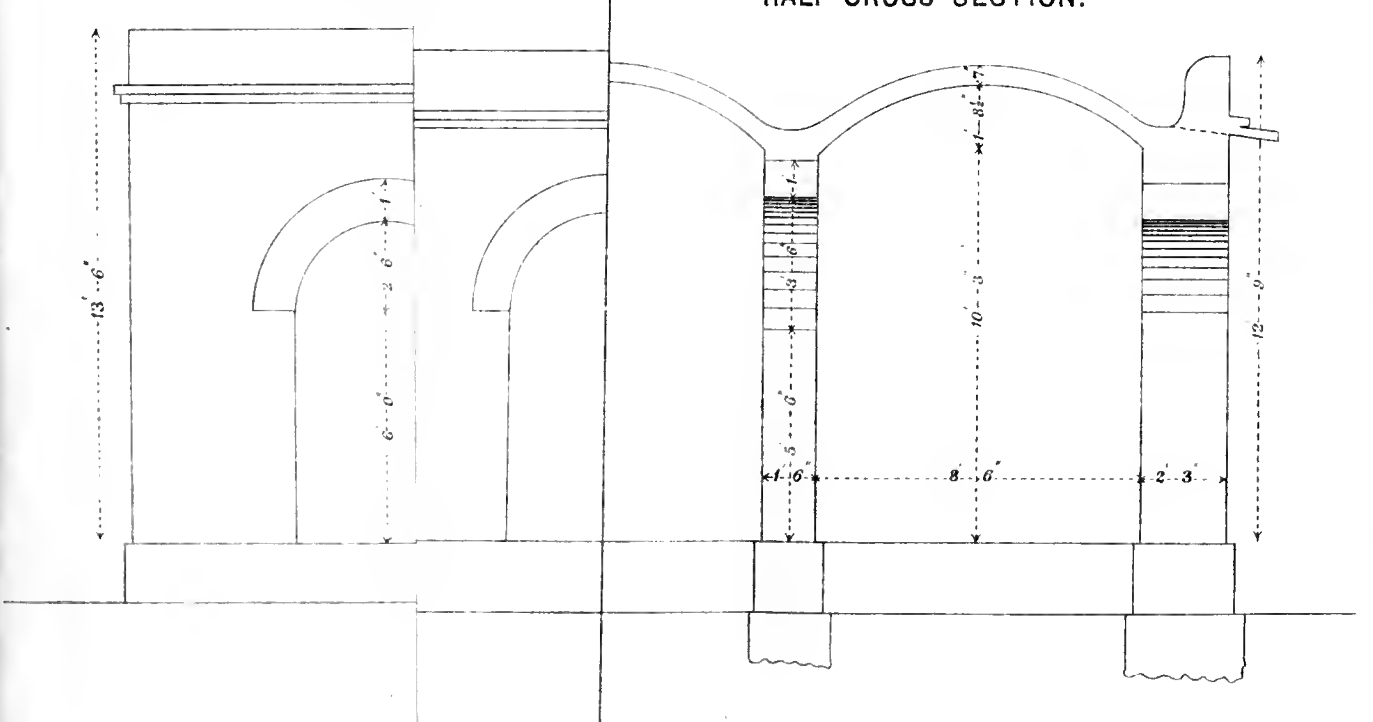


FIG. 4.

HALF EL

HALF CROSS SECTION.



The "STAR" Press, 19, Lall Bazar, Calcutta.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

IX.

Coursed Rubble Archwork in Bridges up to 20ft. span.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Masons No. ...	3			
Do. " ...	$3\frac{1}{2}$			
Do. dressing stones	12			
Coolies No. ...	3			
Do. " ...	$2\frac{1}{2}$			
Do. " ...	3			
Bhistie " ...	$1\frac{1}{4}$			
Grinding mortar, c. ft.	25			
Sundries	...	Variable.	Do.	Do.
Materials.—				
Stone fairly sqd., c. ft.	40			
Through bonds, c. ft ...	45			
Lime slaked, dry, c. ft...	12			
Sand " ...	12			
Surkhi " ...	12			
Sundries	...			
Scaffolding ...	...			
Centreing	...			
Petty Establishment ...	...			

Specification.—As for coursed archwork in buildings, the only difference is that there is much less of face dressing in small bridge archwork, than there is in buildings.

X.

NOTES FROM HOME.

(From our own Correspondent.)

The recent calamity at Exeter, where the burning of the theatre caused such a loss of life, calls attention again to the necessity of adopting in these buildings means of prevention, that in so many cases do not appear to exist at present, and the various technical journals, both at home and abroad, have from time to time put forward suggestions that at least deserve attention.

All agree in that electric lighting ought to be compulsory before the stage, and, if possible, by incandescent lights behind the scenes. An iron fireproof curtain between the stage and the house, which should be used habitually at each performance, and the employment of some less combustible material than canvas for the scenery. Fine wire gauze would, it is thought, be practicable, but the question of cost is against it. The *Genie Civil* recommends flock silk instead of canvas, the advantage of which is that it burns more slowly than canvas, something after the manner of tinder. A Dr. Geyring has invented a scenery which is described as a semi-metallic wire netting which may be painted on the same as canvas whilst being incombustible. The Theatrical Committee appointed in Paris after the Opera Comique disaster has decided upon recommending this system.

Various details of construction are suggested from various sources—ideas that are more or less impracticable—and one is inclined to agree with the *Builder* in saying that until people can be cured of giving way to panics they will kill themselves wherever there is an alarm of fire in a theatre, and structural improvements will be of little avail.

At a meeting of Municipal Engineers, recently held at West Bromwell, in Staffordshire, a paper was read by Mr. Jones, of Ealing, upon Refuse Destructors. The author reviewed the different sorts that were now used and found that there were about thirty kinds in the Kingdom and described Fryer's, Healy's, the Beehive, the Nelson, and the one at Birmingham known as the Wilkinson. Mr. Jones then went on to speak of the objections that had been urged against the use of the Destructor in towns in possibly causing a nuisance by the shedding of dust from the chimney, and described his "fume cremator," which was a sort of muffle furnace that he introduced to intercept and destroy the products of combustion after having left the furnaces. He was enabled to burn not only house refuse, but town sweepings, and the sludge from his precipitating tanks, and he stated that so successfully was this done that no nuisance whatever was caused.

The paper gave particulars of the cost of destroying refuse by the Destructor in several towns, and several details were also given of the height of chimney shaft and particular circumstances that governed the cost in various towns. In the discussion which followed the paper, it was stated that Bournemouth had recently erected a Destructor costing £3,000—£600 for 3 acres of land, £900 for ironwork and £1,500 for brickwork and the chimney shaft, the latter costing £500, being 137 feet high. It was also stated that refuse was destroyed at 1*s.* 3*d.* per ton.

The Sanitary Institute is to hold its tenth annual Congress, at Bolton, from 20th to 24th September. As is usual, an Exhibition of sanitary appliances will be held in connection with the Congress. The proceedings open with an address from Lord Basing, F.R.S., the President. Each of the sections will be opened by an address from their respective Presidents, Engineering and Architecture being in the hands of Professor T. Hayter Lewis. The meeting is to be supplemented by excursions, and at its close addresses to the working classes are announced to be given by Major Flower, A Wynter Blyth, and Henry Law, C.E.

The largest crane in Europe has just been erected in Hamburg at the entrance of the new harbor for sailing vessels. This crane is capable of lifting 3,000 centners which represent the full load of fifteen railway trucks. The weight is 5,000 centners. The machine was constructed in the Krupp Works at Essen.

By the Board of Trade Report on the Railway Accidents of 1886, it is pleasant, in a sense, to see the greater security of Railway travelling year by year. One table shews that in 1874, 86 passengers got killed through causes beyond their own control. Last year this number fell to 8. In 1874 1,613 persons similarly got injured and last year this number got reduced to 615. More eloquent still is the astounding fact, that of the number of passengers who travel in a year only 1 in 90 millions gets killed and only 1 in 1,179,000 gets injured. But among the railway servants the numbers, though improving, still go to shew the great danger of the employment, and this in turn pleads for the greatest consideration on behalf of the men from the companies and from the general public.

The waste slag from the basic steel converters, especially in those districts where the ores are of a highly phosphoretic nature is being extensively ground up for manure. At Bilston, in Staffordshire, one firm is doubling its grinding plant in order to compete with the demand.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Punjab, October 6, 1887.

With reference to the Notifications in the Public Works Department, dated the 12th of March 1887, granting special leave for six months to Major-General Æ. Perkins, C.B., R.E., and dated the 29th idem, stating that Colonel J. P. Steel, R.E., had assumed charge of the office of Chief Engineer and Secretary to Government, Public Works Department, it is hereby notified that the former officer returned to duty and received charge of the said office on the forenoon of the 24th of September 1887, relieving Colonel J. P. Steel, who, under the orders of the Government of India, has been transferred to the Central Provinces.

Burma, October 1, 1887.

Lower Burma.

With reference to *Gazette of India*, Public Works Department, Notification, dated the 9th September 1887, Mr. A. B. Gatherer, Superintending Engineer, 3rd grade, temporary rank, reported his arrival at Rangoon on the forenoon of this date and assumed charge of his duties as Superintending Engineer, 1st Circle, Lower Burma, from the same date.

Madras, September 27, 1887.

Mr. J. F. Somers-Eve, Assistant Engineer, 1st grade, is granted furlough (m. c.) for one year from or after 15th September 1887.

Mr. H. E. G. Evans, Executive Engineer, 4th grade, sub. *pro tem.*, is granted furlough (m.c.) for one month from 24th August 1887.

The following posting is ordered:—

Mr. C. J. Ussher, Executive Engineer, 4th grade, sub. *pro tem.*, to the Office of the Secretary to Government, Public Works Department. To join on return from leave.

Central Provinces, October 8, 1887.

Mr. C. Z. Bunning, Mining Engineer, Warora Colliery, reported his arrival at Bombay on the 26th ultimo from the sick leave granted him.

With reference to Central Provinces, Public Works Department Notification, dated 4th current, Mr. C. Z. Bunning, Mining

Engineer, assumed charge of the Warora Colliery from Mr. W. Donkin, Officiating Mining Engineer, on the forenoon of the 4th idem.

Bengal, October 12, 1887.

His Honor the Lieutenant-Governor is pleased to make the following temporary and sub *pro tem.* promotions in the Engineer Establishment :—

Mr. J. R. Swinden, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, *sub. pro tem.*, with effect from 1st August 1887.

Rai Kali Prosono Mookerjee Sahib, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st August 1887.

Mr. B. K. Finnimore, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 8th July 1887.

Mr. T. Butler, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 1st August 1887.

Mr. W. B. Gwyther, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 11th August 1887.

Rai Haran Chunder Banerjee Sahib, Assistant Engineer 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 25th August 1887.

Mr. L R. Fraser, Assistant Engineer, 1st grade, attached to the Bhagulpore Division, passed the Lower Standard Examination in Hindustani on the 3rd instant.

Establishment—Irrigation.

Mr. C. J. L. Middleton, Executive Engineer, 4th grade, sub. *pro tem.*, Pooree Division, is granted furlough in India on medical certificate for one year, with effect from the 18th August 1887.

N.-W. P. and Oudh, October 8, 1887.

Irrigation Branch.

Major F. V. Corbett, R.E., Superintending Engineer, 3rd Circle, Irrigation Works, is granted six months' special leave on urgent private affairs, with the usual subsidiary leave, with effect from the 14th October, 1887, or such subsequent date as he may avail himself of the same.

Mr. A. J. Hughes, temporary Superintending Engineer, 3rd class, is transferred from the charge of the 2nd to the charge of the 3rd Circle of Irrigation Works, *vice* Major F. V. Corbett, R.E., granted six months' special leave on urgent private affairs.

With reference to Government of India, Public Works Department Notification, dated 30th September 1887, appointing him to officiate as Superintending Engineer, with temporary rank, in the 3rd class, Mr. J. S. Beresford is appointed to the charge of the 2nd Circle of Irrigation, *vice* Mr. A. J. Hughes, transferred to the 3rd Circle.

With reference to Notification, dated 20th September 1887, posting him to the 3rd Circle, Irrigation Works, Mr. C. Hill, Executive Engineer, 4th grade, sub, *pro tem.*, is posted to the Agra Canal.

With reference to Notification, dated 21st September 1887 posting him to the 1st Circle, Irrigation Works, Mr. J. H. A. Ivens, Assistant Engineer, 1st grade, is posted to the Meerut, Division, Ganges Canal.

India, October 8, 1887.

Mr. E. T. Faulkner, Assistant Engineer, 1st grade, State Railways, is temporarily promoted to Executive Engineer, 4th grade, with effect from the 10th May 1887.

The following Assistant Engineers, 2nd grade, appointed by the Secretary of State for India in Council from the Royal Indian Engineering College, who have gone through a course of practical training in England, are posted as follows :—

To Madras.

Mr. Leonard Latham Wickham.
Mr. Thomas William Score Smyth.
Mr. Mathew Loam.

To Bombay.

Mr. Francis Reilly.

To Bengal.

Mr. Herbert Nicoll Weldson.
Mr. Paul George Jacobs.

To North-Western Provinces and Oudh.

Mr. Frederick Campbell Rose.
Mr. George Thomas Barlow.

To Punjab.

Mr. Frederick William Knaggs Yeoman.

To Central Provinces.

Mr. H. L. Cleaver.

To Hyderabad.

Mr. Edward Gower Stanley.

To State Railways.

Mr. Robert Richard Gales.
Mr. John Woodside.
Mr. Francis Dundas Couchman.

With reference to Public Works Department Notification of this date, the services of the undermentioned Assistant Engineers, 2nd grade, are placed at the disposal of the Director-General of Railways :—

Mr. R. R. Gales.
Mr. J. Woodside.
Mr. F. D. Couchman.

Mr. R. T. Denne, Assistant Engineer, 1st grade, State Railways, is, on return from furlough, temporarily transferred to Biluchistan.

Director-General of Railways.

Mr. G. Moyle, Executive Engineer, 3rd grade, sub. *pro tem.*, has been granted, by Her Majesty's Secretary of State for India, leave for eleven days in extension of the furlough granted him in Director-General's Notification, dated 4th March 1886.

Assam, October 8, 1887.

Mr. O. G. Smart, Executive Engineer, 4th grade, and Manager, Jorhat State Railway, on being relieved by Mr. Curry of his present duties as Manager of the Jorhat State Railway, is appointed to officiate as Executive Engineer, Khasi and Jaintia Hills Division, *vice* Mr. A. B. Gatherer, temporarily transferred to Burma, under orders from the Government of India.

Mr. H. Kench, Executive-Engineer, fourth grade, temporary rank, on being relieved of his present duties as Executive Engineer in temporary charge Khasi and Jaintia Hills Division, is appointed District Engineer, Kamrup, *vice* Mr. G. W. Winckler transferred to Silchar.

Mr. G. W. Winckler, Executive Engineer, 3rd grade, District Engineer of Kamrup, and at present in temporary charge of the office of District Engineer, Lakhimpur, is transferred to Silchar, and appointed District Engineer of Cachar, *vice* Rai Bholanath Doss, Bahadur, who has vacated his appointment on obtaining medical leave.

Mr. D. J. Clancey, at present Officiating District Engineer, Cachar, will, on relief by Mr. Winckler, revert to his former post as Assistant Engineer, Khasi and Jaintia Hills Division, until further orders.

Rai Sahib Brij Mohan Lal, B.A., Assistant Engineer, 1st grade, who was granted privilege leave for three mouths in ordor dated the 6th June 1887, reported his return to duty on the afternoon of the 1st October 1887.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 26th September 1887.

73 of '87.—Jean Thorrand and Victor Nicolet, Manufacturers of Cement, and Antoine Bonnet, Director of the National School of Voiron, all of the City of Grenoble, in the Department of the Isére and Republic of France. *For a novel artificial cement.*

156 of '87.—Frank Leman, residing at Elgin, in the County of Kane and State of Ilinois, one of the United States of America, Mechanica Engineer. *For improvements in the art of manufacturing watches and other mechanisms.*

The 3rd October. 1887.

121 of '87.—Lalla Nanoo Mull, son of Lalla Buddree Dass, General Merchant of Delhi, in the Punjab. *For an improved roller cotton gin.*

136Iof '87.—Frank Proctor, of Stevenage, England, Engineer. *For improvements in machinery for cultivating land.*

Notices.

The Office of Publication of Indian Engineering *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India ...	Rs. 12 ...	Rs. 7 ...	Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong. Shanghai*, and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

NOTICE.

SHOULD a sufficient demand arise, we shall be glad to reprint Ganga Ram's Tables for Rolled Iron Beams on paper of the size of Molesworth's Pocket Book, so that Engineers may paste them in their Pocket Books.

CONTENTS.

NOTICE TO CORRESPONDENTS.

OUR news letters and communications (set up in type) have been held over for want of space.

INDIAN ENGINEERING.

SATURDAY, OCTOBER 22, 1887.

THE MYSORE ADMINISTRATION REPORT.

THE address delivered by the Dewan of Mysore before the representative ryots and merchants from various parts of the Province on the 30th September last, will be read with great satisfaction throughout India, especially by those who have the interest of her people at heart. It is a State document that might be profitably read, marked, and inwardly digested by the other Feudatory Princes of this great Empire. "A model principality" is now become a stereotyped expression, applied to any native Government that can show a surplus of income over expenditure, in its annual report, however the result might have been attained. But no device is needed in the case of Mysore to make the worse appear the better cause. Ours being a strictly technical paper, we regret being precluded from reviewing the address in all its bearings. Suffice it to say, without in the least intending to create an invidious distinction, that the happy results shown in the annual budget distinctly mark Mysore as the premier native State in India. Nothing could have saved it from the effects of the terrible ordeal it passed through within the last five years, but the elasticity of its revenues and the practice of extreme economy, which did not, however, interfere with the efficiency in the various departments of Government. Before the famine of 1877, that so sorely pressed the population of Mysore, the cash balance in the treasury exceeded 80 lakhs, but after it, there was not only a deficit of 80 lakhs, but the population was reduced by nearly one-fourth. How the country could have again arrived at this stage of prosperity—127½ lakhs of income, which after deducting the year's expenditure, left a balance of 18 lakhs—is a problem that some of our financiers might profitably study.

Under the various heads of Public Works Department, the actual expense during the past year and the Budget grant for the current year are as follow :—

	ACTUALS. 1886-87.	BUDGET. 1887-88.
Irrigation	Rs. 7,68,904	Rs. 10,67,812
Communication	,, 7,97,548	,, 8,47,872
Building	,, 2,53,417	,, 3,49,302
Miscellaneous Public Improvements	,, 1,06,979	,, 1,34,264
TOTAL ...	Rs. 19,26,848	Rs. 23,99,250

Towards these works, the Budget grant from Provincial funds amounts to 16 lakhs, the balance being available from District and other funds.

Let us now examine the items that go to make up the above account and classify them under separate heads.

RAILWAYS.—As regards these undertakings the traffic returns on the lines already opened show a steady increase ; and the transfer of the Railway to foreign capitalists has enabled the Government during the last two years to devote to irrigation much larger sums than they would have been in a position to allot. Ten and a half lakhs have been set apart this year for tanks and channels, but as the financial prospects are very hopeful this amount might be still more enhanced so as to develop to the utmost the irrigation capabilities of the province.

Tank Maintenance.—In a country where famine is of frequent occurrence, too much care cannot be taken to preserve intact reservoirs of water in the event of a drought occurring. It has therefore been an ancient custom in Mysore that the villagers must do the earthwork required for the proper maintenance of their tanks, and appeal to Government only when stonework or masonry is required. Acting on this principle, last year a tentative scheme for labour contributions from ryots for the earthworks of all tanks yielding a revenue up to Rs. 300 had been introduced into 8 selected taluks. This measure would have met with unqualified success but for the obstinacy of some ryots who are blind to their own interests; and the partial success attending it in the last year has encouraged the Government to continue it in the future to all tanks irrespective of its income and in spite of obstructions. The Dewan points with just pride to the condition of Bangalore tanks, where the Deputy Commissioner had compelled the ryots to fulfil their obligations.

River Channels.—The improvements of these important means of communication and usefulness in times of scarcity, still engage the attention of the Mysore P. W. D. until the capabilities of western rivers have been fully developed. The enlargement and extension of the Iodi Rampur Channel is now seriously taken in hand, as also surveys of other channels, but there are difficulties in the way of carrying out the scheme which have retarded the progress of works.

Roads.—A network of roads is being extended in all directions, Railway feeders finding an important place in the project. A metalled and bridged road through the Kolar Gold Fields is now being constructed, which will connect the mines, on the one side with the Kamasamudrum station of the Madras Railway, and on the other with the Bowringpett station. A long-talked of road from Magadi to Closepett is now being pushed through, and the important road to the west of the Baharendan Hills, to open out the fertile Jagar Valley is rapidly approaching completion.

Gold Mines.—From an engineering point of view this is, we believe, the most interesting part of the address, and on the success of which the future prosperity of Mysore, we would almost say, glory, depends. The examination of the auriferous tracts has been recently completed. Their preliminary investigations were carried on by Mr. Lavelle, the original concessionaire, aided by Mr. Marsh, and the localities were gone over again by Mr. Foote, Superintendent of the Geological Survey of India. Their reports have been before the public and a good deal of information elicited in regard to the various zones of gold-bearing strata running through the Province. The Government have thus been enabled to adopt a definite policy in regard to grant of mining leases and revised rules have been issued. They differ from those previously promulgated in the important particular of prospecting licenses. This system of prospecting licenses will have a desirable effect in putting down mere 'speculation' as known in commercial circles, for it will enable intending investors to make a proper selection of the land required for mining purposes, and to be careful in carrying on prospecting operations, with the certainty of acquiring a right to such land as may be considered valuable.

UNSANITARY CONDITION OF CALCUTTA.

Calcutta, noted for its palaces, pale faces, and putrid smells, should welcome in a grateful manner the excellent Report which has just emanated from the Health Officer to the Municipality. No Municipal record, however perfect and elaborate in its details, should, we think, be considered complete without a supplement like that which Dr. Simpson has, for the first time since his connection with the Municipality, presented in the form of an Annual Report. He has, we think, succeeded in making the conditions of the unhealthy portions of the town intelligible to those who are responsible for their sanitation; and if the figures given by him and illustrated diagramatically and by colored maps can be relied upon, they disclose unmistakably a state of things which is anything but satisfactory. Taking the diagrams and maps for our guidance, it is not difficult to discover that mortality from cholera was largest in the riparian wards and in the Machooa Bazar and Cotton Streets, where, and in their neighbourhoods, we are told, filth and sewer and surface gases reign supreme—the result, no doubt, of choked drains, imperfect or want of surface drainage, closely packed population, and we may be allowed to add the imperfect ventilation of the sewers and the houses huddled together in utmost confusion in the localities indicated by the Health Officer. The elimination of the tanks in the Raja Bagan *busti*, where they only serve to conserve and disseminate germs of disease, the opening out of the street recommended by Dr. Simpson in the localities just referred to, and the extension of the boon of pure water-supply for the consumption of those who are dependent exclusively on tank water should, we think with the Health Officer, redeem some of the worst features of urban life. We are in accord with that Officer in thinking that there is an urgent need for an elaborate enquiry as to the cause, or causes, which have led to the decline of the public health of the city; the deterioration of the sanitary condition of the town and imperfect distribution of filtered water which should be placed within the reach of all classes, more particularly the lower, who are prone to run to the nearest tank and drink to the full, despite the filth, poison and life with which the water teems. These people are as reckless as the native civic fathers are indifferent as to the fate of the rest of the population, so long as they are themselves within easy reach of the gifts of civilization. They are perhaps of opinion that their lives are more valuable than those whom custom, caste and religion treat as menials or slaves unworthy to enjoy equally the advantages of pure air and water and comfortable quarters.

We would next draw attention to the indifference with which the native Commissioners seem to regard the necessity or importance of regular flushing of the sewers, whose foul condition is evidenced by the mephitic exhalations with which our olfactories are assailed on every turn.

The conservancy and prompt removal of offals, unhealthy accumulations resulting from the mixed living and dietary of the native population, and the filth and litter from cattle owned by them, next deserve the serious consideration of the Commissioners, who should earnestly study the representations, suggestions and recommendations made by Dr. Simpson, with regard to the present undesirable condition of the town and its suburbs and the advantages likely to accrue from the proposed improvements, whose necessity will sooner or later be recognised by those who view the existing state of things through *couleur de rose* spectacles.

We regret the unfavorable reception the Report has had at the hands of the native Commissioners, and trust that better counsels will prevail after its careful study. Unfortunately for those who will be seriously affected by the apathy of the guardians of public health on which depends principally the wealth and prosperity of a community, the standard of sanitation cleanliness, comfort and personal habits observed and applied by these gentlemen, is so opposed to that of the Western nations, that we were not the least surprised at reading the resolutions passed at the last general meeting of the Commissioners. Before concluding, we must acknowledge the merits of the Report, which is full of valuable information and is an elaborate *exposé* of the sanitary or rather unsanitary condition of the town and its neighbourhood.

ACCIDENTS ON INDIAN RAILWAYS.

FROM an official paper, published in a late issue of the *Gazette of India*, we find that, compared with the corresponding quarter of 1886, the number of accidents to trains, rolling-stock, permanent-way, &c., during the first quarter of the current year, shows an increase of 38 or 7·12 per cent., against an increase of 812 or 6·66 per cent. in the mileage open, and of 138,273 or 1·19 per cent. in the train mileage of all descriptions.

The decrease on the Rajputana-Malwa Railway, and increase on the Southern Mahratta Railway, occurred chiefly under "Trains running over cattle on the line," the numbers recorded being 16 and 19 respectively, against 27 and 6. On the North-Western Railway while the cattle accidents and accidents due to fire in trains decreased from 22 and 16, respectively, to 7 in each case, they were more than counterbalanced by increases under several other class of accidents, particularly under "The bursting of tubes of engines, the failure of machinery, springs of engines, &c." Of the decrease on the Eastern Bengal State Railway, 9 occurred under "Trains running over cattle on the line," and 7 under "Failures of couplings." On the Northern Bengal, Great Indian Peninsula, and Oudh and Rohilkhand Railway, with the exception of a decrease of 7 accidents on the second named line, under the head "Goods trains or parts of goods trains, engines, &c., leaving the rails," there were no variations of importance under any one class of accidents.

On the Dacca Railway the increase is due to the cattle accidents having risen from 5 to 15, and to 5 accidents having occurred under "Goods trains or parts of goods trains, engines, &c., leaving the rails," against *nil* recorded during the corresponding period of 1886. The increase on the Madras Railway occurred chiefly under "Trains running over cattle on the line" and "Fire in trains," the numbers being 26 and 18, against 18 and 8.

The casualties resulting from accidents to trains, &c., were among passengers and others, 47 injured, against 6 injured; and among servants, 4 killed and 6 injured, against 11 injured. Of these casualties, 28 passengers and 2 guards were injured on the G. I. P. Railway in a collision that took place on the 11th March 1887, between a passenger train and a down empty special train between Khewadi and Nephad, owing chiefly to the carelessness of the Station Master at the last station. On the very same date a down goods train collided with an up goods at Khewadi, owing to the driver of the former having disregarded the signals while under the influence of liquor. The driver was killed and rolling-stock damaged to the extent of Rs. 30,000. On the Mysore Railway a driver and two firemen were killed, and Permanent-Way Inspector and an under guard slightly injured, in an accident that occurred on the 1st March, current year, to the engine of a down goods train, which was thrown off the line between Maddur and Mandger stations owing to the connecting rod of the engine having fallen foul of the line. On the East Indian Railway passengers were injured in a collision that took place on the 15th January of this year between an up mixed train (which was turned into a wrong line at Bhagulpore through the carelessness of the points jemadar), and the down loop mail which was standing on the down platform line.

Out of 49 cases of "Fire in trains," 18 occurred on the Madras Railway and 14 on the G. I. P. Railway.

The accidents to servants in the employ of Railways, or of contractors, whilst performing duties connected directly with the transit of passengers and goods, from causes other than accidents to trains were, 28 killed, 107 injured. The casualties to passengers from causes other than accidents to trains were, killed 10, injured 9.

Of other persons killed and injured by running trains, &c., 4 were killed and 6 injured, whilst passing over the line at level crossings; 26 were killed and 6 injured whilst trespassing on the line; 8 committed suicide, and 3 were killed and 4 injured from miscellaneous causes. The total numbers killed and injured from the above causes amount to 41 killed and 16 injured against the same number killed and 18 injured, during the corresponding quarter of 1886.

Notes and Comments.

RAILWAY PROGRESS IN CHINA.—The Kaiping Railway has been connected from Su-ko Chuang to Tien Chuang on the west. The total length is now over 100 *lis.* Rails and trucks have all been placed in readiness as for travelling purposes.

EXPORT OF BOX-WOOD.—It is proposed by the Forest Department to export 100 tons of box-wood to England. The cost of export would be Rs. 17,000. We have tried some specimens of Indian box-wood from the Himalayas, but our engravers could make nothing out of them.

RAILWAYS FOR TONQUIN.—The Technical Commission, now sitting in Paris, are laying out an elaborate system of railways for Tonquin. The most important line runs from Hanoi to the coast at Haiphong, with branches southward to Hue and north to Laokoi on the borders of China.

RAILWAYS IN THE PHILLIPPINES.—The official inauguration of the works for the construction of a railway from Manilla to Dagupan took place at the former city on the 31st July. On that day the laying of the foundation stone of the central station took place with appropriate pomp and ceremony.

RAILWAYS IN SUMATRA.—THE Deli Railway Company have applied to the Government for a concession to extend a branch line into the principality of Serdang to Bobongan. The planters there stand sorely in need of improved means of communication. The Sultan of Serdang has granted, free of charge, the land required for the purpose.

BRADLAUGH ON THE PROFESSION.—"Fifty years ago all right-minded Royal Engineers, not to speak of less showy officers, would have grown blue in the face if any one had gravely proposed to allow any common English Civil Engineers to set foot in any official capacity in India, and, much more, to share with them the glory of building barracks or bridges. Since then Bradford Leslie has cut in, and bridged the Hughli."

PRINCE'S DOCK EXTENSION WORKS, BOMBAY PORT TRUST.—The Progress Report for August 1887 shows satisfactory results. Nearly Rs. 51,000 worth of work has been completed and the total amount paid to the contractors to date is over Rs. 37,00,000. The daily average number of men and women working on the Dock and at the quarries for Messrs. Kirby & Co. was 2,056, the greatest number in one day being 2,608.

LIQUID FUEL.—Some of the *primâ facie* advantages are thus briefly enumerated :—(1.) Reduction of weight of fuel. (2.) Instantaneous extinction of furnace fires. (3.) Avoidance of loss of heat due to the frequent opening of furnace doors. (4.) Greater cleanliness and freedom from ashes. (5.) More equable generation of steam. (6.) Greater efficiency of evaporation per unit measure of heating surface. (7.) Increased power of steam generators.

SINGAPORE TRAMWAYS.—The keen competition experienced from jinrickshaws has told unfavorably on the working for the past half-year. However, the popularity and inconvenience of this mode of locomotion has been established and the Directors propose to gradually complete the doubling of the line throughout its length, thereby securing a more frequent and regular service, overtaking and creating increased traffic, with reduced wear and tear of material.

TOWN ALLOTMENTS IN MANDALAY.—On the 1st instant six lots of land for building sites in the European quarter of Mandalay were put up to auction at the instance of some European applicants. The average size of each lot was one acre and three-quarters. Each lot realized more than double the upset price, which was fixed at one hundred rupees per acre. Natives of India purchased three lots, thereby defeating the object of Government, which was to reserve the site for Europeans.

A UNIT OF WEIGHT WANTED.—One of the great disadvantages under which the trade of India is laboring is the absurd system of weights, since each province has its own arrangement, of expressing and signifying maunds and seers. As the unit varies in different places, these anomalies are both productive of inconvenience and fraud. The Government have pronounced that the existing discrepancy must be obviously corrected, after minutely investigating the matter.

THE MOO VALLEY RAILWAY, UPPER BURMA.—The Rangoon correspondent of a contemporary states that the Chief Commissioner has recommended the construction of a railway up the valley of the Moo river. The valley consists of rich paddy land, and its trade is capable of great extension provided an outlet for its surplus produce is obtained. The cost is estimated at Rs. 60,000 per mile, and it is believed that the railway would pay at least four per cent. in a few years.

MADRAS HARBOUR WORKS.—We glean from the reports of progress made during the months of May and June that but little work was done during the former month, owing to the custom of withdrawing the cranes on account of liability to cyclones at very short notice—thus stopping constructive work. Another negative factor was the persistent ground swell. This latter cause also retarded progress in June, during which month nothing was done to the north pier pending the entrance question.

THE JADE QUARRIES IN BURMA.—The jade quarries, which are situate in the Mojaung district, at the headquarters at the Chindwin about ninety miles above Bhamo were leased to two lessees for Rs 60,000, when we first occupied Burma, and the trade was entirely in the hands of Chinese. The leases are now renewed for one year at a time only, while inquiry is being made by the Deputy Commissioners of Bhamo, Upper Chindwin, and Mojaung, as to the best mode of making the property contribute to the revenue. The Government has no desire to create any monopoly in jade.

THE DURABILITY OF PORTLAND CEMENT.—In connection with the articles now appearing in this Journal on the "Use and Misuse of Concrete", we are glad to find that the important question, as to the behaviour of Portland cement concrete when exposed to the action of sea-water, raised at Aberdeen, owing to the rapid deterioration of some concrete walls in the harbour is to be thoroughly investigated—Mr. Messent having been called in to report upon it—and the result will be of interest to all concerned in such works, besides being of vital importance to the harbour authorities of Aberdeen.

AN IMMENSE NUGGET.—On the 23rd August an extraordinary incident in the recent mining history of the Victorian colony occurred, when an immense nugget, weighing about 51lbs. of pure gold, was unearthed in the now famous Midas mine at Sulky Gully, near Ballarat. This mine is on the property of Sir William Clarke, known as Dowling Forest Estate, and on several occasions lately nuggets, varying in size, though small, have been obtained.

This discovery, however, eclipses anything of the kind that has been known for many years in Victoria. The nugget has been named the Lady Loch, and sent to England.

The South Indian Railway.—Mr. C. C. B. Knapp, the Junior Deputy Consulting Engineer for Railways, has returned from the South Indian Railway line, whither he had proceeded to inspect some of the new waterways that had recently been put in and completed ready for inspection, in view to their being tested and passed for use for public passengers traffic, as the Railway authorities are very desirous that they should have the full benefit of the use of these during the coming monsoon, so that through traffic might not be suspended should ever the temporary diversions of the line, at these spots, now in use, breach.

Exports of Copper from Japan.—We have been favored with the following statistical figures :—

	1885.		1886.		
	Ingots, Slabs and Sheets.	Wire.	Ingots, Slabs and Sheets.	Wire.	
	Weight in Piculs.	Piculs.	Weight in Piculs.	Piculs.	
Yokohama	85,259	16	105,796	...	
Kobe, Osaka	50,221	1,188	55,928	1,077	A picul *weighs* 133⅓ lbs.
Nagasaki and other Ports	411	5	786	22	163,609 piculs= lbs. 21,841,801·5 =tons 9,750, 9 cwt,0 qrs, 9lbs.
Total export for year 1886	135,891	1,209	162,510	1,099	

The Reay Paper Mill.—A Paper Mill, which bears the name of Lord Reay, was opened on the evening of 5th October, with ceremony, by His Excellency the Governor. The capital consists of five lakhs divided into shares of rupees five hundred each. Great care has been taken in the selection of machinery, which has been purchased from different manufacturers who have made particular branches of paper machinery their specialities. The directors are negotiating for the construction of a railway station near the Mill, which they are confident would be beneficial alike to the Railway Company and to those interested in the new enterprise. It is stated that the traffic in raw materials and coal consumed by the Mill and in produce sent out will come to about twenty-five tons per day.

The Abolition of the Consulting Architect's Division, P. W. D., Madras.—The Department of the Consulting Architect to the Government of Madras is about to undergo re-organisation, and its scope of operations limited. Gradually this branch of the Madras P. W. D. has become an *Executive* branch, and his Excellency the Governor is much opposed to this, and considers the Consulting Architect should always be with the Government, and that his duties should be confined to advice in regard to architectural matters, and designing when called upon to do so. The office is, therefore, to have only draftsmen and a clerk, while the remainder of the clerical and accounts portions of it will merge into the Executive Engineer's Office, Presidency Division. The Consulting Architect will, in future, accompany Government to Ootacamund.

The Nagpur Extension of the G. I. P. Railway.—The Railway authorities are constructing another line on the side of the existing one, thus making the extension a doubled-lined railway. Many of the smaller culvert and minor bridges have already been widened and masons are busy with their handicraft on the others. The earthwork is also rapidly being pushed forward. A great portion of the permanent way, on the Bhusawal side, has been laid. This is a step which the authorities are to be thanked for, and they will find that the cotton traffic from Berar alone will repay them. The cotton produce is increasing yearly and new mills and presses are being constructed in or projected at every station. This growing trade will necessitate the rapid despatch of the cotton bales by rail, and the convenience of a double-lined railway will be most probably taken advantage of to the full.

The Wire Connection between China and Europe.—An arrangement is reported to have been made between the Chinese Government and the Great Northern Telegraph Company, working in conjunction with the Eastern Extension Company, for the extension of the Imperial Chinese Telegraphs to Kalgan and Kiachta, which will give a direct telegraphic route from China to the Continent of Europe and Great Britain. According to the Convention alleged to have been entered into between the contracting parties, the Great Northern Company solely, or in conjunction with the Eastern Extension Company, are to pay the Chinese Government Tls. 100,000 on condition that the Chinese charge the same rate per word as the two Companies, namely, $2, the arrangement to continue in force for 16 years. Considerable indignation has been expressed at this bold attempt to obtain a monopoly which would be injurious to the commercial interests of the Far East.

Russian Cotton Mills in Central Asia.—A correspondent of the *Times of India* says that Russia's want of initiative in all but military matters and the lack of enterprise of her commercial community have long been the subject of disparaging remarks of foreign critics, but of late much has been done to remove this stigma, and an enterprise is to be shortly started by Russians on Russian capital which may have a vast effect on England's cotton mills and her Asian markets. Intelligence comes from Charzhdooè that Prince Demidoff and M. Nechaeff-Maltseff have arrived there with a view to inspecting the cotton plantations of the place and selecting a site for large mills, which they intend building on the cotton fields near the Samarkand Railway. Russian kerosine, which is already being exported largely to India, is to be apparently followed up shortly by the invasion of Russian cotton goods into Afghanistan and the surrounding countries, if not into India itself.

Government Stores for India.—Sir L. Pelly, on 13th September, asked in the House whether any resolutions of the Government of India, with connected correspondence between the Government of India and the subordinate local Governments and between the Government of India and the Secretary of State for India, on the question of purchase of stores and articles for the use of Government in England and in India respectively would be placed upon the table of the House. Sir J. Fergusson stated in reply that if the honorable member will move for the resolution of the Government of India of the 10th of January 1883, which contains the rules now in force regarding the supply of articles of European manufacture required for the public service in India, the Secretary of State for India will be glad to let him have the papers as an unopposed return. As regards the correspondence asked for, Lord Cross does not think it necessary to give it, as it is long and somewhat controversial, and contains nothing which is not in the resolution.

The Paumban Channel Scheme.—In continuation of the remarks made in a previous issue on this scheme, we further learn that Monsieur Poilay, the Engineer who was employed by a French firm of contractors to examine and report upon the proposed works of the Paumban Channel, returned to Paris, *viâ* Bombay, by a late steamer, and probably in a few days the result of his labors will be in the hands of the *Directeurs* of the firm of contractors, and later on with the English Paumban Channel Company. The capital of the Company is £1,000,000 which has been fully subscribed, and the total expected outlay on construction account, including cost of land, wharves, sheds, light houses, &c., is, £878,000 ; but the Directors considering the estimates excessive, invited fresh tenders for the contract, with the result that an experienced and responsible French Engineering firm undertook to complete the works, as shewn in the Company's plans and estimates, at greatly reduced rates.

A Government Resolution.—A Resolution in the Public Works Department states that the Notification of 1880 is limited to the tenure of appointments by officers of the Corps of Royal Engineers holding the rank of Chief Engineer to five years. The Government having recently had this matter under consideration, it appeared that the reasons which led to the framing of the rules quoted were equally applicable to all classes of officers employed in the Department, and the sanction of the Secretary of State has been obtained to revise them accordingly. The Governor-General in Council is now pleased to order that no Chief Engineer of the Engineer Branch, P. W. D., nor any officer of corresponding rank in the Superior Accounts Establishment of the P. W. D., nor any officer holding the office of Secretary or Deputy Secretary to Government in the P. W. D., shall, without reappointment, hold the same post for more than five years. This rule will apply to all other officers of the classes enumerated with effect from this date, from which the period of five years will begin to run.

The Jumma Musjid, Delhi.—This the largest mosque in India, situated outside the Fort walls on the *maidan*, is built of red sandstone and stands on an eminence about 40 feet above the level of the road. It is enclosed by a high red sandstone wall, pierced with three enormous gates which are approached by long flights of steps. The mosque is faced with marble ornamentation and is surmounted with three enormous domes of white marble. It is flanked by two graceful towers 130 feet high, built of red sandstone and marble in alternate layers. A large tank is in the centre of the courtyard and in one corner of the court there is a small model of a mosque in which are stored away numerous relics. Muezzins are called from each of the small minarets at each angle of the Court, and about 7,000 persons can worship here at the same time. From the summit of the lofty minarets a most extensive view of this wonderful city and the surrounding plain, strewn in every direction with the remains of palaces and tombs in a more or less perfect state of preservation is obtained.

U. C. S. Meetings.—At a meeting of Gazetted Uncovenanted Officers, held at Calicut, on Wednesday the 21st of September 1887, resolutions were passed tendering warmest thanks to Mr. H. S. King, M.P., and the gentlemen who have acted in concert with him for the interest they have taken to obtain some redress of the grievances under which the Gazetted Officers of the so-called Uncovenanted Services suffer ; endorsing the aim and action of the Indian Uncovenanted Civil Service Association, London, working under Mr. H. S. King's auspices ; and impressing on all concerned the superlative importance which attaches to the payment of furlough and pension allowances at par—the concession asked being one which, at a comparatively trifling charge to Government, would remove an invidious distinction, and an unfailing and ever active source of discontent, and a hardship, as crushing as it is unmerited, from all. Meetings with like results were also held at Bezwada, Madras, Jubulpore, and Darjeeling. It is of extreme importance that similar meetings should be held at all centres of administration in India.

Calcutta Water-Supply Extension.—At a recent meeting of the Calcutta Municipality, Dr. Sanders brought forward a proposition for a series of experiments to be conducted in well boring in different parts of the town so as to strike springs, the yield from which would materially add to the existing supply. It was mentioned that Dr. Warden had bored wells two inches in diameter and some forty or fifty feet deep, from which excellent spring water was obtained. It was pointed out, however, that the Engineer was of opinion that the cost of boring wells of any size would be something enormous, and that even if a bed of sand was reached and a clay bottom followed, that the supply from the sand formation would soon be exhausted. It was also pointed out that the low lying plain of Bengal was not rich in springs, and that to obtain good water a depth of about 200 feet was necessary to be reached. It was also stated that Dr. Simpson was at present engaged in drawing up a report on this very subject, and in view of the submission of this report it was agreed to postpone the further consideration of the question. We would recommend the Commissioners to study Mr. Agabeg's Report on the Port Canning Boring, which appeared in this Journal, and the comments thereon.

A New Industrial Enterprise.—We glean that the first of a series of mills to be driven by water power was opened on the 5th instant, by the Gokak Water Power and Manufacturing Company, Ld., at the celebrated falls of the River Ghât-prabha, in the Southern Mahratta Country. This mill, which is intended to spin cotton, overlooks the Falls, and has been constructed to hold 22,000 spindles. For the necessary power to drive the mill, water is diverted from the river at the head of the rapids, about half a mile above the Falls, into a channel running parallel with the river, and rushes down the face of the cliff through a perpendicular steel pipe, about 180 feet long, into the turbine house below the Falls, where three turbines of 250 horse-power each transmit the power to the mill. The transmission by steel wire ropes is first up to a pier on the southern cliff immediately overlooking the turbines, at a length of 300 feet, and thence to the mill situated 439 feet further south. The extraordinary length and peculiarity of the line of transmission, and the speed attained by the huge pulley wheels, are said to surpass any thing of the kind in the world, and the smoothness and ease with which everything works reflects the highest credit on the Engineering skill of the eminent suppliers of the turbine machinery, Messrs. Escher Wyss and Co. of Zurich.

Current News.

SIR C. A. ELLIOT will enter upon his new duties as Public Works Minister in December.

A SMALL but well defined cyclone passed northward of Madras on Sunday morning, the 9th instant.

MR. PYNE, who has been superintending, the construction of the Amir's workshops, is about to start for India.

THE Bengal and North-Western Railway have offered to work the Tirhoot system, and complete the Assam-Behar scheme.

A RESOLUTION for remedying the block in the Telegraph Department will be published before the Government leaves Simla.

IT is said that the Punjab Government have offered a lakh of rupees towards bridging the river Gugger on the Umballa-Kalka road.

THE late Major-General Hyde will most likely be succeeded by Major-General Peile as Inspector of Railway Stores at the India Office.

THE Railway paper says "There has been a fire in the locomotive workshops at Sukkur, which destroyed about forty thousand rupees' worth of property."

MR. WYNNE, Chief Engineer of the Bengal-Nagpur Railway, is expected to arrive in Bombay at the end of the present month, having completed his arrangements in England.

A MINUTE showing the public offices built at Simla during the last six years and the expenditure incurred in their construction, is a new task which certain officials have been set.

WE believe that the Secretary of State has advised the Government of India to accept the offer of the Bengal and North-Western Railway Company to finish the Assam-Behar line and work the Tirhoot one.

IN consequence of a breach between Venkatagiri and Vendad, and the state of the bank near Gudur, trains temporarily ceased to run on the Nellore-Tirupati Railway. Communication has since been restored.

MR. EWING, Resident Engineer of the Pothanore-Mulliapuram section of the Madras Railway, has been appointed and taken charge of the Bangalore-Mulliapuram section, in the room of Mr. Bullmore, deceased.

COLONEL SMITH, the Consulting Engineer for Railways, has just issued a satisfactory report of his last inspection of His Highness the Nizam's Guaranteed State Railway. He suggests several improvements.

MR. WILLIAM KING, A.B., D.Sc., Director of the Geological Survey of India, having returned to duty after expiry of leave Mr. R. Bruce, Foote reverted to his substantive appointment, as Superintendent of the 1st Grade.

THE total length of railways opened in India at the end of March 1887 was 13,002 miles as against 12,190 miles for the corresponding period of 1886, and the number of passengers carried, 1,697 per mile as compared with 1,640.

THE Central Provinces Survey, it may be added, is progressing rapidly. Traverse work is almost finished in the Bilaspur District, and the party employed thereon will be transferred to Raipur early in the coming season.

THE Rambagh-Ranikhet cart-road has at last been completed. Colonel Lang, R.E., Chief Engineer, P. W. D., accompanied by Colonel Brown, Superintending Engineer, has left Naini Tal on a visit of inspection to the new road.

IN the month of September last the Maisur gold mine produced 1,355 oz. of gold from 1,412 tons of quartz, the gold being valued at £2,250, the Nundy Droog Mine produced the good average of 247 oz. of gold from 85 tons of quartz, which was valued at £957.

MR. A. R. COLQUHOUN, who is at home just now, has, we hear, applied for the command of the Burma-Chinese Delimitation Commission. He is so exactly fitted for the post by years of experience and travel and study that his natural claims can scarcely be passed over.

IN view of the formation of Fuel and Fodder Reserves along State Railways, all Railway Officers have been instructed to bring to the notice of their respective Governments any areas of land among the State lines under their management, which may appear suitable for the purpose.

THE Toungoo-Mandalay Railway construction is proceeding apace. Ballast trains have been running for some time at both ends; and now it is proposed to run them in the central divisions. Some drivers have been engaged, and sent up for this purpose to the localities pitched upon.

AN interesting monograph on the silk industry in the Punjab has been published by the local Government. The general conclusion arrived at is that the only part of the province which seems fairly suited by climatic conditions for the cultivation of the silkworm consists of the low outer ranges of the Himalayas, and a strip of country immediately below them.

WE hear that Mr. Chisholm's designs for the Hyderabad Town Hall arrived a short time since. They are pronounced by experts to be superb, but it will cost a good round sum of money to carry them out. We hope, however, that the latter circumstance will not be allowed to prevent their execution, for Hyderabad is sadly in want of a few attractive public buildings. In this respect, it is far behind many other Native States we could name.

THE report on the operations of the Factories Act in Calcutta for the year ending the 30th of June last, shows that there were 43 factories in existence during that period. Of these 13 are jute mills, 12 jute presses, 4 cotton mills, 3 Government Military factories, 2 dockyards, and the rest are rice, silk, paper, shellac and other factories. There were 122 accidents during the half-year in the factories, of which only six proved fatal. The work of inspection was carefully carried out.

MR. PALMER and his Assistants at Hyderabad-Deccan, are busy taking levels and preparing an estimate of the cost of the Mahsaib Tank Scheme. It will, we hear, take a good many lakhs of rupees to restore and enlarge the tank so as to enable it to act as a reservoir. Most people, however, believe that it would be preferable to the Hussian Saugor as a source of water-supply for drinking purposes. The pollution of the latter still goes on, although a line of pipes is now being laid down from it to the Residency Bazars.

THE Rangoon Port Trust is not giving that satisfaction which it ought. A good deal of anxiety prevails in the supervision of establishments, the Vice-President who is supposed to attend to this matter having his hands full as Collector of Customs, and the Chairman being the Commissioner of the Division. There have been loud complaints about the way things are managed. Contracts are given out carelessly; construction is not properly supervised, and yet lavishly paid for. The other day the flag-staff, which had been blown down, was set up at an enormous cost, people say. Some change apparently is urgently needed.

NOT satisfied with the reductions made in the Public Works Department, Madras, by the abolition of the temporary establishment, the Government of India inquired why further reductions could not be made in the permanent establishment, as the money allotments for the coming and current official years have been reduced, as also the number of divisions. The local Government in reply state that, while this may be the case, the work of the Department has not diminished, and owing to the works being scattered at great distances from each other, it is quite impossible to carry on the work of the Department, or to secure the supervision necessary if the existing staff is curtailed.

IN his evidence given before the Sub-Committee of the Public Service Commission, Mr. R. A. W. Wale, Telegraph Master, Madras, in speaking of the grievances of the telegraph subordinates, said that when a subordinate made an invention he was not permitted to sell or use it for his own benefit. He stated that he himself had invented a new telegraphic block system for use on railways, but was not permitted to make use of it to his own advantage, whereas if a superior officer of the Department brought out an invention he was generally rewarded by Government. We now learn that the Governor-General of India in Council has been pleased to authorise Mr. Wale to file the specification of his invention.

OWING to the very large addition to the existing rolling stock of the Madras Railway, as also the large addition to the sister line, the S. I. R., pending sanction, the question of the supply of timber is at present engaging the attention of the authorities. Both these Companies sent their Locomotive Superintendents to Burma, and these officers entered into special engagements with Agents in that country for the supply of Burma teak to their respective Companies, when wanted, in sufficient quantities of good quality, and at cheap rates—the result being a decided saving. Now, however, as the Madras Forest Department have declared their ability to supply the necessary timber, a meeting of Railway and Forest Officers is to be held shortly to discuss the matter, and decide whether Burmah or India shall supply the teak timber required.

POISONOUS AND HARMLESS SNAKES.—The following rule is given for distinguishing poisonous from harmless snakes among the Vipers. Tree Vipers, Bungaras and the snakes which resemble them. 1. Head broad, triangular and very distinct from neck. (a) Those with head covered with large shields or plates are harmless. (b) Those having the head covered with small scales are poisonous. 2 Head scarcely distinct from neck. (a) Head covered with large shields and subcaudals (shields beneath the tail) single, poisonous. (b) Either head covered with scales and subcaudals single, harmless.

TO MAKE ICE.—Take a cylindrical earthen vessel and pour 3½oz. of commercial sulphuric acid and 1¾oz. water into it, and then add 1oz. of powdered sulphate of soda. In the centre of the mixture place a smaller vessel containing the water to be frozen; then cover the vessel, and, if possible, revolve the whole with a gentle motion. In a few moments the water in the small vessel will be converted into ice. The same mixture may be used a second or third time for making a block of ice. The operation should, if possible, be performed in a cool place—in a cellar, for example.

Letters to the Editor.

[The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

GLAZING POTTERY.

SIR,—Will you or any of your readers be so good as to inform me of a short and easy process for glazing tiles and sewer pipes during their manufacture. The process described in Tile Making manuals is somewhat difficult to apply to common country kilns.

X. Y. Z.

AN INQUIRY.

SIR,—May I be permitted to enquire, through the medium of your much esteemed journal, the date of re-opening of Government Engineering College, Seebpore.

A. E. BONNAR,
RANIKHET; *October* 9, 1887. *Student, C. E. College.*

[9th November.—ED., *I. E.*]

INFORMATION WANTED.

SIR,—Can you or any of your correspondents kindly inform me of the method, *deduced from theory* of cutting, from a beam of wood the curved strings of geometrical and spiral staircases, so as to obviate as far as possible any mending or chipping after the pieces are sawn to obtain the required curvature and tortion, the height and the diameter of the cylinder and the width of the string being given.

MORVI; *October* 9, 1887. B.

THE LOCO-PROBLEM SOLVED.

SIR,—With reference to "Enquirer" in your issue of October 15th, the answer is simple, the piston will knock out the cylinder cover.

I may say I have seen this in practice from the breaking of a piston rod; but the theoretical explanation is also simple: The strain being removed the piston travels faster than it should, although the speed of eccentric remains the same, so that the piston will reach the end of the cylinder before the valve has cut off the exhaust and there is consequently no cushion.

While replying to this, I may mention that you were in error in reference to the largest engine made. The largest engine is at Harleer Water-Works and was constructed by the Hall Foundry, Cornwall—diameter of cylinder 144 inches and stroke 13 feet. The engine of Southwark Water-Works is larger than that mentioned by you, being by the same maker, its size being—diameter 132, stroke 12 feet.

LOCO.

"C. E. PENSIONS."

SIR,—The following letter I have just received from Colonel Hill, M.P. for Preston, and I should be much obliged if you would publish it, because it contains encouragement and advice and also holds out hopes of our being ultimately successful.

There must be no tendency to relax our efforts however, we must try and increase the number of such good friends as Colonel Hill and Mr. King have proved themselves to be, and above all, let us *pull together*, sinking all small differences between the various classes of men composing the Department, and then there is no reason why we should not be as successful as the Doctors were.

C. E.

HOUSE OF COMMONS; *September* 13, 1887.

DEAR SIR,—Yours of 17th July duly reached me, for which I thank you.—On Friday I drew the attention of the House to the question of the payment of the C. E. pensions in sterling, but to no purpose. The Secretary of State says your agreement was in rupees, and in rupees you must be paid.

Your only chance is to agitate; let the Government see that a feeling of discontent prevades the whole Department, which will tend to injure the public service and declare yourselves appalled at the prospect of being deprived of 50% of your pensions through the continued fall in value of the rupee, and that your duty to your wives and families compels you to endeavour to find other employment. If you all *go together* and *confine yourselves* to the pension question, you may eventually succeed.

Yours truly,
EDWARD S. HILL.

PUNKAHS.

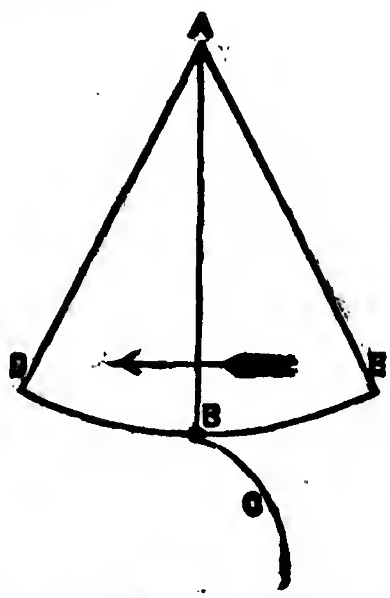
SIR,—The following information will, I hope, allow your correspondent "Mag" to finish his Punkah.

The length of suspending cords was thus given in my lecture:—"The limit of movement of a punkah is to be found in the man who pulls it. Twenty-five pulls a minute of a length of 36 inches gives in practice a speed of 168 linear feet to the punkah curtain. Twenty-five pulls per minute correspond to a *length of suspending cord of* 50 *inches*." No matter what the height of the ceiling may be, the suspending cords of an ordinary punkah should not exceed 50 inches, and means must be found to fix the point of suspension accordingly. A punkah may be of any convenient length, and the bar should weigh not less than 4½lbs. per foot run.

The bridle of the pulling rope should be attached at two points, one-fourth of the length from either end.

The depth of the curtain should not exceed 20 inches, and it should be quite plain. The weighting of the curtain is found in the following manner:—

Draw a piece of tent rope through the fold or hem of the curtain and add lengths of stout twine until the curtain makes the right curve in swinging both ways. This movement will be explained in the diagram in which A is the centre of suspension, B the swing bar at half stroke, D E the range of movement, and C the curtain, shewing the true curve and throwing the air downwards. The movement of the curtain is in the direction of the arrow.



Then draw out the cordage and weigh it, against an equal weight of swan shot, which should be equally distributed along the hem (inside and sewn in), and the Punkah will then be truly weighted.

BOMBAY; *October* 10, 1887. JOHN WALLACE.

"NEW TYPES OF CHEAP ROOFS."

SIR,—In reply to the enquiry of Mr. D. B. Rabadina in your last issue. There are two methods of obtaining the transverse strength of solid beams or bars of any section. *First.*—By actual experiment. This is simply done by loading several specimens till they break and averaging results. We then obtain M° the moment of rupture which is $\frac{WL}{4}$, if the breaking weight is applied in the centre, and $\frac{WL}{8}$, if distributed over the beam (supported at both ends).

S the so-called modulus of rupture is $\frac{M^\circ}{a\,d}$, and its value for different forms of iron and other materials is given in works of reference.

M the working modulus is $\frac{M^\circ}{\text{factor of safety}}$ which in the case in point I took as 4½.

The *second* method is by calculation.

Here M the moment of resistance of any section is found by mathematical analysis to be $\frac{f}{c}I$ and can be calculated out by giving a value to f and c. This method of finding the transverse strength of a beam is clearly inferior to the former and the results of the two often disagree. The one is based on actual experiment and the other is deduced from calculation of the momental forces brought into play.

If S is not known we must use the theoretical formula. Now in the case in point, the flat-bottomed O. R. rails differ entirely in shape from the double-headed rails which were experimented upon. The neutral axis not being in the centre of the section as in the former case. Consequently, it would not have been correct to have assumed, that $S : S' :: ad : a'd'$.

Had the forms been similar it could have been done, but in this case the second or theoretical formula had to be made use of as the strength of the two sections varies as $\frac{I}{y} : \frac{I'}{y'}$

Lala Ganga Ram's tables of strength of rolled beams given in the same number are entirely based on the theoretical formula, and hence probably the discrepancy he complains of between the strength given by the makers and that obtained by calculation.

What we want is a reliable table of values of S for different sections of rolled beams. This is doubtless obtainable somewhere; if not, it would be worth while for the P. W. Department to institute experiments on a large scale.

While on this subject, I wish to point out that there are still some letters wrongly printed in the list of errata published in the issue of October 8th, which might be misleading. In formula (2) the denominator should be w not W, the same applies to the formula $\frac{247}{\sqrt{w\,b+20}}$ which is here given correctly.

I would strongly recommend your correspondent to possess himself of "The Stresses in Girders and Other Similar Structures" by Bindon B. Stoney, which is far and away the best book on the subject. He should get the latest edition, in which graphic statics are employed.

W. G. Bligh.

AURIFEROUS TRACTS IN MYSORE.

Sir,—The writer of the article in Indian Engineering (of the 1st instant) reviewing my Report on the Auriferous Rocks of Mysore, not only objects to my having expressed opinions differing from those put forward by Mr. Lavelle in his earlier Report, but also accuses me of misquoting him and Mr. Marsh and of making sundry other blunders. The writer is, of course, perfectly welcome to accept Mr. Lavelle's conclusions in preference to mine, if it so pleases him; but with regard to the alleged misquotations and blunders, I beg to traverse his allegations most positively.

If he will take the trouble to compare the three reports more carefully, he will find that I have been guilty of no misquotations.

Referring to the Kadkole tract, about 10 miles south of Mysore, I said "the small show of gold" obtained by Mr. Lavelle from washings in the *Kadkole nullahs* must have come from veins too small in size to be worth mining.* Had I said the *Kadkole river*, as the reviewer tries to make out, I should certainly have misquoted Mr. Lavelle. He himself says, "I investigated the country 10 miles south of Mysore to the west of the public road along the banks of a small stream that runs a little to the north of the village of the Kadkole, where I found gold in the first test and continued the examination for about 3 miles to the west." It is to that small stream and its affluents that I applied the term "Kadkole nullahs." I examined the tract prospected by Mr. Lavelle very closely—not "*superficially*," but could find no reefs whatever (nor does Mr. Lavelle mention any). The country rock is most unpromising, and knowing that Mr. Lavelle's findings only amounted to traces, I could only consider further washings as perfectly unnecessary.

With regard to my conclusions as to the Ckiknaykanhalli workings, which your reviewer calls inconsistent, shallow and unreliable, because I venture to differ from Mr. Lavelle, I can only say that I still think the place deserving of further and deeper prospecting than it has yet undergone, but that there are other localities in Mysore better worth the attention of mining capitalists.

My inconsistency may perhaps become less inexplicable and less overwhelming to your reviewer, if I inform him that I am not the head of the Geological Survey of India. The Head of the Department is the Director, then Mr. H. B. Medlicott, now Dr. William King. †

To come to the Belligudda mines, whence Mr. Lavelle thinks that silver and antimony have been taken, as well as copper, I have not doubted the fact that the three minerals may in some cases occur together, but I do doubt the fact of their so occurring at Belligudda. I could not find any trace of any sulphide of any metal, or of metallic copper, in the waste heaps, though I searched the latter very carefully, and the sulphides are not metallic ores easy to be overlooked. A special analysis in the Geological Survey of India laboratory of a specimen of the slag gathered from the great slag-heaps west of the hill shews no indications of antimony or silver having been present in the ore! To my apprehension Mr. Lavelle's evidence as to the presence of silver and antimony at this mine is nothing more than a gratuitous assumption.

If the ore occurred in true lodes instead of pockets I could understand the reviewer's difficulty about believing the exhaustion of the mineral deposits. The mining of pockets of ore on the slopes of a big hill offers no insuperable difficulties to even very primitive miners. Vastly larger pockets of similar ore have been worked clean out in the Nellore and Vimkonda copper districts by miners of the same stamp.

The reviewer is very angry at my not accepting Mr. Lavelle's high estimate of the Sonnahalli gold-field. I am sorry I cannot agree with him. My opinion is based on precisely the same evidence that he had to go upon; mainly upon the remaining *débris*—in which indications of gold were extremely rare, indications of silver absolutely wanting, though the *débris* of the gangue was most carefully searched. That I had no time for a survey of the field in addition to my prospecting it, is no proof that my examination was too cursory.

I am next fallen foul of because of my assertion that "no such mineral as carbonate of silver is known to science." My assertion was made advisedly, and I adhere to it, and any one taking the trouble to look up the subject in the very latest authorities will find that I am correct. The invention of a new mineral is on a par with the statement that a big hill is largely made up of rich silver ore which cannot be found by later searchers.

If your reviewer will kindly refer to the last five paragraphs on page 5 of Mr. Marsh's report and the first three on page 6, he will see that my "startling statement" that Mr. Marsh visited Bellibetta is literally true, and that I have not made any error or cool affirmation by drawing on my imagination in my "zeal to set Mr. Lavelle right."

Mr. Marsh himself speaks of "ascending the hill." As to the presence of silver he remarks "no lode could be seen, and if silver is present it is probably in a diffused and earthy form, but as no assay was made its presence is still an open question."

I made several blowpipe assays before writing my report and could find no trace of silver in any of the specimens tried.

Your reviewer imagines that I regard as a foe the person from whom Mr. A. G. Lock, the author of "Gold, its occurrence and extraction" obtained his information as to the occurrence of old gold workings near Halé Bidu, which were unknown to Messrs. Lavelle, Marsh, and Rajah Mudaliar. I never regarded that person as a foe, for I have not the faintest idea who he or she may be. Had I known of the workings I would most certainly have visited them, as it would have given me an opportunity of seeing the famous ruins of Halabida, which I passed at a distance most reluctantly.

In conclusion, I would ask your reviewer what he meant by the sentence "The country he (I) traversed consisted of a 'series of flying visits.'" I can't understand that. †

R Bruce Foote, F.G.S.,
Superintendent, Geological Survey of India.

* This is a gratuitous assumption on the part of Mr. Foote. On page 214 column 1 line 7 from the bottom the word '*nullah*' is used, Kadkole river is not even mentioned by name. The quotation in italics is from Mr. Foote's report and the word 'river' is to be found on the first line of the second column. Is he satisfied that the paragraph is misquoted? Whether our correspondent examined the tract prospected by Mr. Lavelle superficially or not, it is certain that in almost every test he found gold which to a great extent bears out Mr. Lavelle's statement.—Ed., *I. E.*

† Mr. Foote's defence is evidently weak when he takes advantage of two accidental omissions. The insertion of the word "South" before "India" and of the words "exploitation of the" before the word "country" are all that is needed to satisfy the most hypercritical. With regard to the first item it is evident Mr. Foote is unaware of our valedictory article on Mr. Medlicott and of our regular notices of the "Records of the Geological Survey of India;" besides that the official changes (referred to) have been duly intimated in this Journal. With regard to the second item, the fact of Mr. Foote's investigations consisting of a "Series of flying visits" remains unrefuted.

Since our Correspondent writes under the *imprimatur* of a scientific title and his official position we may add that as a co-Fellow of the Geological Society with Mr. Foote, we could have had no object in disparaging his Report; but we have obligations in our connection with the leading American and British Mining Institutes.—Ed., *I. E.*

Literary Notices.

The North of England Institute of Mining and Mechanical Engineers.

Part III. of the Transactions for the current year contains articles on "Miner's New Electric Safety Lamps;" "Rapid Determination of Specific Gravities;" "Archer and Robson's Sprayer;" and the "Cambrian Rocks of Merionethshire;" with discussions on the "Coal-measures of Spain" and "Movements of the Earth's Crust."

The Royal Meteorological Society.

No. 62 of Vol. XIII. contains the President's Address at the Annual Meeting this year with the Report of the Council for the past year. The President quotes Mr. Hawksley to the "effect that Engineers were greatly indebted to meteorologists for the information collected by them concerning floods and rainfall," without which knowledge, "it would not be possible for Engineers to carry on their work efficiently," and he proceeded to urge meteorologists to investigate the cause of the various phenomena connected with their science, and so increase the practical utility of their work." The papers that make up the number contain nothing of special interest to our readers; but the accompanying pamphlet on "Hints to Observers" contains instructions for taking observations and tables for their reduction, and should, we think, be found in the library of every Engineer.

The Geological Society of India.

The last Quarterly Journal contains rather more than the usual number of papers read before the Society. Those by Professor Bonney and Messrs. Waters, Rutley, Newton, and Davis are illustrated with well-executed Plates.

General Articles.

THE USE AND MISUSE OF CONCRETE IN BREAKWATERS.

THE HARBOUR WORKS AT ABERDEEN.

II.

THE work was carried out by means of a staging of solid timber framework, supported on pine masts (*Figs.* 14, 15, and 16, Plate II, also reproduced herewith), its upper surface being 30 feet above H. W. O. S. T. The masts were placed smaller end downwards and resting in sockets of heavy cast-iron shoes, and the butts above were dressed cylindrically and surmounted by cast-iron caps fitting on to them. The tops of the caps were flat, measuring 6'10¼"×6'2", and the framework of the staging was bolted to these. Space cannot be given for describing the details of the framework, which culminated in two longitudinal girders 13 inches wide by 3 feet 2 inches deep, with transverse girders 14 inches broad by 3 feet 6 inches deep, both fastened to the mast caps and to each other. The masts were in pairs, at 18 feet 1 inch intervals longitudinally, and 27 feet apart from centre to centre in the transverse direction. The staging was strongly braced and strutted, and it was guyed by jointed 1½" rods to 18 cwt. anchors laid in the sea on either side of the staging at 3-bay intervals. The shoes were sunk in holes by the divers, who fitted the masts into them after they had been floated out and swung into position by the steam derrick crane at the end of the staging. The masts were temporarily secured by spars projecting from the end of the staging until the caps and upper framework were put on, and the tie-rods and bolts fixed. Barring interruptions, the staging could thus be erected at the rate of 9 lineal feet in two days. As the breakwater was 35 feet wide at the level of the roadway, and the staging 27 feet between the centres of the masts, while the centre lines of the breakwater and of the staging coincided, the masts were all within the line of the work and were built into it. This was a great security to the staging, Mr. Cay said; only so much of it being needed in advance as was necessary to carry on the building, and at the end of a season not more than three or four pairs of masts were left standing in the sea, and some of these were built into the lower courses of the work. Only 360 lineal feet of the upper framework of the staging, including the iron caps, were provided, the portion in rear being taken down and used again in the front. The heads of the masts were then sawn off at the level of the roadway. A short piece of staging was erected on shore, at the same level as the top of the sea-staging, to receive the cranes during winter or stormy weather, and the cranes were drawn back to this on a car of the same level running on rails on the breakwater. The total weight of crane and carriage was 103 tons, but it was easily moved in or out by double-purchase travelling gear on the car worked by hand. No accident ever happened to the staging either from ships or from the force of the sea.

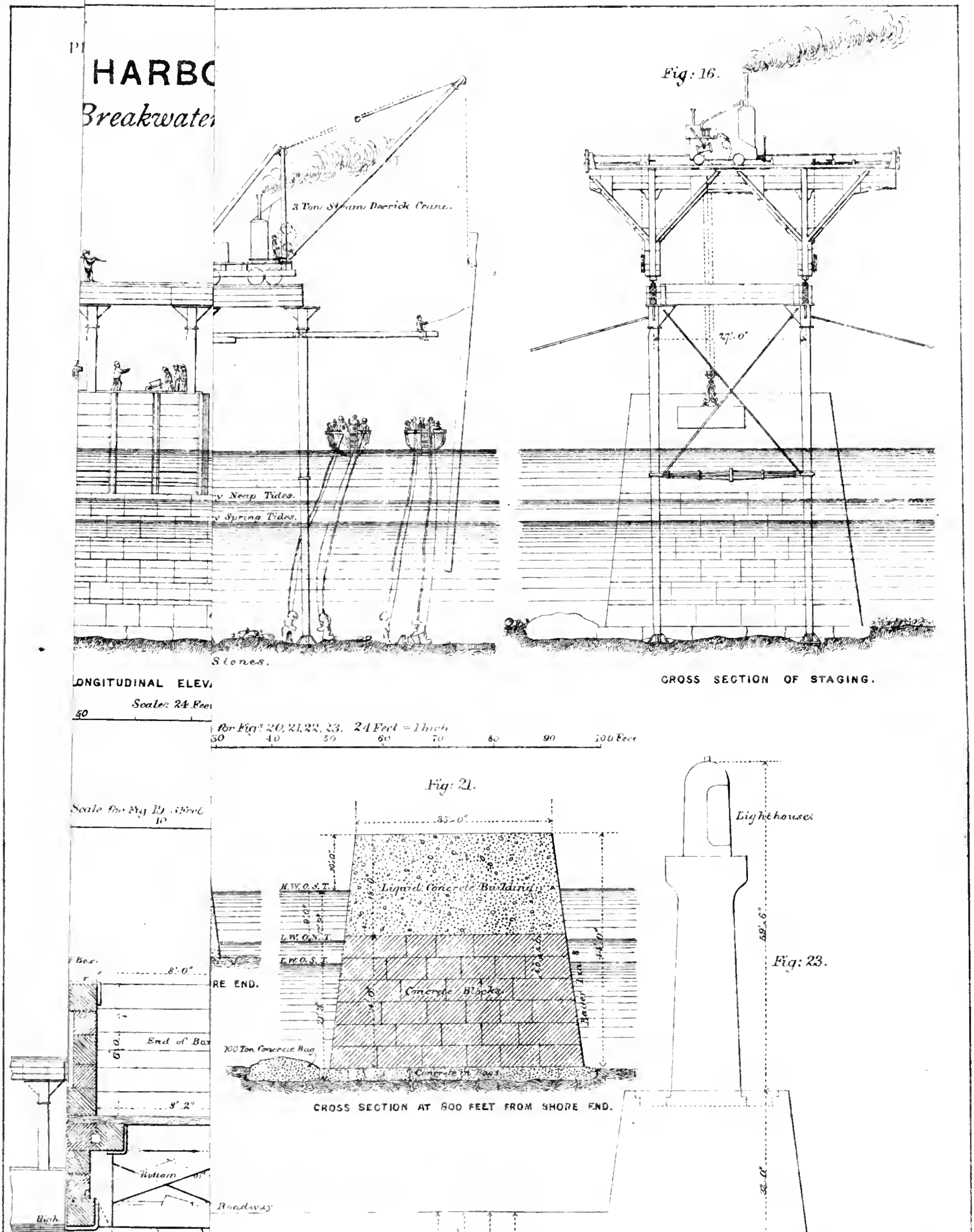
The foundation bags and the blocks of the superstructure were laid, and the apron bags were filled by two 25-ton steam "Goliath" travelling cranes running on the staging, with crab-ways overhanging on each side, thus giving a total transverse travel of the centre of the load of 42 feet. A 3-ton steam derrick crane, with a 50-feet jib was employed for erecting the staging progressively from its end. The gauge of the wheels of all 3 cranes was 27 feet, there being only two rails on the top of the staging.

During the discussion on Mr. Cay's paper, Mr. Parkes, who led off, objected to the staging that the only real use of it was for depositing the concrete in bags, for the block setting and concrete *in situ* building could have been done from a Titan running on the work itself. The cost of the staging must, therefore, be added to the cost of the concrete-bag foundation, and brought it up to 7*s.* per superficial foot, whereas he "knew from experience that where rubble stone could be put in for a foundation the cost of it would not exceed about 1*s.* 6*d.* a foot, so that 5*s.* 6*d.* might be regarded as the extra expense of the concrete foundation, and it was a question whether the additional solidity gained was an equivalent for that amount. It might be so at Aberdeen and other places, but it ought not to be taken for granted that it was so in every case." Sir John Hawkshaw said that supposing the staging and plant, instead of being retained for further use had been sold for one-fourth of the original cost, which was a fair price, the work all round would have cost about 28*s.* per cubic yard, which was not a high figure for work of that description, and Mr. Alfred Giles thought it was most unfair to argue that the cost of the plant was 30 per cent. of the cost of the breakwater as Mr. Brunlees had calculated, for it was to be used also for the extension of the north pier, about the same length of work. As the cost of the breakwater, including a great part of the staging, was executed at a cost of £65 per lineal foot, there was not much to complain of. Mr. Cay, in reply upon the discussion, explained that the staging was determined on before the bags were thought of, and was meant to serve for building the blocks. And construction was more rapidly done from it than from a Titan crane which would have required an almost impracticable extent of overhang, owing to the circumstances of the work. Under these circumstances it was unreasonable to charge the expense of the staging exclusively against the bag-work on the foundations. The cost should be charged to the concrete blocks and the apron. And the plant was intended to be used for another similar work at Aberdeen.

The blocks used in the Aberdeen work were all 4 feet high, and usually 6 feet wide. At first they were of sizes varying in weight from 7½ to 18 tons; but latterly the small blocks were mostly used for incorporating among the liquid concrete, and the larger, from 10½ to 24 tons weight, for block building. The blocks for the head of the breakwater were radiated and dove-tailed into each other, a semi-cylindrical projection cast on one fitting into a corresponding recess in the next. The weight of some of these blocks was 25 tons.

We have seen that the largest blocks of concrete used by Mr. Cay in the South Breakwater at Aberdeen weighed only 24 tons, whereas Mr. Parkes' blocks at Karachi and Madras were 27 tons each. But in the one case there was a thick mass of concrete *in situ* above the blocks, and in the other there was nothing except a layer of concrete to make the roadway. Mr. Cay remarked, at the end of his paper, that "the concrete blocks of 10 to 20 tons appeared to be the weak point in the design. Had the foundation turned out to be of sand or soft material their use must have been given up, as a slight yielding of the foundations would take off the superincumbent weight from the blocks, and they would be loosened and broken up by the heavy seas which strike the work. The blocks composing the part of a breakwater below low water level should be from 100 to 200 tons weight each. This practice, with concrete building *in situ* above low water would, in case of a dislocation by weakness or undermining of the foundations, enable each portion independently to resist the sea. He is also of opinion that some, if not all the blocks below low water level, might with economy and advantage be deposited in a liquid state in bags."

During the discussion, Mr. Parkes said that—with regard to the concrete blocks of from 10 to 20 tons—he agreed in the opinion that the plan was not altogether faultless. He objected, however, more to the variety in the size than to the size itself. To bond the work there must be blocks of different sizes. He thought, however, that bonded work was a mistake, the blocks should be of uniform size, resting upon one another, and in no case should one block rest upon two. It was admitted that a block might bridge over a settlement, so as not to rest upon the one below, in which case the latter might be drawn out by the sea and a hole be made in the work. That



The "STAR" Press, 19, Lall Bazar, Calcutta.

could not happen, Mr. Parkes said, if the blocks were placed one above another in a columnar form. But Mr. Parkes' columnar structure would need to be carried up well above the reach of the blow of the waves, for the strength of it must needs diminish upwards; and the topmost course being unbonded, and having no stability, except that due to the weight of the individual blocks and the lateral pressure of the adjacent blocks of the same course and the small hold given by the joggles, if exposed to the impact of a heavy sea, would be sure to give way, as it did at Madras.

Referring to Mr. Cay's opinion the blocks below low water should be from 100 to 200 tons in weight, Mr. Parkes said that that depended on the facility with which they could be placed. If the blocks were large, there was great expense in placing them, "otherwise the larger the better." Sir John Hawkshaw said the size of the blocks should have relation, not only to the sea, the particular locality, and the cost, but also to the depth at which they were placed. At Holyhead, where the water was 70 or 80 feet deep at the end of the breakwater, a block of 200 tons weight would not be of the slightest use, while the operation of placing it itself would be very difficult. At great depths the size of the blocks was not of much consequence. Mr. Stoney agreed that the blocks of 10 to 20 tons weight were the weak point in the design, and for various reasons thought that large blocks of from 300 to 500 tons each would form the best substratum of a vertical wall. They should be built on shore, and floated out to their destination in fine weather.

We must now describe how Mr. Cay's small blocks were weighted and protected. For a length of 363 feet down to low water mark of spring tides, the breakwater was built of liquid concrete deposited *in situ*, in frames or cases (*Figs.* 1 to 7, Plate I given with the article in a former issue). And the same system was adopted for the upper 18 feet of the remainder of the breakwater, extending vertically from the level of 1 foot above low water of neap tides to the roadway of the breakwater. The work was thus executed. A strong framework of grooved posts, with panels sliding into the grooves, was erected round the site of the compartment to be built, but after it was started the end of the completed work served for one side of the frame. The bottom and sides of the case were lined with jute bagging, and the frame was strengthened by tie-rods. The jute bagging was 39 inches wide, and weighed 29½ oz.; it cost 8*d.* per lineal yard, and could generally be used twice. It being considered important to exclude the tide from the unset concrete, the cases were arranged to be of such size that they could be filled in one tide. The concrete set harder than the blocks made on shore, owing to the moisture being better retained. Each making extended completely across the breakwater, and being 18 feet in depth, and the work having a batter of 1 in 8, it was 37¼ feet wide at the base, to 35 feet at top. The lengths varied from 8 to 31 feet, so that the weight of each block, when complete, ranged from 335 to 1,300 tons. The great size of the larger making was rendered possible by incorporating ordinary concrete blocks with the liquid concrete, to the extent sometimes of one-fifth of the whole mass; this saved time. No attempt was made to join one making to another, and Mr. Cay came to be of opinion that pieces about 16 feet long and 670 tons in weight were best, for longer pieces would be apt to bridge over any settlement that might occur, and leave the blocks underneath a prey to the sea. But the posts of the end of the frame were half buried in the concrete deposited within it and left when taken out vertical grooves from the top to the bottom of the piece. The concrete of the next piece fitted into these groves, and presented lateral movement of one piece without the other adjoining one. Thus the concrete top formed a mass practically monolithic in the horizontal direction, while in the vertical direction each piece had an advantageous power of settlement or adjustment. The concrete thus built *in situ* at Aberdeen was cheaper than the blocks made and stored in the yard, without including the additional expense required for setting the latter in the work. "These masses of concrete," says Mr. Cay, 'gave great security in the progress of the work. Their construction was kept well up with the advance of the foundations; and as soon as a length of the work had received its covering of concrete it was safe from the effect of storms." The proportions of the concrete found best for this work, keeping in view the risk from storms when new, were 1 of cement to 3 of sand, and 4 of gravel. But in the middle of the fine season much of the concrete was made of the usual proportions for blocks, 1 to 9.

During the discussion on Mr. Cay's paper, Mr. Parkes said he entirely approved of the capping of concrete *in situ*, and particularly of its not being continuous longitudinally. No additional stability was gained by an increase of length in the parts. The superstructure, he believed, would be just as stable in a series of vertical slabs extending the whole width of the breakwater as in a continuous length of concrete. Mr. Cay thought 16 feet was the right length for the slabs, but he, Mr. Parkes, thought that 8 feet would be quite as good. Why then, it may be asked, did not Mr. Parkes, in building the Madras piers, use a series of vertical slabs extending over their whole width—24 feet, and of 8 feet in thickness, instead of 2 series, 12 feet in length and only 4 feet 6 inches in thickness? Or, at least, why did he not adopt the capping of concrete *in situ*, the use of which at Aberdeen he so entirely approved? If only his foundation had been of bagged concrete, either of these plans might have saved his work from destruction. Sir John Hawkshaw thought great credit was due to Mr. Cay for the manner in which the work at Aberdeen had been carried out, and particularly for the mode in which a portion had been constructed of concrete deposited liquid. Mr. Abernethy used almost the same words of eulogy, but in regard to the height to which the bagged concrete should be carried up, if used throughout instead of blocks, and from which the concrete deposited in frames should begin, he said he would make it lower, because there would be an open joint along the whole face between the mass of solid concrete and the bags so deposited. He was of opinion that blocks of concrete, or concrete *en masse*, should be carried considerably below the level of low water. We cannot see how, practically, there would be an open joint, for the width of the top layer of bags would be considerably wider than the face of the concrete *in situ*, and the surface would be beaten flat or dressed down, and the inequalities filled up with small hand set bags, as already described; and the liquid concrete poured on afterwards ought to make a perfect joint.

Mr. Cay protected the seaside toe of the work at Aberdeen by an apron of bags, each containing 100 tons of concrete. It began where the rock ceased, at about 500 feet from the shore and a triple row of 16 tons bags was carried round the head of the breakwater and returned along the harbour side for 110 feet. The method by which these 100 tons bags were filled and deposited along the toe of the work is shewn in *Figs.* 17, 18 and 19 of Plate II., Mr. Cay's description of the apparatus and process will not bear abridgement and the following are extracts from it:—

"The machinery for this was a box of pitch pine, capable of holding 100 tons of concrete, supported at its ends on two brackets projecting from the breakwater over the site on which the bag was to be deposited. The bag, which was a little larger than the inside of the box, was then fitted into it, and filled with liquid concrete: when full, the mouth or cloth lid of the bag was sewn up, and the bottom of the box, which turned on two wrought iron hinges on one side, was opened by pulling two triggers holding up the other. In this way the bag of concrete was dropped into the site excavated for it close to the toe of the foundation of the breakwater. In shape the box was rectangular, but slightly larger at the bottom than at the top, to allow of the bag leaving it easily. Its average dimensions inside were 32 feet 1 inch by 8 feet 1 inch by 6 feet deep; the sides consisted of top and bottom pieces 15 inches by 15 inches, and between them were two pieces 13 inches by 13 inches, and one piece 13 inches by 16 inches. Wooden keys, 3 inches by 4 inches, were fitted transversely between each piece, and the whole bolted together so as to form a timber girder 6 feet deep, by 15 inches wide at the top and bottom and 13 inches wide in the middle.

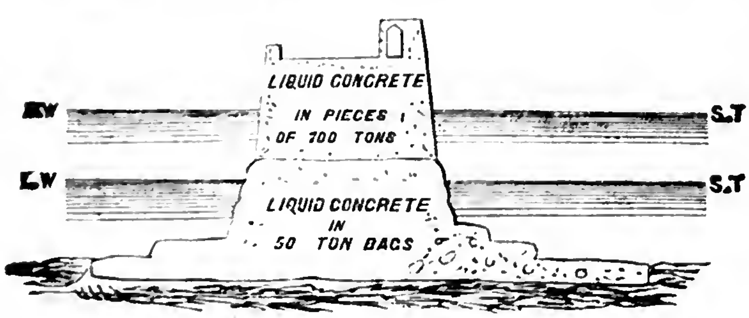
The bottom was a strong timber framework, consisting of two solid timber girders along each side 4 feet 8 inches deep, braced together with diagonals and bolts, and with 4-inch planking laid transversely on the top. The weight of the straps and pins of the two wrought iron hinges was 42 cwt., the pins being 4 inches in diameter."

The two triggers supporting the bottom of the box were at the opposite side from the hinges, were of complicated structure, and weighed 13 cwt. each. They were liberated by a pull from above, and the bottom of the box then fell open. To avoid damage from storms the apparatus was taken to pieces when precaution was thought necessary; part was lashed to the staging, and part removed ashore. At the close of the season the whole was removed to the blockyard.

"The weight of the sides of the box was 17 tons, and that of the bottom 17 tons, but the whole was easily moved by the two 25 tons staging cranes, one holding up each end. Two or three bags were generally deposited in succession, and the work was carried on night and day till finished, when the box and brackets were cleared away and secured as described. On one occasion three 100-ton bags were deposited in forty-seven hours, reckoning from the time the bottom of the box was taken out to the work to the time it was brought back to the shore. Before the workmen were practised in the use of the box some of the bags were dropped 2 or 3 feet short of the toe of the work. In this case the intervening channel was filled with small bags of concrete of 5 tons weight, deposited by a skip. The large box was filled by the aid of smaller ones of wood, holding about 6 tons each, which were loaded under the mixers, carried down to the box, and lifted into it by the cranes."

The head of the breakwater, which is shewn on Plate II., was finished with a semi-circular end, the diameter of the semi-circle being the width of the breakwater. On it the concrete cap was carried down 4 feet lower than usual, or 22 feet below the roadway, and the foundation was protected by an apron of 100 tons and 16 tons bags as above described. Above this was placed a tower, 20 feet high (*Figs.* 22 and 23), of liquid concrete built *in situ*, of 1,040 tons, so as to add weight to it, and the tower is surmounted by a concrete lighthouse 62½ feet high.

Mr. Cay's paper contains a description of the diving arrangements and apparatus. 32 divers were employed. He also describes the method of block-making and concrete-mixing, in Messent's mixers, and gives particulars of the cement used, and winds up with a statement of the progress made and of the expenditure on the work, which was executed at about the estimated cost. In his reply upon the discussion, Mr. Cay stated that in the extension of the North Pier at Aberdeen, then about to be carried out, and long ago, we believe, successfully completed, the whole of the sub-marine part, from the foundations to about 3 feet above low water ordinary spring tides, a height of 22 feet, was to be formed of bags, each containing 50 tons of liquid concrete. A wide platform of these bags would be first laid as a foundation, and would be left to settle into the sand. When consolidated by the action of the waves, bags of concrete would be deposited on it, so as to bring the surface above low water, above which the work would be entirely of concrete deposited liquid in frames, in pieces of about 700 tons each. The 50-ton bags would be deposited by a hopper barge, similar to that used for depositing dredgings, except that the slope of the well in the middle would be modified.



The discussion on Mr. Cay's paper, in which Mr. Parkes took so prominent a part as we have seen, took place in December 1874, and the latter's design for the Madras work was not sanctioned till 3 months afterwards, and the works themselves were not started for another year. Another paper discussed at the same meeting was on "The extension of the South Jetty at Kustendji, Turkey," by Mr. George Lenton Roff, and Mr. Parkes concluded his remarks on Mr. Cay's work by saying that he should be glad if some reasons were given for the particular dimensions adopted for the breakwater, namely, 35 feet in width and 11 feet above high water. The breakwater at Kustendji (in the Black Sea) was only 12 feet wide at the top. Sir John Hawkshaw, who, having been on four occasions consulted by the Aberdeen Harbour Commissioners with regard to the operations designed and carried out by Mr. Cay, was to some extent responsible for them, very properly expressed his surprise at this comparison. The Kustendji jetty, which also, by the way, rises 11 feet above water, is built in only 19 feet of water; the depth at Aberdeen is 35. Sir John said that in many seas a breakwater only 12 feet wide would be of no more use than a sheet of paper; the sea would pass through it as soon as it was built, if it were built at all. The thickness must depend upon the impact of the sea, and in some cases the thickness of the Aberdeen breakwater would be insufficient. At Wick Sir John Hawkshaw said a block 45 feet wide, and weighing 1,400 tons, had been moved by the sea bodily and horizontally, and shifted landwards. It was, therefore, no matter of surprise that some piers had to be made broader than others. Mr. Parkes was, however, bent on carrying out the "important experiment" he had begun at Karachi, and which he afterwards wished to continue even after it had so signally failed at Madras. We have shewn in the papers on the Madras Harbour that a cap of concrete built *in situ*, though only 6 feet thick, forms part of the design for the restoration of the works, which has been adopted in the recommendation of Sir John Hawkshaw's Committee, and the use of bags of concrete for the protection of the toe of the work was also recommended in certain circumstances.

The contribution to the *Englishman* in January 1882, already referred to, concluded thus, and on reconsidering the subject the writer still thinks he was right in the recommendation he then made.

The system has met with high approval from many eminent Engineers, and for moderate depths of water it seems much the best that can be adopted. A wall such as has succeeded so well at Aberdeen cannot, of course, now be built up from the sea-bottom at Madras, but what is very possible, and seems the best plan now to adopt, is to spread out the existing rubble base of the eastern arms of the groynes, and add to it as may be necessary, and then to build up with large (say—50 ton) bags of concrete to low water mark and a concrete *in situ* superstructure, as at Aberdeen, of not less than 34 feet width at top. Where many of the 27-ton blocks remain it might be too expensive to shift them out of the way until the new bed of rubble is prepared, but ways would be found of surrounding and covering them up with either bags or concrete in frames. If room can be given, a row of 100-ton bags should be laid along the top edge of the rubble slope on the sea face of the work outside the foundation course of 50-ton bags; but this would add considerably to the expense, both of base and plant.

This then is our prescription for the case of the Madras Harbour, and, unless Mr. Parkes has a better one to propose, we think the sooner Mr. Cay is called in the better.

Petroleum has been discovered in an ordinary well outside the East Gate of Canton.

A property in Melbourne, which has just been sold, fetched £797 *per foot!* It had a frontage to a principal street of 85 feet by a depth of 86 feet.

NEW TYPES OF CHEAP ROOFS.

By W. G. Bligh, Executive Engineer, P. W. D.

V.

As stone slabs are largely used in building, some information regarding their strength, and also cost, will be found generally useful. From experiments instituted by me a few years ago, S, the modulus of transverse rupture of Mirzapore stone, was found to have a value of close upon 600. Now $S = \frac{M^\circ}{a\,d}$, M° being the moment of ultimate resistance of a beam, and with this datum we can calculate the required thickness of slabs for any span. Taking 10 as factor of safety.

The working modulus of transverse strength $= 60$ lbs. $= \frac{WL}{8\,a\,d} = \frac{12\,wL^2}{8 \times b\,d^2}$. Now in the case of slabs we take a strip 12 inches wide, *i.e.*, $b = 12$, whence $60 = \frac{wL^2}{8\,d^2}$, and

$$\therefore d = L\sqrt{\frac{w}{480}} \;\ldots\;\ldots\; (5)$$

Giving w an average value of 140lbs., d becomes ·54 L inches. Hence the following rule. With a value of w of 140lbs., to find thickness of slabs in inches, multiply the span in feet by ·54. Stone slabs are far the best material for use in this type of roof. Jack arches answer equally well constructionally, but their appearance inside a room is not good. There is far too strong a smack of the godown or hotel about them to find favor in a dwelling house, whereas the stone slabs have a very neat and clean appearance, and with the beams properly painted look well even in a drawing-room. Slabs are superior to anything else for flooring, as well as roofing; that it is a wonder that their use is not more general. Want of information regarding the proper price of stone of this description delivered at Mirzapur and Chunar, together with the cost of the railway freight, is probably the principal cause of the very limited application of stone in buildings. The stone merchants in Mirzapur advertise no fixed rates for different descriptions of stone, and when applied to are often most exorbitant in their demands. The Dholepur State are now daily advertising the prices of stone from the State quarries, and these rates will apply equally well to the Mirzapur sandstone. I generally pay contractors for flagging on roof or floor Rs. 7 per 100 s.ft.: this includes setting in lime and fitting together. Ordinary flagging, roughly sized, but undressed, costs 4 per 100 s.ft. and slabs suitable and ready for roofing should be obtainable delivered at the railway station at Rs. 6 per 100 s. ft. The length should be specified exact, the width is immaterial, one side (the lower) should be fairly smooth, in most cases the stone splits so well that it does not require touching with the chisel. The edges should not be cut square, but hammer chipped bevel wise—*vide* Fig. A in annexed Plate.

When fitted together on the rail, and also sideways, a wedge-shaped space is left all round. In the apex a little lime should be placed and then the whole interstice filled up flush with tar before the concrete is laid on. This forms a watertight and elastic joint. Truly dressed squared joints are expensive and liable to leak.

The top table of the double-headed rail forms a rather narrow bearing for the ends of two slabs. In practise, however, it is found to be quite sufficient. When rails are used for spanning culverts, earth being simply thrown over the slabs, this method of support on the rail will not answer, especially with a moving load. The arrangement then adopted by me is to end the slabs in the centre of one of the spans and not over the rail, each slab covering two rails as shewn in sketch—Fig. B in Plate.

This method is also applicable to a roof, but it is not at all necessary, and it entails extra cost, on account of the increased length of the slabs.

The flat base of the Oudh and Rohilkand rails forms an excellent bearing surface for slabs, the rails being inverted. In 12 feet spans and under, I generally prefer to use them. In a building with rooms of different widths both descriptions can be employed with advantage. The East Indian rails are 23 and 20 feet long, the Oudh and Rohilkand 25 18 and 15, hence for a 12 feet span a whole East Indian rail would have to be sacrificed, whereas the 15 feet Vignoles rail would be just about the length required. The depth of terracing should *never be less* than 8 inches. A thin layer of concrete is sure to crack up in time and leak.

On the East Indian Railway special cheap rates obtain for carriage of stone. They are as follows:—

For small quantities, *i.e.*, under a truck load, 33⅓ pies per 100 maunds per mile. For a wagon load of 325 maunds, under 150 miles, 20 pies; 150 to 300 miles 16⅔ pies, 300 and over, 14 pies per 100 maunds per mile.

A cubic foot of stone weighs close upon 2 maunds.

The following table gives approximate weight of slabs of different thicknesses per square and railway freight:—

Thickness of slab	Weight per 100 sq. feet.	Freight 100 sq. feet 100 miles in less than truck load.	Freight of 100 sq. feet in exact wagon loads of 325 maunds.		
			100 miles.	200 miles.	300 miles.
	Mds.	Rs.	Rs.	Rs.	Rs.
1½	25	4·34	2·60	4·34	5·47
1¾	29	5·03	3·02	5·03	6·34
2	33⅓	5·80	3·47	5·80	7·30
2¼	37½	6·51	3·90	6·51	8·20
2½	42	7·29	4·37	7·29	9·20
2¾	46	8·00	4·80	8·00	10·06
3	50	8·68	5·20	8·68	11·00

Cost of stone at Mirzapur delivered at railway station.

Slabs up to 6′ × 3′ × 2¾″ ...	... *Stone up to* 15 *cubic feet.*
Rough Rs. 5 per 100 square feet.	... Rough 5 As. per cubic feet.
,, Dressed Rs. 8 per 100 ,,	.. ,, Dressed 6 to 8 As. per c. ft.
Fairly dressed Rs. 10 ,, ,, ,,	... Fairly dressed 10 to 12 As.
Finely ,, Rs. 12-8 ,, ,, ,,	... Finely ,, Re. 1 and 1-4

Very large stones up to 10 tons, Rs. 1-4 to 2 per cubic feet

A very large trade is done in river-borne stone which is sent from Mirzapur or Chunar, to Benares, Ghazipur, Patna and Calcutta, and also finds its way up to Allahabad and *viâ* the Gumti and Ghogra rivers as far as Lucknow and Faizabad.

Boats carry from 100 to 1,000 maunds. The rates for carriage are about as follows per 100 maunds.

Mirzapur to Benares ...	...	Rs. 5 or 6
,, Patna ...	...	,, 15
,, Calcutta ...	...	,, 30
,, Lucknow...	...	,, 40
,, Faizabad ...	...	,, 40

The best time to despatch stone by boat is during the rainy season. The ferry rates for transist across the Ganges are very heavy and amount at first-class ferries to ¼ anna per maund or Rs. 3-2 per 100 cubic feet which is about 50 per cent. on the value of Rubble stone. It is in fact cheaper to carry stone from Chunar to Benares a distance of 20 miles than to ferry it across the river in the ordinary way. The ferry contractors have virtually a monopoly of the carriage of goods as the only practicable approaches are at the first-class ferries. The result is, that with the occasional exception of slabs, no stone is ever used on the north side of the Ganges for building purposes, although situated quite close to the quarries. A Government duty is imposed on all stone quarries in the Benares division.

The rates are as follows:—

	Rs.	As.	P.
Slabs and all sorts of stone blocks per c.-foot ..	0	1	0
Rubble stone per 100 c. foot ...	... 1	8	0
Ballast or broken stone per 100 c. foot ...	0	4	0

The due on rubble stone is undoubtedly a heavy tax, it amounts to fully Rs. 2 per 100 c.-feet of masonry. Good building rubble stone is obtainable at Railway stations for Rs. 6 per 100 c.-ft. including duty.

It seems probable, that a reduction in the duty on Rubble stone, and the concession of specially favorable terms for ferry crossing would tend to stimulate the demand for stone of all kinds and eventually result in increased revenue to Government.

The best substitute for stone slabs are Bull's patent tubular tiles. These weigh about 8 lbs. per s.-ft. and cost about Rs. 3-8 per 100 s.-ft. delivered in wagons at Allahabad. These tiles have only just been introduced and in a short time will probably be available at all large centres. They are now manufactured up to a length of 2'-6." Some experiments I made in the transverse strength of the tiles of the section shewn in Fig. C of Plate, gave the breaking weight, 2'-4" between bearings, to be very nearly 320 lbs., applied in the centre. The tiles being 10 inches in width this gives a breaking weight of 384 lbs. on a strip of 12 inches. Then using the same notation as before M° the moment of resistance of the section $= \frac{WL}{4} = \frac{384 \times 2{\cdot}33}{4} = 224$ft.lbs

Taking 5 as factor of safety

M or working moment of resistance = 45 lbs.

whence $\frac{wL^2}{8} = 45$ and L or limiting span $= \sqrt{\frac{360}{w}}$ ...(6)

Taking w as 120 lbs. per s.-ft. the value of L becomes 1·4. Thus we see that single tiles can be used up to 1·6ft. spacing, and above that a double layer with mortar interposed becomes requisite. The cost will then closely approximate to that of slabs.

Below is a table giving the calculated comparative cost of different descriptions of flat roofs.

APPROXIMATE COST PER FOOT RUN OF ROOF.

Span.	Segmental tied.		Rail & Slabs or Tubular tiles.		Same as col. 3 with 200 miles railway freight and duty.		Rolled beams and Jack arches.		Wooden beams and terrace.	
Feet.	Rs.	As.	Rs.	As.	Rs	As.	Rs.	As.	Rs.	As.
10	2	2	4	0	4	13	5	6	6	14
12	2	14	5	1	5	15	6	0	9	4
15	5	15	7	4	8	0	10	0	14	7
18	8	6	10	4	11	1	15	0	20	0
20	9	2	13	6	14	4	18	0	23	13
25	13	8	...		...		30	0	37	10
30	19	7	...		...		50	0	...	
35	23	6	...		...		66	0	...	

To find cost per ft. square, divide amount per ft. run by the span.

In the above estimates the following rates for work were employed :—

Arch Brickwork	... 25 per 100 c.-ft.
Concrete	... 12 " " "
Plaster over concrete	... 3 " " "
Woodwork	... 3-8 per c.-ft.
Rolled Beams	... 7 to 8 per cwt.
Iron work in ties	... 10 per cwt.
Rails ...	... 0-10 " ft. run.

Centering in segmental arches	10 ft. span	Rs. 2 per 100 s.-ft.
	15	" 4 " "
	18	" 7 " "
	20 & 25	" 8 " "
	30 & 35	" 9 " "
Terracing in wooden roofs		" 10 " "
Stone slabs ...	...	Rs. 7 and 8 " " "

The allowance for centering in the arched roofs is most liberal. Where materials for laggings etc., are at hand the actual cost should not exceed Rs. 5 or at most Rs. 6 per 100 s.-ft.

Rolled beam roofs have been included in the list of comparative cost. They are it will be seen more expensive than rails or slabs but not very much so, except in the larger spans. They can be used with stone slabs too, but the distance apart is usually 4 or 5 feet, and this is rather long and necessitates heavier slabs, which adds to the expense when carriage is considered. The usual spanning is of jack arches 9 inches deep, thrown from one lower flange to the other with a rise of about $\frac{1}{10}$. The top is brought up level with concrete, a slope for drainage being given by this means. For floors, rolled beams are by far the most suitable on account of their rigidity, being obtainable up to 2 feet in depth. Their cost in Calcutta is Rs. 5 to Rs. 6 a cwt. but with waste carriage etc. the cost 500 miles up-country would reach Rs. 7 to Rs. 8 a cwt., on which datum their cost has been estimated.

The Engineering firms who supply these beams furnish a list of safe loads for different spans and sections which gives all the information needed to work out the most economical section and the required spacing. The loading comes to 180 to 160 lbs. per s.-ft. exclusive of the height of beam itself.

The construction of a permanent roof of imperishable materials is not only cheaper in itself than the time honored and obsolete form of wooden roof, but admits of a further saving in cost by the adoption of a cheaper type of construction for the walls, than that generally deemed necessary. In the comparative statement of cost, it will be seen, that the rail and slab roof is dearer than the segmental tied arch, the difference in the larger spans being considerable. But the flat terrace roof with iron beams, whether of rails or rolled beams, has certain distinct advantages of its own. One, is ease of erection, a point of some importance, in which it scores unmistakeably over its rival, and secondly, from the nature of the roofing, an inferior material can safely be employed for the walls as of the buildings, which in some cases more than neutralizes the higher cost of the actual covering.

The vast majority of buildings in India are single-storied: such being the case, the walls are subjected to a much less pressure than in houses of several stories in height. Notwithstanding this we find that the thickness of walls in practise is greatly in excess of what is deemed requisite in European buildings while the material is often superior. It is clear, that an increased thickness of walling is indispensable from climatic requirements, but such being the case, considerations of economy would naturally suggest, that the material composing the walls should be of a less expensive character. What we require is a *sufficiently* strong and durable masonry of non-conducting properties.

The three varieties of work usually employed in India are generally classified as follows :—

(1).—Pucca masonry *i.e.* burnt bricks or stone laid in lime mortar.

(2).—Kacha pucca masonry, *i.e.* burnt bricks or stone laid in mud mortar

(3).—(Kacha brickwork) *i.e,* sun-dried bricks laid in mud mortar.

For high buildings or wide spans where pressure is considerable and unequal, pucca masonry of course must be adopted. But in the great majority of structures in this country such as bungalows, kacheries, Police stations etc., these considerations do not exist, and the use of pucca masonry must be characterised as unnecessary extravagance : kacha-pucca and in some cases kacha work would answer the purpose every bit as well at much less cost. The objection to which mud mortar is open, *viz.* that it admits the inroads of white ants, falls through with the modern types of roof construction from which wood is rigidly excluded. In spite of the self-evident truth of these assertions, we find the prejudice in favor of pucca work so deeply engrained in the public mind, that large sums of money are annually wasted in building with pucca masonry when the less expensive kinds would meet all requirements. We have seen that kacha-pucca walls can be used up to 15 ft. spans, for tied arched roofs, with perfect safety, beyond that, it is certainly advisable to use the more expensive material, as any settlement however slight is sure to damage the roof, irretrievably. This objection does not hold in the case of flat roofs, with which kacha-pucca walls can be used for almost all spans. Now

Design for

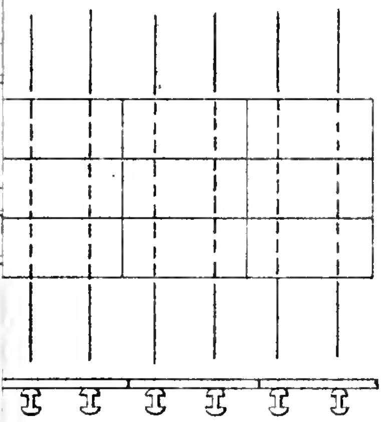


FIG. B.

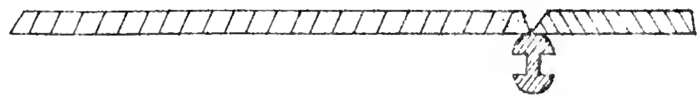


FIG. A.

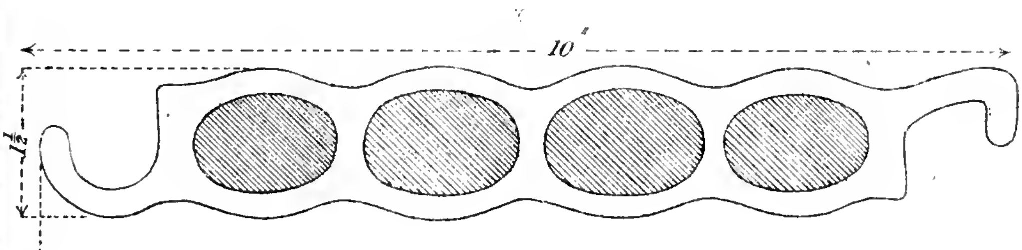
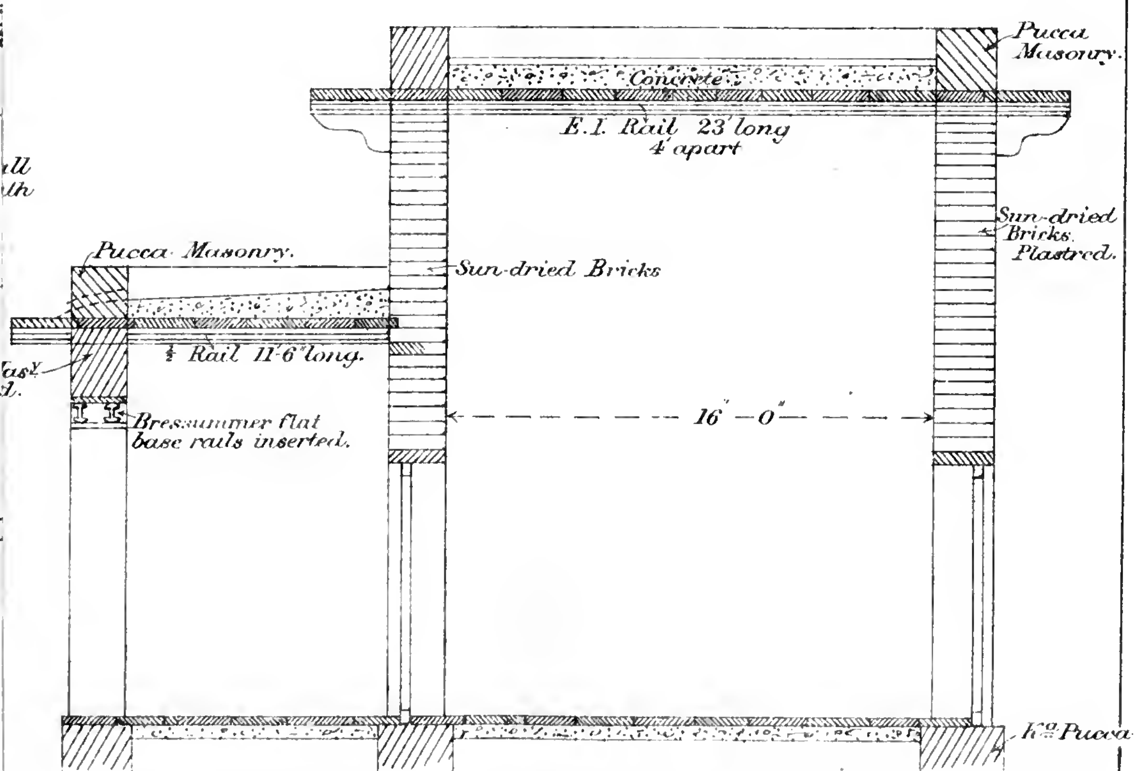


FIG. C.



Example of Pucca Roofed Kacha Building.

Additions to Inspection House at Mirzapur.

The "STAR" Press, 19, Lall Bazar Street, Calcutta.

as long as it is preserved from the wet well built sun-dried brick work is every bit as good as kacha-pucca and it is certainly the best material for excluding the heat. It will safely carry any weight that can be put upon it in a single storied building of ordinary dimensions and has the immense advantage of very low cost. The usual rates for the three classes of work are Rs. 20 to Rs. 22 pucca masonry, Rs. 10 to Rs. 15 kacha-pucca and Rs. 3-12 to Rs. 4-12 kacha. Thus if we can succeed in thoroughly protecting the exterior walls from damp, there is no reason why the cheapest description of walling should not have the preference. In tiled roofs, the inner walls are entirely protected by the slope, the verandah pillars and outer walls only, need be of pucca bricks or stone. In flat roofs, on the other hand, the upper portion of the walls above the level of verandah are exposed to the weather—*vide* outline in Plate. But good plaster with a thin outer coating of Portland cement forms thoroughly efficient protection against damp. The Plate shows a section of a building of this type lately erected. In this, the whole of the walls above plinth are of sun-dried brick work, plastered within and without, and with a thin exterior surfacing of Portland cement. The verandah pillars and walling above rail bressumers being kacha pucca pointed.

The slabs are carried right across the walls and form a wide cornice resting on the rails which project on the two sides and on stone corbels at the ends. The parapet walls above the slabs are of pucca masonry. The foundations are kacha-pucca, the floor, stone flags on concrete. This building though entirely exposed on three sides has shewn no signs of damp whatever. A structure of this description will last as long as any other provided the outer plaster is good. There is nothing liable to decay excepting the door-frames which can be protected from white ants by a layer of tar at plinth or iron chowkats can be used.

A further example is given in Plate of the design for the Victoria Hospital at Mirzapur. To effect economy all the inner cross walls and the inner long walls up to level of verandah roof are of sun-dried brickwork. The upper exposed portion of the long walls being together with the rest of the work of coursed rubble masonry in mud mortar pointed. This was done for the sake of external appearance. Here the upper stone walling rests on the lower kacha walling, a novelty which might be condemned by some people at first sight without adequate reflection. The lower portions are however quite capable of carrying the weight, being completely protected, and in this case any objections must be the result of unreasoning prejudice. Referring to the statement of comparative cost of roofing, we will now institute a further comparison of cost between the first and second types—taking the nature of the walling into account. In the case of segmental vaults the walls are kacha-pucca up to 15 ft. span and pucca above that whereas the rail roofs are carried entirely by kacha walls.

In each case the height of walls up to springing has been taken as equal to the span—above spring or rail level the walls in both alike are pucca, consequently this has not been taken into account.

	Cost per foot run.						Difference.	
Span.	Segmental roof.	Walling.	Total.	Rail roof.	Walling.	Total.	Segmental.	Rail.
12	2-14	5-6	8-6	4-0	2-5	6-5	+2-1	—2-1
15	5-15	6-12	12-11	7-4	2-14	10-2	+2-9	—2-9
20	9-2	12-0	21-2	13-6	3-14	17-4	+3-14	—3-14

In every case the flat roof carries off the palm, but the cost of slabs is taken at the minimum.

(To be continued.)

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

X.

Coursed Rubble Masonry in Superstructure in Buildings with thin walls and numerous doors, windows and recesses.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Masons No. ...	3	Variable.	Do.	Do
Do. " ...	3			
Do. " ...	1			
Do. dressing stones	12			
Coolies No. ...	3			
Do. " ...	2½			
Do. " ...	1½			
Bhistie " ...	1			
Grinding mortar, c. ft.	26			
Sundries	...			
Materials.—				
Rubble stone, c. ft. ...	74½			
Bond & through stones, c.ft	14			
Lime slaked, dry, c ft...	12½			
Sand " " ...	12½			
Surkhi " " ...	12½			
Sundries	...			
Scaffolding ...	...			
Petty Establishment ...	...			

Specification.—The same as for VI. "Coursed rubble in plinth," except that there is more careful selection of stones, finer setting, no quarry chip being allowed in work, and the use of only throughs as bonds. X.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Madras, October 11, 1887.

The following posting is ordered :—

M. R. Ry. N. Ratnasabhapati Pillai, Rai Sahib, B.A., B.C.E., Assistant Engineer, 1st grade, to the II. Circle. To join on return from furlough.

Mr. H. A. Moss, Assistant Engineer, 2nd grade, is declared to have passed on the 30th September 1887 the professional examination prescribed in the Public Works Department Code.

Central Provinces, October 15, 1887.

Establishment.

Colonel John P. Steel, R.E., Chief Engineer, 2nd class, who under orders of the Government of India has been transferred to the Central Provinces, assumed charge of the duties of Chief Engineer and Secretary to the Chief Commissioner, Public Works Department, Central Provinces, on the forenoon of the 8th current.

Mr. P. W. Gilliland, Assistant Engineer, was relieved of his duties in the Jubbulpore Division, on the forenoon of the 6th current.

N.-W. P. and Oudh, October 15, 1887.

Buildings and Roads Branch.

Furlough for one year and four months, with the usual subsidiary leave, is granted to Captain J. H. C. Harrison, R.E., 1st Assistant Principal, Thomason Civil Engineering College, with effect from the 27th October 1887, or such subsequent date as he may avail himself thereof.

Rai Brijpat Rae Sahib, Assistant Engineer, 1st grade, is, on being relieved of the duties of District Engineer, Bareilly, posted to the charge of the Hardoi District, Lucknow Executive Division.

Irrigation Branch.

Mr. C. H. Hutton, Assistant Engineer, 1st grade, is temporarily transferred from the Nadrai Aqueduct Division, Lower Ganges Canal, to the Office of the Chief Engineer, Irrigation Works, on special duty.

Bengal, October 19, 1887.

Establishment—General.

Mr. J. C. Hewitt, Assistant Engineer, is granted "Language leave" for three months, with effect from the 15th of October 1887.

Mr. J. W. Johnson, Inspector of Local Works in the Dacca Division, is, on return from furlough, appointed to be Inspector of Local Works in the Burdwan and Orissa Divisions.

Mr. L. R. Roberts, Inspector of Local Works in the Burdwan Division (on furlough), is appointed to be Inspector of Local Works in the Dacca Division.

Rai Madhub Chunder Roy Bahadur is appointed to officiate as Inspector of Local Works in the Dacca Division, during the absence, on furlough, of Mr. Roberts, or until further orders.

Mr. J. C. Hewitt, Assistant Engineer, passed the prescribed examination in colloquial Hindustani on the 6th instant.

Rai Aughore Nath Mookerjee Sahib, Assistant Engineer, 1st grade, is transferred from the Darjeeling to the Dacca Division.

Burma. October 8, 1887.

Burma State Railway.

Mr. W. Wiseman, Executive Engineer, 2nd grade, 4th division, is granted privilege leave for 21 days, with effect from the 24th September 1887.

Mr. R. L. Campbell, Executive Engineer, will assume charge of the 4th division, Toungoo-Mandalay Extension, during the absence on privilege leave of Mr. W. Wiseman, Executive Engineer.

Mr. G. Deuchars, Executive Engineer, 4th grade, temporary rank, is granted three months' privilege leave, with effect from the 20th September 1887, or such subsequent date as he may avail himself of the same.

India, October 15, 1887.

Mr. W. L. Buyers, Executive Engineer, 1st grade, State Railways, is granted special leave for a period of one year.

Mr J. Tait, Executive Engineer, 3rd grade, State Railways, is appointed Officiating Deputy Consulting Engineer to the Government of India for Railways, Central Division.

Rai Sahib Fakir Chand, Assistant Engineer, 2nd grade, State Railways, is transferred to Hyderabad.

The privilege leave for two months and nineteen days granted to Mr. H. T. Geoghegan, Engineer-in-Chief, Madras State Railway Surveys, has been commuted by Her Majesty's Secretary of State for India to leave on medical certificate for five months and nineteen days.

Military Works Department.

Lieutenant H. Mullaly, Assistant Engineer, 1st grade, officiated as Executive Engineer of the Meerut Division, Millitary Works, from the 2nd March to 17th April 1887, both days inclusive.

Director-General of Railways.

Mr. W. Monics, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India, leave on medical certificate for six months in further extension of the furlough previously granted him.

Assam, 15th October 1887.

Mr. Bolinaryan Barrah, Assistant Engineer, First Grade, and District Engineer of Nowgong, who was granted privilege leave for seventeen days in Orders, dated the 19th August 1887, reported his return to duty on the forenoon of the 3rd October 1887, and assumed charge of his office from Mr. G. E. McLeod, Deputy-Commissioner, on the same day.

Sub-Conductor G. Targett, R.E., Sub-Engineer, Third Grade, who was granted furlough for one year in Government of India Notification, dated the 9th September 1887, availed himself of the same from the afternoon of the 20th September 1887.

Mr. E. J. Mitchell, Assistant-Engineer, second grade, who was granted privilege leave for three months in Orders, dated the 31st May 1887, reported his return to duty on the forenoon of the 27th September 1887.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 10th October 1887.

61 of '87.—William Stronach Lockhart, Engineer, of London, England.—*For improvements in sewing machines.*

173 of '87.—Alexander Cochrane Scott, of Dundee, in the County of Forfar, Scotland, Mill and Factory Furnisher—*For improvements in driving drums or cylinders for spinning or twisting machinery.*

178 of '87.—Francis William Tytler, Superintendent of Post Offices, residing at Goruckpore.—*For the production of green indigo direct from the indigo plant, called "Tytler's Green Indigo process."*

179 of '87.—Francis William Tytler, Superintendent of Post Offices, residing at Goruckpore.—*For increasing the quantitive production of indigo blue from the indigo plant as now grown in India, called "Tytler's Process of Blue Indigo manipulation."*

Notices.

The Office of Publication of Indian Engineering *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai*, and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

NOTICE.

SHOULD a sufficient demand arise, we shall be glad to reprint Ganga Ram's Tables for Rolled Iron Beams on paper of the size of Molesworth's Pocket Book, so that Engineers may paste them in their Pocket Books.

CONTENTS.

Obituary.

OLLENBACH.—At Quetta, on the morning of the 12th October, Oscar Charles Ollenbach, Assistant Engineer, aged 24 years and 11 months (Deeply regretted.)

INDIAN ENGINEERING.

SATURDAY, OCTOBER 29, 1887.

THE KUMAON IRON WORKS.

IN our issue of the 4th June last we had an article on the Kumaon Iron Works, in which we shewed that the failure of the attempt to utilise the mines was, in a great measure, due to gross mismanagement, and that if the undertaking were conducted on economic principles by a body of capitalists with sufficient funds to provide against all contingencies, and above all without official interference, it would prove a remunerative concern.

We have since been put in possession of valuable information on the subject which will be of great interest to our readers. As we have said before, the two most important deposits of iron in the Kumaon district are the brown ores at Dechourie and Kuladnoongi, and the hæmatites at Ramgurh. The former, which contain 38·25 per cent. of metallic iron ore, are about 8 miles, and the latter, with 61 per cent., are 28 miles, distant from the Iron Works. As the Dechourie Works were built by Government before 1859 it is difficult to account why the mines which yielded the baser materials were placed in closer proximity to the works than the more valuable product which was placed at a disadvantage as regards the carriage of materials, thus augmenting the cost of the manufacture. Be that as it may, experts are of opinion that each of these deposits of iron is sufficient to justify the erection of a foundry for their special working.

The excessive proportion of alumina in the Dechourie ore affects its suitability for the blast furnace; it necessitates not only the addition of a large amount of limestone, but also of silica in order to form a blast furnace slag of a proper composition and right melting point. As the Dechourie ore contains about 16½ per cent. of alumina, 18 per cent. of silica, and 2 per cent. of limestone, an addition to one ton of this ore of 5½ cwt. of limestone and 1¾ cwt. of silica will be required for the production of white pig iron for the puddling or basic Bessemer process. In the production of grey pig iron for castings, 6¾ cwt. of limestone and 2 cwt. of silica will be necessary for one ton of ore. The want of silica in the Dechourie also accounts for the fact that the addition of the Ramgurh ore, containing a high percentage of uncombined silica, has proved so beneficial. The Ramgurh ore costs about 8 times as much as the Dechourie ore, and therefore this admixture is a costly experiment, even considering that it contains 20 per cent. more metallic iron than the Dechourie ore. An addition of 1¾ to 2 cwt. of quartz found in the bed of the river close to the works, with 5½ to 6¾ cwt. of tufaceous limestone would have given the same result at a much smaller expense.

Now comes the question of the working of the Dechourie ore. It depends entirely on the supply of vegetable fuel, obtained from the neighbouring forests belonging to the Iron Works, covering an area of 124 square miles, and situated within a radius of 15 miles from the works. They are capable of yielding 32,000 tons of wood yearly suitable for making charcoal for blast furnace purposes, but they should be protected from cattle-grazing and fire. This quantity of wood would yield about 7,000 tons of charcoal, which would allow one furnace blast to be worked giving about 5,600 tons of grey pig iron for castings or 6,000 tons white pig iron. With these 6,000 tons of white pig iron a single rolling mill producing yearly about 4,500 tons of finished iron goods could be occupied. The charcoal prepared by natives, although well burnt, is generally in such small pieces that it is not suitable for blast furnaces. Ritter von Schwarz, who has had a good deal of practical and local experience, and to whose Report we are indebted for our present information, recommends the basic Bessemer process as the best suitable for the production of finished wrought iron goods. In this process white pig iron is used, which can be produced cheaper than grey pig iron. The pig iron can be taken in a liquid state from the blast furnace to the converter, and as a matter of course no fuel would be required for remelting. Small bar iron, hoop iron or other rolled iron goods of the smaller kind would be suitable under the existing circumstances of the works, for a simple reason that they do not require much physical strength, but only quickness of movement and manual cleverness from the workmen, for which the natives of India have a particular aptitude.

We now come to the cost of raw materials. The prices of iron ore, charcoal, and limestone per ton delivered at the Dechourie Iron Works are as follow :—Ore Rs. 1-1, charcoal Rs. 11-5, limestone Rs. 1-4. Accepting these as the ruling prices, the approximate cost of production of one ton of grey pig iron for castings is Rs. 35·80 ; of one ton of white pig iron for the basic Bessemer process is Rs. 33·00, and one ton of small bar iron is Rs. 74·00. These are all actual expenses and do not include rent and interest of capital invested, as well as Government fees and taxes.

From what we have said above it is quite apparent that the Kumaon Iron Works offer a good field for capitalists, notwithstanding certain drawbacks, and that not owing to natural causes, but those over which control might have been judiciously exercised. A little enterprise thrown into the scheme would be more profitable than a hundred sensational newspaper articles. *Verbum sap.*

FREE TRADE OR FAIR TRADE ?

THIS is a question becoming more urgent, more imperatively in need of answer, with every mail from England, from those with any regard for the traditions of England's commercial greatness or national wellbeing. It is a question with which Engineers must needs be concerned ; will they, nil they. Germany now-a-days secures all the big contracts for rails and railway plant ; the Yankees have quite cut Sheffield out in Sheffield ware, axes, saws, files, and so forth ; France is cutting Manchester out in the matter of textile fabrics ; Governments now-a-days send to Krupp's factory for cannon instead of as formerly to England. And American wheat, although a farm laborer's wage in America is at least ten times what it is in India, is fast superseding Indian wheat in the world's markets. That is very much because the Indian agriculturist will not take the trouble to clean his wheat, and *will* adulterate it with extraneous matter adding weight ; unfair trading in short, not justly attributable to Englishmen ; which Englishmen engaged in the trade do all that in them lies to prevent. But, as to the other matters referred to, they allow themselves to be handicapped by traditions about free trade ; and it is time they were exploded. Free trade is a good enough shibboleth to swear by, and act up to, provided that all the parties concerned in the business abide by it. But, it does not pay, it cannot pay, to have the reciprocity all on one side. When England goes in "red-handed" for free trading ; and America, and France, and Italy, and all other civilized countries, decline to do so, England must needs be at a disadvantage.

If only fair trade were accepted as a warrantable gospel by the British nation instead of the free trade cant that finds acceptance, millions of pounds that are now being periodically wasted for the sake of a fad would become available for practical purposes. We might have a paying overland railway to Burma ; there would be no financial difficulties in the way of the recently proposed line from Benares to Pooree ; the country might be opened out, its inhabitants advantaged, trade developed, in dozens of ways that now, because of the dominance of what is after all said and done, only a partial, half-hearted free trade, are hindered and prevented.

Frenchmen, in spite of their existent Republic, may legitimately be charged nationally with a tendency to conservatism in character. But that is assuredly not a charge that can be laid at the Yankee door. General acceptance stamps them as above all things "cute" and alive to their own interests. Yet they, in common with the French, fight shy of free trade. In fact, England is the only European nation holding now-a-days to a notion started by dreamers like Cobden and Bright forty years ago, and now—played out. Even the English colonies, Australia and Canada, have repudiated, and will have no connection with free trade. When Sir Cecil Beadon was Lieutenant-Governor of Bengal, and famine was sore in Orissa, he held fast to its dogmas, and persuaded himself that shibboleth laws of supply would cause grain to be poured into a district where there was great demand, but no money to pay for the requisition. With what deplorable results history has told. The gramercy of free trade has all too often been made an excuse by governments and individuals for doing nothing. Clear your minds of cant, that honest thorough-going English worthy Dr. Johnson used to say. It is more than time for Anglo-Indian people at any rate to clear their minds of free trade cant, which benefits Birmingham, Sheffield and Manchester, at their expense. Free trade has had a fair forty years' trial, and has failed at all points. Let us give fair trade a trial now, and see what comes of it. As some encouragement thereto it may appropriately be mentioned here that an appendix to the third Report of the Royal Commissioners appointed last year to enquire into the depression of trade in England shews that, "in protectionist France, wheat was on an average two and sixpence a quarter cheaper than it was in England, with her corn laws abolished, from 1846, the date of their abolition, down to 1870; that wheat has moreover been on an average cheaper in France than in England, during the whole period 1846-83, the last year recorded in the Blue Book; and the same table will shew that while the average price of wheat in England for the four years preceding the abolition of the corn laws was only £2 12s. 4½d. per quarter, the average price of wheat from 1846 down to 1875 was £2 12s. 11¾d. per quarter."

So much for the much vaunted free trade in corn! How about the iron and steel trades, in which as a result of free trade America and Germany have supplanted England?

It is an idle evasion to throw the onus of responsibility for depression of Indian trade on depreciation of silver, the Secretary of State's drawings, and Currency Office quotations for the rupee. Metals used in coinage depend for their value on the condition of trade. Except to pensioners and people with fixed incomes the depreciation of silver has been amply made up for by cheap prices in local markets, and cheap freights.

The real remedy for disturbing market fluctuations is not to be got at by Currency Commissions, or hocus-pocus of gold and silver coinages. It must be sought in increase of exports. And to that desirable end nothing will contribute more than judicious expenditure on and expansions of India's railway systems.

THE ADMINISTRATION REPORT, N. W. P., AND OUDH, 1885-86.

II.

WE resume consideration of the North West Provinces and Oudh Administration Report for 1885-86. A good deal of good work has been done in the building line. To wit, civil courts at Allahabad, central jails at Bareilly, Allahabad, Benares, Fatehgarh, Unao, and Rae Bareilly. New distilleries have been constructed at Hardoi, Benares, Cawnpore, Gorakhpur and Allahabad. The Muir Central College at Allahábad, of which the foundation stone was laid by Lord Northbrook, in December 1873, was completed during the year under review. Mr. Emerson, C.E., designed the building; and we are told that full effect has been given to the Architectural features of his "striking and effective design." Execution of the work, *ab ovo usque ad mala*, has been in the hands of Mr. Heinig, Provincial Engineer of Allahabad, who devoted himself to it as a work of love, in addition to his regular duties.

Attention has been paid to the conservation and restoration of the Bundelkhand tanks, on which Rs. 80,000 have been expended. We are glad to find recognition of the fact that the value of these tanks in times of drought is due almost as much to the effect they produce on the adjacent tracts by keeping the moisture in the sub-soil and thus raising the level of the wells, as to the actual amount of irrigation work they are capable of performing. The total *kharif* area irrigated was 702,258 acres; a decrease as compared with the previous year of 71,057 acres, accounted for by the favourable and well distributed rainfall of the season. Again, in the same connection, the Rohilkhand and Dún Canals show a decrease of revenue—due again to heavy rainfall; and obviously a matter for congratulation rather than regret. The different canals were closed, as far as navigation was concerned, for about two months. The complete destruction of the Kali-Nadi aqueduct severed connection between the upper and lower portions of the Lower Ganges Canal. The old aqueduct being manifestly inadequate it was decided not to attempt its reconstruction, but to inaugurate an entirely new work.

A good plan, over-ruled in good season, and before much advancement had been made with unavailing work by a mammoth flood, a flood three times as destructive in force and volume as its predecessor. Discharging at its height, between 130,000 and 140,000 cubic feet of water per second, it swept down the valley, completely destroying every vestige of the old aqueduct, and breaking through the embankment a gap 600 feet wide. Physically and morally it was a most discomposing accident. But experience, as Mr. Carlyle says, is the best of school-masters. It is obviously better that the strength of the flood to be contended against should approximate to a known quantity instead of a longitudinal weak minded unalgebraic x on which men lean their opinions without knowing very well why they do, save that they have read somewhere of a tradition of the elders about putting bits of putty in drains. As regards the new aqueduct, we are told that a very large increase in the allowance for waterway was found necessary, and a design and estimates for a work with 11 spans of 60 feet, providing a waterway of 7·23 square feet per square mile of catchment area, was submitted to the Government of India. Its consulting Engineer approved the main features of the design, but increased the number of spans from 11 to 15; and the waterway provided per square mile of catchment area from 7·23 square feet to 9·81 square feet. Detailed drawings and estimates for this modified design were forthwith put in hand, and are now being considered.

On the Cawnpore branch, during the year under review the raising of the Dabowh railway bridge, and the lowering of the floor of the Kharoti road bridge were works completed. Good progress was also made in constructing silt traps at different points along the branch. On the Agra canal five minor distributaries, and two branches were completed; and on three others "good progress was made."

The following table shows the progress on the Betwa Canal with respect to mileage :—

	Miles completed.	Miles in progress.	Estimates submitted for sanction (miles	Miles projected and being estimated.	Total.
Main canal, branches, distributaries (main and minor), escapes, and drainage cuts.	330⅜	104½	16	60	510⅞

The amount expended on repairs of the Dún Canals during the year under review was fairly conterminous with that of the preceding year, a trivial excess of Rs. 1,000 being legitimately debited to damage done to the head-works of the different canals by heavy floods. On the Rohilkhand Canals repairs cost Rs. 7,821 less than in the previous year; and on the Bijnor Canals the expense was about normal. The net result on all minor canals and irrigation works is a decrease in the repair expenditure of Rs. 7,458.

Although the heading of Telegraphs is blank, nevertheless, we learn that, on the 31st March 1885 there were 41 combined postal-telegraph offices open, in which at the close of the year 66 signallers were at work and working satisfactorily.

WINTER'S BLOCK INSTRUMENT FOR CARRYING OUT THE BLOCK SYSTEM ON RAILWAYS.

In India and the Colonies more than in any other country where long lengths of single lines of Railways are worked and the traffic insufficient to warrant the construction of double lines, the application of the Block System for the safe working of such lines has become a necessity—a necessity whose origin is traceable to the first pioneer Railway in the world. The system was for the first time adopted in England, whence the sphere of its adoption has increased concentrically with the extension of Railway construction and operation. In this country, owing to the long stretches of single lines, the application of the ticket mode of working has been found unsuitable, and wherever applicable, *crossing* orders have been with certain exceptions discontinued or disregarded and the train practically allowed to run from station to station without regard to mid or meeting stations as laid down in the Time Tables after it has been ascertained by the Block System that the line is clear. It is evident from the foregoing that the Block System thus adopted as the only mode of working single lines, is open to grave objections and conducive to danger so long as it is not used, as in England, merely as an auxiliary to either the crossing order or the staff and ticket system. The apparatus with which the name of Preece is connected is admittedly one suited to the requirements of a double line, and the only important feature in this system worth recognition is that wherein the removal of the danger signal is made subject to, and governed by, the combined action of the signalman at each end of a section. The Preece system has been working in this country for some time, and though it has been adopted by the "Great Indian Peninsula," "Bombay, Baroda and Central India," and other lines, yet we cannot lose sight of one or two important shortcomings discovered during its trial on the above lines. The system in use on the G. I. P. Railway is known as the 'positive,' wherein the line by means of a miniature semaphore is indicated as at *Danger* when a train is on it and *Clear*—the normal condition of the arm—when the train arrives at its destination; but there is *nothing to shew in which direction the train is travelling*; and what is of much greater importance, *there is nothing to shew whether A signalled the train to B or vice versa.* There is always a noticeable disagreement between the outside and the miniature semaphores in the office, and such being the case the advantage derivable from the use of the latter system is quite lost. The 'affirmative' method is applied to the working of the Bombay, Baroda and Central India Railway, and in this the normal condition of the arm is at danger when it is required to start a train, say, from A towards B. A asks B for Line Clear. B gives Line Clear by turning his switch handle to *off* and giving Line Clear signal. This is acknowledged by A and the arm drops to Clear. When the train is about to start, the starting signal is given by A when B replaces his switch handle to On and raises the Arm at A to Danger again. A replies and the operation is then said to be complete until the arrival of the train at B, when arrival signals are exchanged. In this mode of operating *not only is there no indication of the direction of a travelling train over a section or record of the fact that A gave Line Clear to B or vice versa, but there is also the absence of information whether a train is on the section or not.* The inference deducible from such conditions resolves itself into the following conclusions:—

1st.—That the system is unreliable in its most essential features.

2nd.—That the safety of the working of the line is *solely* and *absolutely* dependent on the memory and register book of the signaller; and

3rd.—That all the value of the Block instrument is lost, inasmuch as any temporary signal-giving apparatus might be substituted with same degree of success or reliance.

While thus directing attention to the shortcomings and possible failures of the 'affirmative' system under the circumstances described, we are not slow in pointing out the only one redeeming feature in this mode of working the Block System and that is that the miniature arms are worked in accordance with the actual semaphores outside. It may be held that these conditions are of a secondary consideration when the Block System is only used as an auxiliary; but there is no doubt of their immense importance when the system is used as the sole mode of working the traffic on a single line.

Conscious of the shortcomings and failures of signalmen and the unreliability of the instruments referred to, the difficulty of the position is further enhanced by the fact that though the correct working of the semaphores may be relied on on double lines where they are no doubt valuable, they are vague and inefficient on a single line. What is really required then is a self-registering or indicative instrument, which will at a glance shew the conditions which are absent from those in general use and will be entirely independent of the signalman.

From the knowledge derived by the examination of the various patents for such instruments, we are in a position to say that there is not one among the number which so completely fulfils the requirements as that known as the Winter Block instrument applicable to single or double lines. The principle on which this apparatus is based will be gathered from the following:—

No signal is considered complete until it has been acknowledged; and it is necessary that the signal itself should be followed by its acknowledgment before the instrument indicates the signal that has passed. Thus suppose a train has to leave A towards B, it is not enough that B should give Line Clear to A, but it is also necessary that A should acknowledge this signal before the instrument at B, indicates that a train is coming from A. So also when the train arrives at B, the arrival signal must be given by B, and acknowledged by A, before the instrument indicates that the train has cleared the section. The indications of this instrument are so clear that it is impossible for any one to misunderstand them; no false currents can affect them and they shew at a glance all that is needed for the Station Master to know, in order that the traffic may be worked exclusively by the Block System.

Notwithstanding the advantages thus secured it is yet possible from human imperfections and fallibility for the Station Master to neglect the warnings of the instrument and give orders for the train to proceed without the Line Clear being received from the other station. To provide against this contingency Messrs. Winter & Craik have jointly introduced a starting semaphore outside in view of the Driver, worked in connection with the Block instruments and so arranged that it cannot be lowered to allow a train to leave until Line Clear has been obtained from the next station, and the train itself is made when entering the section to set the semaphore to Danger automatically. To arrange for the application of the apparatus to double lines a slight modification in the terminal connections outside the instrument will be necessary.

Without entering into a detailed description of the instrument and the semaphore, which can be ascertained from the illustrated pamphlet, it would suffice to place the following summary of its most prominent features before our readers for their information and consideration.

1.—The signal giving permission to start a train is effected by means of a local battery controlled by the signals from the distant stations.

2.—As the local battery is only brought into use immediately after the signals from the distant station having done their work and corrected, if necessary, the effect of any false current on the controlling relay, it follows that the indications of the instrument are quite unaffected by any false current due to either lightning or contact with another wire. These are manifest improvements in the Block instruments as applicable to the safe working of the Block System which should receive the serious consideration of all Railway Companies in this and in other countries. We are only surprised that it has not ere this been brought into general use, seeing that the invention obtained two gold medals at the Calcutta Exhibition in 1883-84, and it leaves nothing to be desired.

We are of opinion that the invention has not received, at the hands of the Government, and those interested in the safe management and working of Railways, the recognition it merits.

Notes and Comments.

SEEBPORE ENGINEERING COLLEGE.—This Institution will re-open on Monday, the 7th November.

THE KIMBERLEY GOLDFIELDS.—Advices from West Australia of late tend to shew that the clouds which overhung the future of the goldfields at Kimberley have at length rolled away.

THE CALCUTTA TRAMWAYS.—The Directors of the Calcutta Tramways Company, Limited, have declared an interim dividend at the rate of 2½ per cent. per annum for the half-year ending 30th June 1887, tax free, now payable.

KARACHI AND ITS GRIEVANCES.—The Government of India have declined to sanction the survey of the proposed Hyderabad-Pachbadra railway, but they suggest the practicability of a feeder line from the Indus to Mirpore Khas.

THE E. E. A. AND C. TELEGRAPH CO.—The Directors of the Eastern Extension, Australasia and China Telegraph Company state that the accounts for the half-year ended 30th June last shew, subject to audit, a balance of profit of £66,655, after the payment of the interim dividend for the first quarter. The Directors have now declared a dividend for the quarter of 2*s.* 6*d.* per share, tax free, and carry forward a balance of £35,405.

THE MADRAS LIGHT-HOUSE.—There are twenty lights on the coast line of the Southern Presidency, *viz.*, 13 on the east and 7 on the west coast. All the lights now use kerosine oil, with the single exception of the Madras Light-House which burns cocoanut oil. The latter is described as white, catadioptric, reciprocating flashing. The arc of illumination is 310°, facing east, and the height of centre of lantern is 128 feet above high water. The column is of imported granite and was completed in 1843.

PROFESSIONAL EXPERTS IN COURT.—Professor Thurston, in a circular announcing that he is compelled to decline all applications for service in suits at law, makes the following sensible suggestion:—"I should in all cases prefer to respond to the interrogatories of the court with approval of both sides, rather than serve either litigant alone." This is certainly better than the present system of taking expert testimony, where the scientist or professional man is expected to hold an argument with the opposite counsel who has "read up" for the occasion, and considers himself competent to prove the expert wrong.

PUBLIC WORKS DEPARTMENT, TRAVANCORE.—The expenditure under this head for the year ending August 1886 was Rs. 6,30,382. Of this, Rs. 2,66,113 were spent on communications, Rs. 1,75,909 on public buildings, Rs. 59,568 on irrigation works, and Rs. 44,393 on miscellaneous works. In the Maramuth Branch the expenditure amounted to Rs. 2,89,324, or Rs. 40,107 in excess of that of the previous year. Rs. 26,943 were spent on tank works, Rs. 31,159 on the improvement and opening of village roads and Rs. 29,615 on the construction of a palace for His Highness the Maharajah, &c.

RE-ORGANISATION OF THE TELEGRAPH DEPARTMENT.—To remove block in promotion in the Telegraph Department, Government offers special inducements for retirement, and special personal allowances to officers retarded in promotion; allowances will be determined partly by length of service and partly by departmental rank. Classes and grades, moreover, are recognized on the new basis. The future establishment will be divided into six classes: the first three as officers in the Direction, the fourth as Superintendents, and the fifth and sixth as Assistant Superintendents. Only the last three classes will have their salaries altered. The ultimate strength of the Superior Establishment is fixed at 84.

RECLAMATION AT HONG-KONG.—The Praya Reclamation Scheme consists in pushing out into deep water the entire marine frontage of the City of Victoria and in placing a new Praya Wall 250 feet outside of the present Praya (or Strand) thus securing, it is said, an average depth of 20 feet along the sea wall even during the lowest tides. It is estimated that the average cost of the reclamation will not exceed $2 a square foot, while the new land will sell at more than $4 a square foot. This reclamation, according to the scheme, is to be carried out by the marine lot-holders at their own expense, on condition that the Government lease to them the areas which they would be able to reclaim.

GOVERNMENT COMPETITION WITH PRIVATE ENTERPRISE.—The Manager advertises that the Umaria Colliery is now in a position to supply large quantities of coal at the following prices at the pit's mouth loaded into Railway wagons, *viz.*:—Large coal, Rs. 5-8 and Rs. 4-8 per ton, screened rubble, Rs. 2 per ton. He adds that a prolonged series of experiments on both broad and narrow gauge locomotives has shewn the equivalent of the Umaria coal as compared with the best Welsh to be as 1·28 to 1, and that he will always be ready to advise regarding the adjustments of furnace bars, &c., that in some cases are found advisable to bring out the full burning qualities of the coal.

ENGLAND'S COMMERCIAL RIVAL IN THE EAST.—One of the most striking features of the commercial rivalry which Germany is at present waging with England is the great attention paid to East Asia, and especially to China and Japan. There are several reasons for this. In the first place, these countries are beginning to take with greater friendliness to European civilization and Europeans, and this change of attitude opens up a boundless prospect to industrial nations dependent largely upon export and import for their prosperity. Germany is, of course, late in the field as compared with England, but she is now unmistakably making up for lost time, as English manufacturers know to their cost.

FRESH GOLD DISCOVERIES.—In these days when the ills of the commercial world are mainly ascribed to the steady falling off in the supply of gold, satisfaction will assuredly be experienced all over the globe at the opening up of fresh gold mines in Sumatra. The subject has been attracting attention in France and Holland, with every prospect of mining enterprise finding profitable employment there ere long. That island has been famed for its golden treasures from ancient times. One of its native names turns out to be Pulu Amas or gold island. The primitive appliances and tools available among the natives, do not admit of the outturn being proportionate to the extent and richness of the deposits.

ADVANCE CHINA!—The pioneer steamer destined to ascend the upper waters of the Yangtsze river, which, as we announced, has been shipped on board the *Kaisow* at Glasgow, has been designed by Mr. Josiah McGregor, of Queen Victoria Street, and has been constructed by Messrs. Bow, McLachlan & Co., of Paisley. Her dimensions are 160 feet length and 27 feet breadth, and on a draft of 4 feet 6 inches she will carry 350 tons of cargo (measurement.) Accommodation will be provided for eighty-four Chinese passengers and eight Europeans. The steamer is to have a speed of 14 miles an hour. The engines and boilers will be shipped in about a month's time. On arrival at Shanghai the vessel will be put together under the superintendence of Mr. A. J. Little.

HOPE DEFERRED MAKETH THE HEART SICK.—In our issue of a fortnight ago we adverted to Mr. E. J. Martin's probable arrival in India shortly, and to his chance of obtaining a Chief Engineership which would fall vacant in November. Our informant alluded to the Central Provinces appointment, but by some misunderstanding, the paragraph in our "Notes and Comments" column was headed as if the news referred to one of the Bengal appointments. We now hear that Colonel Steel, R.E., gets the appointment, and although Colonel Steel is no doubt to be congratulated on his good fortune, we cannot help pointing out that Mr. Martin is senior to him. We suppose that Mr. Martin will now be appointed to Mr. Wickes' circle, and Mr. Wickes to Mr. Vertannes'. *How long, O Lord!*

QUETTA GUP.—A Correspondent writes:—There is not much news here. The Bolan after being washed away was ordered not to be repaired at first, but then orders came again to finish it at once, and this as you see from Elston's letter is now nearly done. Some of the places were completely washed away and the present is entirely a new line. Two miles of line have been added to the S. P. Line in extending it to the Killa Abdulla Fort and a move has been made with the completion of the unfinished portions of the line. This time on carefully prepared estimates which are not to be exceeded. A large sum of money has been sanctioned by Government for defence works, but it is very late in the season and fears are entertained of their being completed this official year. A little cholera has broken out in the Pishin Valley and precaution is being taken to prevent its spreading.

THE BENARES BRIDGE.—The testing of the railway bridge over the Ganges took place on the 24th ultimo, Colonel Dowden, Consulting Engineer, Mr. Hederstedt, Chief Engineer, Mr. Hartwell, Officiating Agent of the Oudh and Rohilkhand Railway, and Messrs. McAdams and Dennison, Resident Engineers, being present. The testing train consisted of two engines, 13 trucks and a brake-van. The first test was what is known as the "standing test," the train halting at each of the larger spans while the deflections were noted. For the second test the train ran over the structure at the rate of five miles an hour, the deflections and observations being noted as it crossed each span; and when returning brake foremost, the oscillation of the top booms was noted. For the third test the train ran at twenty miles an hour; and for the last and final test the speed was increased to thirty miles, the deflections and oscillations being duly noted in the usual way. The entire testing operations occupied the whole day, and the safety of the "Dufferin Bridge" has been fully established. The bridge was opened for passenger and goods traffic on the 1st instant.

SIR ROPER LETHBRIDGE ON MR. BRUCE-FOOTE'S REPORT.—We are indebted to the commercial correspondent of the *Times of India* for the following epitome of a communication to the *Times* by Sir Roper Lethbridge on the Auriferous Tracts of Mysore: 'Mr. Bruce-Foote's "series of flying visits" enabled him to discover a considerable number of ancient workings unknown to the local officers, concealed amid the jungle that has overgrown them. He reports on no less than thirty-two gold-bearing localities, spread over three "groups" or "fields," a fourth "group" being formed by the Kolar field already established. In some, though very few, instances he differs from Mr. Lavelle's conclusions; generally, however, he is able to confirm the local officials. Sir Roper Lethbridge says two important points are brought out clearly by Mr. Bruce-Foote's report. The first is, that vast quantities of gold must have been removed by surface-mining in Mysore in very ancient times, pointing to the conclusion that this region was the source of those prodigious hoards of golden treasures of which we hear in the chronicles of Southern India. The second is, that it is useless in Mysore to scratch the surface where the ancients have been beforehand with you, and have carried away and crushed all the paying quartz; whereas if you at once go below the point at which the old miners were stopped by water or other engineering difficulties, you will get paying ore.'

SPECIAL LEAVE.—The following circular has been issued by the Government of India in the Public Works Department and communicated:—As it is probable that in consequence of reduced grants for works there will shortly be an excess of officers in the Public Works Department available for employment, I am directed to inform you that it has been decided, subject to approval of the Secretary of State, which has been asked for, to offer special leave on the following conditions to a limited number of officers: *First.*—The leave will carry ordinary furlough allowances, whether furlough is due or not. *Second.*—The leave will count as service for pension, but not for furlough. It will not, however, be counted against furlough at credit when the leave is taken, nor will it form part of the aggregate amount of leave specified in sections 47 and 132 of the Civil Leave Code. It will not interrupt the period of three years necessary to intervene between two periods of ordinary furlough. *Third.*—It will not be given for more than two years, and officers will be liable to be recalled from it if their services are required after the expiration of one year; if so recalled, or returning at the expiration of the two years, it will be at their own expense. *Fourth.*—As regards leave, subsidiary to this leave, it will be subject to the ordinary rules regarding such leave. *Fifth.*—Temporary promotions to the Executive class will not be allowed on account of absentees on special leave. I am to request that you will submit a list of officers on the Provincial List who are recommended for this leave and are likely to take it under the terms offered. As it is probable that the Government of India may have surplus officers on the Railway List, whom it could transfer, it is not absolutely necessary that the number of officers included in the list should be limited to the number actually surplus on your list; but great care should be exercised in selecting officers to whom, on general or special grounds, it would be desirable to grant such leave. Local Governments and Administrations for information, and to the Director-General of Railways, with the remark that the officers on the Railway List to whom it is determined to offer this leave will be selected by the Government of India.

Current News.

CAPTAIN COTTER, R.E., commands the new Company, Burma Sappers and Miners, at Mandalay.

EFFORTS are being made to commence the building of the Ghuggur Bridge, for the future Umballa-Simla Railway.

SIR T. HOPE is engaged writing a review of the chief events of his administration of the Public Works Department.

CAPTAIN J. H. TAYLOR, R.N.R., Port Officer of Madras,—a strennous advocate for the N. E. entrance to the Harbour—is dead.

BRIGADE SURGEON RICHARDSON has been appointed Sanitary Commissioner, North-West Provinces, and Surgeon-Major Stevens as Sanitary Commissioner, Punjab.

A MEETING of the Uncovenanted Civil Service in connection with the agitation which is now being carried on at Home and in Parliament, was held at Lahore on the 24th instant.

DR. BURGESS, Director of the Archæological Survey Department, is now in Simla, arranging in consultation with the authorities a programme for the re-organization of the department.

A RAILWAY line to Bunnu, surveys for which have been sanctioned by the Government of India, is regarded as necessary to the completion of the strategic system of frontier railways.

WE learn from a home paper that a contract for thirty large and powerful locomotives has been let by an Indian Railway Company to Messrs. Neilson and Co., of the Hyde Park Engine Works, Glasgow.

MR. LAMBERT, the Deputy Commissioner of Police, has been inspecting the Calcutta theatres with a view to suggesting any additional precautions that may be considered necessary against fire and fire alarms.

THE Geological Survey operations in the Central Provinces will commence next month, and the officers of the department, who are now in their recess quarters, will proceed with their establishments to the hills shortly.

THE Residency Water Supply project at Chadderghaut is progressing. The authorities have indented for three engines from England to pump the water, and, we believe, they are desirous of completing the works by January.

MAJOR M. C. BRACKENBURY, R.E., Class I, grade 3, Superior Revenue Establishment of State Railways, is, on return from furlough, appointed Under-Secretary to the Government of India in the Public Works Department, Railway Branch.

COLONEL WALLACE returned from leave by the *Victoria* which arrived in Bombay on the 22nd instant, and Mr. Horace Bell who is now acting for him as Director, North-Western Railway, returns, we believe, to his appointment on the Tirhoot Railway.

SOME proposals are at present under the consideration of the authorities at Simla to divide the forests in the North-West Provinces and Oudh into two instead of three Conservatorships, with the object of making the Dehra Dun Forest School into a distinct charge.

THERE are some ten or twelve candidates in the field to succeed the late Major-General Hyde at the India Office as Inspector of Railway Stores. Very possibly the choice will fall on Major-General Peile, R.E., late Public Works Secretary to the Government of these Provinces.

THE sales of pictures amounted to a little over Rs. 3,000 at the Simla Fine Arts Exhibition, as against Rs. 4,600 last year. The sum realised by admission at the door was more by Rs. 100 than on the last occasion, and even more than in 1885, when the Exhibition was held in the Telegraph Office.

WHEN Lieutenant-Colonel A. J. Filgate, R.E., Accountant-General, Public Works Department, returns from leave at the end of this month, Major A. G. Begbie, R.E., who has been officiating for Colonel Filgate, goes on furlough, and Mr. R. G. Macdonald will act as Deputy Accountant-General during Major Begbie's absence.

SINCE the resuscitation of the Public Works Workshops, Madras, on their former scale, business has so largely increased, and new machinery got out from England to meet growing requirements, that it has now been found necessary to secure the services of another well-qualified, experienced foreman, especially in the use of vertical saw-mills, in addition to the existing staff.

THE work of driving in the piles for the railway bridge across the channel near the native jetty at Karachi has been completed for a single line of rails; arrangements are being made to start driving piles for the second bridge across the same channel, in order to form a double line. To connect the first bridge only two girders more require to be fixed, and this will shortly be done.

THE Government of India has intimated to the Madras Government that a sum of ninety lakhs of rupees, under "Provincial" has been sanctioned for some of the lines of railway lately surveyed in the Presidency, and for which estimates have been sanctioned. The first line to be started will be that from Vellore to Villapuram, 135 miles in length, in which there will be three divisions.

A DEPUTATION, consisting of the principal merchants and land-holders, waited on the Collector of Hyderabad on Friday, and urged the immediate commencement of the Hyderabad-Umarkot Railway. In reply, Dr. Pollen said he, although warned by Sir Theodore Hope not to commit himself to such a scheme as a railway through the so-called desert, considered the line from Hyderabad to Umarkot a crying local want.

SIR THEODORE HOPE was to have left Simla on the 26th of October, and, after visiting Umballa, Lahore, and Mooltan, he will halt at Sukkur, where the Viceroy and party will be the guests of Sir T. and Lady Hope, and a visit will be paid to the bridge works. From Sukkur on the 31st of October his carriage will be attached to the Viceroy's train, with whom he will continue in his tour along the frontier to Sibi, which will be reached on the 9th of November. From Sibi Sir Theodore will visit the Kattan petroleum works, and thence return to Sukkur, where he will once more join the Viceroy's party on the 16th of November, and accompany them to Jhelum, which will be reached on the 23rd of November. From there he will go to Rawul Pindi and Peshawur by mail train, and meet the Viceroy at the latter station, where a halt will be made for three days. On his return journey he will visit Rawal Pindi, Lahore, Umballa, Cawnpore, Jhansi and Allahabad, and arrive at Calcutta on the 6th of December. This programme has been, however, somewhat changed since the Viceroy's frontier visit was abandoned.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

INFORMATION WANTED.

SIR,—May I be permitted to enquire, through the medium of your much esteemed Journal, that can you, or any of your correspondents, kindly inform me the process how to melt ivory or convert it into a liquid state? I shall feel myself indebted to him who will be kind enough to do me this favor.

BHOWANIPORE; *October* 25, 1887. FANINDRA CH. MUKERJI.

ON FINDING THE NORMALS TO CURVES.

SIR,—I have had lately several cases of elliptical stone-arches, which required a careful determination of the voussoir beds, or in other words of the normals at these points. Though Mr. Thompson's method (*vide* your issue of 6th August, page 93) gives correct results, it will be found in practice that a simple constructive method is as a rule an advantage and can easily be remembered. Perhaps you may find room in your interesting Journal for the following short analytical observation and the constructive method deduced from it, which may be known to many of your readers:

The general equation for a conical section with the origin of the co-ordinates in the point of intersection of the major axis and the curve has the form

$$y^2 = 2px + qx^2 \quad (1)$$

p being the half parameter. If y' denote the first differential of y with respect to x, we obtain by differentiating (1)

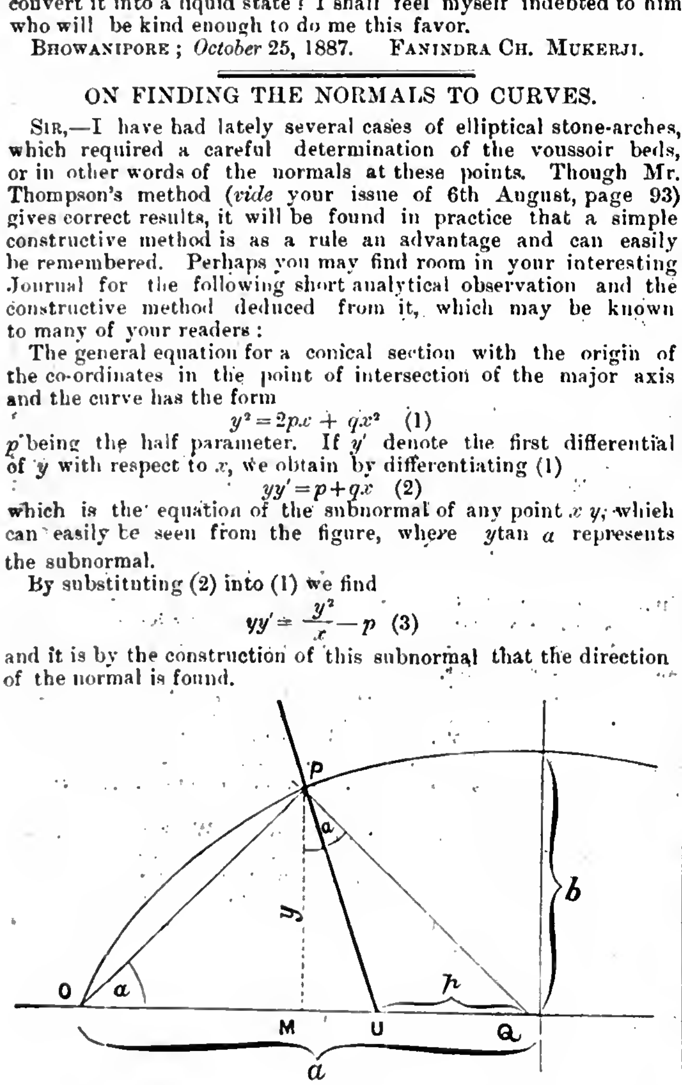
$$yy' = p + qx \quad (2)$$

which is the equation of the subnormal of any point $x\ y$, which can easily be seen from the figure, where $y \tan a$ represents the subnormal.

By substituting (2) into (1) we find

$$yy' = \frac{y^2}{x} - p \quad (3)$$

and it is by the construction of this subnormal that the direction of the normal is found.



Draw the chord O P on the full size ellipse by a thin twine held tight over these two points, erect P Q at right angles to it with the use of an accurate square. This gives the point of intersection Q on the major axis, and from the similar triangles O M P and M P Q it will be seen that M Q represents the value $\frac{y^2}{x}$. The half-parameter $p = \frac{b^2}{a}$ where a and b are the semi axes, major and minor respectively, is once for all calculated and a thin batten cut to the exact size of p. Q U $= p$ is deducted from Q M, leaving M U as the subnormal. P U is then of course the normal for the point P.

The nature of the equations shews the above method to be applicable also to the parabola and hyperbola.

AHMEDABAD; *October* 16, 1887. LUPUS.

THE BOMBAY P. W. D. SECRETARYSHIP.

SIR,—I think it would be fairer to your readers, as well as those whose actions you criticise, if you made a little surer of your facts and wrote your articles in a less acrimonious spirit.*

To begin with, Mr. J. H. E. Hart, late Secretary to Government, Bombay P. W. D., is a quite different man to Mr. G. H. R. Hart, Private Secretary to two Governors of Bombay, but you appear to have thought them to be the same.† In your last number you write as though you were certain that Colonel C. A. Goodfellow, the next in the list to Mr. Hart, had not been offered the Acting Secretaryship. From what I hear, and heard 18 months ago, I understand that he would not have accepted it, even if offered, and it is by no means certain that he was not offered it.

He is a most retiring man and appears to have no wish to come in contact with his fellow officials more than is absolutely necessary, so that even if he cared for the place he would very likely not prove a good man for it; as a Secretary to Government should be anything but shy. Well, after him, of the men out here, comes Mr. Howard. There are only two Chief Engineers in the Bombay P. W. D. One goes with the Secretaryship to Government as a *sine quâ non*, as proved by the Examiner lately giving Mr. Hughes the pay of a 1st class Chief Engineer when Acting Secretary lately. On Mr. Hart going on leave we have only Col. G. as Chief Engineer. The next man in the list should be entitled to the next Chief Engineership, and that is Mr. Howard, so that the order you quote of the Government of India is not contravened in appointing Mr. H. to the Secretaryship. From your argument it follows that because the senior on the list (Col. G.) is not anxious or fit for the post of Secretary, the next to him (Mr. H.) is not to get it, but an outsider is to be appointed, *because* there is no third Engineer (the first having gone on furlough or retired) ready-made in the Presidency. I think the Government of India's ruling means that a man cannot be made Secretary to Government who would not in the natural course of events be Chief Engineer at the same time, so that it will only operate on the Bombay side when *both* the two senior men of the Department are to be passed over. I therefore think you are entirely wrong in your seemingly hasty judgment on Lord Reay, with respect to Mr. Howard's appointment, as he clearly has not contravened the Government of India's orders.

STOIC.

* A strong indictment—the truth of which we must leave our readers to decide.—ED., *I. E.*

† Our information came from Bombay, and we fell into error on this point in good company. We are, nevertheless, obliged for the correction.—ED., *I. E.*

DRAINAGE AREAS AND DISCHARGES.

SIR,—With reference to the correspondence in some of your recent numbers on the calculation of flood discharges from the drainage area of streams and rivers in India, it may be of interest if I give a brief note on some of the chief drainages in my district, as before we go into theory it is best to get as large an array of facts as possible.

The Bara Banki District, in Oudh, is bounded from the North-East nearly to the South-East corner by the River Ghogra, and on the other sides by contiguous districts having no physical characteristics differing materially (at any rate near the border) from those of Bara Banki.

Its extreme length is 70 miles, its greatest width 30 miles, and the total area is 1,700 square miles.

The drainage of the centre of the district is carried by the Kulliani River, which flows from the North-West to the South-East right through the district, the Goomtie River drains the South-West and South; and the remainder of the district is drained by the Ghogra River.

Generally, the district may be described as a rich cultivated flat plain, having falls of from 1·5 to 4 feet a mile, though of course on the *lateral* slopes of the larger water sheds the fall in some localities is much greater—even reaching to 10 feet a mile in very small drainages.

The district may be further sub-divided into two parts:

(1) North of the Kulliani.

(2) South of that River.

To the North the soil is generally sandy and tanks are not very numerous, while in the rest of the district the country is thickly studded with tanks, jheels, and groves; which all have a great influence as flood regulators.

Our chief flood regulators besides the differences in soil are in nearly the following proportions.

I. Jheels and tanks 12 p. c. of the whole area.

II. Cultivation of rice 10 p. c. "

III Groves, &c., 7 p. c. "

and from such land there is but little flow off except in very violent storms, and even then the height of the floods is not very much influenced, though their *duration* is.

These peculiar features in the country make it often difficult to determine a drainage area with accuracy, as the different areas sometimes spill into each other in the most bewildering fashion, causing the results of measurements of actual velocity to vary in a manner that would seem almost impossible to any one who had not had experience in a similar locality, and made a special study of the subject.

The nominal rainfall of the district is 36 inches and the maximum fall in 12 hours (last 10 years) 5½ inches.

The area of cultivated land in the district, including all crops and seasons, amounts to nearly 70 per cent. of the total area.

With these remarks the following tabular statement will speak for itself:—

	Name of Stream.	Drainage area Sq. mile	Flood discharges C.ft. per S.
KULLIANI VALLEY.	Kulliani Right branch	91	2,040
	Do. Left Do.	65	1,396
	Do. at Bara Banki and Byramghat Road	290	9,700
	Do. at Bara Banki & Fattehpur Road	206	5,922
	Do. at Oude & Rohilkhand Railway (main line)	349	12,928
	Do. Hydurgurh & Durriabad Road ...	468	17,581
	Do. Bara Banki & Fyzabad Road ...	503	22,906
	Jahwa Nala	39	2,844
	Nya Nala, Hydurgurh & Durriabad Road	21	4,990
	Raree Nuddi Do. Do. ...	90	7,550
GOOMTI VALLEY.	Goomti River Hydurgurh and Durriabad Road	...	52,000
	Jamooria Nala	35	2,060
	Loni Nuddi	30	4,500

H. W. HUGHES,
District Engineer, Bara Banki.

AURIFEROUS TRACTS OF MYSORE.

SIR,—I find Mr. Foote is somewhat annoyed at the tone of your review of his report on the Auriferous Tracts in Mysore, and takes exception to certain statements which he is pleased to *traverse most positively*. He declares himself not guilty of misquotation and perhaps incapable of any, and in proceeding to shew wherein you had erred positively supports your allegations.

Alluding to Kadkole, Mr. Lavelle distinctly declares that he did not obtain the auric results from the nullah or nullahs or rivers, but from the *high ground* to the north of the village Kadkole, and the context of the next following paragraph to that quoted by Mr. Foote and reproduced here will clearly shew that.

"I investigated the country 10 miles south of Mysore to the west of the public road about the banks of a small stream that runs a little to the north of the village of Kadkole, where I found gold in the first test and continued the examination for about three miles to the west." Then follows: "In almost every test I found gold. The tests were not made in the bed of the river nor in the deposits of the river, but from the *high ground and principally from where the country rock was laid bare at various distances from the stream, being most careful that there was no chance of the gold being carried by storm-floods and deposited where found.*"

His remarks on Chiknayakanhalli deserve no further comment at your hands, as they are based on gratuitous supposition and wrong inferences. You should, however, be obliged to him for the information afforded in regard to his position in the Geological Survey Department, which, I hear, at the time your review was written was that of Officiating Director of the Geological Survey of India. Your remarks, I presume, were addressed to Mr. Foote, and not the Head of the Geological Survey of India.

Belligudda, is the next place, regarding which Mr. Foote thinks your reviewer has tripped or fallen into error. Does Mr. Foote really contend that because the samples he took contained no traces of the mineral those taken by Mr. Lavelle did not? The only course open to Mr. Foote was to have sent for the samples taken by Mr. Lavelle, and before coming to any conclusion favourably or adversely to the opinion expressed by the latter gentleman, he should have carefully assayed them. I hold that pockets of the mineral, so long as they are not proved to be absent from possible or probable localities, may exist in such localities, and the particular places referred to by Mr. Foote may exist and perhaps do exist. I further contend that such pockets as were not available to primitive appliances and modes of mining are still untouched, and such of them were exhausted as were found and were within the reach of the primitive miner.

Your reviewer is next represented as being very angry for Mr. Foote not accepting Mr. Lavelle's high estimate of the Sonhalli gold-fields. In this case your observations still hold good. Mr. Foote, on his own admission, had not the time to closely examine this and all other places he visited and of judging more deliberately than he did or was possible.

The invention of a new mineral—carbonate of silver—he finds on a par with the statement that a big hill was largely made up of rich silver *ore* which cannot be found by later searches. To begin with, you did not hold that the particular hill was, as described by Mr. Lavelle, a veritable silver hill, nor do you, I daresay, so hold now. As far as I can see, all you wanted to make clear, and which has not been called into question, was that the metamorphosed *silver falherz*, which composed the Comet lode in the Reese river, had been described as having been found in a state of carbonate, the sulphur in this case being replaced by carbonic acid. You did not, it is clear, wish it to be understood that such a mineral is of common occurrence or is generally known, but that under exceptionally different conditions such an article has been said to occur, and your allusion thereto is, I find, not so positive as your critic tries to make out.*

You should be much obliged for the reference to Marsh's report, where I find that Mr. Marsh *did* visit Bellibetta, but from the context of that portion of the report it is not clear whether he examined all the places referred to by Mr. Lavelle. It does not appear as circumstantially from this report as that submitted by Mr. Lavelle that the top of the hill was reached by both, that the workings near the site of an old temple were seen by both at the same time, or that the hill was closely examined together or independently of each other. It is a singular fact that except at the commencement of the exploration, Mr. Lavelle in his careful examination of the hill does not once refer to another or Mr. Marsh by the use of the plural *we*. That Mr. Marsh did not examine the north face of the Bellibetta hill and the whole of the hill will no doubt be clear from the following:—"I learn on good authority that to the north and east of Bellibetta are numerous workings." This has reference to the hill and not the district to which he alludes in the very next paragraph and which he did not examine. He alludes to the examination of the north-east, north-west and the saddle of the hill, but is silent as to the exploration of the east and north faces or portions of the hill, both of which were visited by Mr. Lavelle. Mr. Marsh's remarks on the non-finding of silver lode has reference to the west end of the hill where there were numerous workings and where it *was said silver* was formerly obtained. This is different from what Mr. Lavelle describes the hill to consist—alternate courses of carbonate of silver (metamorphosed silver falherz in which the sulphur is replaced by carbonic acid) and auriferous quartz—after more accurate examination of it and from which he took silver and gold ores. He again visited the hill to verify the opinion he had formed of its silver-bearing capabilities and saw no reason to alter that opinion. This I mention not from a belief that Bellibetta is as it is supposed by Mr. Lavelle to be what its name declares it to be, but to shew that Mr Marsh's remarks bear no allusion to the hill as a whole, but to the workings at west end of the hill.

INVESTOR.

P.S.—I am neither known to Mr. Lavelle nor to Mr. Foote.

*The source whence we derived our information on the metamorphosed silver falherz being found in the Reese river ore in a state of a carbonate, was from Mr. Julius Silversmith, in page 237 of his Handbook for Miners, &c., published at New York in 1866, who thus describes the *invention* (we always thought the right word was discovery) of the new mineral. He says:—"The Reese river ore, from the Comet lode, seems to be metamorphosed silver falherz. The sulphur is represented by carbonic acid, so that almost all copper and silver is a carbonate. It contains silver 22·35, copper 17, antimony and some lead. It has a dull greenish-black or black color; streak shining; powder greenish-gray. In a closed tube it yields nothing volatile. In an open tube some sulphurous acid can be observed. On charcoal it fuses slowly, but boils up suddenly in contact with glowing coal leaving a button of silver and copper. This button when played upon with the oxydation flame on another spot of the charcoal gives first a bluish coating of antimonious acid, then a yellow one, nearer to the assay of the oxyd of lead. The silver can be separated from copper by cupellation with lead."—ED., *I. E.*

Literary Notices.

INSTITUTION OF MECHANICAL ENGINEERS.

THE May Volume, or No 2 for 1887, contains President Carbutt's Address on "Fifty Years' Progress in Gun-making," illustrated by six plates. Mr. Carbutt having for many years devoted close attention to the subject, is not only in a position to elucidate the vast progress which has been made in the construction of ordnance, but to dwell on the enormous cost at which the advances in gunnery are being carried on. The only other Paper in the Volume is that by Mr. F. R. F. Brown on the "Construction of Canadian Locomotives," which deals with those classes of Locomotives which have been built from designs of his own to suit the particular conditions of the Canadian Pacific Railway. This Paper is of interest as indicating the advance or otherwise of Canadian Locomotive practice on other types of Engine. It is an exceedingly useful Paper and elicited a valuable discussion.

General Articles.

THE NEW TREASURY BUILDINGS, CALCUTTA.

THIS handsome structure, which was designed by Mr. E. J. Martin, F.R.I.B.A., was constructed in the years 1883 and 1884. It is three storied, and is built in red brick with terra-cotta and artificial stone ornamentation. The large terra-cotta arch over the main gateway facing Government House was at the time of erection the largest yet designed, and with the rest of the terra-cotta was supplied by Messrs. Stiffe and Sons of Lambeth, London. As will be seen from the drawings published herewith, the building consists of one main block facing Government House, from which three wings run at right angles towards the Town Hall. The floors are all of rolled joists and arches covered with terrace, so as to make the building as fireproof as possible. The handsomest elevations are the south, facing the *maidan*, and the west opposite the Town Hall. The wings form two handsome quadrangles open to the west which are laid down in plain turf. The general appearance of the building is very pleasing, and the ornamentation handsome. The style greatly resembles Mr. Martin's greatest work—Writers' Buildings.

LOCAL "SLUFF" IN THE N.-W. P.

WHEN the execrated resolution of Lord Ripon's Government regarding local self-government was first promulgated, it created a feeling of nothing less than dismay in the hearts of all those P. W. Officers, whose services were thus summarily placed at the disposal of the new formed District Committees. The wording of the resolution was so *very* unpleasant. The District Engineer, a Government officer, has henceforth to be in the position of the "*servant*" of the Native Board—*mulazim* or *naukar*—to put it in plain unvarnished vernacular, and was totally isolated from his own Department. He was not even given the status of secretary, or of an ex-officio member, as the Doctor, but was delivered up, bound hand and foot, to the tender mercies of a body of natives, composed of greasy city mahajuns, pleaders, and even of some of his own contractors, who were supposed to scrutinize every item of expenditure and *worrit* him generally.

For myself I must say I felt extremely uncomfortable at the first Board meeting (they call them Boards,—how it has a European ring!); I sat as close as possible to the President (our Collector) for protection, my chair a little behind, to shew that "the servant" occupied a seat at this august assembly only by sufferance, and felt unspeakable things.

The desire uppermost in one's mind was to break out into fearful blasphemy, and then run amok with a long knife. If His Excellency the Viceroy and Governor-General had been anywhere near I should have gone for him straight and ended by "Ripping" him up, slaying myself in a melodramatic manner afterwards.

However, beyond an occasional uncomfortable lumpy feeling in one's throat the meeting went off without any unpleasantness whatever. My accounts and estimates were passed, without even being looked at, and everything was got through swimmingly.

According to the letter of the G. O., all bills of contractors, etc., etc., were supposed to be brought up before the meeting and formally approved of, previous to payment. This absurd and monstrous arrangement could never have worked in practice, and the difficulty was easily surmounted by the simple expedient of burking it entirely. The President (unfortunate man) countersigned everything, and the list of the previous month's expenditure was passed by the Board. This satisfied the Examiner, and everybody else was happy. We started on these lines and continued so to the end.

From the first, nothing was more clearly evident, than that the so-called self-government was a mockery and delusion. It was not that the President or Chairman—as they now term him—rode rough shod over the Committee; by no means, on the contrary, all our Collectors have been most careful to avoid the semblance of dictation. But the fact remained that as regard public works the members were totally ignorant of the wants of the district and utterly indifferent. Outside of their own little Pedlingtons, they knew nothing and cared less; and were quite content to leave the initiation of projects to those who had visited the remotest parts of the district and were naturally intimately acquainted with its requirements. The accounts, correspondence and everything was in English, an unknown tongue to the majority of our legislative assembly, who were in consequence totally unprepared to offer any adverse criticism, even if the desire of interference existed. Had the intentions of the radical faddist, who originated this absurd scheme, been carried out in its entirety, *i.e.*, with a native Chairman and energetic meddling members, the results must have been most disastrous. In our large district, it would have been equivalent to putting, say, the St. Pancras Vestry in charge of the Public Works in South Wales.

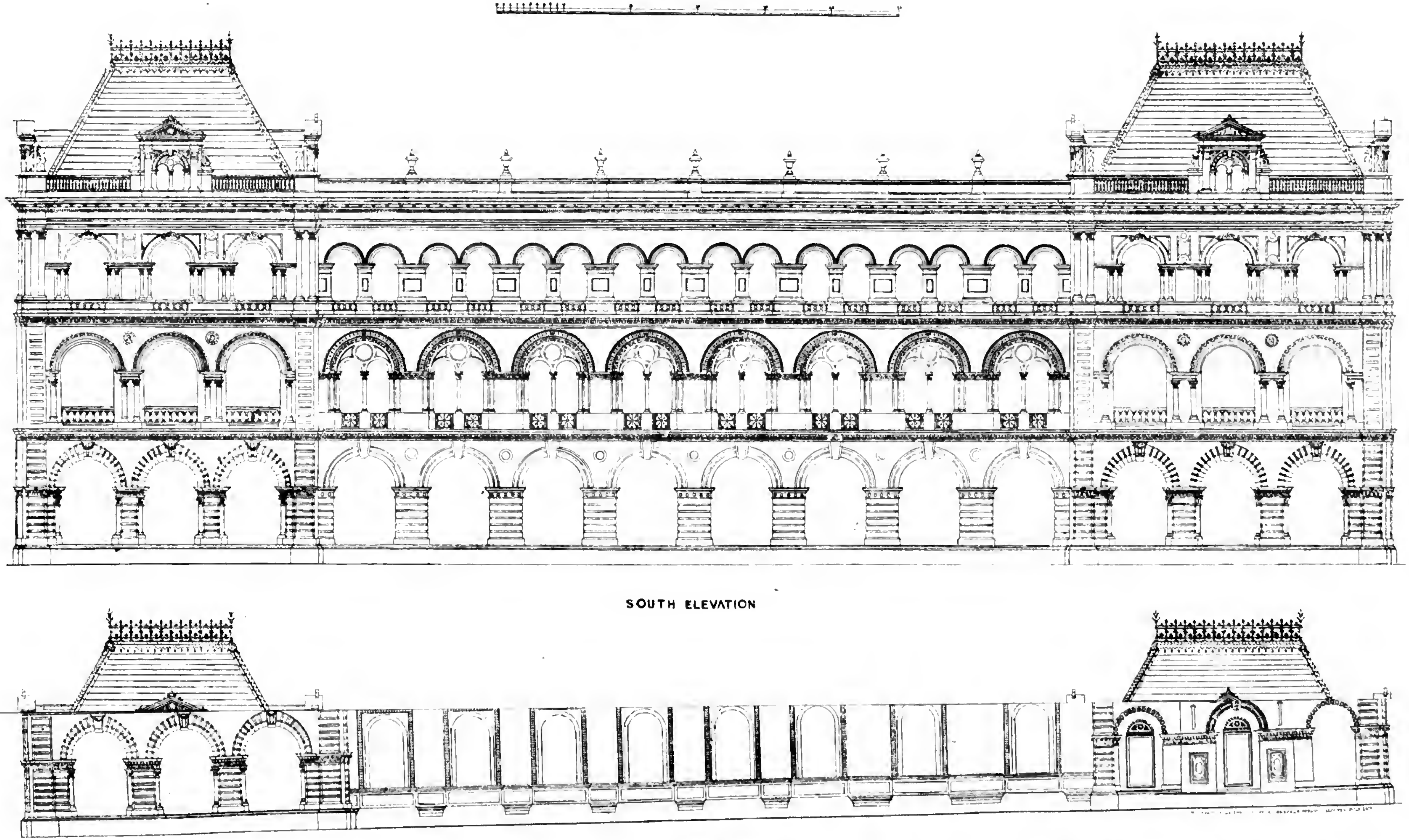
However, the results of some years of local self-government have unmistakably proven that the new system as worked in our district has been an immense success. Like Balaam "It came forth to curse, but ended by pouring forth blessings." The reason for this is easy to see. All the objectionable points of Lord Ripon's scheme of local self-government were inoperative for harm, while we reaped the immense benefit of freedom from the bonds of redtape and official obstructive interference, qualities which seem inseparable from the Provincial Executive Engineer of the present day. Our connection with that individual and his abominable office was cut off completely. The accounts went direct to the head fountain, the Examiner, who is infinitely better to deal with than the Executive Engineer's Accountant, and our projects to the S. E. or mostly to Head-Quarters itself for sanction. We never had any trouble. We got as much money allotted as we asked for, or nearly so, and the result has been quite a phenomenal improvement in our communications, some of the main lines of which were in no better state than in the days of Akbar or Shahjehan. In theory the District Engineer was the slave of the Board, whereas in practice he bossed the whole show. Where the Collector has full confidence in his District Engineer and backs him up, the result is sure to be satisfactory.

Whilst in the Provincial Branch (a "*kunkering* hero," as ribald outsiders sometimes term us), I have invariably been extremely fortunate in getting a good Deputy Commissioner or Collector to work under. A great many men in our Department hate the Civil Service and would be glad of a return to the old original times, when the District Engineer was a purely Departmental officer. For myself I greatly prefer to work under Collectors. In fact, I have always sided with them in attacking our common enemy, the Provincial Executive; whom we both regard as the incarnation always of obstructiveness, and sometimes of something worse. I am merely stating my own experience, but I know that there are others who have a very different tale to relate of humiliating interference by the Board, of a worrying Collector, of money wasted and no progress. To ensure success in the old plan, the following conditions were essential: A *fainéant* Board, a good Collector, an experienced and pushing Engineer. Now, in most districts these qualifications were not to be had in combination. The Engineer is often a subordinate in the P. W. D. or else an experienced assistant, and as the initiation of projects must rest with the D. E., as also the carrying out of the works, it followed naturally from the almost total absence of professional supervision, that mistakes were made in designs and work often slovenly done. The Heads of the Department were fully aware of this, and also of the fearful waste of public money involved in the employment of two sets of Engineers, Provincial and Local, going over the same ground. But for years nothing was done to attempt a remedy. No one dared to broach the subject of the abolition of Lord Ripon's great fad—

ing.

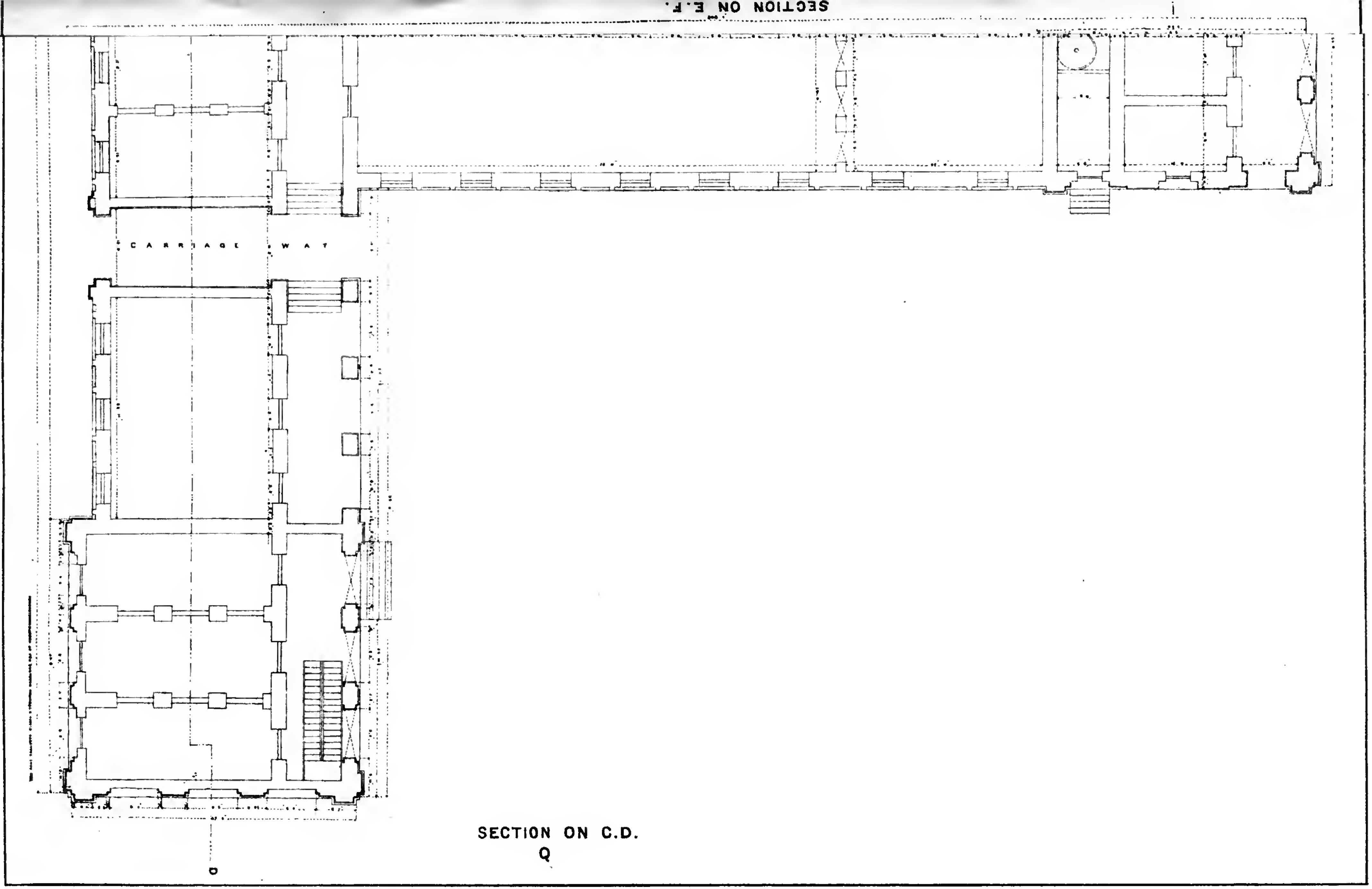
ELEVATIONS

Scale of Feet



SOUTH ELEVATION

NORTH ELEVATION


SECTION ON E.F.
CARRIAGE WAY
D
SECTION ON C.D.
Q

local self-government—in fact it could not be done. At last, and quite recently, the knotty problem of reconciling the principles of local self-government with economy and efficiency has been satisfactorily solved. The reactionary change has been quietly and unostentatiously carried out in most, if not all, of the North-Western Divisions, and is now a *fait accompli*. The originator deserves immense credit for his ingenuity. The main points in the re-organization are these:—The Sacred District Board is left intact, but its functions are now limited solely to the allotment of funds and initiation of projects. It has nothing to do with the executive work.

The District Engineer is now professional secretary to the Chairman and is no longer a "servant" of the Board. His position otherwise is absolutely unchanged, except that he comes under the supervision of the Divisional Engineer. He does all the work, Provincial and Local, and accounts as before direct to the Examiner. The Executive Engineer has thus no accounts, and his detestable office is deadened off the face of the earth at one fell swoop. He becomes in fact a Superintending Engineer of sorts. The Chairman of the District Board, or Collector, as is usually the case, is now relieved of all responsibility regarding accounts and from the hardship of having to blindly sign innumerable forms, accounts and bills, of which he did not, and could not, know anything. The establishment is necessarily largely reduced, and general efficiency must be promoted, while the Department is confined entirely to professional work.

WATER-COOLER.

(Dubern's Process.)

THIS apparatus is calculated to cool rapidly the very large quantity of water that is necessary to condense the steam of engines and the vapour of the volatile liquids of ice machines.

For these last, by no other means is it possible to obtain practically, in most parts of India, large quantities of sufficiently cool water, as the largest tanks or even rivers though affording a plentiful supply yield but rather warm water for such purpose, whereas wells though giving rather cool water are below requirements in point of quantity.

Wherever the supply of cool water for steam engines or any industrial purposes is limited or difficult, the water-cooler removes all difficulties. To produce the same results as if 250,000 gallons of specially cool water had been used per 24 hours, only 2,000 or 2,500 gallons of water is needed as a stock and for circulation: the size of apparatus to give such a supply is 100′×40′×20′ high: the cooling ranges from 125 or 135 F. brought down to 90 F., as fast as delivered by the engines. When the initial temperature is 95 F. instead of 125 F., the same size of apparatus cools down that same amount of water to about 80 or 82 F.

This size of water-cooler is now in daily use by the Crystal Ice Company of Calcutta. In the hottest weather one-half of it supplies daily 120,000 gallons of water to three 6-ton ice-machines Ether condensers, after having cooled it from 96 or 98 F. down to 80 or 82 F: the other half is to deal with about the same amount of water for the steam condensers, and bring it down from 115 or 120 F. to 90 F. The left hand side of the cooler was the only part working at the time, supplying 110,000 gallons.

Where but a 10 H.-P. condensing engine could be kept at work by wells or other small supplies, a 100 H.-P. can safely and regularly be kept going, the consumption of water being the least attainable by any means, owing to the cooling and partial evaporation of water taking place whilst entirely protected from the sun's rays and in a systematic and rational way. The consumption is about 2% when cooling from 120 F., and 1% when cooling from 95 F. In other words, for steam condensation, the water can be used 50 times, and for ether condensation, 100 times over again before it is all evaporated.

Without the help of this cooler, it would not have been possible for the Crystal Ice Company to start in such central position as it is in Calcutta, having neither river nor canal to draw water from, nor sufficient room for tanks of adequate size for such an important ice factory, working sometimes up to 150 H.-P., and whose requirements could not be supplied there without the cooler. Coolers four or five times as large as this one are in no ways impracticable. Henceforth, therefore, the erection of mills with large condensing engines, or large ice factories, can be considered as practicable in almost any locality, provided there is but a small water-supply available.

All that is then needed is to pump the hot water from the engines, through the cooler, over and over again to a height of 20 feet, say 2,500 gallons of hot water over again every quarter of an hour, and thereby the engines are benefitted to the same extent as if they really had 1,000 tons of well water passed through them.

All ice-machines or steam engines now under difficulties from over-hot or short water-supply can be freed from them, through the addition of this water-cooler. It is to a great extent due to this help, that engines of the above-mentioned Ice Company are now able to produce in the hottest weather as much ice as they did in England in the winter (February).

The apparatus consists mostly of a shed of wood supporting from 500 to 1,000 running feet of metallic triangular drains; hence, relatively, unskilled labour is quite sufficient to make and erect it. It is advisable to make it in the locality where required, as it is bulky and heavy to transport.

If desired, the iron work consisting of drains, tie-rods, piping, galvanized sheets and pumps, or even the whole of the superstructure, including the wood work, is supplied with drawings to erect it and the license to use the patent. However, if so preferred, and specially ordered, the whole of the structure can be made of iron.

The total first cost (including license) depending somewhat on the locality, comes to about Rs. 5 per 100 gallons capacity of the cooler per 24 hours. So a 25,000 gallons one would cost on the whole Rs. 1,250: one for 100,000 gallons Rs. 5,000, and so on.

Including the H.-P., the cost for working and also replacing the perishable parts (coal-tarred dripping cloths or sails) comes to about eight annas per 20,000 gallons cooled per day from 125 to 90 F., for steam condensation or such purposes, or from 95, to 80 or 85 F., for ice-machines in the worst circumstances.

In the fourth half-yearly report of the Crystal Ice Supply Company is found the following paragraph: "Dubern's patent water-cooler has proved a complete success, giving us ample supply of water for condensing at temperatures not exceeding 82 F. even in the hottest weather."

The water-cooler is a really invaluable addition to any ice-machines to help them out of all serious difficulties arising from the great heat they have to contend with in India. Mr. Dubern, who is Managing Engineer to the Crystal Ice Supply Co., Calcutta, has also devised a new system of ice tanks, the ice produced by which is of a quality hitherto unattained by any other system, being truly nothing short of the hardest and very best picked natural ice. This result is obtained without any mechanical agitators to stir the water during the freezing, which last remains unimpeded throughout the whole process and requires no care or looking to, till finished. His other patents may be seen at work on the 6-ton machines of the Crystal Ice Company, now enabling them to produce an average of 7 tons of ice per 24 hours in the hottest weather.

THE first American railway engine that has been imported into China left Shanghai on the 8th ultimo in the *El Dorado* for Tientsin. The boiler weighs five and a half tons.

THE KIDDERPORE DOCK WORKS.

THE sub-joined *first* Quarterly Report by Messrs. Vertannes and Cloete, on the part of Government, is published for general information by the Government of Bengal, in the Public Works Department.

The Kidderpore Dock scheme as at present authorised to be proceeded with to comprise:—(1) the acquisition of all land required for the construction of both Docks Nos. 1 and 2, and for the boat canal to Tolly's Nullah and the construction of the following works:—(2) sixty feet lock, (3) eighty feet entrance to tidal basin, (4) tidal basin with 60-ton shears, (5) double passage from basin to Dock No. 1, (6) Dock No. 1 with width of 600 feet, (7) boat canal from docks to Tolly's Nullah, (8) Graving Dock, (9) boat wharves, tramway with lifting bridge over Tolly's Nullah, and (10) the removal and reconstruction of the buildings in the Government Dockyard.

The revised estimates relating to these works being under preparation, Mr. Apjohn, the Superintending Engineer in charge of the Dock Works, has not been able to give definite information regarding the principal items of works which those estimates provide for; he has, however, submitted an index map and statement, which shew the progress made on such works as have been taken in hand up to the end of the quarter under report. The condition of the works on 30th June may be described as below:

TEMPORARY WORKS AND PLANT.

A want of locomotive power was felt, but more engines and trucks for the removal of spoil were shortly expected, on the arrival of which work would proceed with greater facility.

It must be borne in mind, however, that in starting works of the nature of these under report, a considerable length of time must pass in making preliminary arrangements, collecting plant, &c., before a fair rate of actual progress can be attained. The season up to 30th June was a favorable one, and more work was executed than it was anticipated could have been done. The Tramway to Akra, being 5·5 miles in length, was completed and opened for carriage of material in February last. Tramway lines, 9·4 miles in length, have been laid in the vicinity of the docks for the removal of earth, and are in use.

PERMANENT WORKS.

Acquisition of Land.—The land required for Docks Nos. 1 and 2, and for railways to Tolly's Nullah and Akra, had been acquired, but considerable delay to the work had been caused by some of the land required for the boat canal not having been handed over, and some inconvenience has been felt on account of all the buildings in the Government docks not having been vacated.

Tidal Basin.—Work of excavation in the foundations for the walls of this work was begun in January 1887, and brickwork started in March. By 30th June 38 lakhs of cubic feet of earthwork had been moved, and 418,000 cubic feet of brickwork executed in a length of 320 running feet of walling on either side of the basin.

Dock No. 1.—The diversions of the Garden Reach Road and of some minor roads on this dock site had been made. Of earthwork 202 lakhs of cubic feet had been done, and 1,241 running feet of walls had been founded and raised to a height of 19 feet. In this walling 721,370 cubic feet of brickwork had been executed.

Boat Canal and Dock.—The excavation of 18 per cent. of the estimated quantity of earth in the canal had been carried out, and the excavation of the boat dock, comprising 50 lakhs of cubic feet of earth, had been completed. More work in the boat canal could, it is understood, have been done, but for the fact that all the land required for this work had not been handed over.

Boat Wharves, Tramway and Lifting Bridge.—The Strand Tramway between Calcutta and the docks, a length of 2·70 miles, had been completed, and the lifting bridge over Tolly's Nullah at Hastings constructed and was open.

Expenditure.—Up to end of June a total sum of Rs. 55,42,506 had been expended on the works connected with the dock scheme. It should be noticed, however, that Rs. 21,59,000 of this, or 38·9 per cent., represents the cost of acquiring land.

As the works executed during 1886 in connection with the dock scheme were merely of an experimental nature, the month of January 1887 should be taken as the time in which the works were started.

Taking this into consideration, the progress made up to 30th June 1887 has on the whole been satisfactory, and there is every reason to believe that the character of the work and of the quality of the materials used are of the best description.

REPORT ON THE WATER-SUPPLY SCHEME PROVIDED FOR THE CITY OF JUBBULPORE.

BY J. G. H. GLASS, M. INST. C.E., EXECUTIVE ENGINEER.

IV.

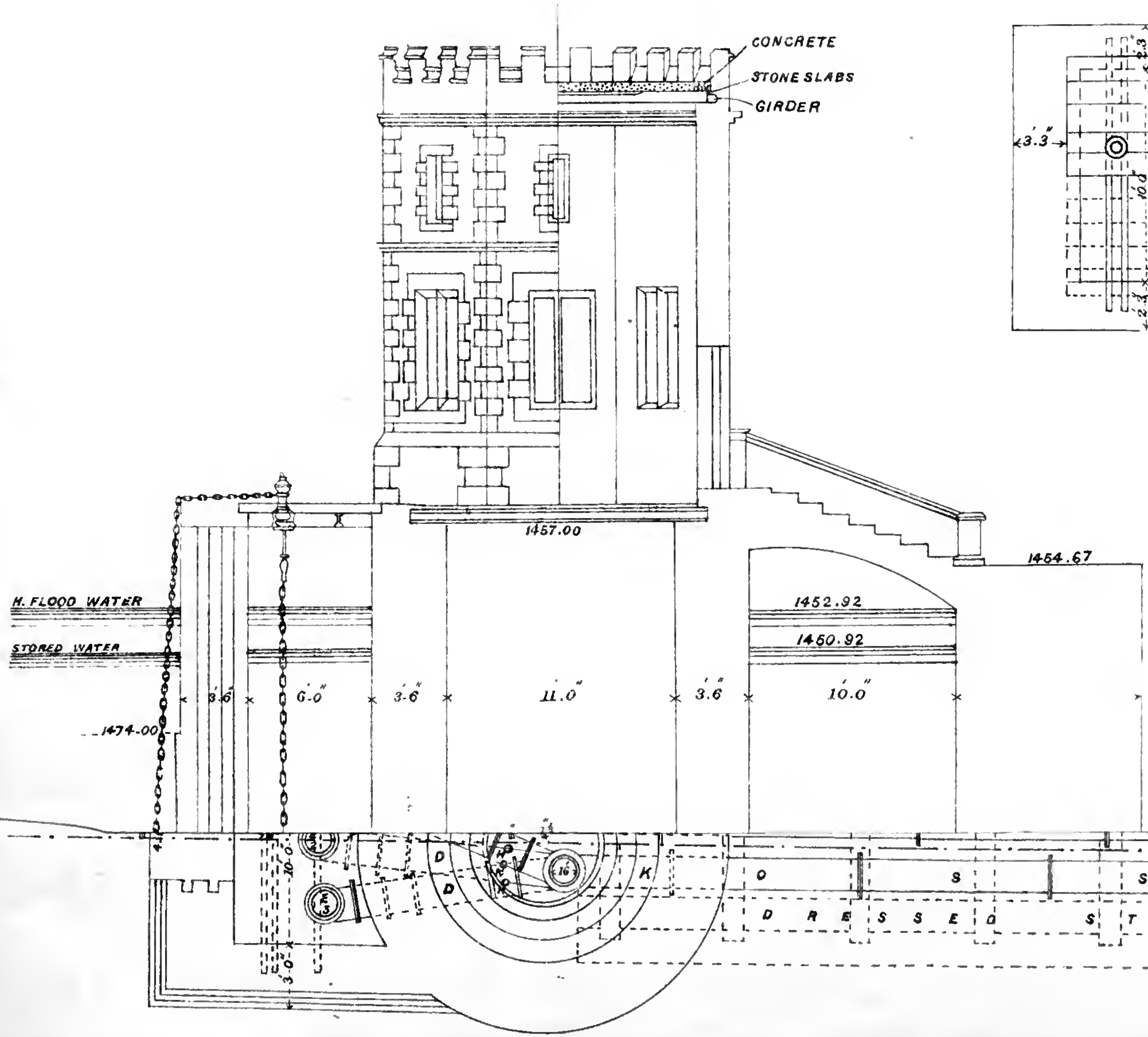
IN consideration of the head of water against the Tower, that the walls are of no great thickness, and that it is of importance the Tower should be water-tight, it was deemed advisable to give a coating of Portland cement mortar to the outer face. The lowest part received a coat 1½" in thickness, and this thickness was gradually reduced until within 10 feet of high flood level, where it is half an inch the minimum thickness given. It was not continued above high flood level. The inner face of the Tower was also rendered with Portland cement mortar, with the object of protecting the stone from atmospheric influences. The mortar was not put on in any perceptible thickness. It was merely rubbed into the pores of the stone by means of a small wooden float of the same curvature as the face stones, and is only what may be called '.skin thick.' This work was of course done before the Reservoir filled.

Special precautions were taken to guard against leakage where the inlet pipes pass through the Tower from the vertical pipe into the strained water chamber. From the drawing of one of the inlet pipes which accompanies, it will be observed that special collars with gussets are cast on the part in the wall. The pipe rests on a stone cut to receive it, and placed about the centre of the wall. Portland cement concrete was filled in round the pipe, and on both sides of the bed stone the same material was carefully packed. The finishing off of the concrete above, below, and at the sides of the pipe was so arranged that there was no through joint anywhere. There are four pipes through the Tower wall, and all were bedded in the manner described. The result is satisfactory, as at only one of them has there been any leakage, and that is not of any importance. When the Reservoir first filled an occasional drop of water passed from the jointing of the second inlet (from the bottom), but since then it has lessened in frequency, and it is not unlikely it will entirely cease in time.

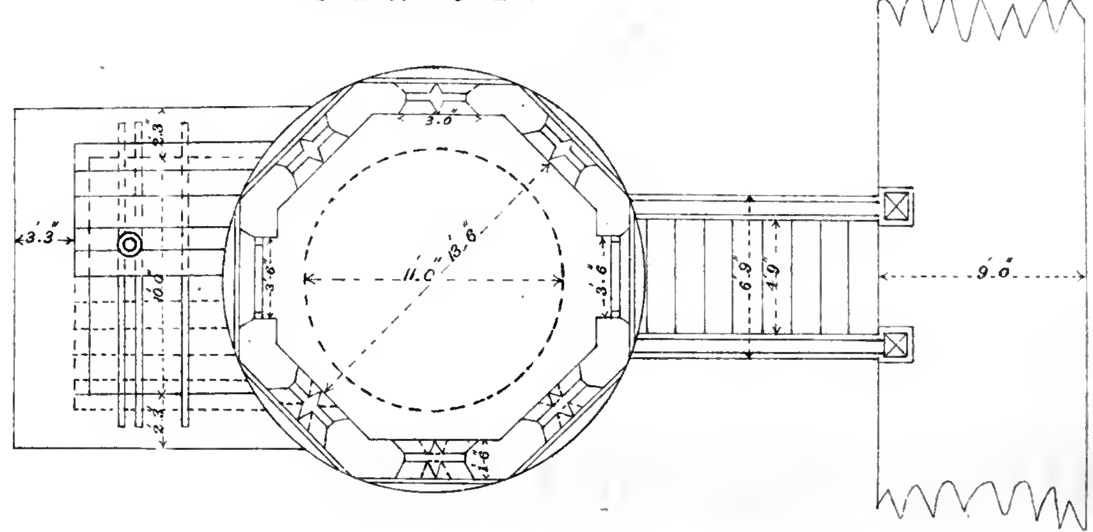
The ineqalities in the rock foundations of the Tower and the spaces between the foundation courses of masonry, and the sides of the excavation were filled in with cement concrete to ensure a true bed for the masonry and the founds being water-tight.

In the original design it was intended to cover the Tower with an ordinary pent roof of Jubbulpore glazed tiles so as to give a room for the shelter of the men employed in working the valves. But so insignificant a design on the top of a massive Tower, and surmounting so imposing a structure as the masonry Dam was considered inappropriate; and it was thought well worth the small additional cost involved to build a battlemented octagon from the circular shaft that it might be in keeping with the work of which it forms a part.

TOWER AND S.W. CHAMBER AND CULVERT.



PLAN OF TOWER.



JUBBULPORE WATER WORKS.

J. H. GLASS,
Executive Engineer,

Strained Water Chamber.—In 1881, the then Chief Engineer, Colonel J. O. Mayne, R.E., on returning the Plans and Estimate for the Jubbulpore Water Works duly sanctioned, remarked that "some proposals are also necessary for the strainers to prevent any solid matter entering into the pipes." This was indeed a very important matter and one that required careful consideration. In the original report, it is remarked, "no special arrangements are made for filtering the water, as it is not considered that any are necessary. The area of the catchment is so large as compared with the spread of the Reservoir, sixteen times nearly, that the impounded water is not liable to objectionable impregnation in harmful quantities. It will be sufficient therefore to arrange for wire gauze at the inlet pipes, more to prevent the ingress of fish and solid matter than for purification of the water." The intention in my mind was to fit wire gauze cages over the inlet pipes with an arrangement of fixed slide rods for removing the cages for repairs, &c. In working out the details of this proposal, two main difficulties presented themselves. The first was what area should be given to the cage so as to prevent any strain on the wire gauze when the pipe was in full supply. If made too small the gauze would be rent by the water flowing into the pipe, and it was of importance to keep it as small as possible to obviate the cage being of unwieldy dimensions. The second was that wrought-iron would enter largely into the construction of the frame, and it is well known that this material rapidly oxidises and becomes destroyed when immersed in soft water. If then any part of the frame should give when the cage was being drawn up for repair or inspection it would be difficult to recover it. Again, there would never be any certainty, especially in the lower inlets, that the cage was properly seated, and unless the whole opening was protected the desired object would not be attained. For these reasons this proposal was rejected and other measures were considered. In December following two proposals were submitted to the Chief Engineer, similar in design but different in position, and as regards some of the details. The more costly of the two was recommended for acceptance, as being in every respect more suitable and efficient. The first was to build two walls connecting the Tower and the Dam and enclosing a space to be used as the chamber for strained water. In the walls teakwood frames holding wire gauze screens were to be put, through which the water would flow into the space enclosed by the walls, and the inlet pipes from the vertical supply pipe in the Tower would open into this space or strained water chamber. The second proposal was similar as regards design, but the position (see drawing) was placed on the Reservoir side of the Tower, and thus three walls were necessary to enclose the desired space for the strained water chamber.

The arrangement which has been carried out may now be described. The strained water chamber is situated (*vide* drawing) on the Reservoir side of the Tower, and is formed by the construction of three walls, the fourth being a part of the Tower. The front wall is provided with an opening commencing from the 1405·50 level with grooves of dressed sand stone at the sides for the reception of the wire gauze screens. From the vertical pipe within the Tower three horizontal pipes radiate at the levels shewn to the strained water chamber, the inlets of which are bell mouthed. Each of these pipes is provided with an ordinary sluice valve within the Tower, so that the supply is under complete control. In event of repairs being necessary to the valves they can be executed after closing the bell mouth in the strained water chamber by means of a ball either of wood or other material of suitable diameter. When the repairs to the valve have been effected the stopper can be readily removed by connecting the length of pipe between the inlet and the valve with the water in the Reservoir. This is done by a pipe of small diameter furnished with an ordinary cock, screwed into the large pipe between the valves and the inlet, and opening into the Reservoir. The presure on the stopper is thus equalized, and it can be removed without difficulty. The floor level of the Tower is 1399·67, or 10 feet above the lowest part of the reservoir bed. At this level a fourth pipe passes through the Tower and the strained water chamber, and thence to the Reservoir where it terminates in an ordinary hinged flap valve, which is worked by a chain and pulley from the top of chamber. This is called the scouring pipe, and it is for the purpose of removing any sediment that may deposit in front of the strained water chamber. It is carried through the culvert under the Dam to a short distance beyond the toe of Dam. To the portion of it within the strained water chamber a 16″ valve worked by gearing from the top of chamber is attached; and within the tower it is provided with an ordinary screw down valve. The floor of the strained water chamber slopes abruptly on all sides towards the valve, and the removal of any solid matter that may accumulate within the chamber is thus assured by closing the outer or flap valve and opening the valves within the chamber and the tower. The scouring action set up by opening these valves is very considerable, and no sediment or other matter deposited on the floor could be unaffected by it. When it is required to open the flap valve the valve within the Tower is closed, and that in the strained water chamber is opened. The pressure on the flap valve is thus removed, and it can be opened without undue strain on the hinged joint or other parts.

The front wall of the strained water chamber is fitted with two sets of grooves (*vide* drawing) for the reception of screens of copper wire gauze of 40 meshes to the lineal inch, through which the water flows from the Reservoir. These screens are fitted into teak wood frames (*vide* drawing) 4½ feet wide and 6 feet high, and are thus capable of being easily handled. They are in double sets to admit of one being taken out for cleansing whilst the other is in position. The arrangement for lifting the screens is very simple. The lowermost of the screens rests in a cast-iron shoe fitted with side rollers of gun metal (*vide* drawing.) Two chains of galvanized iron, one on each side, are led from the shoe to the top of strained water chamber, and when it is necessary to remove the screens, shear legs, to which are fitted two ordinary pulley blocks, are placed immediately over the grooves. The chains are then passed through the blocks and the screens hoisted; and as each screen clears the top chamber wall it is removed by being pulled to one side. The arrangement is of the very simplest kind, and with ordinary care there is no chance that it can get out of order

(To be continued.)

The annual official returns of the production of minerals in the United Kingdom shew that the quantity of coal produced during 1886 was 157,518,003 tons, as compared with 159,351,000 tons in 1885; iron ores 14,110,000 tons, as compared with 15,417,000 tons; clays 2,390,000 tons, as compared with 2,531,000 tons; salt has fallen from 2,207,000 tons to 2,142,000 tons; slates and slabs from 469,000 tons to 456,000 tons; tin ore from 14,376 tons to 14,232 tons; and oil shale from 1,770,000 tons to 1,728,000 tons. The total value of the minerals raised in the United Kingdom during 1886 is given as £55,010,000, which is a decline of nearly three and a half millions on the value returned for 1885.

We learn from Riga that it is proposed to join the Dwina and the Dnieper by a new canal which is to connect the river Loutchesa, flowing into the Dwina near Vitebsk, and the river Orchitcha, flowing into the Dnieper. This project also entails deepening and improving the means of navigation on the Dwina and on the Dnieper, which will cost two million roubles (£180,000,) while the cost of the construction of the canal is estimated at eight million roubles (£717,000). This canal would shorten the present water communication by 257 miles, and provide a navigable waterway of 921⅓ miles, connecting Riga and Kremenchong.

The practice in U. S. Government buildings, according to the *American Architect*, is to use the following constants for mortar per M of brick :—

M = 50 c. ft. (20 bricks per foot).
Sand = ·35 c. yds.
Cement = 1·46 bbls. of 300lbs.
Or lime = 1·75 bbls.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XI.

Wrought Stone or Block-in-Course Archwork in Bridges 20 to 40 ft. span.

Items per 100 c. ft.	No. or quantity.	Rate.	Amount.	Total.
(1)	(2)	(3)	(4)	(5)
Labor.—				
Masons No. ...	6			
Do. " ...	6½			
Do. dressing stones	30			
Coolies No. ...	2½			
Do. " ...	3			
Do. " ...	3			
Bhistie " ...	1¼			
Grinding mortar, c. ft.	20	Variable.	Do.	Do
Sundries	...			
Materials.—				
Stone blocks, c. ft. ...	90			
Lime dry, c. ft. ...	9·6			
Sand " ...	9·6			
Surkhi " ...	9·6			
Sundries	...			
Scaffolding ...	...			
Petty Establishment ...	...			

Specification.—The stone blocks to be of selected shape, so that when dressed to proper radiation they shall make close joints not exceeding one-third of an inch. All the stone blocks must be of a size to cover whole thickness of arch. The thickness of voussoirs at haunches to be not less than 10 inches, diminishing towards crown, where they will not be less than 6″. The keystone at soffit will be 12″ in 20 to 25 ft. arches, and 15″ in arches 30 to 40 ft.

N.B.—The number of masons noted in this and other details are required for dressing hard trap stone. Fewer masons would be required for dressing softer descriptions of stone.

X.

NOTES FROM HOME.

(From our own Correspondent.)

The inquiry is still proceeding as to the destruction of the Exeter Theatre, and very important evidence has been adduced tending to shew that the construction of the theatre has been far from what it should have been. It is to be hoped that the catastrophe may result in the making of regulations that will be enforced by authorities more responsible than those at present seem to be. The inflammable nature of the scenery and the stage accessories cause frequent fires in these buildings for I find that since October 1886 theatres have been burnt down at the following places:—Ravenna, Paris, Leschin, Rotterdam and Exeter, all with more or less loss of life, and further at Philadelphia, Gottingen, Bucharest, Northampton, Laibach, Rouen, Caceres in Spain, Venloo and Stockport without loss of life.

A trial was recently made at the Royal Albert Docks with a new life-boat. The boat, 26 feet long by 7 feet beam, comfortably carried forty men and floated buoyantly with a freeboard of two feet two inches. The exceptional height of the freeboard is one of the features of the invention and is obtained by a hood of stout flax canvas extending along above both sides of the boat and supported by a series of jointed stays inside. Opened up the hood increased the height of the side about two feet, but for the purpose of stowing away the boat on shipboard the hoods can be shut down leaving the vertical height of the boat fourteen inches. Four such boats can be piled under one set of davits—the uppermost one being suspended thereon in little more space than is occupied by an ordinary ship's boat. The boat weighs seventeen and a half hundredweight against an ordinary weight of a boat is twenty-seven to thirty hundredweight and even two tons. An ingenious arrangement of lateral bulkheads increases her buoyancy. Underneath the boat runs a small handrail on either side of the keel, so that if in an unusually heavy sea the boat should capsize, the crew hanging on to the rail on one side would find little difficulty in righting her. The advantages claimed for the boat are that she is unsinkable. (2) Economy of space on deck in storing. (3) Large carrying capacity in proportion to size. (4) Unusual buoyancy and lightness. (5) Structural strength and moderate cost.

Machine guns are a favourite development of the ordnance of the present day. A new quick firing 30 pounder gun manufactured at the Ellwich Works has recently been tried at Portsmouth. It measures 170½ inches in length and weighs 34 hundredweight. Next to the size of the gun the principal feature is the entire novel system of mounting adopted. No trunnions are required, the piece being supported on rings. The carriage is also fitted with hydraulic recoil gear and with a spring for forcing the gun back to the firing position after discharge. As a result of the trial it was found that ten rounds could be fired in fifty seconds A 60 pounder quick-firing gun is also shortly to be tried.

The terrible accident that has recently happened at Hexthorpe, near Doncaster, on the Manchester, Sheffield and Lincolnshire Railway appears to have been caused by the driver of a train disregarding hand flag signals, proceeded to dash into a train at rest at the ticket platform. It transpires that on race days, when the traffic is abnormally large here as at Epsom and other places, the block system is cancelled and the trains are checked or passed on to the platforms. Written instructions are given to drivers and guards to this effect, but in this case the driver seems to have ignored these instructions and not to have seen the flagmen and so only discovered the Midland train when it was too late to avert the disaster.

The largest and the most powerful addition to the British Navy was successfully launched on the 20th instant. The *Trafalgar* was begun in January 1886 and has been built with an expedition wholly unusual in the case of large vessels. Some considerable time must, however, elapse before her complete equipment, and she is not expected to be ready for commission for the next two years. Her cost when fully armed will amount to £920,000. Her length is 345 feet, breadth 73 feet, draught 27 feet. Her engines work up to 12,000 horse-power and her speed is 16½ knots an hour. When fully equipped her tonnage will be nearly 12,000. She is intended for an admiral's ship and will have a complement of 520 officers and men.

Considerable progress continues to be made in the New Thames Tunnel. The carriages to be run on the line are to be something after the pattern of the Pulman Car. These cars are to be more roomy than omnibuses, or even ordinary railway carriages. Each train will carry about one hundred carriages. They will start every two or three minutes and the distance over the first section will be covered in six or seven minutes. The speed will be about double that of road conveyances. The machinery for working will be placed at the Elephant and Castle, and as the Cable system is to be used no difficulty is anticipated with regard to the ventilation.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

The report on the Udston Colliery explosion by Mr. J. Dickinson, the Chief of H. M. Inspectors of Mines, has been issued. He considers that the explosion was due to the ignition of some quantity of firedamp at an open lamp, or at a match, or by being drawn through the gauze of the so-called Scotch safety lamp. The following suppositions are then set forth:—That the explosion was extended by the aid of gas drawn from the solid coal by the exhaustion and pressure produced by the initial explosion; and that some other bodies of gas were ignited by pressure on the same principle as tinder is ignited by the compression of air. It is painful to consider, notwithstanding the ordinary risks of the mine, that several of the miners were found possessed of matches and lamp keys, and that they had been accustomed to open their lamps in the mine. The men had frequently objected to being searched, and Mr. Dickinson is strongly of opinion that the conduct of the miners in this instance renders it necessary that in all cases, powers of search should be given.

The question of mining leases has received renewed attention since favorable terms have been offered by Mr. Bassett to the adventurers in West Seton. These terms are: Dues in kind at one-eighteenth of the produce or a quarter part of the net profits; but no dues are payable until the mine pays dividend, and if calls are made upon the adventurers the amount thereof is to be deducted befere dues are again payable. This appears to be a new departure in mine leases, and contains a principle which should meet with the approval of all mine adventurers—the payment of dues being dependent upon dividends.

Electrolytic cartridges are being suggested for use in mines, a very energetic form having recently been introduced. A glass cartridge is filled with a solution of chloride of ammonium in water, which is decomposed by means of an electric current of considerable intensity into chlorine, hydrogen and ammonia. Finally the chlorine reacts upon the ammonia and produces hydrochloric acid and chloride of nitrogen. This latter substance is most explosive. The gas soon attains a sufficient pressure and bursts the glass cartridge ; the shock of the fracture produces the explosion of the chloride of nitrogen.

The St. John del Rey mines in Brazil are in serious trouble. The lode has been worked in a downward direction, and was of such uniform quality, as to require no great attention from the officers, except as to timbering the side walls. The late Captain Treloar left large pillars of ore to support the hanging wall, which were removed by his inexperienced successors. The falling in of the mine and loss of the lode has been the natural result of such removal, and of the insufficient insertion of timber to take the place of the natural pillars.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

THE work on the Manhattan Bridge, as the new stone and steel structure over the Harlem river at 181st Street, New York City, has been officially named, is more than half finished. The three main piers are ready for the metal superstructure ; in fact, the massive steel pedestals which distribute the thrust of the arches upon the piers are now being placed in position.

Of the 7,000 tons of steel and iron that the bridge will require, considerably more than half has been already cast, and work on the erection of the timber staging for carrying the arches during construction has begun. The bridge is 2,375 feet in length and 151 above the river, or over a third longer and about 50 feet higher than High Bridge.

It will consist of two steel arches of 508 feet span each in the clear ; three granite piers each forty feet thick at the springing line of the arches, and two abutments of masonry. An entire new plant of machinery had to be constructed by the Passaic Rolling Mill Company of Paterson, N. J., for handling the immense segments of which the steel arches are composed.

There are thirty-four of these segments in each rib or arch, and six ribs in each span, making 408 segments in all. Each of them weighs about 10 tons and is composed of steel plates, curved to give the arch the form of a parabola. Upon these arches will rest wrought iron columns, thoroughly braced together and supporting the roadway above. The floor system of the roadway consists of transverse iron floor beams, resting on these columns and carrying the longitudinal iron stringers which are entirely covered with wrought iron buckle plates. This gives the structure a solid iron floor, upon which will be laid the sand, concrete and granite blocks of the roadway. The roadway proper will be fifty feet in width. The Rolling Mill Company will have two or three hundred hands at work in a short time stringing the arches, which will take up most of the winter.

That mountainous section comprising Tennessee, South-West Virginia, Eastern Kentucky and Western North Carolina has at present only meagre railroad facilities, but it is said that it will soon be the scene of the greatest activity in railroad building ever known in the United States. The rich coal-fields, iron deposits and timber resources of East Tennessee are beginning to attaract the attention of foreign capitalists and all the roads in the Central Plateau will cross East Tennessee and tap the coal-fields at Cumberland Gap or Chattanooga.

At the meetings of the American Association for the Advancement of Science recently held in New York, Mr. H. C. Taylor read a paper on " The Question of Isthmian Transit." He said that the " Panama Canal is $350,000,000 in debt, and every year has to pay $20,000,000 for interest and other charges. The outlook in that direction is not bright. The second and more feasible route is that through the State of Nicaragua. The late Captain Eads was very confident that his method of taking ships across by Railway is practicable, but most Engineers disagree with him, at any rate the time will soon be near, says Mr. Taylor, " when it will be seen how important a canal of some kind will be across Nicaragua. Chili and Peru are nearer us than San Francisco, and such a canal will make them our next door neighbors. Government aid is not needed to build this canal. Private means will be ample for its execution. I expect in the near future to see the State of Nicaragua have the same geographical importance on the Western Hemisphere that Constantinople has on the Eastern."

The eminent electrician, Thomas A. Edison, sent an interesting paper discussing a new mode of making electricity. He claims to produce electricity by the alternate magnetization and demagnetization of iron by heat and cold. The electricity generated is taken off by wires. Mr. Edison's experiments in his laboratory were very successful, but he has not yet put this method of making electricity into practical use. It was thought that about 40 per cent. in the cost of making electricity could be saved by this process.

Another interesting paper was that of Mr. P. H. Dudley on " Mechanical Inspection of Railway Tracks and Results obtained." He shewed that by the carelessness of track inspectors in keeping the rails perfectly level over $1,000,000 a year was lost to the railroad companies of this country by damage to the rolling-stock.

It is said that 12,000 miles of new railway will be finished before the end of this year. The Illinois Railroad Commission report that the railroads of that State paid only 1·9 per cent. to their shareholders last year and the greater part of these companies have not paid anything to stockholders for many years. In some other States, the railroads are earning even less. Yet the rails are laid in new countries as if there was a little gold mine under each of them.

It is reported that the Pennsylvania Railroad will heat all their cars by steam from the locomotive this winter. " There will be," says the *Pittsburgh Chronicle*, " some disadvantages to be encountered, but only in case of accident to the locomotive or to the heating apparatus. In order to meet such emergencies it is likely that the stoves at present in the cars will not be removed. The steam process of heating, however, will have decided advantages over the old method in railroad economics. It will require less labor and will not be as expensive as coal. A discovery was made during these tests which was a surprise to experts. This was that it would only take a pressure of four or five pounds of steam from the locomotive to keep up uniform heat through a train of light coaches. The tests already made have been complete enough to demonstrate that a locomotive can generate enough steam to draw a train and supply the coaches.

The last spike has been driven in the railroad which for the first time, brings the town of Sault Ste Marie, one of the oldest towns in Michigan, in close connection with the outside world, and from which it has been largely isolated, except during the summer months. The completed road is that part of the new Duluth, South Shore and Atlantic line extending from Sault Ste Marie to its junction with the Mackinac and Marquette railroad nearly 600 miles west. The foundation for the great International Railroad Bridge across the rapids at St. Mary's river is nearly complete, all the piers except one being built. The approaches on the Canadian side are finished, and workmen are now building the abutment on the American side. The Dominion Iron Works of Canada have commenced laying the bridge on the Canadian side, where the foundations are completed, and will work from that side across the river. The structure will be ready to connect the Canadian Pacific Railway with the line from Sault Ste Marie to Duluth as soon as the roads are finished and require it for their use.

CHINA.

(From our own Correspondent.)

FOUR thousand years ago the Chinese nation was probably the most advanced on the face of the earth in arts and sciences as well as in agriculture and hydraulic engineering. Two thousand three hundred and fifty years before the Christian era, the Emperor Yao caused a large number of bronze coins to be made some of which exist to this day. Bronze lamps and incense urns, as well as spear and arrow heads were also common enough in his days I believe. Ploughing and husbandry generally had been inaugurated by the divine husbandman Shên-Nung four hundred years previously ; whilst the waters on the face of the earth were diverted and confined to certain well defined channels by the Emperor Yü, in B. C. 2286. It is, therefore, but fair to assume that the use of iron was then known, although it is on record that Shên-Nung hardened the point of his wooden plough shear by charing it with fire four or five hundred years before. At any rate metals of various kinds appear to have been extensively used in making vessels of different forms for domestic use. Certainly before the dawn of our era many fine metal urns and vases were made. I have myself acquired several articles made of excellent metal and artistically finished, which date back nearly, if not quite, two thousand years ago. The art of mining, however, does not appear to have advanced with the times despite the encouragement given it by Government at various times. The Empire is, no doubt, vast, its mineral resources are immense and almost inexhaustable, but the lack of capital and capable minds to use it in a proper manner is apparent everywhere.

The few capitalists who, hitherto, have been enterprising enough to engage in any works of a progressive nature have been cruelly punished through the lack of proper administration and management.

Until the Chinese officials are enlightened enough to see that it is impossible for them to introduce modern Western reforms in the Government departments, as well as in private mining and other companies, they are never likely to succeed in any modern innovations they may make.

Fortunately for all concerned there is just a glimpse of leaven at work somewhere years ago. The present Viceroy of the Yun-Knei Provinces was ill-advised enough to ask the Imperial sanction for issuing a set of mining regulations, in which it was stipulated that no foreigners, or even Native Christians were to be allowed to have any interest in mining affairs in the two Provinces under his jurisdiction. Last year the Viceroy of the Two Kuang Provinces was narrow-minded enough to adopt the same or somewhat similar rules for curbing the mining industries of the two Provinces over which he ruled. Now all this *anti*-foreign and *anti*-progressive narrow-mindedness has stifled the mining inclinations of the few native capitalists who are intelligent enough to see that foreign management is indispensable, if successful results are expected. Therefore, everything is at a standstill.

T'Ang, ex-Governor of Yun-nan, who was lately reprieved from the penalty of death he had incurred for the loss of Sontay during the Franco-Chinese War in Tung-king, has been reinstated, into favour, as a progressive official, and sent to Yun-nan with full powers as an Imperial Commissioner of Mining Industry in that distant province. Being forbidden by existing mining laws from employing *Western Foreigners*, he, (T'Ang) has applied to the Throne for permission to employ Japanese Mining Engineers, who are of course *Eastern Foreigners* and the permission has been granted. Two Japanese experts are going to Yun-nan very shortly.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Hyderabad, October 15, 1887.

Establishment.

Furlough to Europe for 16 months, with subsidiary leave for 10 days, with effect from 10th October or such subsequent date as he may avail himself of it, is granted to Mr. J. Craig, Executive Engineer, 1st grade.

Mr. J. H. Handley, Assistant Engineer, 1st grade, is transferred from the West Berar Division to the East Berar Division (Melghat Roads Sub-division), and the transfer of Mr. D. M. Scobie, Assistant Engineer, 1st grade, from the East Berar Division (Melghat Roads Sub-division) to South Berar Division, is hereby cancelled.

Mysore, October 15, 1887.

Mr. A. S. Nagavkar, Executive Engineer, Shimoga Division, is granted privilege leave of absence from the 24th October to 30th November 1887, inclusive.

Mr. B. S. Venkatachariyer, Assistant Engineer, will officiate as Executive Engineer, Shimoga Division, during the absence of Mr. Nagavkar on leave.

Madras, October 18, 1887.

The following intimation, received from the Secretary of State, is published:—Mr. W. Jopp, Assistant Engineer, 1st grade, is permitted to return within the period of his leave.

India, October 22, 1887.

His Excellency the Governor-General in Council having sanctioned surveys being undertaken of different routes for a railway to Bannu, Mr. J. Ramsay, Superintending Engineer, 3rd class, sub. *pro tem.*, State Railway, is appointed Engineer-in-Chief of the project, which will be known as the Bannu Railway Survey, and will be under the control of the Director-General of Railways.

The following changes are ordered in the postings of Assistant Engineers from the Royal Indian Engineering College, who have gone through a course of practical training in England, published in Public Works Department Notification, dated 4th October 1887.

Mr. Francis Reilly, to the North-Western Provinces and Oudh instead of to Bombay.

Mr. Herbert Nicoll Weldon, to Bombay instead of to Bengal.

Mr. Frederick Campbell Rose, to the Punjab instead of to the North-Western Provinces and Oudh.

N.-W. P. and Oudh, October 22, 1887.

Buildings and Roads Branch.

Mr. C. H. Holme, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India four and a half months' furlough, in extension of the leave granted him in Public Works Department Notification.

Mr. W. D. Brockman, Superintending Engineer, 2nd class sub. *pro tem.*, will, on expiry of the three months' privilege leave granted him, resume charge of the 1st Circle, Provincial Works.

Colonel E. Swetenham, s.c., Superintending Engineer, 1st class, temporary rank, will, on the return of Mr. Brockman from privilege leave, be retransferred to the charge of the 3rd Circle, Provincial Works.

Mr. J. W. Alexander, Officiating Superintendent of Works, 3rd circle, will, on being relieved by Colonel Swetenham, s.c., revert to Executive Engineer, 1st grade, and be attached, on special duty, to the Office of Superintending Engineer, 3rd Circle, Provincial Works

Irrigation Branch.

Mr. G. T. Barlow, Assistant Engineer, 2nd grade, is posted to the 1st Circle, Irrigation Works.

Mr. F. C. Rose, Assistant Engineer, 2nd grade, is posted to the 2nd Circle, Irrigation works.

Mr. M. King, Executive Engineer, 1st grade, is, on return from furlough, appointed to officiate as Executive Engineer of the Northern Division, Ganges Canal, *vice* Mr. Beresford, Officiating as Superintending Engineer, or until further orders.

Assam, October 15, 1887.

Rai Durga Das Das, Bahadur, District Engineer, Lakhimpur district, who was granted privilege for three months, reported his arrival at Dibrugarh on the forenoon of the 17th October 1887, and took over charge of the district from Mr. G. W. Winckler, Executive-Engineer, on the same day.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

NOTICE.

SHOULD a sufficient demand arise, we shall be glad to reprint Ganga Ram's Tables for Rolled Iron Beams on paper of the size of Molesworth's Pocket Book, so that Engineers may paste them in their Pocket Books.

CONTENTS.

INDIAN ENGINEERING.

SATURDAY, NOVEMBER 5, 1887.

SHONE AND AULT'S SYSTEM OF DRAINAGE FOR RANGOON.

IN our issue of the 8th October we remarked on the complication that had arisen from the protest of the Military authorities against the discharge of Rangoon Town sewage near Monkey Point Battery. In the spring of 1886, Mr. H. F. White, M.I.C.E., Superintending Engineer, Burma, was deputed to report on Messrs. Shone and Ault's system of drainage as intended to be applied to Rangoon Town ; and on the objections of the Military authorities to that part of the scheme which fixed the outfall near Monkey Point Battery.

Mr. White's report pertaining to the drainage scheme, is produced elsewhere in this issue and from it we glean the following particulars. The drainage project contemplates locating the outfall below Monkey Point Battery, and discharging sewage below low-water at all states of the tide. The objectors contend—

(*i.*)—That the outfall should be removed from Monkey Point Battery.

(*ii.*)—That sewage should be discharged only during a falling tide.

The Military authorities view with apprehension the establishment of the sewage outfall at Monkey Point Battery, as should the place in consequence be rendered unhealthy or uninhabitable very serious loss would be occasioned to Government who had expended large sums of money on barracks, and on a battery at the Point—perhaps the only one suitable for the efficient defence of the Port.

The Deputy Surgeon-General, Her Majesty's British Forces, Burma, enters more into details in his criticism of the site of outfall, basing his objections on the grounds—

(*i.*)—The possible decomposition and putrefaction of sewage lying in ejectors from 10 P.M. to 4 A.M., due to the ejectors, perhaps, not filling after 10 P.M., and, therefore, not working, that is, not automatically ejecting as much matter as had gravitated down to the ejector prior to 10 P.M.

(*ii.*)—The uncertainty, in the absence of experiment in this hot climate, as to condition of sewage at the outfall ; that being sewage it is not wholly soluble, and that the noxious elements that remain may prove injurious.

The first objection as to possible stagnation between the hours of 10 P.M. and 4 A.M., and in this hot climate rapid putrefaction of sewage, Mr. White disposes of by pointing out that the Deputy Surgeon-General has either overlooked or has not understood the working of the automatic system flushing tanks, which go on intermittently flushing the sewage pipes so long as the water-supply is not cut off from the tanks. The ejectors which are of small (200 gallons) capacity are bound to fill and go off several times during the night, ejecting pure water into the main, if there is no sewage coming in.

To the second of the Deputy Surgeon-General's objections Mr. White attaches some weight. Whilst recognizing, what indeed is established in Sanitary science, that sewage diluted in a much larger volume of fresh water is rapidly oxygenized and ceases to exist as a noissome and offensive agent; and whilst allowing to the Shone system the property claimed for it of oxidation of sewage in the process of mixing with house sulliage and pure water from the automatic syphon flushing tank with rapid movement down the short and steeply gravitating sewage pipes and with further breaking up in the ejectors; Mr. White yet thinks with the Deputy Surgeon-General, that experiment alone can prove whether the Rangoon sewage at outfall will be altogether inodorous and wholly innocuous.

The paper discusses this question at length, considering in intimate connection with it the questions of (*i.*) Location of outfall. (*ii.*) Constant or intermittent discharge at outfall. On these points we adduce Mr. White's conclusions from the paper under notice.

(*i.*)—The outfall should not be at Monkey Point, but at a spot about 300 yards above Ainslie Warren's Mills, where there is an unoccupied piece of land on river bank, and where the current at all states of the tide, flood or ebb, is strong inshore.

(*ii.*)—As a tentative measure, sewage may be discharged at all states of the tide three feet below low-water. The Shone system as designed is for constant discharge, and cannot deliver only in the period from high-tide to half-ebb, but the Municipality should look the eventuality in the face, of having to provide a sewage depôt and arrange discharge only at high-tide, should the trial of constant discharge prove a nuisance and unsanitary.

From the foregoing notice it will be apparent that the complications we referred to are not of a gravity to interfere with the prosecution of the Rangoon drainage scheme.

YOKOHAMA WATERWORKS.

"They manage these things better in Japan" spontaneously rose to our lips after rising from a perusal of the regulations promulgated by His Excellency the Governor of Kanaguru for the supply of water to the Foreign town of Yokohama. In the methodical manner in which the rules are framed we recognise the responsibility which has dictated the production of the document. Every thing even to the minutest particular is put down in a clear concise manner, so as not to admit of a dual construction or render any point doubtful. The liabilities of the Government and of the people are accurately defined, and there is no room for the one trenching on the other, or exceeding its limits. Without meaning any reflection some of our Indian Municipalities might with every advantage take a leaf out of the Japanese enactment. In one respect, however, there is a similarity between the two countries, that is in the severity with which the tax is collected. Here, of course, the comparison ends, for while the Japanese Government take every possible care that the water service should be regular, we, for instance, in Calcutta, have to submit to worry and annoyance before an inconvenience is attended to after repeated applications to the powers that be, to say nothing of the spasmodic supply, although large sums of money are annually expended in getting out more powerful engines from Europe, and in elaborating the existing works to increase the supply of this essential necessary of life. In the first place the water service to be of any use must be uncontrolled, but if a Municipality is compelled to restrict its supply, it should be regulated in accordance with the requirements of the family or families occupying a premises rather than the rent which it fetches. At Yokohama a plumber will be sent to each individual house for the purpose of ascertaining in detail the quantity required and of taking measurements for an estimate. But it is, we believe, otherwise in Calcutta, where a single man occupying a large house has enough and to spare, while his next door neighbour is obliged to stint himself in order to make the two ends meet, simply because he happens to live in a smaller house. Then again this very limited quantity is still further reduced on the slightest provocation and from causes wholly unknown to the ratepayer, and complaints are frequent of families employing *bhisties* to procure water from the hydrants in the streets almost every day in the month, although they pay a water rate. In Japan from a point in the service three feet onwards from the meter in the direction of the water-flow, persons supplied by meter may use their own materials and labour for the completion of the service, and may lead the water wherever they will, provided that in the opinion of the water authority no risk is thereby incurred of polluting the water, injuring the waterworks, affecting the accuracy of the meter indication, or promoting insanitary conditions of any kind. To further promote this end no service shall be extended or applied to the supply of water to any closet or urinal without first obtaining the consent in writing and the approval in detail of the Superintendent of the Waterworks, or his representative.

The part "wells" play in the sanitation of Indian towns, and particularly of Calcutta, with its *bustees* reeking with all sorts of filth and abomination, are two widely known to require any comments here; it is therefore a relief to turn to the Japanese regulations on the subject, and the attention they pay to this means of water supply. It is a condition precedent to the supply of water that the consumer will permit any wells on his premises to be closed by the water-authority, at his expense, and to remain closed as long as water shall continue to be supplied to such premises. But this restriction is removed in the case of reservoirs, the contents of which after a proper analysis are found to be pure. As fires are of frequent occurrence at Yokohama, the closed wells will be covered over and at the option of the owner an orifice will be left in the cover for the insertion of a suction hose in the event of a conflagration. The care with which the distribution of water is carried on is beyond all praise. Certain parts of the appliances, within the premises of a householder may be repaired by him, but the meter must of course be supplied by the Government through the water authority, and be fixed and maintained at their expense. They shall be read as often as the department may desire, and at each reading the inspector shall leave with the consumer a memorandum of the quantity of water used since the last reading. Should the meter have gone wrong or give an erroneous reading, a note to that effect shall be made on the memorandum and the charge for consumption since the last preceding reading shall be proportioned to the average consumption of water during the thirty days preceding that, and it shall be continued till the imperfection in the meter has been rectified. The charge for water furnished by uncontrolled supply for ordinary domestic purposes shall be 6 per cent. per annum of the assessed annual rent of the tenement to which such water is supplied; provided that when such rental is under 300 silver dollars, the charge shall be 18 dollars per annum, and when such rental exceeds 600 dollars the charge shall be 5 per cent. of the rental. The charge for water furnished by meter supply shall be at the rate of 24 cents per 1,000 gallons (English); except when the consumption does not exceed 20,000 gallons in a quarter; in which case the charge shall be 4 dollars and 80 cents for such quarter; and except when the consumption is over 150,000 gallons per quarter, in which case the charge for such excess shall be at the rate of 15 cents for 1,000 gallons. In the above calculation domestic animals and wheeled vehicles are not included; they involve extra charges but nominal in value—the same also for the supply of water to gardens, fountains fish-ponds, lawns, &c. Special and elaborate arrangements have been made for the benefit of the shipping on the principal jetty in the port.

RAILWAY ROUTES TO BANNU.

THE Punjab Public Works Department will jubilate at the prospect of employment of some of its members during the ensuing cold weather. A recent *Gazette of India* announces the sanction of Government for a survey of the possible railway routes to Bannu, a forward movement in pushing to completion the strategic lines on the North-West Frontier. We are inclined to believe the Government have acted wisely. The Sind-Pishin line has given us a formidable footing in the direction of Kandahar, where we could not only offer a stout resistance to an advancing army, but we would be free from any anxiety in respect of our base of operations. So far so good. But what have we hitherto done towards fortifying our position in the other direction, *viz.*, that of Cabul? If the system of strategic railways is to be of any use, it must include the protection of all vulnerable points on the frontier in whichever direction they may lie, and considering that the capital town in Afghanistan is only 160 miles from Peshawar, it is time that a watchful eye were kept along that route as well. In connection with the Sind-Sagar Railway a route has already been hit upon from Mianwali to Mari on the Indus opposite Kalabagh, and surveys have been made to join this with the line from Rawulpindi to Khushalghur at Langar or Gagan. But surveys will now be undertaken for an alternative route between Mari and the Sohan river. There is also to be another line of frontier road from Kalabagh to Lakki, a point in the communication between Kohat and Bannu. "Under the alternative route for the Bannu Railway," says the *Civil and Military Gazette*, "are included a survey for a line from Dera Ishmael Khan direct and a second proposal which, crossing the Indus from Mari to Kalabagh, proceeds by Isakhel and Lakki, and a third, also from Kalabagh, is to ascertain if a more direct line across the Khattak Hills would even with steep gradients and special engines, be economically possible. For the last two a very good reconnaissance has already been made, and a route that the railway will have to follow is understood to be pretty well decided already." There seems to be an insuperable objection to making Dera Ishmael Khan the starting point from the Sind-Sagar system, by reason of the treacherous nature of that portion of the Indus which passes that town; whereas great facilities exist at the Mari and Kalabagh crossing, whether by means of a ferry or a bridge. The cost of a ferry at that point "to carry all wagons across without breaking bulk" is estimated at 3 lakhs, "an expenditure insignificant compared with anything that could be attempted across the 10 or 20 miles of alternating streams, shoals, and sandbanks that occasionally stretch from Dera Ishmael Khan to Bukkur." The proposed line is to follow the right bank of the Indus meeting the Kurram river near Isakhel. Then crossing the latter it would follow the same track, cross the Shunwall nulla and on to opposite Lakki which could be spanned by a bridge, and the line carried along the existing road by Naurung to Bannu. An alternative line is also proposed: "it might follow on up the right bank of the Cambilla to the point where it will be bridged by the new frontier from Naurung to Peyzu, and thus follow the alignment of that road into Bannu, providing, moreover, a convenient point from which a branch could be thrown off to opposite Tank and the Gomal Pass. Considering the engineering difficulties in the way, and the number of bridges that will have to be constructed, it may fairly be assumed that the cost of this undertaking could not be less than Rs. 65,000 or Rs. 70,000 per mile. From Mianwali to Bannu according to the route laid down as above is 112 miles. Apart from its strategic value, the *Civil and Military Gazette* takes a hopeful view in regard to the traffic. It is said that the trade in alum and salt is already pretty considerable from Kalabagh. The black shales there, and at Kotri and Chachali, give a large amount of alum even under the crude system at present in vogue and it will develop under trained labour. Salt, almost pure, lies on the surface, and last year about 80,000 maunds were exported. Coal is also spoken of as abounding on the other side of the range, the product of Kalabagh having been used for steamers plying between that place and Kotri. That place is famous for its blacksmiths who would formerly work on iron brought from the Waziri hills, but now Karachi supplies it with old iron.

MR. COLQUHOUN'S PROPOSED RAILWAY.

I.

In an article published in the *Asiatic Quarterly Review* for October, Mr. Colquhoun deals with the new territory in Burma as England's "gate to China;" a grand chance for England's depleted commercial centres; a boon generally to civilization. "We have now," he writes "an unrivalled opportunity of reaching the markets of Southern and Western China, and of commercially cementing our relations with the other peace-power of Asia, by the extension of our railway system to Ssumao, the south-west gate to China."

Four years ago Mr. Colquhoun and Mr. Holt Hallett, with the aid of several of the world's leading chambers of commerce, carried through an exploration survey of the *terra incognita* lying between Tounghoo and Kiang Hung—a survey more or less intended as the embryo for a Burma-China railway. Long before railways were, schemes for opening up the country Mr. Colquhoun proposes to open up, found favour with Anglo-Indian Governors in India. As far back as 1829, Lord William Bentinck interested himself in the matter. In 1861, Sir Arthur Phayre, then Chief Commissioner of British Burma, recommended sanction of a survey to Kiang Hung. In 1869, the Secretary of State, the Duke of Argyll, sanctioned such a survey, provided it could be carried through without political complications, or "undue expenditure." And so the shilly shally went on until Mr. Colquhoun and sundry chambers of commerce took the matter in hand, and now as a result of his survey he comes forward with proposals for a Burma-China railway; a scheme which is approved of by everybody who has practical knowledge of the needs and aptitudes of Upper Burma, including Mr. Crosthwaite, the Chief Commissioner, and which we hope to see in practical operation before very long. Having that end in view Mr. Colquhoun makes the following bid for the support of chambers of commerce and trades generally:—

"Burma, we must remember, is our gate to China, and therefore our north-eastern frontier is of vastly greater commercial importance to us than our north-western one. Compare the two for a second. On the latter the railways are mainly strategic and political, hardly in any sense meant to attain any commercial object; they are purely defensive, and lead to barren regions. On the former we move towards a friendly and peaceful power, offering us new markets, with well-founded hopes of vast future expansion. The opening of such markets must lead to an enormous development of our mutual trade."

It should be borne in mind in this connection that China and India are the two most populous countries in the world, and that the line of railway proposed by Mr. Colquhoun would open out the Chinese provinces nearest to Burma—rich, secluded, land-locked markets containing probably a hundred million inhabitants. As Mr. Colquhoun puts it:—"A greater population than our immediate neighbours, France, Germany, Holland, Belgium, and Denmark combined." An eastern world people combination that ought surely to make the mouths of Manchester and Birmingham men water, and induce them at least to promote construction of the contemplated railway. Construction which cheap labour is likely to render cheap in completion. With regard to probable interest on capital the following extract from the Report of a House of Commons Committee that sat in 1884 on East Indian Railway Communications is interesting inasmuch as it affords standing ground for analogy.

"The great financial success of the Rangoon-Prome Railway—a success almost unprecedented in railway construction in India—has demonstrated the railways in Burma will, on account of the enterprising character of the people, and the great undeveloped wealth of the country, not only give large indirect returns in land, customs, and forest revenue, but will pay within a very short period after being opened to traffic, a fair percentage of net income on their capital cost."

The trade of South-Western China has long been coveted by the British world of commerce; but the policy of the Burmese Government was always opposed to anything of the sort, and obstructives of the Theebaw order of official human beings always stood in its way. *Now*, when at last there is a fair field and opportunity the commercial world is frightened about dacoits and the unsettled state of the country, and on that score somewhat doubtful as to the amount of support it would be prudent to give. Dacoitee however cannot endure very much longer. Already there are signs and tokens that the country is getting too settled for its continuance. And the sooner railways are made all over the country the sooner will the last vestiges of the nuisance be exterminated. Meanwhile, it is well for the commercial world to be reminded that Upper Burma is a country more generally fertile than Lower Burma. Wealthier generally. Mr. Colquhoun writes:—"The wealth of Upper Burma, including its resources in Western China, the Shan States, and Siam is incalculable; but it lies fallow at present *for want of communications.*" The Italics are ours. Beyond rice Lower Burma cannot of itself give a railway much to carry; but the upper country produces, besides rice, wheat, maize and other cereals; cotton, tobacco, and many valuable forest products. The tea plant, and the caster-oil plant grow wild. Wood, oils, resins, and India-rubber are plentiful; sticklac is found in considerable quantity. Mr. Colquhoun vouches for it that "in mineral wealth the country is undoubtedly rich."

Even the brief skimming we have given of some of the resources of the province induces warrantable belief that a railway through it ought to pay, over and above its ultimate aim of opening out trade with China.

Of course for that railway regular surveys have yet to be made, and they *may* suggest difficulties that have escaped Mr. Colquhoun's observation. But we certainly do not think that any such untoward result is at all likely.

Notes and Comments.

SALEM WATER-SUPPLY PROJECTS.—Mr. Target, the Public Works officer deputed to prepare a scheme, has now completed his investigations, and the plans and estimates are under preparation. Three different schemes have been investigated.

RAIL-BORNE COAL-TRADE OF BENGAL.—There has been a decrease of 7·22 per cent. for the quarter ended 30th June 1887, and this falling off is ascribed to the despatches up-country, the N.-W. P. and Oudh being now supplied from Umaria.

KUMBAKONAM DRAINAGE SCHEME.—In regard to drainage of this town, which was discussed some time ago in this Journal, we learn that the Government await the report of Mr. E. F. Handcock, who has been specially deputed for the purpose of completing the scheme prepared by Mr. Hanson in 1881.

THE SIND ARTS COLLEGE.—Mr. J. M. Strachan, Engineer and Secretary of the Kurrachee Municipality, has submitted a plan and estimate of the Sind Arts College and Victoria Museum conjoined, the estimated cost of which is two lakhs. The managing committee have recommended that a building grant of Rs. 25,000 be sanctioned.

THE HYDERABAD-PACHPADRA RAILWAY.—The *Sind Gazette*, commenting on the Government of India's reply rejecting the memorial from Sind relative to the Hyderabad-Pachpadra Railway, exposes two grave arithmetical blunders, amounting to 70 lakhs, made by the Public Works Secretary in his calculations on the cost of construction.

MEERUT TOWN HALL.—This Building was designed by Lieutenant Kunhardt, R.E., constructed at a cost of Rs. 60,490, and opened by His Royal Highness the Duke of Connaught on the 11th October 1886. The thanks of the Board to Mr. H. M. Bird, Executive Engineer, District Engineer, who supervised the construction, are very properly placed on record.

HONG-KONG MOUNTAIN RAILWAY.—The centre rail of the Peak Tramway is now being laid. The tramway will therefore be in working order very shortly, the delay in opening it having been caused by having to send home for this new rail when the principle of the safety rope was found unsuitable. An automatic break has been substituted for the latter, and the centre rail is to afford the necessary grip.

THE BENGAL-NAGPUR RAILWAY.—Mr T. R. Wynne, Agent and Chief Engineer, Bengal-Nagpur Railway, and his staff, consisting of 19 European Engineers, arrived in Bombay from Europe by the P. & O. Company's steamer *Victoria*, and left for Nagpur and Sitarampur to go on with the "Works." Mr. R. A. Way, Deputy Chief Engineer, received the "Chief" and his "Staff" at Bombay.

MYSORE STATE RAILWAY.—This line will not lack for Government professional inspection. Being in Southern India, the Consulting Engineer to the Madras Government has to inspect it, and being hypothecated to, and worked by, the Southern Mahratta Railway, which has its head office in the Bombay Presidency, as well as most of its lines, it has also to be inspected by the Consulting Engineer to the Government of that Presidency!

THE GOVERNMENT ASTRONOMER'S ADMINISTRATION REPORT FOR 1886.—Mr. Pogson places it on record that a new clock erected by Messrs. P. Orr and Sons, in the Mount Road, showing hours and minutes only, is controlled by currents from the Observatory regulator. He adds that its very superior make and careful supervision render it a great public acquisition, most creditable to the liberal spirit and enterprise of the eminent firm who have supplied it.

ITEMS FROM CHINA.—Mr. George Dundas Churchward, M.I.C.E., has been selected from four hundred applicants for an important post in connection with the railways now under construction in China. Mr. Churchward is known as a clever Engineer. We hear that Messrs. A. Ransome and Co., Saw-mill Engineers, of London, have at the present time a large order in hand for a pioneer plant of tree-fellers and other machines for clearing the forests and making the sleepers, &c., for the Formosa Railway.

THE INDIAN MIDLAND RAILWAY.—Very satisfactory progress has been made. The rails have been laid to within a few miles of Jhansi, and trains will probably be running early next month. The Jumna Bridge has been quite completed, and an engine, one of several ordered from England, has passed over with the Consulting Engineer. The appointment of Mr. Brock as Locomotive Superintendent and of Mr. Wright as Traffic Superintendent is, writes a correspondent, to the *R. S. G.*, viewed with the greatest approval by the working staff.

MR. R. F. CHISHOLM.—Public opinion is much exercised in the Southern Presidency by the revelations made in this Journal by the late Consulting Architect, Madras, as to the causes which led to his premature retirement from the public service. There can be no question as to the harsh and unfair treatment meted out to Mr. Chisholm. It has elicited widespread sympathy, but we apprehend that the injury done will never be acknowledged or remedied by the Executive. But stranger things have happened in the proceedings of Government.

PRINCE'S DOCK EXTENSION WORKS, BOMBAY.—The Progress Report for September 1887 shows satisfactory progress. The total excavation done during the month amounted to 6,498 brass. The total since the commencement of the contract deposited at Mody Bay and Bunder, in main and subsidiary dams, and behind walls, amounted to 365,518 brass. A certificate for Rs. 48,164-6-6 was passed on the 12th instant, the total amount paid to the contractors to date being Rs. 37,48,450-3-10. The daily average number of men and women working on the Dock and at the quarries for Messrs. Kirby and Co. was 2,372, the greatest number in one day (5th) being 3,117.

INDIGO ADULTERATION.—The Madras Government consider it undesirable to have recourse to special legisla- with a view to prevent the adulteration of indigo, which is found to exist in certain districts of that Presidency. The best means of putting a stop to the evil complained of appears to be for the purchasers to carefully examine the article offered for sale, and, if it is found to be adulterated, to institute criminal proceedings against the vendor. If this course were adopted in a few cases, it may reasonably be expected that the practice of adulteration would soon cease. The suggestion to distribute hand-bills warning the manufacturers of indigo of the evils arising from adulteration commends itself to Government and might usefully be adopted in the districts concerned.

Forest Operations in the N.-W. P. and Oudh.—The work of the Department in these Provinces appears to have been carried on with considerable energy and fair success during the past year. The gross receipts for the three circles were Rs. 15,73,556 against Rs. 14,61,494 in the previous year, and the expenditure Rs. 9,19,580 against Rs. 9,74,518. The net surplus was Rs. 6,53,976, or Rs. 1,67,000 more than in 1885-86. The year was, indeed, the most profitable that the Department has known. The dearth of duly qualified men to fill the responsible posts of Rangers is still felt in all the Circles, although the difficulty is steadily diminishing as the Forest School turns out certificated men. Foresters and Forest Guards are also reported to be gradually improving, as the higher pay now offered attracts better men.

Lightning Conductors.—Professor Tyndall says:—"The convenience of a chain as a prolongation of the conductor is very obvious, but I am obliged to veto its adoption because the contact of link with link is never perfect, and because I have known instances in which the electricity in passing from link to link encountered sufficient resistance to partially fuse the metal. The abolition of resistance is absolutely necessary in connecting a lightning conductor with the earth, and this is done by closely embedding in the earth a plate of good conducting material and of large area. The largeness of area makes atonement for the imperfect conductivity of earth. The plate, in fact, constitutes a wide door through which the electricity passes freely into the earth, its disruptive and damaging effects being thereby avoided. These truths are elementary, but they are often neglected.

British Rails in India.—The consumption of British rails in the United States has this year pressed the Indian demand very closely, 110,289 tons having been forwarded to the American Union during the first eight months of this year. The Indian demand for the same period was 109,326 tons—the continuance of unbroken peace throughout being, of course, favorable to railway extension. The aggregate exports of British rails to 31st August of this year is 492,569 tons, as compared with 343,328 tons and 367,284 tons in the corresponding periods of 1886 and 1885 respectively. The manufacture of steel sleepers is said to promise to be quite an important industry in Great Britain. One Indian Company has ordered 27,000 tons, another line has ordered 280,000 ties and other companies are alleged to be now negotiating, with a view to a adopting the new permanent-way.

English Army News.—Six Colonels of Royal Engineers will be placed on the half-pay list, among them Colonel V. G. Clayton, Commanding the Submarine Mining Battalion at the School of Military Engineering, Chatham. This is not the same as commanding the School itself. That appointment is held by Colonel J. B. Edwards, C.B., Royal Engineers, and is a post worth £1,2 0 a year, with quarters. The other five Colonels going on half-pay are H. S. Palmer, on special duty at Yokahama: R. Barton, Commanding Royal Engineers at Devonport; R. Owen Jones, C.B., Ordnance Survey, London; H. C. Seddon, Superintending Engineer, Portsmouth Dockyard; F. W. R. Clements, C.R.E., Birmingham; E. Micklem, C.R.E., Brighton; G. Blunt, C.R.E., and Commanding the troops at St. Helena (ordered home); C. E. Luard, C.R.E., Liverpool. The two last named will be placed on half-pay on the 21st of October.

The Bangalore Water-supply.—Various schemes having been tried or proposed, and as no plan has been brought forward that will ensure a supply of absolutely pure water at any reasonable cost for the Troops stationed at Bangalore, Government has now resolved to offer a prize of Rs. 1,000 for "the best essay which shall bring forward a workable and economical scheme" for providing the needed supply. Such a scheme must not be simply a modification of any of the proposals already considered, though any one or more of the suggestions contained in these proposals may, if necessary, be made use of. A further sum of Rs. 1,000 is to be paid to the successful essayist if his proposals are adopted as the foundation of a scheme by the Government. The essays should be submitted to the Chief Engineer, Public Works Department, on or before the 31st March 1888. We may have something to say on this subject ere long.

Pondicherry Water-Supply.—A project has been set on foot for supplementing the present supply of drinking water to the town of Pondicherry, which is considered perfectly inadequate to meet the wants of the resident population. But it is doubtful if the scheme, at least, in its present shape, will live long. The capital outlay is estimated at three lakhs of francs, and the annual cost to the Municipality at about Rs. 24,000, an obligation which the Council is not disposed to accept. The revenue to be derived from the supply to private houses is altogether mythical; it is not, therefore, probable that Pondicherry will enjoy the blessings of a new and abundant water-supply for, at least, some time to come. The quantity of water brought into the town daily by means of the Mootrapalium channel only gives about 1¼ gallons to each man, woman and child of the population, and as this is of doubtful quality the consequence may be better imagined than described.

Advantages of Standard Types for Railways.—We glean from a review of Mr. E. Calthrop's pamphlet on "Standard Details" that the great divergency of types in Indian railway carriages has disastrous effects on the finances of the railway company and consequently on the rates charged for passengers and goods. With the vast distances to be traversed in India and the miles that stretch between many important centres of trade and the nearest sea-port, it is absolutely necessary that Indian rates should be low, as otherwise it would not pay to send goods at all, while the enormous length of the lines tends directly to make traffic expensive. Any saving, however small, is, therefore, of direct value to the company, as the margins are so low as to leave little or nothing for costly work. Nowhere is the possible saving so great as in the railway workshops. The subject is one well worth the consideration of those who have money invested in railways, and the waste that goes on in Indian workshops might be lessened with advantage to all

Earthwork Defences.—A professional correspondent writes to a Bombay paper:—"Now that the question of defending our harbours against heavy artillery is being taken up in earnest—before deciding on the relative merits of concrete, stone, iron and earth as materials for the parapets of our works, might it not be worth while to try what effect artillery has against thick parapets built partially or wholly of sun-dried bricks. Any officer who has seen *kucha* brickwork used extensively for building purposes, as it is in the north of India, must have been struck with the enormous elasticity which that material possesses, rendering it so suitable in districts where earthquakes are of frequent occurrence. Now that experiments are about to be carried out at Rurki, where skilled labour is available from the Head-quarters of the Sappers and Miners, it would be an easy matter to construct parapets of *kucha* brick in mud, puxa and earth combined, against which to try our artillery. A parapet composed of parallel walls of brick, with earth packed in between would naturally suggest itself as the first form on which to experiment."

THE MADRAS HARBOUR.—At the head of all the Departmental Works of the Southern Presidency in the Report for 1886-87 stands the Madras Harbour. This work has occupied the same place in the Public Works Reports for several years, and will in all probability occupy a prominent position in them for several years yet to come. And after all, it is a serious question whether the "Harbour" ever will be a Harbour in anything else but the name. At present it is a place to be carefully avoided in a storm: will it ever be anything better? People in other parts of the world might, a South Indian paper thinks, be somewhat astonished if they were reading this Report, to see it recorded that two vessels were wrecked in the harbour, and that the divers on the harbour works behaved very gallantly in rescuing the crews. The distinguishing characteristic of the Madras Harbour is, that it is a place in which a vessel is pretty sure to be wrecked when a storm comes on. On the works the Government net expenditure for the year was Rs. 8,02,965, and during the year under review the Harbour Works and its Establishment were made over to the Harbour Trust Board.

IRRIGATION *versus* RAILWAYS IN CEYLON.—Whatever increase has taken place of late years in the expenditure of the Colony has been chiefly in the direction of Irrigation. No Government has expended the sums that Sir Arthur Gordon has done in the repair of tanks, and in the general work of irrigation. A large proportion—one-fifth—of the principal source of revenue in the Colony has been by legislative enactment appropriated in perpetuity for the purpose of irrigation, and handed over to the care of an Irrigation Board. He cumbers the estimates with still further grants, generally aggregating upwards of Rs. 3,00,000, for the repair of large tanks. The Governor's theory is apparently this: that, by the permanent appropriation of, say, Rs. 2,50,000, the upkeep of existing, and the building of all new, minor works is to be provided for; but that, in order to restore the great works of antiquity, it is necessary to supplement this by further drafts upon the exchequer annually. It is all very well for the Governor to protest that he has the cause of railway extension very much at heart, that it is the first public work to be undertaken, and so forth: but he must know very well that, so long as he continues to *pour out* money, as he has done on irrigation, all chance of the railway extension being taken in hand is hopeless.

THE BENGAL-NAGPUR RAILWAY.—The chief features in the programme of work on the Bengal-Nagpur Railway for this season are, according to some authorities, the construction of about 350 miles of the main line from Nagpur to Raigarh, from the Nagpur end, and of about 160 miles from Assensole to Chakhardarpur from the Bengal end; these to be pushed on as rapidly as possible. Work on the intervening portion at present will be confined to re-surveying the present alignment with the view of improving the gradients and lightening the job. On the Katni-Bilaspur branch construction on the first division out of Umaria is to be put in hand at once, whilst the Pendraghat is to be re-surveyed. Up to the present time some 400 miles of permanent way, consisting of 75lb. steel rails and steel sleepers, have been ordered in England, some portion of which has already been delivered. Contracts have also been let at home for a large quantity of girders, signals and other plant. Sixty locomotives and some 1,200 wagons and carriages are likewise in preparation there, and will soon commence to reach Bombay. On arrival they will be despatched at once to Nagpur, where arrangements have been made for their erection. It may be added that, if possible, the section from Nagpur to Raipur will be opened as a broad gauge line throughout by July next, notwithstanding that the amount of work to be done is formidable.

GOVERNMENT SCHOLARSHIPS TENABLE IN ENGLAND.—A special examination will be held of candidates for these scholarships in the month of April. The conditions are—I. That the candidate is a native of India within the meaning of the Statute; II. that he is under 22 years of age at the date of the examination; III. that the competition be open to all Bachelors and Masters of Arts, Bachelors and Masters of Law, Bachelors and Doctors of Medicine, and Bachelors of Civil Engineering of Australian University; IV. that the examination be in one or other of the following courses:—(*a*) For Graduates in Arts—(1) English Language and Literature, 500 marks. (2) Any one of the Optional branches of the B.A. curriculum, 500 marks. (*b*) For all other Graduates—(1) English Language and Literature, 300 marks. (2) The entire curriculum for the B.L., M.B., and C.M. or B.C.E. Degrees, 700 marks. Graduates in Law, Medicine or Engineering, who have also graduated in Arts, will be allowed to select either course. The scholarship will be awarded to the candidate who obtains the highest number of marks in the aggregate, provided that the marks gained are not less than 500; but the Vice-Chancellor and Syndicate shall have the power to adjudicate between the best candidate in Arts, Law, Medicine and Engineering, respectively, should there be candidates in two or more of these branches.

PRECIOUS STONES IN INDIA.—The author of an interesting paper in the *Journal of the Society of Arts* has the following regarding Indian gems:—There are in India three extensive tracts, widely separated from one another, in which the diamond has been sought for. The name of Golconda, originally applied to a capital town (now a deserted fort in the neighbourhood of Hyderabad), seems to have been used for a whole kingdom; but the town itself is many miles distant from the nearest diamond mines, and it was only the mart where the precious stones were bought and sold. The second great tract occupies an immense area between the Mahanuda and the Godavari rivers: and the third great tract is situated in Bundelcund, near the capital of which—Punnah—some of the mines are found. For those content with a slowly-paying occupation and a hard life involving close supervision of the workers, diamond mining will pay, provided such persons possess capital sufficient to last them a few years. The diamonds now are usually brought from Parteal, close to the southern portion of the Nizam's dominions. The deepest pits are not more than twelve feet. The matrix of the diamond in those localities is a conglomerate sandstone. The appliances of modern machinery for excavation, &c., directed by men of science, may possibly bring to light gems that have not been discovered by the rude native processes of search. The only Indian mines now worked for diamonds are the northern ones in Bundelcund; the produce, between £40,000 to £60,000, is sold locally, and only about 100 carats are sent to Europe.

Current News.

Mr. G. A. Barnett, C.I.E., Agent to the G. I. P. Railway, goes home on leave for eighteen months about the beginning of next month.

The Hyderabad-Pachpadra proposal is fathered in London by the financial promoters of the Nizam's State Railway, and assisted by merchants interested in the port and trade of Karachi.

Mr. J. Oates, Controller of Stores of the East Indian Railway Company, intends to proceed on furlough, and Mr. H. Wood, the Assistant Controller, will probably act for him.

It is stated that two additional companies are to be added to the Corps of Royal Engineers. One company will be stationed at Aldershot for field duty and the other will be quartered at Chatham.

It is understood that the question of sending columns or parties of exploration into the little known country between the Kurram and the Zhob has been decided in the negative, for this cold weather, at any rate.

The Commander-in-Chief left Rurki for Hurdwar on Wednesday afternoon, having previously inspected the Sapper establishments, where he saw pontooning and field telegraphy at work, and paid a visit to Thomason College.

Mr. Wilson Bell, Chief Engineer, G. I. P. Railway, who is now on leave in Europe, is expected to return to Bombay by the next mail steamer. Mr. Bell will act for Mr. G. A. Barnett during that gentleman's absence on leave.

In connection with the general scheme for the internal defence of India, plans are now under consideration at head-quarters for the construction of defensive works for the protection of the chief bridges on the main lines of railway.

Mr. W. R. Robinson, Acting Agent and Manager of the Madras Railway, proceeds either on three months' privilege leave or eight months' furlough to Europe as soon as Mr. F. B. Hanna assumes charge of the office of Agent and Manager.

The Madras Government have been requested by the Calcutta authorities, for the future, to arrange for the selection of fuel and fodder reserves in making surveys of, and deciding upon, the alignment of all projected State Railway lines in this Presidency.

The office of the Engineer-in-Chief of the Madras State Railway Surveys at Bangalore will, practically, be closed at the end of this month, one or two hands only being still retained for a month longer, to complete some survey tracings and arrange records.

The electric light has been introduced into the East Indian Railway collieries at Giridhi, and marks the opening of a new era in Indian mining. The miners are said to be delighted with the innovation, and go to their work with greater confidence than before.

A new club for Secunderabad looms in the near future. A site had been selected for the building in close proximity to the cantonment gardens. A design and estimate for the same, approved by the Committee, have been submitted by Captain Fox, R. E.

The total net decrease in the receipts from Indian railways, both guaranteed and State lines, from the 1st of April to the 10th of September this year, has been Rs. 17,69,646, while on the assisted companies and those in Native States there has been a net increase of Rs. 2,24,167.

Mr. Tew, the Chief Accountant of the Engineering Department of the Nizam's Guaranteed State Railway has tendered his resignation. We learn that Mr. P. Barboza is to succeed him. Mr. Tew has been appointed Assistant to the Inspector-General of Police, H. H. the Nizam's Dominions.

The subject of electric tramways is likely to come under the notice of the authorities in India before long. We understand that arrangements have been made in London to supply the City of Madras with a tramway system on the new principle, pending the acceptance of the offer by the authorities on the spot.

It has been ruled that Indian Service, so far as regards service for pension of officers of Royal Engineers who have elected for continuous service in India, will reckon as in the case of other officers from the dates of arrival in India, three years of British Service being, however, also allowed to reckon as Indian Service.

The Bombay Town Council has sanctioned the purchase of an "automatic road-sweeper," at a cost of Rs. 750, as an experiment. The vote was passed on the recommendation of the Municipal Commissioner, who was struck with the efficient way in which one of these machines that he saw in the London Streets performed its work.

A Resolution says that the question of closing the Calcutta Mint for silver coinage has been under consideration. The proposal seems feasible, as the Bombay Mint is equal to meeting the whole rupee-coinage. Before taking action, however, Government desires the opinion of the Calcutta banking and mercantile community.

Some curious inaccuracies have been discovered in the statistics contained in the Government of India's letter about the Hyderabad-Pachpadra Railway. The outlay for the British portion of the line is estimated at 175 lakhs. This should be 105 lakhs. The interest on this at four per cent. would require a little over four lakhs, while the figures in the letter are Rs. 9,80,000,

The Tounghoo-Mandalay Railway seems to be making rapid progress, and I hear that 8 stations will be opened out from this end by April next, while by the same time seven stations will be in working order, from the Tounghoo end. A good deal of material has been sent up lately for the railway construction; and some more rolling-stock for the completed portion is expected shortly.

Inquiry into the causes of a serious derailment that recently took place on the South Indian Railway having conclusively shewn that it was due to modifications and alterations that had been introduced in this country of designs that had been approved of in England, strict injunctions have been issued by the Madras Government to the Railway officers concerned that no alterations or deviations from approved designs should be carried out in this country except with the approval of the Company's Consulting Engineer in England.

The Secretary of State, will, it is understood, issue to the Board of Directors the formal notice closing the contract with the O. R. Railway in January next, and by the end of the year it will become a State Railway. The six months' notice was taken at first to mean the closing the line on the 30th June; it has however been finally decided to extend the period to the end of the year, and thus allow for the full closing of the accounts, the provision of funds, and the return from England of the prospective officer, who is to be the first manager.

Mr. C. T. Ambler, who has had charge of Mr. Dear's business for some time, continues to control affairs until the final settlement of the estate and current contracts, after which the rights and titles of the deceased in the extensive forests on lease to him and all the timber depôts pass, by bequest, to Mr. Ambler and General F. H. Murray in two-thirds and one-third shares, respectively, the business to be carried on by the legatees under its old name. As the timber and sleeper contracts are on a colossal scale, involving a large outlay of capital, it is expected that the successors will sell out, retaining a large number of shares, to a limitted liability company

The new loop-line connecting Mian Mir East on the Umballa line with Mian Mir West on the Mooltan line, has been completed. This loop will enable trains to run straight through from the Peshawar and Delhi line to the Karachi line without passing through Lahore. The work has been carried out during the hot season, the 32nd Pioneers, and 24th P. I. assisting, throwing up the embankments, the N.-W. Railway Staff, under Mr. List, laying the road. The construction, of this loop will do away with the necessity for turning the single-coupling carriages of the N.-W. R. at Lahore; to facilitate this purpose a siding will also be constructed near the Station Hospital, Mian Mir.

The *Indian Daily News* says:—There have been several attempts to supersede the *dhobi* in Calcutta; but hitherto the attempts have not been attended with success. Another attempt will be made at 44, Free School Street shortly. There are on the spot a number of washing machines, in which there will be no beating, rubbing, and scrubbing to pieces, but steam and motion will be the chief agencies for cleaning, there being an engine of sixteen horse-power to supply them. The water used will be the filtered water of the Municipality. There is machinery for starching and ironing, and the chances of infection from any source may be said to be reduced to a minimum. The drying is to be done by centrifugal force.

We are informed that the Esplanade Hotel, Bombay, which has lately changed hands, is to be thoroughly renovated, and the whole house thoroughly repainted and decorated. The proposed alterations, are being carried out under the personal superintendence of Mr. R. F. Chisholm. The work of restoration, or renovation, under the new proprietorship, could not possibly have been entrusted to a more skilled professional in the building art than Mr. R. F. Chisholm.

"At his command the palace learnt to rise;
Again the long-fall'n column sought the skies;
The canvass glowed beyond e'en Nature warm;
The pregnant quarry teemed with human form."

These lines may very truly be applied to the clever architect to whose genius Madras owes the few splendid buildings it possesses; who has beautified Baroda; who is improving Hyderabad; and who is now adding to the architectural adornments of Bombay.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

U. C. S. PENSIONS.

SIR,—In your issue dated 15th October 1887, reference is made to alterations in pensions of U. S. officials.

I would be thankful to learn through the medium of your paper, whether the taking of pension is procurable without invalid medical certificate, *i. e.*, a person having the required number of years, can apply for pension and get it without bothering about a doctor, or, which is the same, can one retire, when pension is due, even should he be in good health. INQUIRER.

THE AURIFEROUS TRACTS OF MYSORE.

SIR,—Mr. Bruce Foote was engaged from the 2nd February to the 7th May this year on his task of examining the scattered lands in Mysore said to be gold-bearing, and during this period 1,300 miles of ground was travelled over by him in marching and field work, so that an average of 14 miles of travelling was performed per day in checking Messrs. Marsh and Lavelle's work. This "verification" must therefore have been verily and truly made up of "a series of flying visits!"

PROSPECTOR.

THE LOCO. PROBLEM ANSWERED.

SIR,—In reply to "Enquirer" in your issue of 15th instant, I beg to say that (1) the piston will not halt within the cylinder, but will travel in the direction assigned to it by the valve, before the accident. (2) The piston will break the cover if the lever is in full gear, since there will not be sufficient time for the valve to allow enough steam to form a cushion; but if the lever is nearly out of gear there will be sufficient time to form a cushion and the cylinder cover will not be broken.

OLD TOWN, CUDDALORE; *October* 22, 1887. J. C.

GLAZING POTTERY.

SIR,—Will you permit me to inform "X. Y. Z." that the processes described in Tile-making Manuals for glazing tiles and sewer pipes are the simplest possible. The secret of successful glazing lies in the *body* of the ware. The first thing is to make your clay *refractory* so that it will take heat without melting or losing shape; the next is to make your kiln *reverberatory* so that heat may be accumulated without a fluxing blast. With these two conditions you can apply any glaze from lead to salt (if you know the way) or you can make an Indian clay, rich in silica, glaze itself by simple high temperature. R. F. CHISHOLM.

PUNKAHS.

SIR,—Mercifully the punkah season is over for a bit, and therefore those intending to improve their systems of pulling have time to consider whether Mr. Wallace's experiments prove everything. He states, and makes a foundation of, the advantage of a downward current, but in producing this he appears, with his 50-inch suspending rope, to run very much to the sort of punkah one gets on boardship,—that flaps your hair and papers about and irritates as much as it cools you!—and many would prefer the old plan which keeps the whole air of the room in more gentle motion. He does not state either how he arrives at the length 50 inches. The length of a pendulum swinging 25 to the minute is 225 inches, but, of course, "a pendulum" is without friction or air resistance.

During the period of rest those intending to alter their punkahs would do well to consider the Mortimer system now being introduced into the Barracks, for large rooms and many rooms pulled together. It appears a very satisfactory arrangement as it conbines the long sweeps of the old punkah with the downward draft and appears to be very easy in working for the poor coolie. M. B.

INDIA OFFICE AND INDIAN REQUIREMENTS: A MORAL AND A TALE.

SIR,—In connection with the speculation now rife regarding the appointment of Inspector-General of Stores at Home, the strange story in connection with the iron-work of the Srivaikuntham Bridge structure is both edifying and instructive.

The Srivaikuntham anicut (on which the bridge is to be built), is situated 15 miles east of Palamcottah, and there is a good metalled road to it from the latter town. The Tinnevelly Railway station is $1\frac{1}{2}$ miles north of Palamcottah and 36 miles from the Port of Tuticorin. There is also a road practicable for carts from Tuticorin to Srivaikuntham, about 30 miles, which is metalled for about two-thirds of its length.

The iron-work required consists of: (1) 66 main braced girders for 33 spans, (each of 38 feet); (2) 132 rolled iron cross girders, (each of 18 feet $4\frac{7}{8}$ inches); (3) 825 rolled iron longitudinal girders, (each weighing 11lbs. per foot) with the usual fittings and fixings complete, having a total weight of 221 tons.

The girders are to be erected at a height of 24 feet above the bed of the river (which is sandy) and $17\frac{1}{2}$ above the crest of the anicut; the latter is 6 feet wide.

Messrs. Richardson and Cruddas of Bombay, offered to supply, convey and erect the iron-work at a total cost of Rs. 250 per ton, while the cost of making up iron alone at the Government Workshop, Madras, was Rs. 260 per ton. It was found that iron got out from England through the Secretary of State might be cheaper than the Workshop rates, but as the Board had no sufficiently skilled agency to set it up, sanction was solicited for entering into a contract for the work with Messrs Richardson and Cruddas. The Chief Engineer, Public Works Department, Madras, who had been consulted, concurred, and similar sanction was given last year in the case of Malabar.

It will be thus seen that Messrs. Richardson's tender was cheap and reasonable. There is no reason why the Government should not have been favorably disposed towards the proposal. If the iron-work came out from England the pieces would have to be fitted after arrival, which would necessitate the getting of plant and entertaining skilled labor and supervision specially for it; whereas the Bombay firm, in consideration of having the whole contract, offered to transport, erect, and paint the whole at the bridge-site.

The reply, however, to the request of the Madras Government for the arrangement with the Bombay firm elicited the reply that the Government of India could not sanction the proposal as the proceeding would be in violation of Secretary of State's express orders.

And the iron-work is being obtained through Secretary of State in the ordinary way! VERB. SAP.

Literary Notices.

A TRADE CATALOGUE.

MESSRS. P. ORR AND SONS of Mount Road, Madras, who are acknowledged to be the *premier* firm of manufacturing jewellers in India, have favored us with a copy of their new Catalogue which is a veritable work of Art. Chaste designs, sterling quality, intrinsic value, substantial workmanship, and superior finish are the known characteristics of the Firm's stock, and these recommendations are not lessened by the fact that much of it is *Indian-made*, the *bonâ fide* productions of workmen trained in the Establishment. Art Metal Work and Brassware is, we believe, a speciality in which the Firm stands without a rival in the country.

ASIATIC SOCIETY OF BENGAL.

FROM the budget of Proceedings and Journals for the past four months we can find but little of interest for the majority of our readers. Dr. Prain's description of the "Hot-Springs of the Namba Forest" in the Sibsagur District of Upper Assam is a readable Note of some scientific value. Babu Ausotosh Mukhopadhyaya's Note on the "Differential Equation of a Trajectory" represents the curve by a pair of remarkably simple equations which admit of an interesting geometrical interpretation. Mr. H. F. Blanford's Paper on the "Influence of Indian Forests on Rainfall" is of great economic importance intended to encourage further inquiries. Mr. Elson's investigations into the "Density of Water" at the mouth of a tidal river (the Hugbli) under varying circumstances is an instructive contribution to the physiography of the Indian Seas.

REPORT ON THE HORTICULTURAL GARDENS, LUCKNOW.

THE progress made in this very useful Institution during the past official year is highly satisfactory, Colonel Pitcher's report showing efficient and economical management and a great variety and extent of useful work. We observe that with the view of encouraging Arboriculture in the province, well grown trees are supplied the public at the cost of carriage only. But this is only a fraction of the operations conducted in the "Gardens," which we are glad to see has become a training-school for native gardeners.

THE ASSOCIATION OF ENGINEERING SOCIETIES.

WE have before us the Journals of the Transactions and Proceedings of the Seven Societies which form this well-known Professional *Union*, in the United States of America, from July to September of the current year. Among the many important Contributions to be found in the numbers under notice, we find that on the "Preservation of Railroad Ties and Timber" by J. P. Caird in No. 7 and "Stone Pavement" by John H. Sargent in No. 9 above average interest.

General Articles.

STAGING SUKKUR BRIDGE.

This staging is for the purpose of erecting the main pillars and guys of the 820′ cantilever span of the Sukkur Bridge, one each side of the river, the design being the same for both. It is rendered necessary by the design of the pillar, which has no stability in a longitudinal direction till connected to the guy, and is built with a backward rake to give the required camber to the nose of the cantilever.

The inclined back of the staging forms a tram 8′ gauge over each guy, up which a small traveller is drawn by a wire rope. From this hang the pieces of the guy by a differential block, and by this they are drawn up and placed in position, and the traveller also transports the hydraulic rivetter.

In erecting a staging of this height, great care is necessary to keep it plumb, and on account of the warping of the timber, the only way to ensure accurate work is to have all the boring done below to template, and to allow no tampering with the holes aloft.

All the splices are bored to one template, so that any fish will fit in any place, and as the posts do not always hold the exact scantling from end to end, the end centres are carefully marked, and a one inch diameter iron dowel let 4 inches into each post. This ensures every length being truly central.

The augur holes are bored with a guide, so that they are truly square, and no difficulty is experienced in getting the bolts in aloft.

The walings are also bored to template, so that when the posts at the low end have been placed perfectly plumb and strutted from the ground, the waling brings the other posts vertical. The struts are then measured for, with an expanding template.

The erection was done with a derrick pole and a gang of men hauling on the fall of the tackle. The derrick was placed on a platform resting on the walings. All the posts of one setting were first hoisted by the derrick and bolted into place, then a waling in both directions. From these walings blocks were hung as required to lift the remaining pieces. The staging stands on rock, a long sill being placed reaching across two posts where fairly level, but where the rock is rough, and this would have involved much blasting, a short sill only is given. There are 54,127 cubic feet of timber in the two stagings and the total cost is—

	Rs.
Pitch Pine timber	48,938
Deodar "	59,483
Labour	39,199
Stores	15,388
Foundations	2,573
Total	1,65,581

To which must be added Rs. 8,000, the probable cost of pulling down and disposing of the timber and ironwork.

The timber had all to be kept on one side of the river and after being fitted, was towed across by row boats.

The item Stores includes all the staging bolts and other iron work, such as dogs, glands, &c., and an item of Rs. 5,000 for depreciation of cordage used in the work.

Foundations, represents the cost of blasting, and levelling rock. The item Pitch Pine timber, demands particular notice. This, which was selected, and sawn, is in lengths averging 40 feet by 12 inches square and with scarcely a knot, certainly with no bad ones.

The cost of this delivered at Sukkur, was Re. 1-10 per cubic foot, while at the same time the cost of Deodar only 6′ long supplied by the Railway Store Department was Re. 1-14. The nominal price of Deodar is one anna per foot of length in the log, but as a matter of fact it is almost impossible to procure timber over 25′ long.

The price therefore at which first class Pitch Pine can be procured, cannot be too widely known, for even were the timbers the same price, the pine is far better, being much stronger and free from knots.

Finally, it should be noticed that each staging is provided with two large lightning conductors, which are further assisted by the rails of the traveller run.

F. E. Robertson,
Supdg. Engr., Sukkur Bridge.

Sukkur, *June* 20, 1887.

WATER GAS.

That a gas of great heating and illuminating power can be manufactured from one of the elements, *viz.*, water, is a fact not generally known, and we think that the following description of the process, which is translated from *Le Monde de la Science et de l'Industrie* expressly for this Journal, will be interesting to our readers.

Among the various systems now in use for heating and lighting purposes, whether industrial or domestic, there is one which is rapidly making its way to the fore, and in time will doubtless take prominent rank. We refer to water gas, a compound which possesses certain distinct advantages over oil gases, and will proceed to briefly describe the method of manufacture as has been practised for some years past at Essen in Germany.

The process is as follows :—Superheated steam and air are ultimately passed through a mass of incandescent carbon. The gases generated by the first operation are conveyed into the gasometer, while those of the second run to waste. Under the action of heat the steam is decomposed into its original elements. The oxygen then combines with the carbon in the fuel, and the hydrogen is set free. This action, however, is but momentary in duration. The temperature of the fuel is very soon lowered to a point insufficient to ensure the decomposition of the steam. The steam has thus to be cut off for a time while the combustion is urged on by the insufflation of a certain quantity of atmospheric air.

This reaction takes places in a vertical cylinder termed a generator, which is formed by a circular casing of fire-bricks enclosed in a boiler-plate skin.

This generator rests on an annular vessel kept cool by water, the base of which is in connection with an air fan. The introduction of fuel into the generator is effected from the top—at the side of this cylinder two others of similar construction are fixed, termed regenerators. The heated air from the generator has to pass through both these cylinders, down one and up the other, before finally escaping into the chimney. On the current of air being cut off steam is introduced in the opposite direction into the regenerators, which are already reheated by the passage of the hot air.

The small coke obtainable from the puddling and other furnaces is generally used at Essen for filling the generator. This has to just undergo a process of washing, after which the material contains about one-half carbon.

When the coke is cooled to dull red color under the action of the current of steam, the workman in charge by means of a register cuts off the steam and closes the inlet to the gasometer, and by the same movement opens the valve in the compressed air pipe and the connection between the generator and the chimney. The fire then rapidly burns up, and the gaseous products in escaping melt at the top with some fresh air introduced by a special tuyere for the purpose of completing their combustion. The whole from thence finds its way to the chimney shafts after first traversing the reheating cylinders. When the fuel has quite regained its proper temperature, the workman by turning the handle in the opposite direction restores the *status quo ante*. The steam then rushes into the side cylinders, while the channels of entrance and exit of the air are closed.

The furnace and the heating chambers are at this moment entirely filled with the products of combustion. The entering current of steam is first utilized to drive out all these gases, and communication with the gasometer is not re-opened until the whole apparatus is filled

N ENGINE

KKUR BRIDGE.

g *for Pillar and Guy.*

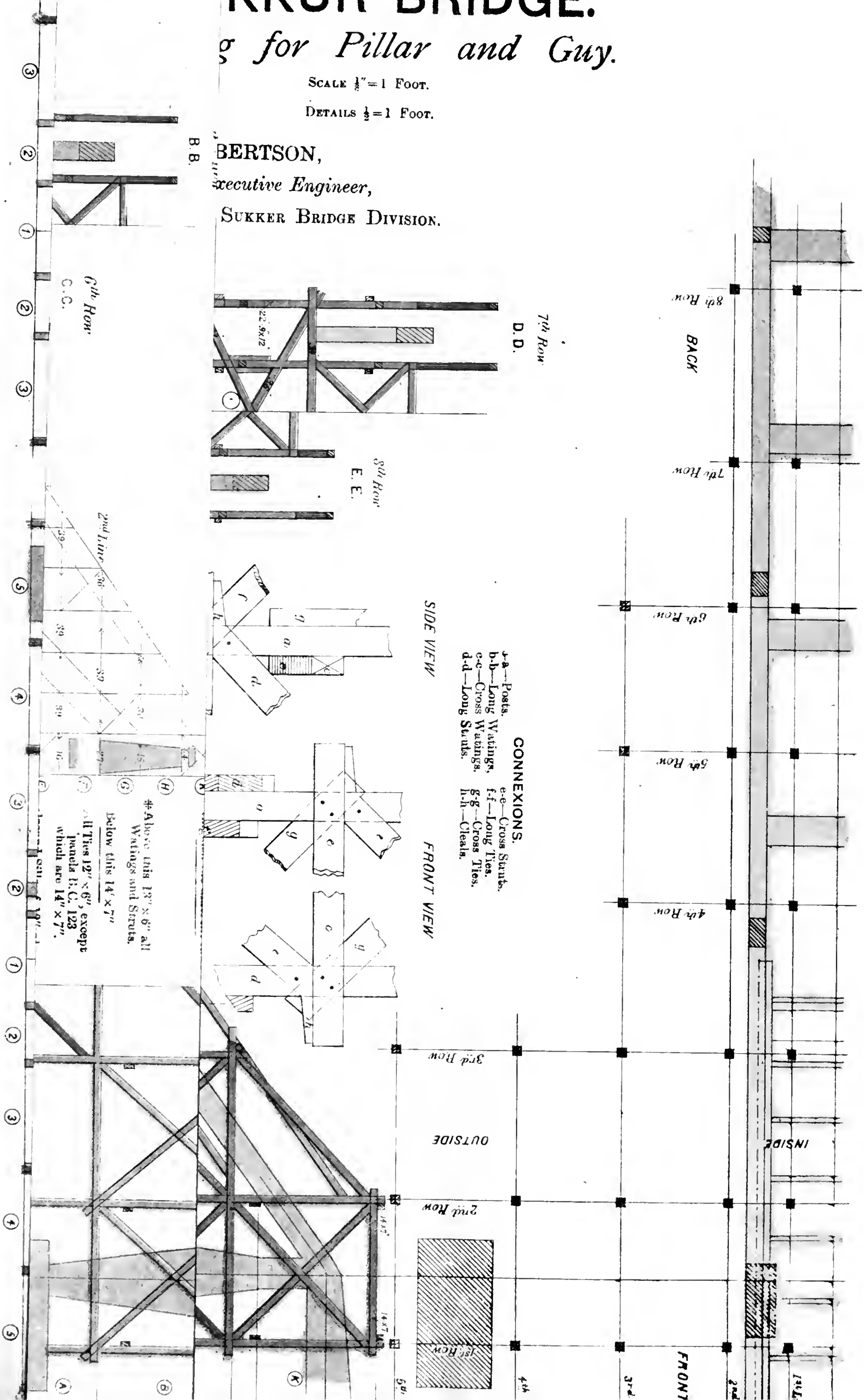
SCALE 1/8" = 1 FOOT.

DETAILS 1/2 = 1 FOOT.

BERTSON,

Executive Engineer,

SUKKER BRIDGE DIVISION.



with pure steam. The passage of the steam lasts about 5 minutes, that of the air current about double that time.

Water gas consists of a mixture of carbonic oxide, carbonic acid and hydrogen, and contains about 90 per cent. of combustible gases. It can be used in this state if only required for heating purposes, but for lighting it has to be purified like common gas with hydrate of oxide of iron. Water gas has hitherto been exclusively employed for metallurgical purposes. This gas on combustion developes an intense heat, so much so that a wire of platinum can be melted in the flame, which must consequently attain a temperature of over 2000° centigrade. Cold or hot air in contact with the flame becomes heated to a degree quite unattainable by ordinary methods. For illuminating purposes water gas has this advantage that it burns with an absolutely steady flame. However, the flame is of blue tint and useless for the purpose. Endeavour was formerly made to render it luminous by blending it with gas from heavy hydrocarburets. The inconvenience of this system was that the hydrocarburets condense in cold and it had to be abandoned. M. Falmejelm has, however, succeeded by aid of his "magnesian comb," formed of calcined magnesian paste, in imparting powerful illuminating properties to the flame of water gas and this has been further improved upon by M. Auer.

Necessity was the mother of invention in the case of water gas as in other things, and it was first used in America in localities where the proper oil for the manufacture of illuminating gas was unattainable, and where large quantities of cheap refuse anthracite and petroleum were available. Over one hundred cities in America are now lighted with water gas. The preparation, which rests on a much more rational principle than that of oil gas, does not require any very heavy expenditure, as is still the case with electric lighting. Its use will probably be widely spread after the introduction of a few slight improvements which are still wanting.

NOTE ON THE SHONE AND AULT SEWAGE SYSTEM AS APPLIED TO RANGOON TOWN.

By H. F. White, M. Inst. C. E., Superintending Engineer, P. W. D. British Burma.

In compliance with directions from Mr. Mathews, Chief Engineer, British Burma, I beg to submit this report on the Shone and Ault system of sewage disposal as proposed for Rangoon Town.

2. I have had the benefit of a perusal of the report of Mr. Mathews's Committee of the 31st October 1885, and of all the documents placed before that Committee. I have carefully studied Shone and Ault's pamphlet and their letter of 5th March 1885, to the Rangoon Municipality, descriptive of their system. I have, with the kind assistance of Mr. O. Deacon Clarke, C.E., examined the drawings illustrating the proposed application of Shone's system to Rangoon Town, and I have through his kindness seen at work the models of Shone's patent ejector, and the automatic syphon flushing tank. I have given careful study to the two reports, of January and November 1884, of the Royal Commission on Metropolitan sewage discharge. I have given careful attention to the objection of the Military authorities to Monkey Point as the place of discharge of the town sewage into the river, as embodied in the Assistant Quartermaster-General's letter No. 2142, dated the 19th December 1885, and in the report of the 16th December 1885, submitted by the Officiating Deputy Surgeon-General, Her Majesty's Forces, British Burma Division.

In connection with these objections from the Military authorities, I examined, in company with Mr. Clarke, and subsequently by myself, the proposed alternative outfalls at Monkey Point and near Ainslie Warren's mills. I also visited the existing night-soil depôts on the river bank, (i) at the west end of the town, at Pongyi Street, and (ii) at the east end, near Botataung iron bridge, from where, I am told, it has been the practice for the last 10 years or more, to discharge the town night-soil during the night into the river, whatever the state of the tide. Finally, in connection with this inquiry, I obtained from the river, on the 17th instant, water at high-tide and at low-water.

3. Taking up the points of inquiry as directed by the Chief Commissioner in General Department letter No. 198-17R.M., dated the 8th July 1885, to the President of the Rangoon Municipality, and as dealt with by Mr. Mathews's Committee of the 31st October 1885, I will, where my views run concurrently with those of the Committee, give my conclusions without further discussion. Only on one point [(c) of the Committee's report], where I find myself unable to accept the Committee's view in its entirety, do I think it necessary to make any remark in explanation of my conclusion.

4. The following, then, briefly is my opinion on the several points taken seriatim—

(*a*) The Shone system of sewerage is specially adapted to low-lying, flat, tide-locked towns, as is evidenced by its perfect success at Eastbourne, Warrington, Southampton in England; and appears quite feasible for Rangoon.

(*b*) Under the conditions stated by the Committee there appears reasonable prospect of the scheme being carried out for the estimated sum of 23 lakhs of rupees

(*c*) Under this head the Chief Commissioner directs the Committee's attention to the consideration of the question, (*a*) whether the outfall near Monkey Point should be arranged so as to deliver sewage into the river on a falling tide only. The Military authorities urge as a very important matter for consideration, (*b*) whether the outfall should not be removed from Monkey Point. On these two points the Committee report, (*a*) that the sewage may be discharged under low-water at all times of the flood and ebb-tide, presumably without inconvenience and injury to any one, and (*b*) that the outfall should be as near Monkey Point as possible.

On the submission of the Committee's report to the Military authorities, opinion was invited as to whether objection was still held to Monkey Point as the place for sewage outlet into the river. In reply the Major-General said, he still viewed with great apprehension the establishment of a sewage outfall near Monkey Point, as, should the place in consequence be rendered unhealthy or uninhabitable, very serious loss would be occasioned to Government, who had expended large sums of money in constructing a battery at the Point,—perhaps the only one suitable for the efficient defence of the town.

The Major-General also invited consideration to the objections advanced by the Deputy Surgeon-General, to Monkey Point as the place of sewage discharge, namely, (i) the possible decomposition and putrefaction of sewage lying in ejectors from 10 P.M. to 4 A.M. due to the ejectors perhaps not filling after 10 P.M., and therefore not working, that is, not automatically ejecting as much matter as had gravitated down to the ejector prior to 10 P.M., and (ii) the uncertainty, for want of experiment, in this hot climate, as to condition of sewage at the point of discharge : that being sewage, it is not wholly soluble, and that the noxious elements that remain may prove injurious.

In connection with his objections, the Deputy Surgeon-General recommends that—

(i) Monkey Point should not be the point of discharge of sewage into the river :

(ii) it should be beyond or on the seaside of Monkey Point ; his intended meaning probably being that a conduit should be laid across the bed of Pazundaung creek ;

(iii) or if (ii) be not practicable, the outfall should be at Ainslie Warren's mills, from where the set of the current during ebb-tide is directly towards mid-channel and far away from Monkey Point.

It is a recognized fact in sanitary science that sewage diluted in a much larger volume of fresh water is rapidly oxygenized and ceases to exist as a noisome and offensive agent, and it is claimed for the Shone system that the sewage admitted to the short and steeply gravitating sewage pipes is constantly submitted to this process of oxidation by being largely mixed with house sulliage and pure water from the automatic syphon flushing tank, and by being quickly moved down to the ejector stations, where it is subjected to a further breaking up and mixing in the process of ejection into the sealed main sewer, and when this sewage, which has undergone the process of oxidization, is poured below low-water into the large volume of water in the Rangoon river, it is rendered almost inodorous and wholly innocuous. The Deputy Surgeon-General's objection (i) as to the possible stagnation, and in this hot climate rapid putrefaction of sewage between the hours of 10 P.M. and 4 A.M., is wholly met and explained by Messrs. Shone and Ault's pamphlets. The Deputy Surgeon-General has either not understood or has overlooked the working of the automatic syphon flushing tanks, which go on intermittently flushing the sewage pipes so long as the water-supply is not cut off from the tanks, and the ejectors, which are of small capacity, only 200 gallons, are bound to fill and to go off several times during the night, ejecting pure water into the main if there is no sewage coming in.

The Deputy Surgeon-General's objection (ii) is harder to meet, and experiment alone can prove whether the Rangoon sewage discharged at outfall will be innocuous. With this objection I think it as well to discuss the most suitable locality for the outfall.

At Eastbourne, where the Shone system of sewage has been adopted, and where it is giving the greatest satisfaction, it is particularly recorded of the outfall at Langley Point, that the set of the tides is such that under *any conditions* the sewage is taken out to sea.

In an estuary river it is accepted that an outfall should ordinarily be located at a deep part of the river, where the range of the tide is great, where the set of current is strong against the bank, and per contra an outfall should not be located where there is slack water or little current, and where, in consequence, there is any probability of solid portions of sewage settling along the banks and becoming exposed at low water. Monkey Point does not, to my thinking, offer the favourable conditions requisite for a good outfall, and it very distinctly possesses the unfavourable conditions under which a deposit of solid sewage may become not only possible but probable. At the site indicated as the place for the proposed outfall there is a small bay, where the water is slack at all states of flood or ebb-tide, I am informed. I visited the spot at half ebb and again at half flood, and on both occasions found floats that I threw in remain perfectly stationary. The current during flood is tolerably near the point of the bank, but is not strong there, very much the opposite During ebb there is no current against the bank, it is far out, roughly 40 or 50 yards out, and its direction is from a point 200 or 300 yards above Ainslie Warren's mills to the buoy marking deep channel along Hasting's shoal. Any sewage discharged therefore at Monkey Point during ebb-tide, would, I think, hang about the bay I have alluded to, and its first movement would be up the river with the flood tide, to be of course eventually taken down with the next ebb. Outside Monkey Point, that is on the Pazundaung creek side, the conditions are equally unfavourable for locating an outfall. At Ainslie Warren's mills during flood, the current is fairly strong along the bank, but at ebb it is far out, moving, as before described, in a slanting direction from the river bank 200 or 300 yards higher up towards the buoy in mid-channel. At this point, where the set of the current is against the bank at all states of the tide, the outfall should be located I think. One of the conditions necessary for the sanitary disposal of sewage and discharge into an estuary river is, that a large volume of fresh land water should be coming down from the sources of the river, as on the amount of such water coming down will depend the pushing down of sewage to the sea. In the absence of fresh water coming down there will be accumulations of sewage in the tidal oscillation space. And if there is little or no fresh water coming down, and only sea water is oscillating past the outfall, it may immediately oxidize and destroy noxious matters in the sewage *at first* poured into it, but as accumulations go on, it will be losing oxygen and becoming less capable as a diluent and oxidizer of sewage. In the Thames, which has a constant and considerable supply of fresh land water from its sources and springs all along its course, it is known that accumulations of sewage of a month or more oscillate opposite London before being pushed out seawards. The experiments made there show, that in the transition period from spring to neaps, a float started at high tide after oscillations of a fortnight advanced seawards only five miles below the starting point. A similar trial made in the transition period from neaps to spring, resulted in a float started at high-water after a fortnight's oscillations being shoved *up* the river seven miles, and a float started at low-water was shoved *up* 22 miles.

In the Rangoon river from December to May, is there any fresh land water entering the river? There is none from the Irrawaddy, for after December the bed of the Panlaung creek, which is the connecting link between the Irrawaddy and Rangoon rivers. is in many places dry at low-water. The water I abstracted from the Rangoon river on the 17th March 1886 at *low-water* was quite saline. That taken at high-water on the same day must of course have been the same, and I was told by a Native, who tasted it, that it was so. I could not taste it, nor could Mr. Mathews, Chief Engineer, on account of the very offensive odour it emitted. The Hlaing river, perhaps, brings down some fresh land water from its sources in the western slopes of the Pegu Yoma, during the five months from December to May, but it must be very infinitesimal in quantity. Will there, therefore, be any pushing out of sewage towards the sea, or will there be accumulations of sewage during the five months from December to May, till the monsoons flush the river and cleanse it? Mr. Mathews's Committee in paragraph 38 give the proportion for one tide, of say six hours, of river water at neap tide to sewage, as 24,000 to 1; but after accumulations of five months, if such take place, would show the proportion of water to be very considerably diminished, and would make it appear very much more unfavourable, $\frac{24000}{4 \times 5 \times 30}$ that is 40 to 1. There is of course no pretence of accuracy in these figures, as there are several factors that would affect the result; they serve only to explain my meaning as regards the probable progressive pollution of the river. Is there, then, danger of the Rangoon river being over-polluted and rendered unsanitary and unhealthy during the months of, say, March, April, and May? Or bearing in mind that the Shone system claims to discharge sewage in an oxidized and innocuous state into an enormous volume of water, need the consideration of the possible accumulation of sewage of months in the river cause apprehension? These are matters for experiment, I think, and on which definite opinion is hardly possible until after trial.

The condition of the night-soil depôts at Pongyi Street and Botataung, which are said to have been in use for the last 10 years, and from which sewage has been discharged at all states of the tide, would lead one to conclude that there would be little harm in the Shone system of constant discharge proposed for Rangoon. I was surprised to find how little offensive both the night-soil jetties were. I went quite to the end of the jetties, and I looked carefully for deposits on the banks, but there were none. The current runs strong under and at end of jetties, so that any sewage discharged is kept constantly moving, and between 7 and 8 o'clock in the morning, when I visited the night-soil depôts, I could see no trace of sewage either floating or deposited on banks.

In the foregoing discussion I have collated all the *pros* and *cons* I could lay hands to, bearing on head (*c*) of inquiry, dealt with in report of Mr. Mathews's Committee, and I will now proceed to give my conclusions—

(*i*) As a tentative measure, sewage may be discharged at all states of the tide three feet below low-water. The Shone system, as designed, is for constant discharge, and cannot deliver only in the period from high-tide to half-ebb; but the Municipality should look the eventuality in face of having to provide a sewage depôt and arrange discharge only at high-tide, should the trial of constant discharge prove a nuisance and unsanitary.

(*ii*) That the outfall should not be at Monkey Point, but at a spot about 300 yards above Ainslie Warren's mills, where there is an unoccupid piece of land on river bank, and where the current at all states of the tide, flood or ebb, is strong in-shore.

Upon head (*d*) I concur in the opinion of Mr. Mathews's Committee. One of the advantages of the Shone system is the elasticity of its application, as it can meet the cases of further expansion or connect with the sewage of adjacent districts. I am of opinion that the extension of the scheme to Pazundaung, Kemmendine, and Cantonment Sudder Bazaar can be effected for Rs. 10,00,000, Rs. 8,00,000, and Rs. 1,39,000 respectively.

(*e*) The house-connections I consider to be a necessary part of the scheme.

(*f*) The Committee have had the assistance of financial experts in forming their conclusions on this point, and I do not feel myself competent to give an opinion on it.

MAHOMEDAN ARCHITECTURE IN THE PUNJAB.

RAI BAHADUR KUNHYA LALL, M.I.C.E.

I.

The Badshahee Masjid, Lahore.

THIS the largest mosque in India, situated outside the Fort walls, Lahore, is built of red sandstone ornamented with white marble and is surmounted with three enormous domes of white marble. It has four towers built of red sandstone and of about eighty feet height at present. They were originally a hundred feet high, but the top story has been reduced. The mosque has a square of 575'×525' and has a large tank in the centre of the courtyard. The mosque is enclosed by a high brick and mortar wall pierced with enormous holes on the north side, and has rooms for devotees in it. It has one gateway built of red sandstone which is a huge structure in itself, and is approached by a long flight of steps constructed of variegated marble. The mosque affords accommodation for about ten thousand persons to worship about the same time. The cupolas are square in plan and are rounded at top, with projections at corners, according to the graceful Mahomedan style of reducing squares to circles. When Sher Singh besieged the Fort, his gunners from the top of the towers commanded the inside of the Fort, and put its inmates to great trouble and danger. From the summit of the lofty minarets, a most extensive view of the surrounding country is obtained. On great State occasions, such as the regal and vice-regal visits, the mosque is illuminated and looks very pretty. In the time of the Sikhs it was used as a powder magazine, but the British Government has restored it to the Mahomedans, for purposes of worship, who have repaired and restored it to a great extent, expending lakhs of rupees on it collected from private subscriptions and donations, The mosque was built about 250 years ago in the time of the Mahomedan Emperor Shahjehan.

II.

The Wazeer Khan's Mosque, Lahore.

This is a much smller structure than the Badshahee Masjid, having a courtyard of only 180'×150'. It has three large domes and four high minarets and a huge gate all covered with ornamentation in what is called "*kausi-ka kain.*" The mosque was built by Wazeer Khan, a Mahomedan Governor of Lahore, whose name it bears. Imperial money was spent on it through Wazeer Khan who superintended its construction. When it was made known to the Emperor that the mosque bears Wazeer Khan's name only, he ordered another mosque known as the Imperial or Badshahee Masjid to be built. So there are two great mosques in Lahore—the Wazeer Khan's mosque and the Badshahee Masjid. Kausi work is a kind of layer of glass spread on a hard kind of plaster, sometimes a material porcelaineous in structure. The plaster is a mixture of lime and siliceous sand, the hardness being due to silication, which accounts for its bearing the heat required to fuse glass. There was lately a man at Lahore who used to practice the art, but his glaze wanted purity and polish. The finest specimens in Lahore of "kausi work" are to be seen in Wazeer Khan's mosque, where the glazing is very fine, in some places so much so, that it seems that the workmen have just finished it. The "kausi work" is in different colors—black, green, and blue—and as glass is mixed in the material, the whole looks very bright. In Wazeer Khan's mosque, the whole of the surface, pillars, arches, cupolas, &c., &c., are covered with this kind of work, and looks very grand. The mosque is about 240 to 250 years old.

N. B.—There is another great mosque in Lahore—"Sanhairi Masjid"—known as the "Golden mosque," the cupolas of which are gilt in gold, and look very bright on a sunny day. The mosque was built by Bikhwari Khan in A.D. 1753, a favourite in the court of the widow of "Mir Manu." The domes are pretty and its situation is picturesque, but there is nothing of architectural interest in the mosque itself, except the gilt domes, on account of which, it is known as the "Sunahairi Masjid."

LAHORE; *October* 29, 1887.

K. L.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XII.

Wrought Stone Steps.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Masons No. ...	3	Variable.	Do.	Do.
Do. " ...	4			
Do. dressing stones	25			
Coolies No. ...	3½			
Do. " ...	2½			
Do. " ...	2			
Bhistie " ...	1½			
Grinding mortar, c. ft.	20			
Sundries	...			
Materials.—				
Roughly sqd. stone, c. ft.	95			
Lime slaked dry, c. ft....	9·6			
Surkhi " ...	9·6			
Sand " ...	9·6			
Sundries	..			
Petty Establishment ...	...			

Specification.—The stones to be quarried fairly square and to be dressed of exactly the height of the risers, the width of stones to be 3 inches more than the treads, that is ordinarily 15 inches wide. No stone to be less than 12 inches in length.

X.

A SIMPLE TEST OF PETROLEUM.—Take an ordinary pint tin cup. Fill it within an inch of the top with water warmed to the temperature of 120 deg. F. Pour on this water three or four tablespoonfuls of the oil to be tested. Stir the oil and water together, and wait a short time, say a minute or two, for the oil to collect on the top. Try the thermometer again, and if the temperature is more than 1 deg. from 120 deg. F., add a little cold or hot water, as the case may be, so as to bring the temperature within 1 deg. of 120. deg. F. Then stir again and give time, as before, for the oil to come to the top. Now apply a burning match or lighted taper on a level with the top of the cup, say within half-an-inch of the oil. If within one second no flash occurs, the oil is reasonably safe; otherwise, it is unsafe. Purchase four or five gallons of oil at a time, and apply this test to each purchase.

REPORT ON THE WATER-SUPPLY SCHEME PROVIDED FOR THE CITY OF JUBBULPORE.

By J. G. H. Glass, M. Inst. C.E., Executive Engineer.

V.

The main supply and scouring pipes are carried through the Dam from the Tower (*vide* drawing) in a culvert opening from the tower. The culvert has a height of 6½ feet to intrados of over-arch, and a clear width of 4½ feet. All the joints in floor walls and over arch, are truly radiated to centres. The masonry is of the very best description of ashlar set in Portland cement mortar. The foundations of this work were put in with special care. The rock was made as level as seemed necessary for the reception of concrete; a trench of the dimensions and in the position shown in the drawing was excavated below the general level of the foundations, and filled with Portlant cement concrete; all fissures in the rock were opened out, decayed material removed from them, and they were then caulked with Portland cement grouting or concrete; and before laying the concrete for the flooring the surface of the rock was well washed. Portland cement concrete was put down all over the foundations and thoroughly consolidated. Over the concrete the first course of the flooring one foot in thickness was laid, all the stones being carefully selected and set in Portland cement mortar. Each stone was driven to its bed by a heavy wooden mallet. The second course of a similar thickness was then put down, care being taken that there was a 'lap' of at least 6 inches over every joint of the lower course, that is, break of joint was secured in every direction as a safeguard against 'blowing,' a very necessary precaution, considering the head of water. The stones of the side walls were rough dressed on the Dam side, and were tailed into the masonry of the Dam, which was carried up simultaneously. This part of the work was done slowly to prevent any unequal settlement, and the over-arch of the culvert was not turned for some time after the side walls were completed. In all other particulars the specification attached to the original estimate was closely adhered to. The culvert is absolutely water-tight, there being no leakage anywhere.

The differences in cost of the several items comprising the Head works as actually constructed, and as originally estimated for, may now be briefly summed up and compared.

(1).—*Masonry Dam.*

	Rs.
Total Estimate, excluding usual contingencies at 5 per cent.	2,58,650
Actual cost	2,58,934
Excess	284

The small excess is more than fully explained by the additional expenditure involved by the use of Portland cement grouting and concrete in foundations, in opening out and caulking fissures, and in the precautions adopted for preventing leakage round flanks of dam. The lime used in the dam was manufactured at a lower rate than was anticipated, and this admitted of the masonry rate being reduced from Rs. 22 to Rs. 21-10-0 per 100 cubic feet. The arrangement with the contractor for the masonry was that he should receive a rate of Rs. 22 per 100 cubic feet, but that from it the quantity of lime issued would be deducted at a fixed rate of Rs. 15 per 100 cubic feet. The work, therefore, and not the contractor, benefited, by the profits on the production of lime that arose from economical manufacture. If to the total estimated cost the usual contingencies at 5 per cent. are added, the work was constructed for a sum of Rs. 12,648 less than that provided.

(2).—*Guard Walls.*

	Rs.
Original Estimate, excluding contingencies ..	11,176
Actual cost	7,216
Saving	3,960

(3).—*Escape Steps.*

	Rs.
Original Estimate	5,444
Alteration in design did away with the necessity of this work, so that the whole amount was saved	
Saving.	5,444

(4).—*Tower.*

	Rs.
Original Estimate, excluding contingencies ...	6,736
Actual cost	8,177
Excess	1,441

Portland cement contrete in foundations, a superior description of work in the Tower to that originally estimated for, and the plastering with Portland cement of both faces of Tower fully account for this excess.

(5).—*Flood Banks.*

No provision was made for this work in Original Estimate. The actual cost amounted to Rs. 421.

(6).—*Tunnel Culvert through Dam.*

	Rs.
Original Estimate, excluding contingencies ...	3,749
Actual cost	5,666
Excess	1,917

Of this amount Rs. 1,872 are due to an omission in original estimate, and the balance is explained by the extra work in foundation, such as Portland cement, concrete, &c.

The original estimate provided for 2,018 tons of all kinds of pipes for the complete scheme. But shortly after it was submitted, and before work was commenced, application was made to the Chief Engineer, Colonel J. O. Mayne, R.E., to increase the thickness of all pipes, from 12″ downwards, to that of the Glasgow Corporation standard. This received his sanction. It was further requested that arrangements may be made for laying a second pipe complete through the culvert, &c., &c. This necessitated an additional weight of piping, amounting to nine tons, and also two valves. The strained water chamber not contemplated in the original estimate, also increased to a small extent comparatively the weight of pipes required. Special pipes for hydrants, bends, bell-mouthed inlets and scours were not provided for in the original estimate, that is, they were not separately estimated for. Further, in the schedule list of pipes, there is, as is the usual custom, a permitted deviation in weight from the actual weights as arrived at by calculations, that is, the pipes are not to be less than the calculated weights, but payment is allowable for such excesses over these weights as are within the limits of deviation laid down in the schedule. The estimate, however, only allowed for actual calculated weights.

The quantity of piping required was estimated for at a uniform rate of Rs. 133 per ton, but the supply was tendered for at different rates:—

(1) For pipes with turned and bored joints,
(2) Plain socket pipes, and
(3) For special pipes, such as bends, flanged pipes, &c. &c.

Nos. 1 and 2 were in the proportion of 15 and 85.

The total quantities required and received were as follows:—

	Tons.
Pipes with turned and bored joints and plain sockets ...	2,142
Special pipes for Tower culvert and strained water chamber	9
Special pipes and castings for bends, hydrants, &c. ...	34
Total weights	2,185
Allowed for in estimate	2,018
Excess over estimate	167

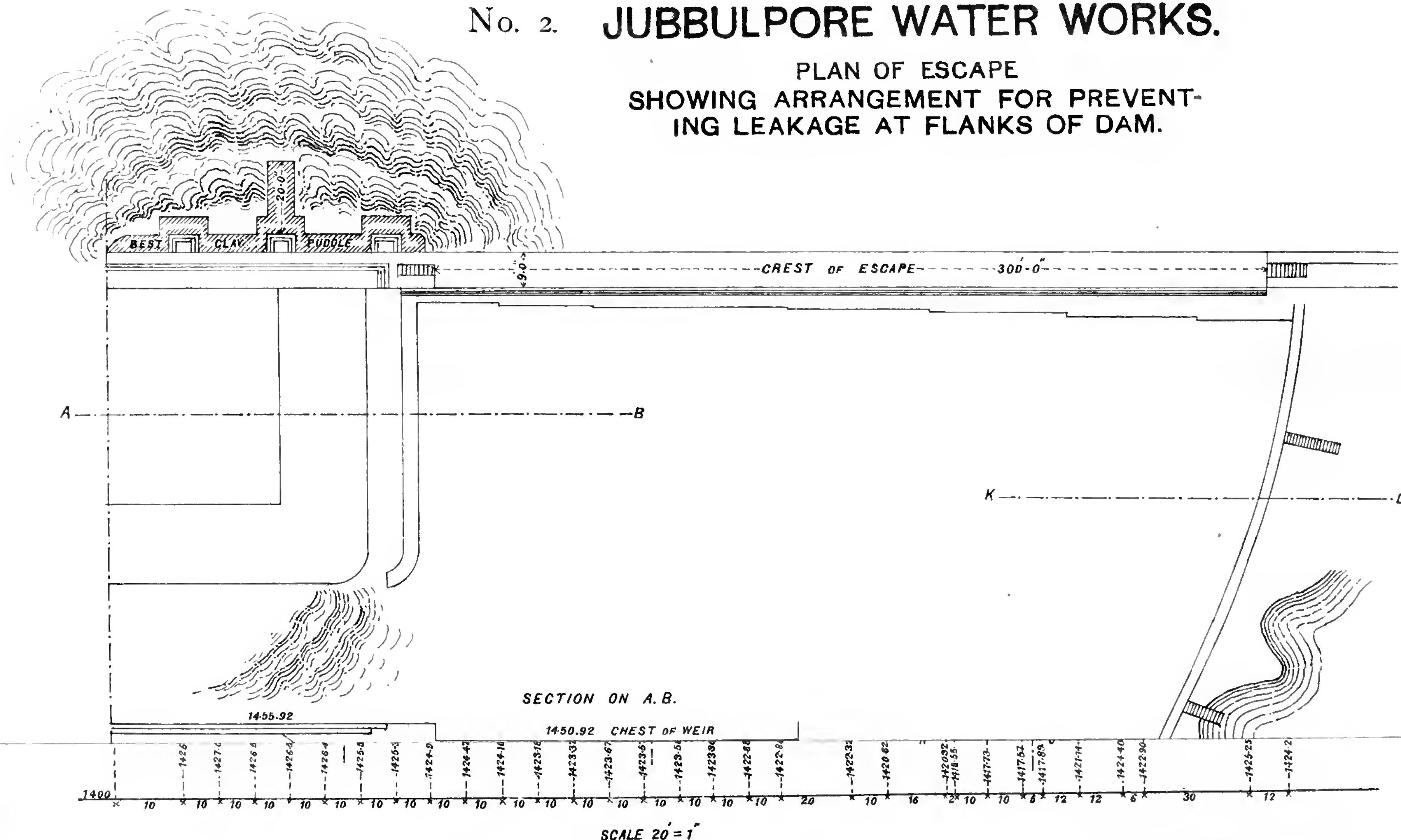
This excess is thus explained—

Revised schedule owing to increase in thickness sanctioned by Chief Engineer + permitted deviation ...	2,139
Second pipe through culvert	5
Special pipes for hydrants, &c., and other pipes omitted in estimate	41
Total	2,185

(*To be continued.*)

No. 2. **JUBBULPORE WATER WORKS.**

PLAN OF ESCAPE
SHOWING ARRANGEMENT FOR PREVENTING LEAKAGE AT FLANKS OF DAM.



J. H. GLASS,
Executive Engineer,
JUBBULPUR DIVISION.

The "STAR" Press, 19, Lall Bazar, Calcutta.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Madras, October 25, 1887.

The following transfers are ordered at the public expense :—

Lieutenant-Colonel A. T. Fraser, R.E., Executive Engineer, 1st grade, from the I. Circle, Vizagapatam Division, to the IV. Circle, West Coast Division.

Mr. C. J. Ussher, Executive Engineer, 4th grade, sub. *pro tem.*, from the Office of Chief Engineer, Public Works Department, to the I. Circle, Vizagapatam Division.

Mr. F. J. Wilson. Executive Engineer, 4th grade, temporary rank, from the IV. Circle, West Coast Division, to the I. Circle, Godavari Eastern Division.

Mr. J. W. Martin, Executive Engineer, 1st grade, sub. *pro tem.*, from the V. Circle, South Arcot Division, to the IV. Circle, Coimbatore Division. On relief by Major Smart, R.E.

Mr. A. T. Mackenzie, Executive Engineer, 4th grade, temporary rank, from the IV. Circle, Coimbatore Division, to the VI. Circle, Periar Project Division. On relief by Mr. J. W. Martin.

The following posting is ordered :—Major A. W. Smart, R.E., Executive Engineer, 2nd grade, to the V. Circle, South Arcot Division. To join on return from furlough.

The following promotions and reversions are ordered :—

Mr. G. F. Handcock, Executive Engineer, temporary rank, 4th grade, to Assistant Engineer, 1st grade, with effect from 6th September 1887.

Rai Bahadur S. Gopala Krishna Aiyar, B.C.E., Executive Engineer, temporary rank, 4th grade, to Assistant Engieeer, 1st grade, with effect from 27th September 1887.

N.-W. P. and Oudh, October 22, 1887.

Buildings and Roads Branch.

Rai Mohendra Nath Chakervati Sahib, Assistant Engineer and District Engineer, Hamirpur, is granted one month's leave on medical certificate from the 21st September 1887.

Irrigation Branch.

Mr. H. Nelson, Executive Engineer, 4th grade, sub. *pro tem.*, Rohilkhand Canals, is transferred from the 3rd to the 1st Circle of Irrigation Works and posted to the Aligarh Division, Ganges Canal.

With reference to Government of India, Public Works Department Notification, dated 19th October 1887, appointing him to these Provinces, Mr. E. Reilly, Assistant Engineer, 2nd grade, is posted to the 2nd Circle, Irrigation Works. This cancels Irrigation Branch Notification, dated 14th October 1887, posting Mr. F. C. Rose, Assistant Engineer, to the 2nd Circle.

With reference to Notification, dated 21st July 1887, Mr. A. H. Barrow, Executive Engineer, 1st grade, sub. *pro tem.*, on return from privilege leave, received charge of the Aligarh Division, Ganges Canal, from Mr. J. A. Cones on the forenoon of the 13th October 1887.

With reference to Notification, dated 8th July 1887, Mr. M. P. V. Horst, Executive Engineer, 2nd grade, sub. *pro tem.*, on return from privilege leave, received charge of the Bulandshahr Division, Ganges Canal, from Mr. S. Athim on the afternoon of the 6th Octtober 1887.

With reference to Notification, dated 17th August 1887, Lieutenant-Colonel G. T. Skipwith, R.E., on return from privilege leave, received charge of the 1st Circle, Irrigation Works, from Mr. J. S. Beresford on the forenoon of the 14th October 1887.

Mr. H. S. Wildeblood, Assistant Engineer, 1st grade, sub. *pro tem.*, passed the Lower Standard Examination in Hindustani on the 3rd October 1887.

With reference to Notification, dated 25th July 1887, Mr. C. G. Palmer, Executive Engineer, 2nd grade, on return from privilege leave, received charge of the Eastern Jumna Canal Division from Mr. H. G. Boyce on the forenoon of the 12th October 1887.

Punjab, October 27, 1887.

Mr. C. F. Tufnell, Executive Engineer, 4th grade, temporary rank, is allowed furlough for two years, with effect from the 20th October 1887 or such subsequent date as he may avail himself of the same.

Mr. A. Grant, Executive Engineer, 4th grade, temporary rank, from the Kohat Provincial Division to the Bannu Provincial Division.

Mr. F. Farley, Assistant Engineer, 1st grade, from the Bannu Provincial Division to the Kohat Provincial Division.

Mr. B. C. Bensley, Executive Engineer, 4th grade, temporary rank, from the Dera Ismail Khan Division to the Peshawar Provincial Division, which he joined on the 20th September 1887, and of which he took over charge from Mr. T. E. Ivens on the afternoon of the 28th idem.

Irrigation Branch.

Mr. W. Smith, Executive Engineer, 4th grade, from the 2nd Division, Bari Doab Canal, which he left on the afternoon of the 10th October 1887, to the 1st Division, Bari Doab Canal, which he joined on the forenoon of the 1th October 1887.

Mr. F. Du Cane Smithe, Executive Engineer, 3rd grade, from the 1st Division, Bari Doab Canal, which he left on the afternoon of the 4th October 1887, to the 2nd Division, Bari Doab Canal, which he joined on the forenoon of the 5th Octoher 1887.

Bombay, October, 27, 1887.

His Excellency the Governor in Council is pleased to make the following appointments during the absence of Colonel C. A. Goodfellow, V.C., R.E., on privilege leave, or until further orders :—

Mr. J. E. Whiting, M.A., M. Inst. C.E., to act as Chief Engineer for Irrigation and Superintending Engineer, Central Division.

Mr. J. C. Pottinger to officiate as Superintending Engineer, Southern Division.

Khan Saheb Pestonji Hormusji Patuck to officiate as Executive Engineer, Ahmednagar.

His Excellency the Governor in Council is pleased to appoint Mr. S. Rebsch, Assoc. M. Inst. C.E., Executive Engineer, 4th grade, to act temporarily as Executive Engineer, for Irrigation, Poona.

Mr. C. T. Burke, B.E., M. Inst. C.E., will continue to act as Executive Engineer, Poona District.

Central Provinces, October 29, 1887.

Establishment.

With reference to Notification, dated the 16th ultimo, Mr. P. W. Gilliland, Assistant Engineer, reported his arrival at Hoshangabad on the forenoon of the 8th current.

With reference to Notification, dated the 16th September 1887, Rao Sahib D. S. Sathaye, Assistant Engineer, 1st grade, reported his arrival at Jubbulpore on the forenoon of the 11th current.

Three weeks' privilege leave is granted to Mr. J. B. Leventhorpe, Executive Engineer, Eastern Division, with effect from the date on which he may avail himself of the same.

Rao Saheb T. N. Mukhopadyah, Assistant Engineer, 1st grade, is posted to the charge of the Eastern Division, during the absence of Mr. J. B. Leventhorpe, Executive Engineer, on privilege leave, or until further orders.

Bengal, November 2, 1887.

Establishment—General.

The Lieutenant-Governor is pleased to make the following promotion in the Engineer establishment, with effect from the 6th October 1887 :—

Mr. J. C. Hewitt from Assistant Engineer, 2nd grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade.

Mr. A. H. Mason, Assistant Engineer, is, on return from furlough, posted to the Eastern Bengal State Railway.

Mr. W. McHutchin, Executive Engineer, 3rd grade, sub. *pro tem.*, is transferred from the Tirhoot State Railway to the Assam-Behar State Railway.

Mr. J. C. Vertannes, Superintending Engineer, is, with the sanction of the Government of India, granted special furlough for two years, with effect from the 7th November 1887, or from such subsequent date as he may avail himself of it, together with the necessary subsidiary leave.

Mr. T. H. Wickes, Superintending Engineer, is appointed to officiate as Superintending Engineer of the South-Western Circle, during the absence, on special furlough, of Mr. Vertannes, or until further orders.

Mr. E. J. Martin, Superintending Engineer, is, on return from furlough, appointed to officiate as Superintending Engineer of the Western Circle, during the absence, on deputation, of Mr. Wickes, or until further orders.

Burma, October 22, 1887.

Lower Burma.

Mr. E. H. Clementson, Executive Engineer, 4th grade, temporary rank, Burma State Railway, has passed the Colloquial test in the Burmese language.

Mr. H. Hoyne Fox, Executive Engineer, 4th grade, sub. *pro tem.*, reported his return from furlough on the forenoon of the 17th October.

With reference to *Burma Gazette* Notification, dated the 21st October 1887, the services of Mr. H. Hoyne Fox, Executive Engineer, 4th grade, sub. *pro tem.*, are placed at the disposal of the Superintending Engineer, Upper Burma.

Burma State Railway.

Mr. W. Wiseman, Executive Engineer, 2nd grade, is granted 23 days' privilege leave, with effect from the 24th September 1887. This cancels Notification dated the 30th September 1887.

Mr. W. Wiseman, Executive Engineer, 2nd grade, reported his return from the privilege leave granted to him in this office Notification of this date on the forenoon of the 17th October 1887.

India, October 29, 1887.

Mr. E. H. Stone, Executive Engineer, 2nd grade, State Railways, is transferred from the Establishment under the Goverment of Bombay to that under the Director-General of Railways.

The services of Mr. F. Lang, Executive Engineer, 4th grade, sub. *pro tem*, on his return from furlough, are placed at the disposal of the Bengal-Nagpur Railway Company.

The undermentioned officers are transferred from Assam to Burma Provincial Establishment :—

Captain R O. Lloyd, R.E., Executive Engineer, 2nd grade.

Mr. H. Kench, Executive Engineer, 4th grade, temporary rank.

With reference to Public Works Department Notification, dated the 1st July 1887, Mr. H. Bell, Chief Engineer, 3rd class, temporary rank, State Railways, is transferred from the Establishment under the control of the Director-General of Railways to that under the Government of Bengal.

With reference to Public Works Department Notification, dated the 29th July, 1887 and of this date, Mr. H. Bell is re-appointed Engineer-in-Chief and Manager of the Tirhoot State Railway.

Mr. G. W. MacGeorge, Superintending Engineer, 3rd class temporary rank and Deputy Consulting Engineer to the Government of India for Railways, Lucknow, is appointed to officiate as Consulting Engineer to the Government of India for Railways, Lucknow, during the absence on privilege leave of Colonel T. F. Dowden, R.E., or until further orders.

Central India.

Mr. C. E. Gael, Executive Engineer, 1st grade, sub. *pro tem.*, who has been granted 6 months' special leave availed himself of subsidiary leave preparatory to going on special leave out of India, on the forenoon of the 19th August last, and reported his departure from Bombay on the 23rd idem.

Director-General of Railways.

Mr. H. Johnson, Executive Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India leave for eleven months in extension of the furlough granted to him in Government of India, Public Works Department, Notification dated 28th February 1887.

Military Works Department.

The undermentioned officers are appointed temporary Superintending Engineers, class III., for such period as may be necessary on account of the execution of Special Defence Works from the dates specified :

Lieutenant-Colonel E. D'O. Twemlow, R.E. Dated 6th September 1887.

Major N. Arnott, R.E. Dated 17th August 1887.

The following promotions and reversions are made in the Engineer Establishment of the Military Works Department, from the dates specified :—

Captain F. B. G. D'Aguilar, R.E., Executive Engineer, 1st grade, sub. *pro tem.*, to revert to Executive Engineer, 2nd grade, with effect from 14th June 1887.

Captain E. Glennie, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*, to revert to Executive Engineer, 3rd grade, with effect from 14th June 1887.

Captain S. A. E. Hickson, R.E., Executive Engineer, 3rd grade, sub. *pro tem.*, to revert to Executive Engineer, 4th grade, with effect from 14th June, 1887.

Captain J. G. Day, R.E., Executive Engineer, 4th grade, sub. *pro tem.*, to revert to Executive Engineer, 4th grade, temporary rank, with effect from 14th June 1887.

Lieutenant-Colonel T. O. Wingate, Ben. S.C., Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, permanent rank, with effect from 16th June 1887.

Captain E. Glennie, R.E., Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, permanent rank, with effect from 16th June 1887.

Captain S. A. E. Hickson, R.E., Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, permanent rank, with effect from 16th June 1887.

Captain J. G. Day, R.E., Assistant Engineer, 1st grade, and Executive Engineer 4th grade, temporary rank, to be Executive Engineer, 4th grade, permanent rank, with effect from 16th June 1887.

Lieutenant H. V. Biggs, R.E., Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent rank, with effect from 30th June 1887.

Captain F. N. Maude, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 28th June 1887.

Lieutenant H. F. Chesney, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effiect from 8th July 1887

Lieutenant H. F. Chesney, R.E., Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 19th July 1887.

Major S. C. Turner, R.E., Executive Engineer, 1st grade, to be Superintending, 3rd class, temporary rank, with effect from 23rd August 1887.

Lieutenant H. F. Chesney, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 23rd August 1887.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 18th October 1887.

168 of '87.—Richard Olpherts, of Red House, Ardee, Ireland, at present of Bethee Indigo Factory in the District of Gorakpore, late a Captain in Her Majesty's Service.—*For an improved process for producing Indigo green from the Indigo plant.*

169 of '87.—The Consolidated Refrigerating Company, doing business at 15, Courtlandt Street, in the City, Country and State of New York, in the United States of America.—*For a process of and apparatus for distilling Ammonia.*

184 of '87.—Pompée de Bondini, Gentleman, and Theodore Tubini, Merchant, both of Constantinople, Turkey.—*For improvements in Lamp wicks.*

Notices.

The Office of Publication of Indian Engineering *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.
An allowance is made for continuous insertions.

INDIAN ENGINEERING.
VOL. I—Jan.-June, 1887.
A few copies, neatly and strongly bound, on sale.
Price, Rs. 25 cash.
Also some odd back numbers for completing sets.
Price Re. 1 cash.

NOTICE.

SHOULD a sufficient demand arise, we shall be glad to reprint Ganga Ram's Tables for Rolled Iron Beams on paper of the size of Molesworth's Pocket Book, so that Engineers may paste them in their Pocket Books.

CONTENTS.

Obituary.

KELLY.—At Umballa, on the 1st November, Michael Alexander Kelly, C.E., Assistant Engineer, D. P.W., aged 61 years.

INDIAN ENGINEERING.

SATURDAY, NOVEMBER 12, 1887.

THE GRIEVANCES OF THE UNCOVENANTED SERVICE.

THE members of the Indian Uncovenanted service are a patient and long suffering body of men, but at the same time it must be borne in mind that there is a limit to human endurance. They have hitherto meekly borne the result of the parsimonious policy of the State and it is plain from the agitation now being carried on in England and here that they mean to assert their rights notwithstanding the disheartening reply of the Under-Secretary for India. There is not a tittle of reason on the side of the Government that the members who retired to England should receive their pensions in sterling, equivalent in rupees, according to the exchange of the day. The question is so very simple in its nature that we wonder how any other but one interpretation could, even by a process of juggling, be placed upon it. To render ourselves more clear let us review the subject of contention between the employers and the employed. On the 19th May 1855, when the affairs of India were under the control of the Board of Directors appointed by the East India Company, for the first time a limit was placed on the amount of the Uncovenanted service pensions for persons appointed after that date—namely, £500 sterling per annum if the officer's pay exceeded Rs. 1,000 a month, or £400 sterling per annum if his pay ranged from Rs. 700 to Rs. 1,000. Fifteen years after, that is, on the 1st July 1870, a resolution was passed, the object of which is thus stated in the preamble :—"As considerable misapprehension exists in regard to the limitation of pensions of Uncovenanted servants both under the old and new rules, the Governor-General in Council is pleased to issue the following resolution." Now it should be observed here that the "considerable misapprehension" did not exist anywhere outside the bureaucracy. The rules of 1855 were as patent as daylight, but it was a difficulty of another sort the Government was called upon to deal with, which we shall mention below. The resolution mentioned above concludes thus :—"The rules therefore regarding the limitations of the amount of pensions of Uncovenanted servants may be thus summarised. The limitations prescribed by the Uncovenanted Service Pension Rules of April 1864, in regard to one-third and one-half pensions do not apply to Uncovenanted servants of the three classes noted below.* Ordinarily the limit of pension for these classes will be £500 per annum. In cases of extraordinary merit, Uncovenanted servants of the first of the said classes

* I. Officers who entered the service before May 19, 1855, or who were promoted before August 6, 1862, to salaries exceeding Rs. 10,000 a year, and whose average salary during the last five years of service exceeds that sum.

II. Covenanted Civil Engineers in the Public Works Department and certain civil covenanted officers in the Telegraph Department who entered the service before the promulgation of the new rules and have elected to abide by the old rules.

III. Native judges who were in the service on October 29, 1866.

may be allowed pensions exceeding £500 per annum, the amount of years being governed by the merits and services of the retiring servant and to be limited to an amount consistent with a due regard to the public. In all other cases the pensions of Uncovenanted servants are subject to the limitation of the New Pension Rules of June 8, 1863, and April 13, 1864, but for 'unusually meritorious services' special pensions may be allowed by the Secretary of State to any appointed before May 19, 1855." Now if the foregoing resolution does not specify in the clearest terms that the grant of pensions is to be made at the par rate of 2s. when paid in pounds sterling, we would like to know what alternative meaning could be attached to it. We should also observe here that in a despatch from the Secretary, dated 8th December 1862, a loophole was left for Government to back out of their pledges, but which they evidently did not take advantage of in framing either the rules of 1863 or 1864. It was this; the Secretary of State had assented to pay pensions in England on the condition that payment should be made at a rate of exchange fixed annually, but it is a notable fact that, though the despatch is quoted among the formal decisions cited in the resolution, that condition is nowhere mentioned in the final summary. What then had in the meantime occurred which led to the omission in the code of the limits in pound sterling specified in the resolution of July 1870? In August 1871 the Government of India circulated a draft civil pension code to local administrations, inviting criticism thereon. In the draft the paragraphs of the resolution of 1870, to which a reference has been made above, were reproduced, but an appendix was added to it containing the original pension rules of 1831, with a note in the following words: "The limit of pension in ordinary cases is Rs. 5,000 per annum, but this is subject to the rules under sec. 57 of the code." In the margin of the note the resolution of 1855 is quoted as a "guide to the direction of the rule," as stated in the Government circular. If that resolution is to be accepted as a guide the limit must be fixed at £500, and not at Rs. 5,000. The real difficulty, however, to which allusion is made, is that from 1862 to 1870 there had been a great influx of Europeans to the ranks of the Uncovenanted service, especially in the Public Works and Telegraph Departments, men of education and good birth, who would naturally expect to retire to their native land, and in whose case the fluctuation in exchange, and consequently a fluctuation in pensions, would act prejudicially and be a source of great injustice. They had been induced to take employment under Government on the explicit declaration of the rules in the resolution of 1855, but now they find, that owing to no fault of theirs that the conditions of things have changed and they are left to the mercy of the annually depreciating rupee to eke out a bare existence with a large family. Government has not even the show of a right, except that might is right. It is a suicidal policy on the part of the State to alienate its faithful servants from their loyalty, and who have ever responded to the call of duty at great personal and pecuniary sacrifices. And what, after all, is the loss to Government compared to the gain, by following a generous course of action? The sum total of pensions to the members of the Uncovenanted service in England is a drop in the ocean of Home charges. We trust to the sense of justice and equity in Lord Cross, who has promised to look into their grievances, for a favorable solution of the question.

THE HYDERABAD-PACHPADRA RAILWAY.

Two men riding for different stables in a race are apt, after passing the post, to give widely different accounts of its incidents. Similarly, spectators looking on from the stand will proclaim one horse the winner of a heat, and a minute afterwards feel much surprised to hear that the judges have given it to another. Opinion in short is influenced by circumstances; by the point of view. The Kurrachee merchants, Municipality, and people are desirous that a line of railway should be constructed, running from the Indus near the town of Hyderabad, *viâ* Oomerkote, to a junction with the Rajputana-Malwa system at Pachpadra in the Jodhpore State. The country to be traversed by the proposed line is referred to by the Kurrachee Municipality in a memorial praying for its construction as "a new, interesting and comparatively fertile country." One fails to see the relevancy of the first two epithets: but let that cavil pass. It is more germane to our argument that the Government of India considers that a large proportion of the route proposed for the new railway would be more appropriately described as "great uncultivated tracts of wilderness." The Kurrachee Chamber of Commerce is of opinion that the proposed line "offers almost certain prospect of being remunerative." The Government of India thinks that a broad gauge railway with heavy gradients and long distances almost devoid of water will cost fully a lakh of rupees a mile in construction. A more favourable estimate suggests Rs. 70,000 a mile. Accepting it for what it is worth, says the Government, it has to be considered that even so, a total expenditure of 245 lakhs would have to be incurred, and on that sum either a dividend would have to be earned, or interest paid. Interest at 4 per cent. for the British portion only, and assuming that the Jodhpore portion could and would liquidate its own debt, would amount to Rs. 9,80,000 per annum. Now the Hyderabad district has a population averaging 8·32 per mile, and yields an average revenue of 13¼ lakhs of rupees: the Thur-Parkur district contains only 204,344 persons in its whole area of 12,729 miles, and yields a revenue of 3½ lakhs: the Western Jodhpore tracts are no less unpromising. Government wants to know how, out of such barren, unpromising material as these figures bear witness to, it could expect to recoup itself for a costly outlay. Moreover, with regard to the possible remunerativeness of the proposed railway, local authorities, the Governor of Bombay and the Commissioner of Scinde to wit, "exhibit a marked reserve." A diplomatic fashion of expressing disapproval, we may take it.

Kurrachee is of opinion that the North-Western Railway opens up but a limited area of country; is in effect a long trunk line, without sufficient branches, and not located with a view to commercial purposes. Kurrachee thinks that it ought to be supplied with lateral communications eastwards. The Government of India, on the other hand, do not admit that the North-Western Railway serves only a limited area, or is unable to convey the traffic which can reasonably be expected to seek the sea at Kurrachee. It runs, they say, from that place to Lahore, whence it extends to Delhi on the east, and Peshawar on the west. It is provided with the Sind-Pishin Branch, reaching to the Amran Range, and able there to receive all trade from Kandahar or beyond; with the Sind-Sagar Loop, which taps at Dera Ismail Khan the Goomul route into Afghanistan; also with branches to Ferozpur (joining the Rajputana Railway) to Khushalgur, to Sealkot, to Pathankot, and to Patiala. The line runs through, or near all the principal cities and centres of trade in the two provinces, and being abundantly ramified may fairly be considered complete in its way. That it has no large branch eastwards from lower Sind is due solely to the inevitable geographical disadvantage under which the province labours of being bounded on the east by the wide desert of Rajputana.

Kurrachee's contention as to the convenience of a daily railway borne postal service between it and Bombay is admitted. But it is denied that the construction of the proposed railway would result in any saving of time in the transmission of mails. And a daily post, it is written, "would be too dearly purchased at the cost of a heavy charge for loss on the railway, upon the general revenues of India." Kurrachee's argument that its pet unborn railway would be an alternative line of military communication between the North-West frontier and the base at Bombay, and would also strengthen military operations from the Kurrachee base is met with the pertness cultivated in Secretariat offices:—"I am merely to say that a line in a different direction would be of considerably greater value."

The engineering features of a Hyderabad-Pachpadra Railway are represented by Kurrachee as offering no appreciable difficulties. Government contends that this is a sanguine view, and refers to a multiplicity of sandhills rising in places to a height of 300 or 400 feet; and to a water-supply sometimes 300 feet below the surface.

In short, no two interests could scarcely regard a proposition from more opposite points of compass opinionative than do the Kurrachee people and the Government of India. We have, in this writing, endeavoured to set forth briefly the leading arguments *pro* and *con*. We are not concerned to act as judge between them. *Cui bono?* If any one wants an explanation in brief of the course pursued by the Government in the matter let him turn to the Secretariat minute on the proposed Railway, and read paragraph 15—until he comes to the following sentence:—"Even if the scheme had been more promising the state of the finances would have precluded their affording any financial assistance." Paragraph 16 informs us that this is a decision arrived at "with much regret!"

MINERALS IN UPPER BURMA.

THE *Burma Gazette* of the 15th October contains three important reports submitted to the Chief Commissioner, by Mr. Jones, Officiating Deputy Superintendent, Geological Survey of India, on Minerals in Upper Burma.

The first one relates to the *Panlaung* coalfield, which is situated on the right bank of the Panlaung river, and in the neighbourhood of *Taungnga* village, nearly opposite the village of *Pachaung*. It was found impossible to examine the country in its present condition, hence explorations for coal were very superficial and, therefore, imperfect. His investigations were confined to accessible groups of outcrops, 11 of which he was able to visit.

The first of these he describes as the *Pagamyaungchaung* outcrop which contains several seams from a few inches to 2 feet, but none exceeding that thickness. The coal is said to have a greasy feel and to readily break up into small fragments. Some of the coal will, it is said, make good fuel.

The next group is the *Mithinchetkyauk* outcrops which are seen on the side of the hill overlooking the Panlaung river in British territory. There are six exposures and remains of old workings on the hill-side and two more 200 feet to the dip of these, varying in thickness from a few inches to 1 foot 6 inches. The third group, or the *Ingondaung* hill outcrops dip generally S. to W., but at a place where an 8″ seam was seen the section was to a great extent concealed by the fallen ground; but it was stated that this seam attained the thickness of 2½ cubits at the depth of 5 cubits. There are other smaller seams dipping in the south-westerly direction at angles from 40 to 90 degrees. Extreme irregularity of bed at some sections was noticeable and the mineral obtained was much broken and finely jointed; the coal burning like oak and jungle wood.

The *Thabyetaungdan* hill was the next locality where groups of outcrops were seen. Here was found the most promising of all outcrops, the section examine exhibiting 7 feet 6 inches coal made up of two seams 2 feet and 5 feet 6 inches respectively, but the high dip—60°—would be a serious drawback to a successful exploratory undertaking. Besides these there are said to be some other seams, but none worth so much attention as those referred to.

Coal seams are also said to have been found in the *Chakimyaungchaung*, *Thaikthaw*, *Kyathaungdaung*, *Chanlenyaungchaung*, and the *Ludwin* groups in thickness ranging from 6 inches to 4 feet and at some of which workings were noticed opened in King Mindon's time. The coal was quarried and valued at Rs. 8 per 100 baskets on the bank, and to this Rs. 16 had to be added for carriage to the Irrawaddy on pack bullocks part of the distance and on bamboo rafts the rest of the way. The price realised on the Irrawaddy was said to have been Re. 1 per basket= about 80lbs. The conclusion arrived at by Mr. Jones is, that in the several seams he had examined he did not see a single one which held out prospects of profitable working. The area over which the coal occurs is said to be 150 to 200 square miles. The coal is said to belong to the tertiary age and the assay conducted by Mr. Blyth resulted in a low percentage of volatile matter due to the great disturbance the coal had undergone and a very small quantity of ash Owing to the irregularity, uncertain thickness, and high dip of the seams the coal cannot be worked by the ordinary methods of mining, but by open or quarry work, and even then it is questionable whether it would pay to send the coal to the nearest point on the Toungoo-Mandalay Railway by road or train.

The second Report deals with the supposed coal at *Thigyit* near *Pyanugwe.* The black substance which had given rise to the report was found to be liquid or brown coal. At a point above the bridge spanning the *Mithwe* stream, the exposed seams were, on digging, discovered to be delusive and irregular and varying in thickness from 2 to 3 feet, and even 6. The whole appearance of the deposit was found to be of lacustrine origin, the bottom of the lake having gradually silted up in recent times by *detritus* and vegetable matter, including logs of wood brought down from the surrounding hills during the rains into the lake where they are now seen *in situ.* No hopes are held out for a large and profitable coal supply from this source.

The third Report is on two coal localities in the *Shan* hills. At *Legaung* where a section was examined the coal showed smut a few inches thick and within a mile of this place fair coal was seen in two seams 1 and 1½ feet thick.

The second locality where coal was discovered was at *Ngu* near *Pwehla.* The mineral is exposed on a hill and the seams vary in thickness from a few inches to several feet. One seam 11 feet thick rests on clayey slate and contains a great deal of clayey matter and the coal is very soft. The continuation of the same seam shows variation in thickness from 11 to 5 feet at other points of exposure.

From the assay of the mineral it is declared as useless for fuel. The *Legaung* coal would make very fair fuel, though its volatile matter is very low, as in all these coals.

The outlook on the whole is, we think, gloomy as to the prospects of a large and profitable coal supply from these quarters, with, perhaps, two exceptions, and it behoves the Government to explore the country thoroughly, with a view to a more promising coal area being found.

Mr. Jones also reports on the argentiferous galena worked near *Bawnin, Bweion* and *Dwinzu* where old workings still exist, and on the pyrites of *Thangyichaung* and *Kyauktat* which in former times were distilled for the sulphur. He also reports the discovery of copper ore in the form of green carbonate associated with quartz at *Kyauktat* and *Taunglebyin* and gold at the latter place obtained, it is said, by working in a stream near by; but this locality was not visited by Mr. Jones.

Notes and Comments.

MR. AGABEG AGABEG.—The *Englishman* learns that this gentleman has been specially engaged for mineral exploration in the Birbhum district. Mr. Agabeg's colliery and general experience well fits him for the work.

THE NELLORE RAILWAY.—The Engineer-in-Chief of the Nellore Railway reported on the 30th ultimo that owing to heavy and continuous rain for four days the line is unsafe, but no breach is reported. All traffic, except the Mails, had to be suspended *pro tem.*

CALCUTTA UNIVERSITY.—For the University examinations in Engineering, 1888, applications from candidates for admission to the F. E. examination must be lodged with the Registrar on or before the 23rd April and from candidates for admission to the L. E. and B. E. examinations must be lodged with the Registrar on or before the 17th June.

IMPROVING THE IRRIGATION OF THE HYDERABAD DISTRICTS.—It has been decided to set aside a large sum in this year's Budget, and to nominate a special committee, with full powers to sanction repairs to tanks up to the budget allotment. The Minister has done a good work in pressing on this all-important question of irrigation. The repairs to the tanks will be commenced at once.

LARGE IRRIGATION PROJECTS IN THE MADRAS PRESIDENCY.—The Godavari works are estimated to cost Rs. 130 lakhs and to yield a return of between 12 and 13 per cent., and the Kistna system is estimated to cost about one crore and 49 lakhs and to yield between 8 and 9 per cent. The Periyar Project, noticed elsewhere, is estimated to cost 56 lakhs and yield from 8 to 9 per cent.

THE MADRAS DRAINAGE SCHEME.—The new drainage scheme is a source of grave anxiety and responsibility to the Commissioners. It involves an expenditure of nearly ten lakhs of rupees, taken from the public of Madras. If the deep main sewers turn out a failure (as it is feared they will) the subsoil of Black Town would be polluted and the well water in the town would necessarily be contaminated.

HOW THE MONEY GOES!—The total expenditure on Indian State Railway stores purchased in England during the past year amounted to £760,660. Of this sum £251,121 was spent on locomotive and rolling stock, and £179,779 on iron bridge work, the number of bridges erected last year being larger than usual. In India the expenditure amounted to nearly 29 lakhs of rupees, Karachi taking nearly half on account of coal purchase.

THE COMMANDER-IN-CHIEF'S TOUR.—The Commander-in-Chief, attended by the senior officers of the Military Works and Railway Departments, including Major Turner and Mr. O'Callaghan, visited the Kojak, using the new driving road constructed up to Kotal since his last visit. The alignment of the tunnel and the railway extension towards Kandahar were explained to His Excellency by Mr. O'Callaghan. His Excellency next proceeded to Gulistan by train, riding into Quetta through the Ghaziabad Pass, inspecting the various defensive positions *en route.*

A GOOD EXAMPLE.—At a meeting held recently at the office of the Agent and Manager, Madras Railway—when the heads of departments, the Consulting Engineer for Railways, with his Senior Deputy, and the Examiner of Guaranteed Railway Accounts were present—it was decided that Mrs. Bullmore's application for a bonus in consideration of the long and good services of her late husband to the Company be recommended to the Board of Directors for their favorable consideration, and that, pending their approval and the sanction of the Government, 6 months' pay be granted as a bonus.

A RAILWAY FROM BURMA TO CHINA.—Mr. Colquhoun has delivered an address before the London Chamber of Commerce, urging the establishment of a railway as a connecting link between Burma and China, notably by a line from Moulmein, through the Siamese and Burmese Shan States to Eser-Mao on the Chinese frontier. After Mr. Colquhoun had explained his views on the question, the Chamber passed a resolution to make an appeal to Government to urge the Government of India to grant a guarantee to private enterprize when prepared to construct railways.

ROADS IN UPPER BURMA.—Regarding the good roads said to lead inland from the Irrawaddy, a correspondent remarks: "D. P. W. roads are here undoubtedly referred to. These are well known throughout the district as being almost impassable, and are carefully avoided, as wading through a sea of mud is the lot of any adventurous person who attempts to use them." This is rather rough on the D. P. W., considering that even in Lower Burma *pucca* roads are the exception and the *kutcha* the rule, and that these latter are at best only fair-weather communications.

THE BENGAL-NAGPUR RAILWAY.—A Correspondent writes: All works have been stopped between Rugganathapore and Assensole for a time, I believe till the knotty question of the value of the coal lands is settled. If the coal companies come to some reasonable terms there is not the least doubt that the line will take the original route from Sitarampur, which from an Engineering point of view is certainly not the best place for a junction. Yet it will improve the coal industry between Sitarampur and the River. The land Acquisition Deputy Collector has been called upon to send in a report on the claims of the Equitable Coal Company.

OUR N.-W. FRONTIER POLICY.—The *Civil and Military Gazette* says:—When the details of the sketch of our frontier necessities by road and rail have been filled in with the iron and stone of accomplished facts, we believe that the real scientific frontier which the safety of the Empire demands will have been secured. To secure the security, however,—to render that frontier *our* frontier, in the proper sense of the term, we must have other arrangements than subsist at present with the tribes whose hills and valleys we propose to intersect by lines of communication, and to march through, if necessary. It is a fringe of land fruitful in men and stones. While our engineers level the latter, our politicals must control the former.

THE METEOROLOGY OF CEYLON.—A Correspondent writes: Ratnapura under the shadow of the Peak holds its own as the wettest of the stations. It would be interesting to know how or what atmospheric influence caused Galle and Kandy to rob Kurunegala of 14 inches of rain during 1886. It is not the absolute rainfall that makes the N. and N. Central Provinces suffer from drought as the bad distribution, the whole quantity falling practically in four months. But a review of the year shews that any one stationed at an exhausting station in Ceylon has a change so near at hand that there is no excuse for a man getting dried up, as within a few hours he can be transported to almost any climate that his doctor may advise or his wish express; *par exemple* from 80° in Colombo after 10 hours one can find oneself at 58° in Newara Eliya.

THE BERAR TRAMWAYS.—The published reports of the two little Provincial lines in the Berars connecting Amraoti and Khamgaon with the G. I. P. Railway from Bhasawal to Nagpur shew the following results:—

AMRAOTI LINE.

Length open 6 miles.

Capital Cost to end of 1886-87	Rs. 4,44,533
Net receipts for 1886-87	,, 44,137
Percentage of revenue on outlay ...	9·93

KHAMGAON LINE.

Length open 8 miles.

Capital Cost to end of 1886-87	Rs. 4,89,612
Net receipts for 1886-87	,, 20,232
Percentage of revenue on outlay ...	4·13

These two short lengths of Railway are worked by the G. I. P. R. Company; they lie in the same tract, and are not situated far apart in that tract, and yet there is a vast difference in their earnings. No explanation is given of the difference.

WANTED—AN ENGINEER FOR THE MADRAS P. W. D.—Anent the advertisement of the Secretary to Government, P. W. D., for an Essay on the best and cheapest means of supplying Bangalore with good water, some one asks: Is it not a rich joke that the Department that prided itself before the Public Service Commission in having the monopoly of Engineering talent in India, should offer a reward of Rs. 2,000 for a paltry water scheme? And has it come to this that the Head of the P. W. D. knows of no Engineer, among his numerous Engineers, competent to be *ordered* to undertake the Bangalore water-supply? Must he entice them with a reward? Why can he not undertake the 'job' himself, and then retire with well-earned laurels? A talented Department surely! Well may 'Ichabod' be now written on the portals of a Department that once boasted of a Sir Arthur Cotton, a Haig, a Fraser, and a Smith (R. S.)

PROVINCIAL STEAM TRAMWAYS IN WESTERN INDIA.—According to Mr. Molesworth, the Morvi Chief laid down a line of way on his own account from Wadhwan to Rajkot, 70 miles, with rails 19lbs. to the yard and 2 feet 6 inches gauge with locomotives, waggons and carriages. He got this laid down and open in March 1886. In April 1887, the Government Engineers in Bombay reported it practically played out, the rails bent and twisted wherever the bank settled, the curves having to be relaid with a heavier rail. The question of an entire change of gauge had to be taken into consideration, but the conversion is pronounced impossible except at a ruinous sacrifice of both permanent way and rolling stock. Mr. Molesworth concludes his discourse with a moral to which exception can hardly be taken. "This unfortunate failure," he says, "forms an instructive example of the disastrous results following the adoption of crude suggestions, without due consideration and competent professional advice."

CERAMIC MOSAIC IN MADRAS.—A Madras paper observes: Many people must have remarked the great sameness of color in the public buildings of that City. This is owing to the want of variety in the building materials, only granite and brick being available. In Lahore, the want was still greater and the architects of the sixteenth century introduced what is now called ceramic mosaics in their buildings. It is thus noticed by Mr. Kipling in the

Journal of Indian Art:—"In the Fort at Lahore there are large panels shewing a gul dasta, or foliated pattern of a branching tree, each leaf of which is a separate piece of pottery. The solidity and crispness of effect of this inlay as compared with a painting of a pattern which wanders from tile to tile is remarkable." We have had the pleasure of seeing some specimens of this mosaic tile work made at the Government brick-fields by Mr. Brassington, the Consulting Architect, which will, in all probability, lead to a revival of this ancient art, and lend color to Madras. The specimens follow the old designs existing in the Punjab, and only differ in the enamels employed, the sea air of Madras necessitating the use of hard siliceous enamels in lieu of the ancient soft kind. The attempts so far made seem to have been highly successful.

THE NORTH-WEST FRONTIER RAILWAYS.—The Lahore paper observes that last March saw the remaining length of rails linked through from Sibi to Quetta, and between Bostan and Gulistan on the one side, and Killa Abdula on the other, or up to the Kojak and the Gwaja Passes respectively. So that we have now uninterrupted railway communication between our principal military base in the Punjab, our seaboard at Karachi, and the Khwaja Amran Range. The line over the range itself is being surveyed, and, in the hands of Mr. O'Callaghan, its completion is not likely to be long delayed. The remaining 80 or 90 miles of railway required to carry us into Kandahar itself, if not to be laid down as yet, is practically already on the Pishin plateau and could be finished almost as rapidly as our troops could march. Although there is a good deal still remaining to be done in connection with the Bolan, either by applying the Abt system to the small section of narrow gauge, or by adopting an improved alignment, which recent surveys have shewn to be perfectly feasible for a standard-gauge line throughout; the completion of these two lines, connecting Sibi and Pishin, have alone changed the whole aspect of affairs. We can now not only place an army on the Helmand at short notice, but rail its supplies and supports direct from the depôts in India.

MANAGEMENT OF MILLS IN INDIA.—Mr. H. E. Walmsley says that while the cotton mills of India were originally fitted out with the best of English machinery, their management is very defective, allowing in a great number of instances a most unnecessary depreciation in the working value of the plant. If such is the case, and still India is able to successfully compete with England in supplying the foreign markets of Asia with cotton yarns and cloths, what would the result be if the management was efficient as it is in Lancashire? It would simply drive English trade completely out of the Asiatic continent, without a possible chance of recovery. Mr. Walmsley says, however, that the machinery is allowed to run without necessary repairs till it soon becomes worthless. Economy is practically unknown and discipline is foreign to any idea of management. This condition of affairs amounts to wilful and culpable neglect, without the least shew of an excuse upon which to base a modicum of justification. A natural effect of all this is a state of demoralization among the work-people. Two causes of mismanagement and consequent unsatisfactory state of affairs are ascribed to placing non-practical men at the head, and to the "vicious system of paying the agent commission on the outturn irrespective of profit and loss."

THE INGERSOLL ROCK DRILL.—The firm of Le Gros, Mayne, Leaver and Co., having their offices in Queen Victoria Street, have recently completed and shipped for the Indian State Railways (North-Western), by order of the Secretary of State for India in Council, and under the inspection of Sir A. M. Rendal, M.I.C.E., the appointed Consulting Engineer of the Indian Government, an important tunnelling apparatus for opening out a coal mine, consisting of two Ingersoll tunnel cars, with adjustable arms and universal clamps, each car supporting four Ingersoll patent rock-boring machines, arranged to work at any angle, and actuated by compressed air supplied by two Ingersoll direct-acting combined steam engines and air compressors, which in turn are supplied with steam by two powerful locomotive steam boilers. The whole apparatus is mounted on steel wheels, to run on rails of 60 feet radius, and is made of a specially compact design. Both the tunnel cars and air-compressors have cylindrical air-receivers combined with them, and the boilers carry cold water tanks under the barrels. The compressed air is to be conveyed to the workings by wrought iron tubes, provided with their special flanged joints, and all the short connections are made with India-rubber steam hose of superior manufacture, protected by tarred marlin, and fitted with Ingersoll steam couplings. All the necessary accessories and appliances are furnished, including a full supply of drill bits, made of selected power-drill mining steel, arranged to bore holes six feet in depth.

THE PERIYAR PROJECT.—This project, just inaugurated, is officially described as one for the diversion of the Periyar river for the purpose of irrigation in the Vigay Valley. The work necessary for diverting the river consists essentially in the building of a dam across the valley of the Periyar and cutting a channel through the watershed to convey the water to the bed of the Vigay. The dam is 155 feet high, and has a thickness of 115¾ feet at the lowest part and 12 feet at the top. The surplus water will be allowed to escape by two channels in saddles, one on either bank of the river. The level of these will be 144 feet above the bed of the stream and their aggregate length will be 920 feet. The main channel for drawing off the water which is to be used for irrigation begins at a height of 113 feet above the bed of the river. For the first part it consists of a cutting 21 feet broad with a fall of 1 in 440. At a distance of a little more than a mile, where the cutting in rock has reached a depth of 30 feet, a tunnel will be commenced with an area of 80 square feet and a fall of 1 in 75. This tunnel will be 6,650 feet in length, and its lower end will communicate by a cutting with the bed of the small stream up whose valley the Goodalur Ghaut now runs. The water thence passes, under suitable control, down the Sooroolly into the Vigay, along which it flows for some 80 or 90 miles till it reaches the parts of Madura to be irrigated, where suitable arrangements will be made for its distribution. The details of the scheme have been worked out with great skill by Colonel Pennycuick and the other officers who have helped him. The estimated cost is Rs. 56,39,913 inclusive of all indirect charges. The water-supply which will be obtained is amply sufficient to irrigate 150,000 acres, but the proposals on which the revenue estimate is based take the area to be irrigated at 101,000 acres with first crop and 35,343 acres with second crop. The final estimate of net revenue from this is Rs. 4,81,053 or 8·53 per cent. on the total estimate including indirect charges.

Current News.

MR. H. J. S. COTTON is on his Irrigation Commission, through Arrah, to enquire into the Canal grievances.

IT is estimated that the restoration of the Secretariat buildings at Allahabad will cost half a lakh of rupees.

THE revision of the boundary between Sind and the Punjab has been under the consideration of Government lately.

THE Jind State has, at last, paid in Rs. 16,021 of contribution towards the cost of the construction of the Sirhind Canal.

THE Annual Report of the Government Telegraph Department may be expected in the course of a few days. It shows good progress all along the line.

THE process of manufacturing carbonate of potash from saltpetre invented by Lieutenant F. B. Pogson, Kotegarh, is under the consideration of Government.

SIR A. L. CAPPEL, Director-General of the Telegraph, after leaving Simla, visits the Punjab, Quetta, Karachi and Bombay officially. He goes home in March.

SOME important alterations, which will cost a fair amount of money, are, we are informed, to be made in the new Secretariat buildings at Simla, during the ensuing winter.

A DETACHMENT of Bombay Sappers and Miners has been sent to Karachi for sub-marine mining operations under Lieutenant Rice, R.E., who has been entrusted with the defences of that port.

THE proposals for the re-organisation of the Archæological Department have been referred for the opinion of the Local Governments, and they may probably be finally decided on during the Calcutta season.

WE understand that the opinions of planters and others interested in the questions dealt with by the Patents Bill are to be taken, through the Local Government, before that measure is finally passed.

THE rains have apparently ceased in Assam, and at Cherrapunji it has been a comparatively dry season, the rainfall this year to the 20th of October being only 440·11 inches as against 462·55 inches last year.

WITH the object of opening through communication at the beginning of the new year, the Marmagoa Railway Company are pushing on actively the remaining portion of the tunnels which are still incomplete.

A GOODS train was recently derailed at Budlapore, on the G. I. P. Railway, owing, it is alleged, to the neglect of the pointsman, and the mail train from Poona was in consequence five hours late in reaching Bombay.

THE Act to amend the Law for the periodical inspection and the management by competent engineers of boilers and prime movers in the Presidency of Bombay has received the sanction of the Government of India.

THE Government of India have approved of the upkeep of a watch and ward establishment to look after the machinery of the Gun-powder Factory at Madras, and for the maintenance of a Proof Factory at St. Thomas' Mount.

MR. MAUGHAN, the Mining Engineer, who has for many years acted as Agent and Manager to the Collieries at Mohpani in the Central Provinces, has been appointed by the Local Administration to the management of the Government mining operations at Warrora and Umaria.

THE Railroads to Paumben and Palghat have been for long under the consideration of the Madras Government. "But I am not in a position to state," Lord Connemara remarked, in reply to an address at Madura the other day, "that funds will be immediately available for their construction."

THE opportunity of the Viceroy's visit is to be fully availed of at Karachi to call his Excellency's attention to the subject of improving the railway communication between Karachi and Upper India. There is great excitement over the Public Works reply to the memorials concerning the Hyderabad-Pachpadra Railway.

WE understand that as soon as Mr. B. Ribbentrop, the Officiating Inspector-General of Forests, returns from leave, as he will do very shortly, he will be confirmed in that appointment, as it is settled that Dr. W. Schlich, who holds the permanent appointment, but who is acting as Professor of Forestry at Cooper's Hill, does not return to this country.

ANENT a paragraph in a recent issue of ours in regard to the reductions in the P. W. D., the Madras Government have now been requested to state why, if no reduction can be made in the Engineering staff, a reduction cannot be effected among the upper subordinate establishment by a larger employment of lower subordinates on small salaries.

MR. FRANCIS B. HANNA took charge of his office as Agent and Manager, Madras Railway Company, on Thursday, on which day Mr. W. R. Robinson, the Chief Engineer of the Company, who had acted up to this time, proceeded on three months' leave, Mr. H. R. P. Carter will act as Chief Engineer, and Mr. H. C. West as Deputy Chief Engineer.

THE Mohpani mines in the Narsinghpur district of the Central Provinces did not recover during the year from the effects of the accident which happened to them in 1885-86, and their out-put during the calendar year 1886 was only 9,157 tons against 20,529 tons in 1885, and 27,111 tons in 1884. The import of coal has kept up in consequence.

THE work of construction of the Bezwada Railway is being pushed on vigorously by the Chief Engineer, Mr. Furnival, and it is expected that a length of about 70 miles, including the section of the main line from Warungal to Dornakal towards Bezwada, as well as the branch to the Singarini Coal Fields will be open for public traffic by the beginning of next year.

IT is doubtful whether Mr. H. F. Blanford, Meteorological Reporter to the Government of India, who is now on furlough in England, will return to his appointment on the expiry of his leave. He proposes to retire, and his successor will, no doubt, be Mr. J. Elliot, of the Bengal Educational Department, and Meteorological Reporter to the Government of Bengal, who is now officiating for Mr. Blanford.

FROM the order of Government dated 10th October, we learn that Government are not prepared to assign, for 1888-89, a larger amount than Rs. 30,000 on account of the Vizagapatam Agency Public Works, pending disposal of the general question of the extension of roads in the Agency tract, which is now under consideration in the Judicial Department. This grant is exclusive of the Maharaja of Vizianagram's contribution of Rs. 4,000.

THE projected boat dock at Bezwada adjacent to the newly constructed line of Railway which passes that town, is not to be commenced at once, but the proposals are to be held over pending the shortly expected visit to this Presidency of the Director General of Railways, and Mr. Molesworth, the Consulting Engineer to the Government of India for State Railways, when the matter, after being discussed on the spot, will be definitely decided in regard to details of construction.

ONE of the number of columns cast at the Public Works Workshops for the new additional buildings to the Civil Engineering College at Madras having been found to crack when being placed in position, instructions have been issued for the convening of a Committee, consisting of Mr. Brassington, the Consulting Architect, Mr. Joyce, Superintendent of P. W. Workshops, and Captain Baddeley, Under-Secretary, P. W. D., to inspect and report upon the remaining columns as also the fractured one.

THE Great Indian Peninsula Railway's fine terminal station at Bombay is fast approaching completion. "The figures of the lion and the tiger which guard the main entrance have been placed in position. A statue of the Queen in Bath stone occupies a commanding position under a cupola in the centre, but has not yet been exposed to public view. It is suggested that the Duke of Connaught should be asked to unveil the effigy of the colossal figure of Progress, which stands on the great dome 180 feet from the ground." The building will be finally completed in about three months.

THE Railway is still eight miles from Jhansi, but it is expected that the engine whistle will be heard there by the middle of this month. Forty miles of rail are laid out from Bhopal and twenty from Manickpur, while directly the rails reach Jhansi from Cawnpore they will be pushed on to the Betwa river to carry down the girders for the bridge. Mr. Bayly is expected early next month to take their erection in hand, as well as those for the other bridge over the Betwa on the Jhansi-Bhopal section. This latter section is expected to be completed by the end of next year. Mr. Glover, the contractor, arrives in December.

THE Allahabad paper complains of the G. I. P. Railway carriages. It is certainly a fact that the G. I. P. line compares unfavorably in this respect with the East Indian Railway. The recent introduction of "Joint Stock" carriages for the through journey between Bombay and Calcutta (now attached to all the mail trains) is a move in the right direction, and doubtless travellers between the North-West and Bombay would be happy to have a similar arrangement made for them. These carriages are built, we believe, by the East Indian Railway Company, and are all that can be desired. In the matter of refreshment-rooms, too, the G. I. P. Railway might take a hint from the E. I. R.

WE (the *C. and M. G.*) have received from the Government of India in the Public Works Department several "*Corrigenda*" to the letter of the 11th October, relating to the Hyderabad-Pachpadra Railway. We have already pointed out the blunders, which the Government now wishes to correct, in its figures. To say "for 175 read 105," "for 245 read 175" and "for 9,80,000 read 4,20,000" is easy enough; but who will build up again the argument that was founded on the erroneous figures? Slips of the pen which alter estimates of interest on outlay by lakhs, and capital by fractions of crores, may indeed be blotted out, with office ink-powder of the cheapest kind; but if the Government of India is really going to demolish the Hyderabad-Pachpadra Railway scheme, it must write a new letter, with a new pen—and, perhaps, a new writer.

SIR ROPER LETHBRIDGE, through the *Times*, offers some reasons for renewed hope among investors in the Indian gold mining companies. The comfort he administers is obtained from an advance copy of the reports of Mr. R. Bruce Foote, Superintendent of the Geological Survey of India, and of Mr. Lavelle and Mr. Marsh, the Mining

Engineers of the Government of Mysore, on "the auriferous tracts of Mysore." The most valuable result attained by the researches of these gentlemen is—according to Sir Roper—that it is now proved on the highest scientific authority that while the attention of the mining public in India has been hitherto concentrated on the rich lodes of the Kolar section of the Mysore gold-fields, there are at least three other districts, of what Mr. Lavelle terms "the more obscure," though not less promising, gold-bearing regions of Mysore which are fairly certain richly to repay the enterprising miner.

The Madras Government has issued a new set of rules regarding quarrying and mining leases in that Presidency, and in doing so announces that the right of the State to minerals is limited to a share of the produce of the minerals worked, commuted into a money payment if thought necessary by the Government, in all lands occupied for agricultural purposes under rayatwarri pottahs, and in jenmam lands in the Malabar district. It is also stated that the Government has no claim to minerals in estates held on sunnuds of Permanent Settlement, in unfranchised inam lands, in religious service tenures, and in lands held on title deeds issued under the Waste Land Rules before the 7th of October 1879, in which no reservation of the right to minerals is made.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE SIND-PISHIN RAILWAY EXPENDITURE SCANDAL

Sir,—I have noticed with surprise, mixed with amusement, a paragraph in your issue of the 1st instant, entitled "Another Civil Engineer Doomed." Of course, I am only a Royal Engineer myself, and not (according to you) fitted to have an opinion on any subject. I, therefore, do not give one on this case, but would refer you to the C. E's. employed on the line you refer to for their opinion of the man you consider so hardly treated. It would not matter to me, but that you seem to infer the Engineer-in-Chief, and through him, the R. E's. generally are at the bottom of the action of Government in awarding the blame to this, as you think, deserving C. E. I have only to say that any C. E. on the line in question will quickly disabuse you of this idea. As you go in for indiscriminate abuse of our corps generally, I am probably wasting my time in noticing *any one of* your misrepresentations; and only do so as you have sent me a copy of your paper; *why*, I do not know, as it contains less abuse than usual of our corps.

I don't think any *gentleman* on the line in question will deny that the man you refer to had more to do with the extravagance which you designate as "terrible," than the Engineer-in-Chief, and the rest of the staff, together.

W. N. B. Whitefoot, *Major, R.E.*,
Late Ex. Eng., S. P. S. Railway.

Mooltan; *October* 28, 1887.

[We deny *in toto* the allegations of our correspondent. His indignation has evidently got the upper hand of his good sense. If he will take the trouble to look through the files of *Indian Engineering* he will find that we have never committed ourselves to the language of which he complains. We say advisedly that there is not a single expression used by us which can be construed into "abuse." We repeat here what we have said dozens of times before; we do not grudge any man his position in office or the emoluments it carries with it, but when an invidious distinction is made between two men performing similar duties, we believe it conduces to the destruction of that *esprit de corps* which is a *sine quâ non* for harmony in the Service. Ed., *I. E.*]

THE BOMBAY P. W. D., AND LORD REAY'S VAGARIES.

Sir,—May I state to you the facts of another extraordinary appointment in the Bombay P. W. D. Colonel C. A. Goodfellow was last week gazetted for privilege leave, the duration of which will, it is pretty well known, be three months, as he is going home to represent the gross injustice done him by the late appointment to the Chief Engineership of a junior man. The question of the appointment of his successor was, owing to Lord Reay's eccentricities, much discussed, and has naturally been the subject of much intrigue. That goes without saying. What he did is almost incredible. Mr. Doig, Executive Engineer, Ahmedabad, (himself not the senior man,) was telegraphed to hold himself in readiness to go to Belgaum to act as Superintending Engineer for Colonel Goodfellow, and Mr. Rebsch, just returned from furlough, was actually sent to Ahmedabad to be ready to relieve Mr. Doig, but his name was not put into orders. You can better imagine than I can describe Mr. Doig's feelings when he found *Mr. Pottinger*, who is six steps junior to him, gazetted last week to act as Superintending Engineer for Colonel Goodfellow. Apart from the injustice done to senior men the wrong done to Mr. Doig was uncalled for, gratuitous, probably unique, and certainly stupid if not worse. It is no wonder that intrigue is considered to be at the bottom of it, and that the close relationship of the lucky man to the Military Secretary is thought to have been the deciding influence in his favor. But the best of it is that the appointment of Mr. Doig even would have been an injustice to several. *Colonel Seton, R.E.*, is the senior for the appointment. He has just returned or is just returning from furlough. *Colonel Twemlow, R.E.*, and *Colonel Cruickshank, R.E.*, are next; they have lately been transferred temporarily to the Government of India for Defence Works, but as their charges are in the Bombay Presidency, there was no obstacle to either of them being appointed, for it is not to be thought that their temporary transfer was meant to interfere with their prospects in their own list. *Mr. Ferguson* comes next and then *Major Haydon, R.E.* Then comes at the head of 2nd grade Executive Engineers *Mr. Doig* and after six more comes the lucky *Mr. Pottinger.*

I take the liberty of sending you this information in the hope that you will again take up the cudgels for us, as you have already several times very ably done. The actions of the Governor are especially to be regretted, inasmuch as he seems to have made a dead set at Royal Engineers and to favor Civil Engineers. All we want is fair play, and such favouritism as he has been and is shewing to us is not only not pleasant as long as it lasts, but is sure to do us injury sooner or later.

Another C. E. and Executive Engineer.

NEW TYPES OF CHEAP ROOFS.

Sir,—I am very much obliged to Mr. W. G. Bligh for his reply as to the use he had made of two different formulæ ad and $\frac{I}{c}$.

Mr. Bligh takes the trouble to explain two methods of obtaining the transverse strength of solid beams or bars of any section, one by actual experiment and the other by calculation.

While explaining the first method Mr. Bligh finds the value of S by the formula $\frac{M_o}{ad}$ and calls it the modulus of rupture, but he does not explain what ad represents. Does it represent the modulus of the section? If it does not, how could the modulus of rupture obtained by that formula be taken as correct. How is it that after finding the modulus of rupture of the 80lbs. rail he did not use that result in finding the strength of the 60lbs. rail? As far as I know "modulus" means a datum of comparison of strength, and if it cannot be used in this case, the formula is at fault.

It appears that Mr. Bligh uses the formula ad simply because the results so calculated are given in books of reference. I, on referring to Rankine's Civil Engineering and Applied Mechanics, find that he obtains the value of f from the formula $M_o = f\frac{I}{y_1}$, and explains that "when the breaking load is in question," the co-efficient f is what is called the "modulus of rupture of the material." Now will Mr. Bligh kindly inform me which formula is correct to use, the formula ad or $\frac{I}{y_1}$ for finding the modulus of rupture? Not only does Professor Rankine give the modulus of rupture calculated by the formula $\frac{I}{y_1}$, but the same result is given in Humber's *Strains in Girders.* Mr. Baker compares in the same way the strength of solid bars and other forms experimented upon by Mr. Fairbairn with others.

We can now find the strength of the 60lbs. rail from the experiment made on the 80lbs. rail, adopting the data given by Mr. Bligh thus:—

$$\text{The moment of rupture} = \frac{WL}{4} = \frac{5 \times 18' \times 12''}{4} = 270 \text{ inch tons.}$$

$$\text{The moment of resistance of the 80lbs. rail} = \frac{I}{y} = \frac{24{\cdot}7}{2{\cdot}626} = 9{\cdot}4$$

$$\therefore \text{the modulus of rupture} = \frac{270}{9{\cdot}4} = 28{\cdot}7 \text{ tons.}$$

To find the strength of the 60lbs. rail we have simply to multiply the moment of resistance of that section by the modulus of rupture. The moment of resistance of the section $= \frac{14{\cdot}4}{2{\cdot}25} = 6{\cdot}4$

$$\therefore \text{the working moment of resistance} = \frac{6{\cdot}4 \times 28{\cdot}7}{4{\cdot}5 \text{ factor of safety}} = 40{\cdot}8 \text{ tons.}$$

In explaining the second method Mr. Bligh tells me that the calculation can only be made by giving the value to f and c. In the case under reference he had the value of f at his command and as to the value of c I do not follow him, since the value of c cannot be given but can be obtained by calculation from the section.

I quite agree with Mr. Bligh as to the value of Lala Ganga Ram's table of the strength of rolled beams.

To shew the correctness of the result given, it appears, that he used different co-efficients in different formulæ of different value.

Dorabjee B. Rabadina.

Bombay; *October* 13, 1887.

ARTESIAN BORINGS.

Sir,—At a recent meeting of the Calcutta Municipality the subject of artesian well borings was broached.

It appears that after a lengthy discussion it was agreed that

Dr. Simpson be asked to make a report. The objections raised during the meeting against the scheme were three, *viz.* :—

1*st.*—Poor chance of striking a rich spring.

2*nd.*—Exhaustion of the water should a spring be met with in the sand beds.

3*rd.*—Enormous cost.

These objections, I believe, were put forward by the Engineer to the Corporation.

I hope, Sir, that a few words on the subject from one who has had some experience with borings in the Calcutta district will not be out of place. To begin with, I shall deal with the objections one by one.

1st.—*Poor chance of striking a rich spring.*

It was stated at the meeting that Bengal was not rich in springs. This, if true, is really news, and important, especially to one who is interested in the matter ; but I am afraid, Mr. Editor, that this is only a supposition, as I am not aware of any deep borings having been put down to prove the section of the alluvium. Now, this being the case, it is rather bold to hazard an opinion on the matter, as theoretical suppositions in regard to borings in an unknown section are useless, and it is only practical results which can give any idea. Even in a known section it is very difficult to give a decided opinion, as there are many causes such as faults, &c., which may interfere with the sheets of water from the porous beds.

At present, I think, the deepest boring in the neighbourhood is the one in course of progress at Canning, which is only down 260 feet, though this depth is not great compared to the thickness of the alluvium bed, still the section passed through has gone to shew that the alluvium below is rich with water. What may be met with lower down time will shew.

I myself am sanguine that far from Bengal being poor in its water-bearing strata, there are large sheets to be met with below, and the belief has been strengthened by what has come under my notice.

In the Mutla river, a few miles from Canning, at low tide there are fresh water springs to be met with on the *churs* or sandbanks, and it is from these natural sources that the native fishermen replenish their stock from time to time. This goes to prove that the pressure of water from below has found vent through fissures and backs till at last it has forced itself to the surface.

2ndly.—*Exhaustion of the springs in the sand beds.*

This is another haphazard opinion to tender. To give a positive opinion on this point is impossible, for to do so the following information must be known :—

Thickness of the sand bed.

Number of gallons of water per cubic yard of sand.

Area of the bed.

Source from which the bed is supplied and the number of gallons per day received.

I don't suppose many of your readers are aware that in the alluvium near Calcutta, between the surface and to 260 feet below, there is over 160 feet of very watery running sand. Now, Sir, with such a thick aqueous bed, the area of which may extend for miles, is it not absurd to think that the amount of water that would be required from it for the daily consumption of the Metropolis would get exhausted ?

The fresh water springs in the Mutla river must have been flowing for years, and I am sure their aggregated amount of water is far more than what is at present consumed in Calcutta daily, and still these springs do not seem to get exhausted. With these facts before me, I do not think I am out of place when I say that the opinion given on this subject at the meeting has been not only absurd but hasty.

3rd.—*Enormous cost of Borings.*

The cost of borings is variable, as it depends upon the size, depth, and the stuff you have to bore through. The cost of boring in the alluvium near Calcutta would not be much.

It certainly is not advisable to go in for a very elaborate boring in the first instance, as the geological section is unknown.

The best thing would be to put down a trial well, say 6" reduced to 4," and go to a depth of 600 feet, that is to say, if no spring is met with within that depth. If this proves a success it will give some data for future operations on a larger scale ; and even should the trial boring be a failure, still it will not have been money badly laid out, as the information gained will be of the utmost importance.

FRANK J. AGABEG,
Superintending Engineer,
Port Canning Boring Operations.

Literary Notices.

THE INSTITUTION OF CIVIL ENGINEERS.

THE ninetieth volume of the Proceedings of the Institution of Civil Engineers has just been issued, and in its 600 pages forms, like its predecessors, the valuable chronicle of the Institution in the papers read and discussed. In the 13 selected papers following these, much information is given on various subjects of interest to Railway and Hydraulic Engineers, and a paper on the detection of leaks in water mains will be found valuable to the Waterworks Engineer. Over a hundred pages are dedicated to abstracts of papers in foreign transactions and periodicals, and these offer the usual high-class selection of instructive matter.

GEOLOGICAL SURVEY OF INDIA.

VOLUME XX., Part 3, of the "Records"—for August 1887—opens with a notice of the long and valuable services of the late Director of the "Survey" —Mr. Medlicott—on the lines of the article that appeared in this Journal on that gentleman's retirement from the service of the Government of India.

The notice of Mushketoff's Geology of Russian Turkestan is intended to supplement Mr. Griesbach's researches made with the Afghan Boundary Commission.

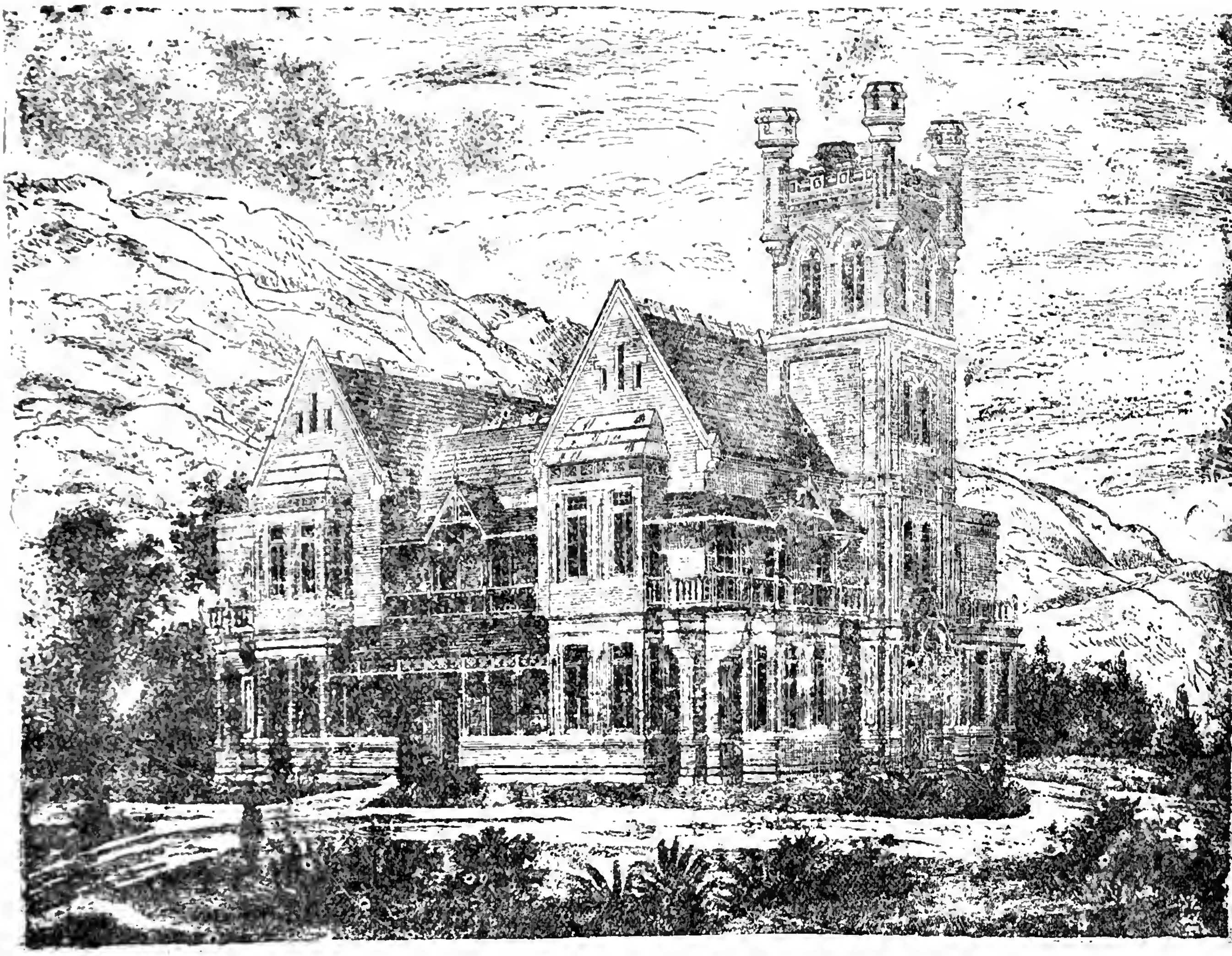
Mr. Middlemiss contributes some descriptive notes on the arrangement, structure, lie and associations of the gneissise and other crystalline rocks of the N.-W. Himalaya.

Mr. Oldham adds something more to our knowledge of the geological structure of the Simla Hill Station in a "Preliminary Sketch," the concluding paragraphs of which inform us that the economic geology of the Simla Hill is very limited : building stone is naturally in abundance and of a quality good enough for rubble masonry ; where dressed stone is required the limestone of Prospect Hill or Jutogh is used. A certain amount of pottery clay is found on the slopes, some of the spurs running north from Simla : it appears to be confined to the neighbourhood of the carbonaceous slates and to be largely composed of the insoluble residue of the limestones associated with them. A large deposit existed on the north slope of Jutogh, but has been almost entirely removed to make bricks and tiles for the new offices in Simla. Another large deposit appears to exist on the Summer Hill spur beyond where the road rounds its northern end, but at present it is only dug to make a few *gurras*, flower pots, &c. Another place where clay is found and worked is on the eastern slopes of the spur east of Annandale. Here there are several potters' houses dotted along the hillside. The water-supply of Simla has for many years been a source of difficulty, and water is now brought in by pipes from the Mahasu ridge.

ON ROLLER FLOUR MILLING. *By Henry Simon, C.E.*

WE have to acknowledge receipt of a handsomely got up publication issued from 20, Mount Street, Manchester, which we hardly know how to designate fitly. It contains an elaborate treatise on roller flour milling by Mr. Henry Simon, C.E., and, moreover, a descriptive illustrated catalogue shewing various sizes of roller mills designed by him, and the manner of their working at a great number of manufactories in Great Britain, ranging from Keith in the North of Scotland to Hayle in Cornwall, and from Londonderry in the North of Ireland to Clonakilty in the South. All over the United Kingdom Mr. Simon's invention seems to have met with remarkable appreciation and success. He says, in the publication before us, that his system of roller milling owes its origin to, and is in its main principle—"Gradual Reduction"—akin to the parent of all roller milling systems, *viz.*, the Hungarian high grinding with rollers ; but in matters of practical application it diverges at once, being from the first carried out on the lines of profitable adaptation of this principle to the peculiar circumstances and requirements of the English market, rather than on those of more or less servile imitation of Hungarian practice, which had rendered useless previous attempts at introducing high grinding into England. It may with confidence be claimed for this system that it was *the first* to prove, in a practical and unmistakable manner, that the gradual reduction of wheat into semolina and middlings by *sharp fluted rolls*, and of this semolina and middlings into flour by *smooth rolls*, entirely without the aid of stones, and upon a much simpler and less expensive plan than the Hungarian, was what was required to grind successfully such wheats as could be had, and produce profitably such flour as can be sold upon British markets. That such a system should be *automatic* in its working was a simple matter of course ; it was precisely the slow, expensive, non-automatic and complicated Continental system which the author avoided, and replaced by a profitable, automatic, commonsense system, suited to the requirements and resources of the British miller.

General Articles.



THE JAGHIRDAR OF ARNEE'S SHOOTING BOX.

We illustrate, above, a house erected by Mr. W. N. Pogson, F.S.A. Architect, Madras, for the Jaghirdar of Arnee. The picture, is from a photo-type of the original drawing, and considering that this is the first attempt of its kind by private enterprise and indigenous talent in India, the result must be considered highly satisfactory. The building was designed as a country "shooting box" for the Jaghirdar of Arnee and the style is English Gothic with such alterations, &c., as were necessary to suit the climate of this country. A principal feature in its construction is the use for the first time in India of Messrs. Homan and Rodgers patent flat brick and iron joist floors. The front is in red pointed brickwork relieved by Sholinghur stone dressings. The internal fittings comprise all the latest improvements, such as hot and cold water service and shower baths, electric bells, draw-up venetian blinds, &c., &c. The original drawing was highly commended in the Madras Fine Arts Exhibition. The total cost of erection is Rs. 24,000 and has been carried out under Mr. Pogson's superintendence.

BANGALORE WATERWORKS.

The following are brief descriptions of the schemes which have already been before the Government and will doubtless prove of interest in connection with the Official Advertisement now appearing in this Journal. Intending competitors would do well to obtain Colonel Mullins' Report, issued as an Appendix to the Madras G. O., dated the 13th June 1884, No 1473W.* It is necessary to observe that some of the subjoined schemes are the outcome of Colonel Mullins' suggestion for the deputation of a qualified officer to work out the details of the projects recommended in his Report. Captain Romilly was the officer specially selected for this purpose, and who it would now appear has done but little towards disposing conclusively of the various matters referred to him for investigation.

I. General Sankey's Scheme.

(1) The construction of a reservoir on the third mile of the Bellary or Tumkur road at a level giving what was deemed to be a sufficient command of the whole station to secure water distribution by gravitation. (2) The supply of this reservoir by the formation of channels to intercept the drainage of approximately the whole area of ground available on a level higher than that of the tank itself. (3) The distribution of the water to the several parts of the station by means of conduits, pipes, &c. The scheme was designed to effect a radical improvement of the water-supply of the whole military and civil population of Bangalore, excepting the Pettah, which had a fairly good supply.

II. General Mullins' Scheme.

(Elaborated by Captain Romilly.)

The source of supply to be the Agaram tank. The water from it to be collected in settling beds and conducted thence by earthen pipes to a well in a pumping station situated below the tank weir at its north-west extremity. From this well the water to be pumped on to filter beds, whence it would gravitate into a clear water basin. From this basin the water to be pumped up over a stand-pipe through cast-iron mains up to the existing cisterns at the various barracks, whence it would be drawn as required by the present distributing pipes and stand-cocks.

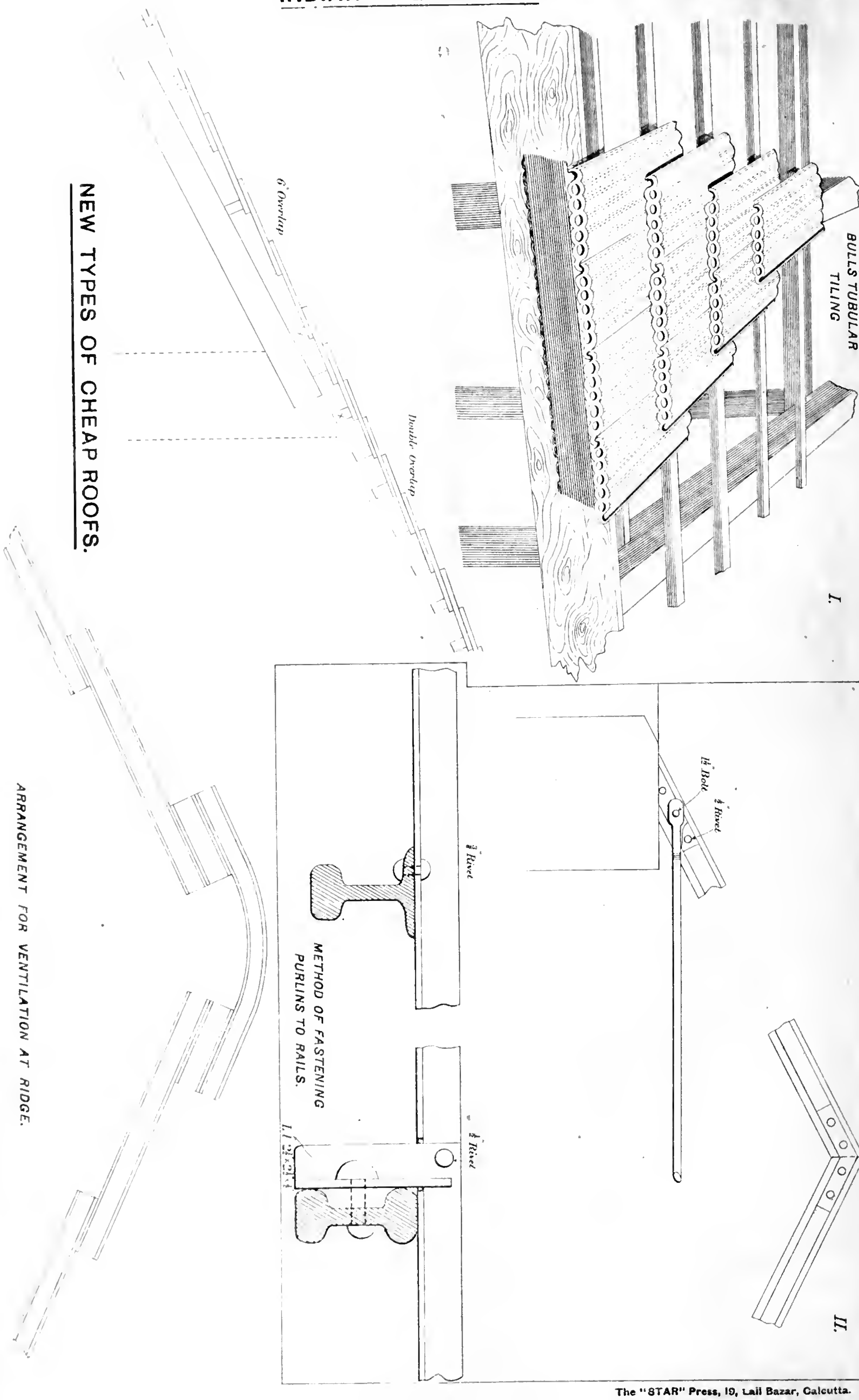
Alternative Projects by Captain Romilly, III. *Project B.*

The source of supply to be the Halsur tank and Dhobies' wells as at present. Condensing apparatus and cisterns for evaporating a supply of pure drinking water to be located at the rock, the condensers drawing their supply from the tank. New mains to be laid from the drinking water cisterns at the rock to the barracks, communicating with stand-cocks, whence drinking water only would be drawn. Arrangements to be made for direct pumping to the barracks from the Dhobies' wells station.

IV. *Project C.*

The source of supply to be the Halsur tank and the Dhobies' wells as at present,—to be improved by the complete diversion from the tank of the western feeder which brings the drainage of the cantonment bazaar into the tank. The construction of a new feeder to bring in the drainage from about 2½ square miles new catchment to the east of the tank. An increase to the capacity of

*Copies of the Report are available for perusal at our Office.—Ed., *I.E.*


NEW TYPES OF CHEAP ROOFS.
BULL'S TUBULAR TILING
I.
6" Overlap
Double Overlap
1½" Bolt
¾" Rivet
¾" Rivet
METHOD OF FASTENING PURLINS TO RAILS.
¾" Rivet
II.
ARRANGEMENT FOR VENTILATION AT RIDGE.

the tank by raising the present water level. The provision of the new engines, the construction of additional wells, &c.

V. Colonel Vibart's Scheme.

The source of supply to be the Arkavutty river. The water to be stored at a point some 15 miles from Bangalore, not far from Savandroog, and, if necessary, to be pumped up to Bangalore.

VI. Suggestion by the Government of India.

Flooring with concrete a space on the high ground commanding the station, of such an extent that the ordinary rainfall thereon would give a sufficient supply of drinking water for the troops. The discharge to be collected in reservoirs and thence distributed by pipes.

NEW TYPES OF CHEAP ROOFS.

By W. G. Bligh, Executive Engineer, P. W. D.

VI.

Tiled Roofs with Iron Framing.

We will now proceed to give some examples regarding the use of scrap rails in tiled roofs. As has already been observed, the "Allahabad Tiling" of ridge and valley, has long held its own as the best and sole reliable system. It may now be said to be entirely superseded by other systems, which are lighter, have fewer parts and are equal, if not superior, in heat-resisting properties. Of these, the two foremost are Frizzoni's lock, and Bull's patent tubular tiling. In Frizzoni's tiling the flat tiles interlock in an ingenious manner, thus enabling the ridge to be entirely dispensed with. For double tiling the arrangement is similar to the "Allahabad" system; half hexagon-shaped tiles being interposed between an upper and lower layer of flat ones so as to afford an air space. This tiling is much lighter and cheaper than the old system and is very superior in appearance. It has been thoroughly tested for some years and must be pronounced a great success. Not being protected by a patent it can be made anywhere. It was first introduced by Messrs. Frizzoni and Co., Contractors of Allahabad and Lucknow, and is an improved modification on the Mangalore tile, now so extensively used in Bombay. In all these systems the tiles are carried on wooden battens, or iron bar purlins, on which they hang by projecting lugs. The 12 inch spacing of the Allahabad tiles is too close for economical reasons. Frizzoni's have this further advantage, that the spacing is 14½ inches. Great care has to be exercised in accurate spacing of the purlins, otherwise the lock tile will not fit properly.

A further advance in efficiency in this direction has been introduced by Bull's patent tubular tiles, a new system which has been brought forward quite lately. As we have already noticed, these tiles are now manufactured to a length of 2 feet 6 inches, will probably be made eventually 3 feet. Thus for single tiling with 6 inches overlap the spacing can be 2 feet, and with double overlap 1 foot 3 inches. A section of the tubular tiling has already been given in the Plate of Article V., October 22.

The pieces are all similar and are easily fitted. The side lips interlock; the upper layer breaking joint. They are fastened to the battens by stout wire nails, passed through a small hole in centre near top edge, either driven into the wood, or in the case of iron, projecting down behind the purlin. Messrs. Schanff and Co., Allahabad, who are the agents of the patentee, issue a printed pamphlet on the subject, which, however, gives very meagre information, and in one case is misleading The 3 inches overlap for single tiling is now admitted to be inefficient to prevent leakage. Owing to the external corrugations, there is a considerable air space between the layers at the overlap; nothing less than 6 inches will do. The so-called double overlap, which practically amounts to double tiling, is also in a way of being superseded by lipless tiles, which are laid together exactly like slates and have a treble overlap. The statistics regarding weight of tiling are not comprehensive and my application to Schauff and Co. for further definite information on the subject received no attention whatever; consequently it is impossible to say exactly what the weight and cost of the lipless or the 6 inches overlap single tiling would be. In the pamphlet the length of ordinary tiles is taken as 16 inches only, and of lighter section. With tiles of this short length one of the main advantages of the tubular system, *viz.* increased length disappears.

The comparative cost of single tiling is given below.

Description.	Weight per 100 s. ft.	Cost per 100 s. ft.	Distance apart of purlins.
	lbs.	Rs. As. P.	
Allahabad ...	1,387	7 0 0	12″
Frizzoni ...	900	4 12 4	14½″
Tubular ...	1,100	4 4 0	24″ to 15″ approximately.

The weight of tubular tiling, 3 inches overlap (small tiles) is given as 900lbs., the cost as Rs. 3-9-5. My figures for 6 inches overlap are merely rough deductions.

From this we see that the single tubular tiling is distinctly superior in every way to Frizzoni's; it is further claimed that the single tiling is as cool a covering as the ordinary double—a matter which is open to doubt.

Double tiling.

Description.	Weight Per 100 s. ft.	Cost Per 100 s. ft.	Distance apart of purlins.	
	lbs.	Rs. As. P.		
Allahabad ...	3,200	17 8 0	12″	
Frizzoni ...	2,200	13 0 0	14½″	
Tubular double overlap	1,500	6 0 0	15″	Approximate.
Do. lipless laid as slates	2,000	8 0 0	10″ or 9″	This is quite approximate.

In the pamphlet issued, the weight and cost of double overlap tiling is put down as 1,406lbs., cost Rs. 5-10-0. I have increased both, as the 2 feet 6 inches tiles are of heavier section and naturally dearer. In this also, the tubular carry off the palm. They are open, however, to the following serious disadvantages:—1*st*. In being very inferior to Frizzoni's as regards dust and wind proofness, and 2*ndly* as regards appearance. In fact, the patentee recommends a strip of roofing felt being laid between the layers to keep out the dust, or that mortar should be used. Something of the kind is certainly required. Experience will no doubt suggest further improvements to this system, which seems likely to beat all competition in affording a cheap, light and watertight roofing. As it is at present, I should certainly prefer to use Frizzoni's double tiling in spite of its increased cost, and the tubular for single tiling. The Figures in I. of annexed Plate give some illustrations of Bull's tubular tiling.

Bull's tiles are now obtainable at Messrs. Schauff and Co.'s brick yards at Allahabad, and their manufacture will probably soon be taken up at other places. I believe Frizzoni and Co., Allahabad and Lucknow, intend manufacturing them as well.

Since the above was written, Mr. Schauff has informed me, that the Section of tubular tiles has been further improved, the external corrugations being dispensed with. If so, this will entirely obviate the objection regarding wind and dust. New dies for moulding have been sent from England.

Wood, being a perishable material should be excluded from tile, as well as from flat roofs, the iron roof with scrap rail rafters and T or ⊔ purlins being also cheaper.

Our section of rafter being fixed, or rather restricted to two varieties, we must first calculate the value of b or distance between the sloping rafters, for single and double tiling and for different values of L for both descriptions of scrap rails.

First.—Double tiling.

	lbs. per s. ft.
Weight of tiling taken as 2,200lbs. =	22
Purlins (say)	4
Total	lbs. 26 vertical, per s. foot

This resolved at right angles to rafter

$$= 26 \times \cos 26^\circ = 23{\cdot}4\text{lbs.}$$

say 24lbs.

Horizontal force of wind 40lbs. per s. ft. resolved normal to rafter $= 40 \times {\cdot}55$—*vide* Molesworth's Pocket Book $=$ 22lbs.

$\therefore$ w or load per s. ft. $= 24 + 22 = 46$lbs.

The following table is worked out from formulæ 2 and 4.

viz.,

$$b = \frac{\frac{89600}{L^2} - 24}{46} \quad \text{E. I. rails.}$$

$$b = \frac{\frac{60943}{L^2} - 18}{46} \quad \text{O. \& R. rails.}$$

With this difference that the weight of rails per foot run resolved normally become, 24 and 18lbs. respectively.

Table No. 1.

Horizontal Span.	Length of Rafter.	Value of b. E. I.	Value of b. O. R.	NOTE. Where the value of b becomes impracticably large or small the column has been left blank.
14½	8			
18	10		8′ 9′	
21½	12	9′ 2″	6′ 4″	
25	14	7′ 0″	4′ 9″	
29	16	5′ 4″	3′ 9″	
32½	18	4′ 4″	3′ 0″	
36	20	3′ 6″		
40	22			

We will now determine the section of the purlins (which are 15 inches apart.) TI is a stronger form than LI and should be preferred to it. The required section can be extracted from the Table No. 2 given below. The values of K are taken from Molesworth's Pocket Book.

Table No. 2.

Serial No.	Dimensions of TI purlins.	Corresponding value of K $= wL^2$ (for TI.)	Weight of 1 lineal foot of purlin.	K for L I.
1	$3 \times 4 \times \frac{1}{2}$ ...	11,282	10·83	
2	$3\frac{1}{2} \times 3\frac{1}{2} \times \frac{1}{2}$ ...	8,890	10 83	
3	$3\frac{1}{2} \times 3\frac{1}{2} \times \frac{3}{8}$ ...	6,882	8·28	
4	$3 \times 3 \times \frac{1}{2}$ ...	6,250	9·17	
5	$3 \times 3 \times \frac{3}{8}$ ...	4,976	7·03	
6	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ ...	4,326	7·50	
7	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8}$ ...	3,381	5·78	
8	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{5}{16}$ ...	2,281	4·88	
9	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$ ...	2,356	3·96	
10	$2 \times 2 \times \frac{1}{2}$ ...	2,667	5·83	
11	$2 \times 2 \times \frac{3}{8}$ ...	2,098	4·53	
12	$2 \times 2 \times \frac{5}{16}$ ...	1,794	3·84	
13	$2 \times 2 \times \frac{1}{4}$ ...	1,474	3·13	
14	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{8}$ ...	1,126	3·28	844
15	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{5}{16}$ ...	967	2·80	725
16	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ ...	800	2·29	600
17	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{16}$ ...	622	1·76	466

The value of w is 46lbs. $\times 1\frac{1}{4} = 58$lbs. nearly, whence multiplying 58 by L^2 we obtain the value of K; and the section required, will be the one opposite the approximately corresponding value in the table. Thus if $L = 5'$ then $K = 25 \times 58 = 1450$, and No. 13 ($2 \times 2 \times \frac{1}{4}$ TI) is what is required. For the very low values LI suits best and a few values of K for LI have been inserted in the table.

The table below (No. 3) shews at a glance the section of TI purlin required with the loading of 58lbs. per foot run for different spans.

The numbers are those in column 1, Table 1, opposite which the required section is given.

Table No. 3.

Span of purlin.	No. of Section.	Span of purlin	No. of Section.
3	16 LI block.	7	7 π
3½	16 TI do.	7½	7 ,,
4	15 ,,	8	7 ,,
4½	13 ,,	8½	6 ,,
5	13 ,,	9	5 ,,
5½	12 ,,	9½	5 ,,
6	11 ,,	10	4 ,,
6½	9 ,,		

The question now to be solved, is whether a closer spacing of rails, than given in Table 1 would not be more economical. The following has been worked out to shew comparative cost—100 feet length of roof being taken 10 feet wide.

Table No. 4.

Spacing.		Cost.	REMARKS.
	No.	Rs.	(Example) take 3′ spacing here $\frac{100}{3} = 33$ rails $\times$
3′	33 rails + 800′ purlins 16	370	$10 = 330$ ft.
4′	25 ,, ,, ,, 15	356	Purlins $\frac{10}{1{\cdot}5} = 8 \times 100 \times$
5′	20 ,, ,, ,, 13	348	$\frac{2{\cdot}3}{112} = 16{\cdot}4$ cwt. Rs.
6′	17 ,, ,, ,, 11	429	330 ft. run rails @ /10 = 206
7′	15 ,, ,, ,, 7	508	16·4 cwt. purlins @ /10 = 164
8′	13 ,, ,, ,, 7	495	
9′	11 ,, ,, ,, 5	572	
10′	10 ,, ,, ,, 4	723	Total Cost Rs. .. 370

The rails have been taken @ As. 10 per foot run, the T I @ As. 10 per cwt. From this we see at once, that the economical spacing is from 3½ to 5½ feet.

With the help of all these tables we can now finally decide upon the most appropriate spacing and sections of rafters and purlins.

For a loading of 58lbs. per s. ft. on purlin.

Table No. 5.

For E. I. Rails. Horizontal Span of roof.	Length of Rafter.	Spacing of Rafters.	Section of Purlin.	Diameter of Tie Rod.	For O. & R. Rails. Horizontal Span of Roof.	Length of Rafter.	Spacing of Rafters.	Section of Purlin.
14½	8	5′	TI $2 \times 2 \times \frac{1}{4}$	¾″	14½	8	5′	II $2 \times 2 \times \frac{1}{4}$
18	10	5′	,,	¾″	18	10	5′	,,
21½	12	5′	,,	⅞″	21½	12	5′	,,
25	14	5′	,,	⅞″	25	14	5′	,,
29	16	5′	,,	1″	29	16	4′9″	,,
32½	18	5′	,,	1″	32½	18	3′9″	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$
36	20	4½′	,,	1″	36	20	3′0″	II $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$
40	22	3½′	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$	1″	above	this the	rafters	require trussing.

Distance apart of purlins 15 inches.

Double tiling weighing 22lbs. per s. ft.

Let W be vertical load on each rafter and W_1 normal wind pressure.

The stress on tie rods $= W \cot \theta + W_1 \sec \theta = S$ lbs.

and sectional area $= \frac{S}{9000}$ inches.

We will now consider Bull's tubular single tiling. In this system the purlins are 2 feet apart, the normal distributed load on rafter is 36lbs, on purlin 72lbs. per ft. run.

By calculations similar to those already made for double tiling, we find that the most economical spacing is from 3 to 5 feet. The latter is the most convenient, as affording fewer joints. With this span, and loading No. 12, Table 2, is the most suitable section T I $2 \times 2 \times \frac{5}{16}$.

With E. I. rafters this spacing and section of purlin will answer for all spans from 15′ to 40′.

With O. and R. rails they will answer for all spans except the last two. The 36 feet span should have the rafters 3 feet apart and purlins I $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ and the 40 feet span 4 feet apart and purlins $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{8}$.

Sketches of methods of fastening the purlins to rafters and the tie rod, &c., are shewn in the Figures of II. in the annexed Plate. Where a joint in the LI occurs, it should fall in the centre of the rail, and two rivets will be required, one in each flange of the flat-bottomed rails, while with the double-headed rails one more L I will be needed, on the other side to connect the further purlin. The connections to the O. & R. rails are very much simpler and less expensive, than with the other section of rail, and they should be adopted in preference whenever practicable.

Compared with wooden trusses the iron untrussed roofs are much cheaper.

The following is approximately correct for double tiling.

Span.	Rail roof per ft. run.		Wooden roof per ft. run.	
	Rs.	As.	Rs.	As.
15	8	1	10	15
20	11	0	15	14
25	13	12	21	3
30	15	8	26	7
35	18	0	31	4

This style of roof has the great merit of simplicity; any ordinary *lohar mistri* would be able to put the iron work together. Rivets are cheaper, and easier to use, than bolts.

For spans above 20′ the rail tiled roof is cheaper than any of the flat roofs, but a tiled roof is always open to the objection of admitting hot air and dust. In the double storied barracks the upper rooms are quite uninhabitable during the hot months.

I am very strongly of opinion that for dwelling houses the flat roof with good arrangements for ventilation is the proper thing for this country. In Plate with Article V., giving section of the Mirzapore Victoria Hospital main building design the verandah pillars are formed of octagonal cut stone columns. These form an excellent substitute for heavy masonry pillars and are very ornamental. They should not be more than 7 or 8 feet long and are connected at top by rail bressummers, in pairs, breaking joint. These are covered by a thin slab, and over this the face wall is built to the required height of verandah roof. The best bressummers are the flat-bottomed rails, laid on their bases, and breaking joint over the columns. They do not require any fastening to the stone capitals. In these columns the shaft is monolithic, tenoned into the base and capital. They cost about Rs. 10 each, of course exclusive of carriage, while their masonry pillars would come to Rs. 5-8 each. They can be spaced at 12½ feet centres, so as to utilize one whole 25′ rail in 2 spans. In tiled roofs, rail posts can be used, the E. I. rails being the best section.

The following table has been worked out from Gordon's formula, giving safe loads on single rail posts of varying lengths; double posts bolted together should be used at a joint in the rail bressummer.

Table shewing safe load on rail posts.

Length of post.	Safe Load. Tons.	
	E. I.	O. R.
ft.		
6	24·7	18·1
7	22·2	16·3
8	20·0	14·9
9	18·0	13·3
10	16·3	12·0
11	14·7	10·8
12	13·2	9·7
13	11·9	9·0
14	10·8	8·0
15	9·7	7·1
	8·8	6·4

(Finis.)

TRAVELLERS who have come from Bokhara and the Khanates under Russia report that between forty and fifty thousand labourers are employed on the railway works between the Oxus and Samarkhand, and that the works are being pushed forward with the greatest energy. The number of labourers given may, says a contemporary, appear large, but it must be remembered that, when the railway was being extended from Kizil Arva to Dushakh, Merv, and Charjui three to four battalions of the Railway troops were employed on this duty, as well as twenty-five thousand coolies, in a quarter where workmen were not and could not be procured in such numbers as in the state of Bokhara. Russia is preparing very quietly and steadily for the next opening of the Eastern as well as the Afghan question.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XIII.

Brick in lime 1st class. Work intended to be pointed.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Bricklayers No. ...	2¼	Variable.	Do.	Do.
Do. " ...	3½			
Coolies " ...	3½			
Do. " ...	1½			
Do. " ...	3½			
Bhistie " ...	1½			
Grinding mortar, c. ft.	25			
Sundries	...			
Materials.—				
Bricks 1st class 9″ × 4½″ × 2¾″ including Waste No. ...	1,350			
Lime slaked dry, c. ft...	12			
Sand " ...	12			
Surkhi " ...	12			
Sundries	...			
Scaffolding ...	...			
Petty Establishment ...	...			

Specification.—The bricks to be selected first-class of good shape and color, and to be carefully laid in work in English bond. No joint to exceed ¼ inch.

X.

COCANADA WATER-SUPPLY.

WATER is supplied in this town by means of tanks and masonry pipes. There are eight fresh-water tanks specially reserved for the purpose—four in Cocanada and four in Jagannayakapur. Into these tanks the Godavari water from Cocanada and Samalcottah canals is taken by means of open supply-channels liable to contamination. Water is supplied from these tanks to the different parts of the town by means of masonry pipes running at a depth of 3 to 5 feet beneath the ground. The following are the two chief defects in the existing system:—During the summer season, canals are always closed for a period varying from 4 to 6 weeks for the execution of repairs, and notwithstanding every care taken to preserve as much water as can be contained in the several tanks, it cannot be denied that the quantity of water so preserved is hardly sufficient for the requirements of the people. Though there is no complaint on the score of insufficiency of supply during the other parts of the year, the quality of water supplied by pipes and cisterns is not considered as good as it ought to be. The water, having to flow through masonry pipes at a depth of 3 to 5 feet, gets deteriorated in its quality by becoming brackish, especially in the rainy season, owing to percolation of water from the salt springs beneath the ground. It would thus be seen that the people suffer during a great part of the year from the bad quality of the water, and during the summer season from scanty supply. In order to remove these evils, it is considered desirable that the water, instead of being taken from the lock at Cocanada should be taken from above the lock at Venkatakristnarayapuram at a distance of 4 miles from Cocanada, inasmuch as the water level at Venkatakristnarayapuram lock is 10 feet higher than at the Cocanada lock. That a reservoir tank sufficient to hold 60 days' supply of water be constructed at Venkatakristnarayapuram, being on a higher level. That a filter-bed be constructed above the largest tank in Cocanada, connecting the same with the said reservoir by means of a covered drain of 2 feet in diameter. And that the water thus filtered and purified be supplied to the different parts of both Cocanada and Jagannayakapur by means of cast-iron or glazed stoneware pipes. A scheme like the one sketched above is at present engaging the attention of the Council, and the cost of which is roughly estimated at a lakh of rupees.

ADDIS' IMPROVED TRAMWAY.

Combining Sleeper, Key, and Fish Plate, with Wedge Shaped Longitudinal Rail, Shod with Iron.

THE sleepers A,A,A, are 6'×9"×6" or of any other length or dimensions suited for the required gauge, always allowing 18 inches on either side of the rail where the sleeper is cut at right angles to half or more or less of its thickness, for the contrivance of a conjointed key and fish plate.

2. The key and fish plate blocks, B, B, B, B, B, B, are so constructed that on the removal of the pins C, C, C, C, C, C, they can be worked either to the right or left in order to facilitate the removal of the rail for repairs or renewals, &c., &c.

3. The sleepers are buried to the full depth below the surface of the natural soil so as to allow of a free passage for the cattle employed for draught.

4. The longitudinal rail is of wood, of any procurable length 4 inches square, to be cut diagonally forming two trapezoidal sections, so that there will be no waste of wood, and easily packed for transit:—thus forming a wedge shaped rail which, when fixed into position on the sleeper, and the key turned on, will secure a firm grip, and, where the rail joins, the same grip constitutes a fish plate. The pins here secure its position, or if further security be found necessary a coach screw can be introduced. The sleepers are placed 4 feet apart.

5. Ordinary tire iron either of a flat or half round section—(the latter is preferable), procurable in any bazaar, is fixed on the longitudinal rail, screwed or nailed down, the heads being countersunk, taking care to break joint over the wooden longitudinal rail and allowing for expansion of the iron.

6. The great advantage of this simple and inexpensive system of Tramway is, that large quantities of timber of every description are procurable throughout Burma, and any ordinary village carpenter or smith, could undertake the construction or repairs of the line. 20 coolies can lay down, and link in one mile of roadway in one day, over dry paddy lands, and fields, or level waste ground, and an ordinary pair of bullocks can draw a load exceeding that which 4 pairs would draw upon an ordinary metalled road.

7. The waggons can be constructed to suit the traffic, price averaging from one hundred to one hundred and fifty rupees each, and built to suit the bulk of traffic.

8. For a 3 feet gauge, including rolling stock, the cost of this system of Tramway, laid down ready for traffic, will not exceed rupees ten thousand per mile.

W. J. ADDIS, C.E.

BASSEIN; *August* 1, 1887.

NOTES FROM HOME.

(From our own Correspondent.)

THE *Builder* thinks that the main onus of the Exeter Theatre fire rests on the architect, Mr. Phipps, who, as a theatre building specialist, ought to have been the person to be most urgent in insisting on every possible structural precaution being taken, whereas he appears to have adopted the opposite part of making light of the requirements, and even promising things which he never took care to see performed, thus casting a discredit upon the architectural profession, which many illogical people will be eager to make the most of.

The accidents from fire in theatres, capped by the Exeter calamity, has sharpened up invention in cases of theatres now in course of construction. Sir George Chubb, the eminent locksmith, announces that his firm can now make doors which, while they can be locked so as to be secure from the outside, will give way at once on a push from the inside. This new device is, it appears, going to be adopted in the new theatre in the Strand. Experts have pronounced it a good and efficient means of accomplishing what is desired. The push must be made on a special portion of the door, but by selecting the central lock rail as the operating portion and projecting it a little, no one can lean against the door without it opening as intended.

The Wenham lamps were employed in lighting up the Covent Garden Theatre on the occasion of the Promenade Concert. The audience present on the opening night were loud of their praise of the new light. It appears that at Adelaide (Australia) the Fire Insurance Companies are reducing their rate where the Wenham is in use. The lamp is adopted at the Casino at Dieppe, and the Committee appointed by the Municipality of Paris pronounced the Wenham the least dangerous of all gas-lighting apparatus, and has recommended it to managers of Paris theatres.

The two inquests on the bodies of the victims of the Hexthorpe Railway accident have resulted in verdicts of manslaughter against the driver and fireman, for neglecting the instructions that were given them and so causing the terrible loss of life which followed. The Manchester, Sheffield and Lincoln Railway having a length only of 287 miles has had the misfortune of having had in little more than three years, two of the most disastrous calamities recorded on any railway in the kingdom. The evidence that has so far been adduced has certain very important bearings upon the question of the brake in use on this line—the train in this case being fitted with the non-automatic brake. It appears that at the first shock of the collision the main pipe broke, and so disabled the brake, and the second shock, which seems to have caused the actual destruction, would have been averted if the brake had been automatic. Former accidents have brought reports from the Board of Trade pointing the superiority of the automatic over the non-automatic brake, for in those cases the vacuum pipes being broken in collision the brakes became inoperative, and the progress of the trains ceased to be arrested. Major Marindin is to report on the Hexthorpe accident and his report is looked forward to with great interest by all those who are connected with the management or economy of railway affairs.

The last number of the *Railway Engineer* contains the first part of the Report of the Director-General of Railways in India which contains information of an interesting and important nature on the subject. The Report is to be continued in the next issue. This is followed by a paper on "Cable Traction," a review of the volume on the subject by J. Bucknall Smith, and as this power is coming to the front now in many places. the work under review has welcome information. The Elevated Railway of New York is described and the usual official Reports on Railway accidents complete the paper.

The Society of Engineers give notice that the first meeting of the session will be shortly held, when a paper on the "Stability of Factory Chimnies" will be read and discussed.

The Mechanical Engineers lately met to resume the discussion on Major English's paper on "Experiments on the Distribution of Heat in a Stationary Steam Engine," and discuss a paper on "Irrigating Machinery on the Pacific Coast by Mr. John Richards of San Francisco.

Among the exhibits in connection with the meeting of the Sanitary Institute at Bolton were Messrs. Doulton's patent safety house drainage pipes, which are made in extra long lengths of 3 feet thus diminishing the number of joints. These pipes are made of the best stoneware with a highly enamelled surface both inside and out, and are connected together by their patent self-adjusting joint. This joint is flexible and water-tight and has been found very valuable and helpful in laying pipes in wet ground.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Central Provinces, November 5, 1887.

Establishment.

With reference to Notification dated 26th October 1887, Mr. J. B. Leventhorpe, Executive Engineer, Eastern Division, availed himself of the privilege leave granted to him, making over charge of his duties to Rao Sahib T. N. Mukhopadhia, Assistant Engineer, on the afternoon of the 28th ultimo.

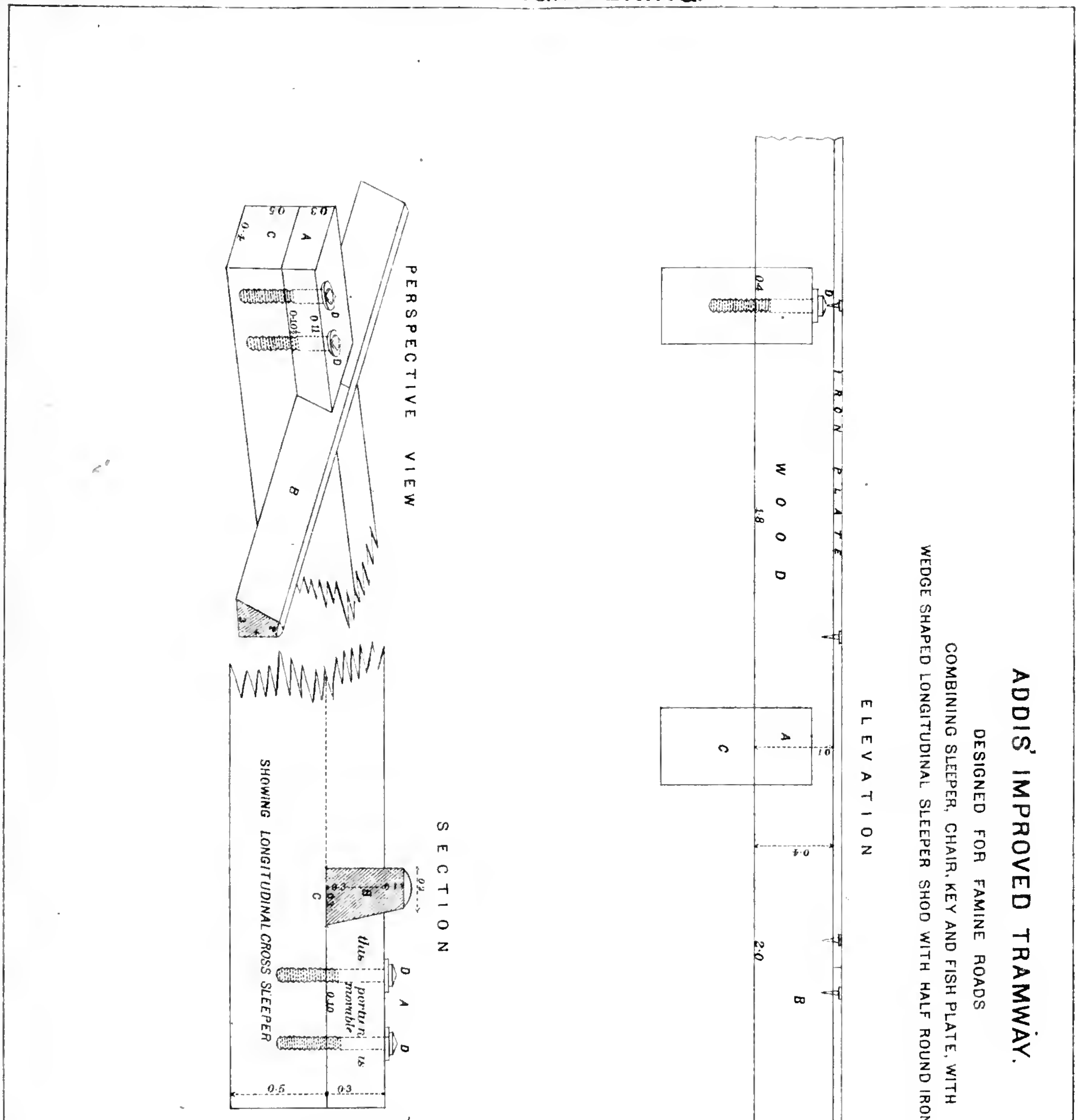
Madras, November 1, 1887.

The following posting is ordered:—

Mr. B. H. Young, Assistant Engineer, 1st grade, to the V. Circle, Chingleput Division, for charge of No. II. Party, Tank Restoration Scheme. To join on return from furlough.

Burma, October 29, 1887.

With reference to *Gazette of India*, Public Works Department, Notification dated the 27th September 1887, Mr. St. J. Hewitt, Assistant Engineer, 1st grade, reported his arrival at Rangoon on the forenoon of the 21st October 1887, and his services are placed at the disposal of the Manager and Engineer-in-Chief, Burma State Railway.



The "STAR" Press, 19, Lall Bazar, Calcutta.

Burma State Railway.

Mr. A. R. Lilley, Executive Engineer, 3rd grade, made over, and Mr. St. J. Hewitt, Assistant Engineer, 1st grade, assumed, charge of the office of the Sittang district (open line), Burma State Railway, on the forenoon of this date.

Bengal, November 9, 1887.

Establishments.

Mr. W. A. E. Hanby, Assistant Engineer, is, on return from furlough, posted to the Eastern Bengal State Railway.

The following reversions and promotion are ordered with effect from the 24th October 1887 :—

Rai H. C. Banerjee Sahib, from Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade.

Mr. D. F. Martin, from Executive Engineer, 1st grade, sub. *pro tem.*, to Executive Engineer, 2nd grade.

Mr. J. W. Johnson, Inspector of Local Works in the Burdwan and Orissa Divisions, from Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, sub. *pro tem.*

Mr. J. S. Lane Long, Assistant Engineer, temporarily attached to the Tirhoot State Railway, is transferred to the Darjeeling Division.

The services of Mr. J. R. Swinden, Executive Engineer, 4th grade, attached to the Buxar Division, are placed temporarily at the disposal of the Railway Branch for employment on the Tirhoot State Railway.

Hyderabad, November 1, 1887.

With reference to this Department Notification dated the 14th instant, Mr. E. G. Stanley, Assistant Engineer, 2nd grade, is, on arrival from England, posted to the Secunderabad Division.

Punjab, November 3, 1887.

Irrigation Branch.

With reference to Irrigation Branch Notification dated 22nd August 1887, Major J. W. Ottley, R.E., Superintending Engineer, 2nd class, temporary rank, returned from 2 months and 27 days' privilege leave and took over charge of the office of Superintending Engineer, Bari Doab Circle, from Major S. L. Jacob, R.E., on the afternoon of the 25th October 1887.

N.-W. P. and Oudh, November 5, 1887.

Buildings and Roads Branch.

Mr. H. Clifton, Honorary Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India 3 months' furlough.

Irrigation Branch.

Mr. E A. Carswell, Executive Engineer, 3rd grade, sub. *pro tem.*, Officiating Executive Engineer, Agra Canal, is, on the return of Captain J. Clibborn, Executive Engineer, from privilege leave, retransferred from the 3rd to the 1st Circle of Irrigation Works.

India, November 5, 1887.

The services of Mr. H. W. Clift, Executive Engineer, 1st grade, State Railways, on his return from furlough, are placed at the disposal of the Chief Commissioner of the Central Provinces.

The services of Mr. W. H. Parker, Superintending Engineer, 1st class, State Railways, are placed temporarily at the disposal of the Foreign Department.

Captain G. F. Wilson, R.E., Assistant to the Director-General of Railways, is placed in charge of that portion of the Office of the Accountant-General, Public Works Department, which will remain at Simla.

The services of Mr. E. T. Faulkner, Executive Engineer, 4th grade, temporary rank, State Railways, are placed at the disposal of the Bengal-Nagpur Railway Company.

The services of Mr. J. M. A. Despeissis, Assistant Engineer, 2nd grade, State Railways, are placed at the disposal of the Agent and Chief Engineer, Bengal-Nagpur Railway Company.

Mr. E. W. Arundell, Deputy Consulting Engineer to the Government of India for Railways, Central Division, officiated as Consulting Engineer to the Government of India for Railways, Central Division, from 19th July to 26th September 1887, inclusive.

The Governor-General in Council is pleased to order the following promotions and reversions of Executive and Assistant Engineers, attached to the several Local Administrations, with effect from the dates specified :

Mr. P. E. Raven, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent rank, with effect from 1st January 1887.

Mr. Sham Nath, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent rank, with effect from 1st January 1887.

Mr. D. J. Clancey, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent rank, with effect from 1st January 1887.

Mr. C. F. McLeod, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent rank, with effect from 1st January 1887.

Mr. E. L. Gramatzki, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. F. J. McLaughlin, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. G. K. Watts, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. J. C. Rees, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem*, with effect from 20th January 1887.

Mr. E. Penny, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. O. G. Smart, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. M. J. Scobie, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. G. G. White, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. J. B. Leventhorpe, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. C. O. Leefe, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 20th January 1887.

Mr. A. Leventhorpe, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 4th February 1887

Mr. Bolinarayan Borrah, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 17th March 1887.

Mr. C. F. Gilbert, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 29th April 1887.

Mr F St. G. M. Smith, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 29th April 1887.

Mr. E. Penny, Executive Engineer, 2nd grade, sub *pro tem.*, to be Executive Engineer, 3rd grade, with effect from 16th May 1887.

Mr. C. F. Gilbert, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, with effect from 16th May 1887.

Mr. F. St. G. M. Smith, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, temporary rank, with effect from 16th May 1887.

Mr. C. S. R. Palmer, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 23rd May 1887.

Mr. C. E. Gael, Executive Engineer, 1st grade, sub. *pro tem.*, to be Executive Engineer, 1st grade, permanent rank, with effect from 3rd June 1887.

Major H. C. Fox, R.E., Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 3rd June 1887.

Mr. J. C. Rees, Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, with effect from 12th June 1887.

Mr. G. G. White, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, with effect from 12th June 1887.

Mr. C. O. Leefe, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, temporary rank, with effect from 12th June 1887.

Mr. Bolinarayan Borrah, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 12th June 1887.

Captain M. Langharne, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 2nd grade, permanent rank, with effect from 12th June 1887.

Mr. J. C. Rees, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 12th June 1887.

Mr. F. Sharp, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 12th June 1887.

Mr. G. G. White, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 12th June 1887.

Mr. E. Penny, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 22nd June 1887.

Mr. C. C. B. Knapp, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 22nd June 1887.

Mr. E. J. Mitchell, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent rank, with effect from 22nd June 1887.

Mr. W. McM. Sweet, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 16th August 1887.

Mr. J. P. Henderson, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 18th August 1887

Mr. Bolinarayan Borrah, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 19th August 1887.

Mr. W. McM. Sweet, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 7th September 1887.

Mr. E. L. Gramatzki, Executive Engineer, 1st grade, sub. *pro tem.*, to be Executive Engineer, 1st grade, permanent rank, with effect from 8th September 1887.

Mr. R. Ewing, Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 2nd grade, permanent rank, with effect from 8th September 1887.

Mr. W. R. Gilbert, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 8th September 1887.

Mr. C. E. Housden, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 8th September 1887.

Mr. M. Leslie, Executive Engineer, 3rd grade, Central Provinces, held charge of the current duties of the Office of the Chief Engineer and Secretary to Chief Commissioner, Public Works Department, Central Provinces, from the 16th September to 8th October 1887.

The services of the undermentioned officers are temporarily placed at the disposal of the Military Department for employment in the Military Works Department, with effect from the dates specified :

Major H. H. Cole, R.E., Executive Engineer, 1st grade, Central India, 10th September 1887.

Lieutenant E. Houston, R.E., Assistant Engineer, 3rd grade, Hyderabad, 20th September 1887.

Lieutenant C. H. Cowie, R.E., Assistant Engineer, 1st grade, State Railways, 23rd September 1887.

Lieutenant J. E. Capper, R.E., Assistant Engineer, 1st grade, Central Provinces, 5th October 1887.

Lieutenant W. R. Hilliard, R.E., Deputy Examiner, 2nd grade, Punjab, 5th August 1887.

Director-General of Railways.

The undermentioned Assistant Engineers, 1st grade, passed, on the 3rd October 1887, the examinations noted opposite their names :—

Mr. R. D. Perceval.—Lower and Departmental Standard Examinations in Hindustani.

Mr. W. J. Weightman.—Lower Standard Examination in Hindustani.

Mr. R. N. Hodges, Executive Engineer, 2nd grade, is, on return from privilege leave, posted to the Bannu Railway Survey.

Mr. F. R. Upcott, Executive Engineer, 1st grade, sub. *pro tem.*, is, on return from privilege leave, posted to the North-Western Railway.

Mr. J. W. Parry, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Sind-Pishin State Railway.

Lieutenant-Colonel J. B. Sparkes, S.C., Executive Engineer, 1st grade, is, on return from furlough, posted as Port Store-keeper, State Railway Department, Bombay.

With reference to Public Works Department Notification dated 24th October 1887, Mr. E. H. Stone, Executive Engineer, 2nd grade, is attached to the Office of the Director-General of Railways.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 25th October 1887.

123 of '87.—Harry Robert Newton, of Thamesyde, Weybridge, in the County of Surrey, England, Architect.—*For improvements in sewers, drains, and cesspools.*

123 of '87.—Percival Everitt, of 47, Cannon Street, London, England, Engineer.—*For improvements in apparatus for receiving payments for and for delivering prepaid goods.*

130 of '87.—William Donaldson, of 2, Westminster Chambers, Victoria Street, in the County of Middlesex, England, Civil Engineer.—*For improvements in pumps actuated by fluid pressure.*

157 of '87.—Alfred Parry, Engineer, residing at Barrackpore, near Calcutta.—*For a rapid filter of simple construction to be known hereafter as "Parry's Excelsior Filter."*

171 of '87.—Alexander Lagerman, of Jonkoping, in the Kingdom of Sweden, Gentleman.—*For improvements in type setting or composing apparatus.*

185 of '87.—Charles Ernest Hoefling, of 19 and 21, Queen Victoria Street, London.—*For improvements in apparatus for synchronizing clocks.*

BANGALORE WATER SUPPLY.

THE Government offer a reward of one thousand rupees for the best essay which shall bring forward a workable and economical scheme for the supply of pure drinking water for the troops in Bangalore. A further sum of one thousand rupees will be given if such essay is adopted as the foundation of any scheme which the Government may resolve to carry out for the above purpose.

Intending contributors are referred to the *Fort St. George Gazette* of the 25th October 1887, for fuller information.

W. L. C. BADDELEY, CAPT., R. E.
Under-Secretary to Government,
P. W. D.

NOTICE.

Burma State Railway.

NOTICE is given that the vacancies for Drivers for the Burma State Railway advertised in July last have now all been filled and no further applications will be attended to.

P. J. DUDGEON,
Offg. Loco. Supdt.

Notices.

The Office of Publication of Indian Engineering is at the "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai*, and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.
An allowance is made for continuous insertions.

CONTENTS.

Obituary.

WRIGHT.—At Bombay, on the 10th November, soon after arrival from Indore, Robert Edwin Wright, Executive Engineer, State Railway Department, District Engineer, Rajputana-Malwa Railway, Mhow, aged 48 years.

SETON.—At Malabar Hill, on the 12th November, Lieutenant-Colonel Alexander Reginald Seton, R.E., Superintending Engineer, Western Defences, son of the late Colonel Bruce Seton.

DANIELL.—At Gurgaon, Punjab, on the 4th November, of pneumonia, Henry Joseph Daniell, District Engineer, aged 38 years, 10 months and 9 days. Deeply regretted. (English papers please copy.)

INDIAN ENGINEERING.

SATURDAY, NOVEMBER 19, 1887.

SCIENCE AS AN EDUCATIONAL AGENT.

A DOZEN years ago Mr. S. Lobb, a Professor at the Presidency College, Calcutta, strenuously advocated a reform of the Calcutta University curriculum, in favour of science and practicality as opposed to dead languages and foreign unassimilated literature. But the time was not ripe; the tradition of the elders proved too strong for him; nothing real we may say was done in furtherance of his recommendation. Since that day of disappointment, however, the traditions of the elders have been breached and weakened greatly; and now Messrs. Eliot and Pedler have seen their way to a new attack on antiquarianism in the wrong place, which bids fair to be successful. Their aim is to inaugurate special courses for students of science, high culture in which is to count for as much in the competition for a degree as proficiency in *belles lèttres* or Sanskrit grammar or any other educational inutility. There can be no doubt about the wisdom of such a reform amongst men with their heads screwed on tight and their eyes and ears open: the wonder is that it has not been inaugurated before. Natural laws have, however, their own methods of working and they seem now to have brought home to the minds alike of teachers and students that in these practical times we live in, it is expedient that in the course of his school and college career a youth ought to be taught what is likely to develop his mind, and help him to earn a livelihood. The inutile fossil booklore that satisfied our forefathers is out of date and insufficient: the world has grown too crowded and competitive for mere grammarians and quibblers. As a writer in the *Calcutta Review* for July puts it *àpropos* of a very different subject, the subject of Indian demons :—

"The educational churning of sorts that is going on in India now is not in any particular like the old legendary churning that induced *Amrita*, the water of life. Under a new dispensation Asurs, fallen from their high estate, are able to take but a very insignificant share in the stirring up of modern muddles and vacuities, as compared with the share they took under the primeval dispensation. And the new churning has no period put to it, goes on increasing and to increase, conquering and to conquer. It can rest satisfied with no mere water of life; must furthermore have wine; generous fulfilment as well as initial sap of vital energies and aspirings."

To that end scientific teaching must help it. Without it, energies and aspirings can avail little in the utilitarian days we live in. We are glad to hear, therefore that at a late meeting of the Senate of the Calcutta University, thanks mainly to efforts made by Messrs. Eliot and Pedler, it was decided that elementary science shall be one of the subjects of examination for entrance students; and that the examination papers are to be so set as to test whether candidates have received experimental instruction or not. That is a move in the right direction. What the Senate of the Calcutta University ordains to-day all Indian colleges will have to agree to to-morrow. And what is done for entrance students now must ere long prove a leaven leavening the whole lump of English education in India. It is trite enough truth, although bigoted conservatives are fond of decrying it, in act if not in words, that everything must have a beginning. Happily, men in authority are beginning to understand that Latin or Arabic are worse than useless studies for most of us, are waste of irredeemable time for a young man intending to adopt Engineering, let us say, as a profession. Just as the higher mathematics, or Greek iambics are waste of time for a medical student. "Shakespeare and the musical glasses" won't do as much for any student as physics, chemistry, or geology. Chopping logic, arguing *pro* and *con* as to the number of angels able to dance on a needle's point, or committing to memory the details of the second Peloponesian war cannot help any man in the actual battle of life. Study of botany is a healthier, as well as a more useful pursuit than search after Greek roots. This is pre-eminently a practical age; year by year with pressure of increasing populations and keener competitions becoming more and more so.

It is well that our Indian educationalists are beginning to see that it is so, and facing the fact that the dry bones of a dead and gone classicalism cannot now be galvanized into life again, that utility cannot be educed from a long ago mummied literature: that utility is the urgent requirement of the day and the generation. More power to men like Messrs. Eliot and Pedler who are manfully setting themselves against the educational traditions and superstitions of bygone ages, and striving to give us something more scientific, practical and useful. It is true that always "the old order changes, giving place to new;" but the old order nevertheless is obstructive, as slow as it can contrive to be, parlously given to the practice of delays, and the invention of stumbling blocks and bogies.

Progress is your only efficient shibboleth in these latter days—in matters educational as in other matters—and the best way to it is through the scientific gate. On the road leading out of it there is no hocus pocus, no making two and two seem five, or black white; no meandering waste of time. Every latter day father should rejoice at his son's emancipation from toils that were irksome to the parent in his youth, and have proved utterly unprofitable to his manhood. All men ought to rejoice that the after generation, instead of beginning its education after leaving school, is in a fair way to gain, at school, useful knowledge and development of practical abilities. It will be a good thing for India in many ways when the flatulent, incapable first-class classical Baboo has to make way for the modest, persevering student of science. And probably no department of the public service will gain more by the reform than Engineering.

P. W. D. REPORT, MYSORE, 1886-87.

MYSORE considers itself an *imperium in imperio* and vaingloriously follows the habitude of local Governments in issuing Administration Reports. The P. W. D. one for 1886-87 is now before us; and we gather that the total original budget grant placed at the disposal of the Department for the year 1886-87 was Rs. 19,40,000, *viz.*, Rs. 12,70,000 under "Provincial," Rs. 3,90,000 under "District Funds," Rs. 2,00,000 under "Provincial Irrigation Fund," and Rs. 80,000 under "Palace Fund." This grant was afterwards supplemented by Rs. 77,573 to meet allotments sanctioned by the Government from "Local Fund General" and from the "assets at credit of District Funds" for certain important works for which funds were not forthcoming from the ordinary District Fund grant fixed for the year. The final grant, therefore, amounted to Rs. 20,17,573, against which an outlay of Rs. 19,26,848 was incurred, being Rs. 2,85,652 more than the outlay for 1885-86. In addition to the above, a sum of Rs. 18,565 was expended from cash contributions by ryots and others; also Rs. 606 from Imperial Funds for repairs of cemeteries and Rs. 24,576 for petty construction and repairs of Educational, Forest and Military buildings and other minor civil budget works.

The most important engineering work carried on in Mysore is in connection with irrigation. During the year under review Rs. 3,78,327 were expended on tanks, Rs. 67,858 on channels. On minor original works Rs. 32,983 were expended. In connection with this head of service, it is desirable to mention that the year under review saw the experimental introduction of a definite system for the maintenance of tanks by the ryots.

During the year under review 5 dispensaries, 3 schools, and 2 cutcherries were built, Government House was refurnished in expectation of a visit from Lord Dufferin at a cost of Rs. 26,000, the Government High School at Shimoga was extended, and the Dariya Daulah at Seringapatam restored. Cooking and dining apartments were constructed in the Palace grounds, Bangalore.

Establishments cost Rs. 3,49,869—a saving of Rs. 12,331 on the estimates.

Throughout the year Major Bowen, R.E., acted as Secretary to the Government of Mysore, P. W. D. He was promoted to the rank of Superintending Engineer, 3rd class, with effect from the 29th April 1886.

The results of the year's working must be considered on the whole satisfactory, whether as regards the total outlay incurred, the general quality of the outturn, or the utility of the works undertaken. A marked improvement in the general efficiency of the local establishment was apparent and the Engineers, with few exceptions, worked throughout the year with commendable zeal and activity. The Upper Subordinates as a body also worked well, but the establishment of Upper, and more especially of Lower, Subordinates was weak, and its efficient recruitment to meet the expansion of works proved a difficulty.

In the preparation of effective projects, there was some backwardness and a tendency to submit and recommend for sanction crude and ill-digested estimates, but in connection with this it must be remembered that the Department was comparatively young and several of the Engineers lacked experience, more especially in regard of irrigation works, which, in the Mysore Province are often very complex and difficult of accurate solution.

The percentage cost of establishment as against total outlay, 17·9 per cent., compares very favorably with similar charges in other parts of India, more especially when the scattered nature of the works and the difficulties as regards rapid prosecution in the Malnad tracts of the Province are kept in mind.

THE RAILWAY PROBLEM IN INDIA.

We had fully made up our mind not to refer again to the subject of Railway extension in this country, whether tempted by sensational newspaper articles or the flaunting prospectus of a new scheme, as we have on more than one occasion delivered our opinion on the subject, and there is nothing new said which would make us alter our purpose. But the recent debate in the House of Commons on the Indian Budget necessitates an expression of views, if for no other reason than to place the matter before the public in a light which will not admit of misconstruction.

We believe that nothing could be simpler or more telling than the figures quoted by Sir John Gorst during the debate, and which we have no hesitation in recommending to the careful consideration of our readers. The whole secret of Railway extension lies in a nutshell. He said in his usual pithy way that there were three conclusions to be drawn from the figures relating to Railways. The first is that Indian Railways pay a large dividend upon the capital invested, the percentage of net receipts during the past three years being 5·27, 5·84, and 5·90. The second conclusion is that the Government of India does not participate in these profits, but has to bear constantly recurring losses, which in 1884-85 amounted to Rs. 10,51,575 ; in 1885-86 to Rs. 7,31,713 ; in 1886-87 to Rs. 14,58,304, and the Budget estimate for 1887-88 is Rs. 15,89,400. The third conclusion is that but for the heavy fall in exchange the Government would have made a profit. Now as to the cause of this deficit. It is mainly owing to the loss occasioned by capital sunk on lines which are partially constructed, and are therefore unremunerative, at least for the present, but nevertheless the Government have to pay interest on it. Out of about Rs. 1,40,00,000 at 4·4 per cent., the Government do not receive any return upon Rs. 50,00,000, and the drain is therefore temporary so far as this amount is concerned.

From enquiries instituted by the Secretary of State he found that previous to 1880-81, the profit made by the Government of India on State lines, including the East Indian Railway, was 6·7 per cent., and exclusive of it, 5·7 per cent. The East Indian Railway now returns 8·7 per cent. on its capital outlay. Leaving this aside, all the profit made upon State Railways is not only absorbed by the payment upon guaranteed lines, but there is a deficit in the bargain. Then, again, the exchange steps in to inflict another loss. The guarantee on the old lines is about 5 per cent., but in order to pay at this rate, the English stock-holder is to be paid at 6½ per cent. by its conversion into rupees. This lesson has not been lost to the Government, for gaining by past experience it guarantees only four per cent. upon lines constructed recently.

Now the public has seen what the guarantee system by the State means and no sane man would ask it to persist in such a suicidal course. But let us see what Sir Richard Temple, the matchless speaker of platitudes and empty phrases, has to say on the subject; and this is what he said :—"Of all questions affecting the immediate future of India, the question of questions was that of Railways. (Hear, hear). Railways had changed the whole face of the country in India, but far more was required, and the question was how this was to be done. It might be done by immediate State operations or by the guarantee system. This was open to great objection as increasing the heavy loss to the State by exchange. At present we were halting between two opinions. If there were to be no more State operations, but private aid was to do the work, it was obvious that as long as people could get a guarantee, either for a long or a short time, they would never put their money into Indian Railways without a guarantee. If a proper and fair chance was to be given to private enterprise, they must put their foot down and say that they would undertake no more State operations, and i after a full and complete trial they discovered that private enterprise was not sufficient, they would ultimately have to revert to the old system, because the country must be covered with a network of Railways."

No, Sir Richard, there is no occasion for halting between two opinions. The indiscriminate guaranteeing system, for such it must be if India is to be covered by a network of Railways whether remunerative or not, has had a fair trial and is found wanting. We have used the word "indiscriminate" advisedly, for we are as staunch advocates of the extension of Railways in India, as can be found here or in England. What we insist upon is that the *necessity* for the undertaking should, in the first place, be shewn to exist, and if the public should hesitate, it is the plain duty of Government to step in and do the needful. Now take the proposal for the Hyderabad-Pachbadra Railway scheme for instance, Bombay has done its best to throw cold water on the scheme, and the opposition, as people *will* say, comes from vested interests; some have even gone so fa as to maintain that a sand-storm may one day involve a Railway station and an entire train in one common ruin. Such an objection is too flimsy to be seriously discussed. If the proposed Railway will serve its purpose there is no reason why it should not be constructed even if the Bombay lines were to suffer a diminution of revenue. Similarly, the wisdom of the Secretary of State's *fiat* that Government Railway works in this country are to be suspended in order to provide Burma with a Railway, may well be doubted. Sufficient reasons must be shewn for any departure from the settled policy of Government, and for the rest it is a mere matter of time.

Notes and Comments.

A Proposed Bridge over the Indus.—A locality has been discovered near Hyderabad where it is believed possible to construct a bridge over the Indus, should it be required to connect the Hyderabad line with Karachi.

Simla Gup.—It is said that the estimate of the new Viceregal Residence at Simla, which, when the work was sanctioned, amounted to Rs. 4,80,000, has swelled up to the modest sum of Rs. 8,00,000, and that Rs. 2,00,000 more are required to furnish the building before it is fit for occupation.

The Mitkiewicz-Barker Chinese Scheme.—The great American 'Concession' bubble has burst at last. The Tsung-li Yamen, which has practically the supreme power in all matters of foreign policy, has cancelled all the contracts made by the facile Viceroy, Li Hung-chang. China is to be congratulated on having got out of the clutches of Jay Gould & Co.

A Wrinkle in Blasting.—The advantages of the omission of hard tamping and simply plugging the hole with a handful of clay are as follows: 1. Economy in hand-labor. 2. Economy in material as the powder is utilized better. 3. Better rending effect. 4. The suppression of the accidents so often resulting from tamping. In place of clay, cement or plaster of Paris might be used.

Shone's Hydro-Pneumatic System.—We have received a Report on the Drainage of Cannes, prepared at the instance of Dr. T. Edmonstone Charles, formerly of Calcutta, by Mr. Shone after a personal visit to the locality. As our readers are familiar with the features of the system, we need not go into the particulars of the project further than to state that the Government of India thought so highly of the Report that 100 copies of it were ordered through the Secretary of State for distribution among Indian Municipalities and Corporate Bodies.

A Railway Wanted.—Behind Moulmein there is a very considerable tract of country which might be turned to account, if only it were developed by railways. Whether this would be sufficient to enable Moulmein to take rank among the first ports of the Empire is doubtful; but, seeing that without any railways at all, it has taken the sixth place among the Indian ports, surely some effort should be made to open out the country behind Moulmein. Just at present railways are more urgently required in Upper Burma, but we trust that the total neglect with which the Tenasserim division has been treated in the matter of railways is not to continue very much longer.

An Ex-Indian Civil Engineer.—James Imbrie Miller, now Principal Assistant Engineer in charge of Northern District New Croton Aqueduct, Tarrytown, N. Y., was formerly Superintending Engineer, Public Works Department, Government of India, occupying the positions of Engineer-in-Chief, Neemuch State Railway, and of Officiating Chief Engineer, Northern State Railway. He became on retirement from the Indian Service Vice-President and General Manager, Lykens Valley Coal Co. and Summit Branch R. R. and Mineral R. R. & Mining Co.; next Divisional Engineer, So. Penn. R. R.; and afterwards Chief Engineer, Survey Buffalo and Geneva R. R. He has had therefore a most eventful career.

A Difficult Problem.—The proposal to grow "guinea grass" on the canal fringes in the Panjab, has, we understand, been negatived by Government. On this subject the *Civil and Military Gazette* remarks that there are, of course, obvious difficulties in the way of properly utilizing a narrow strip of ground, such as the land adjoining Government canals, whose length can be measured in hundreds of miles, and width in tens of feet. But the problem is soluble; and when an Irrigation Officer has arisen who shall invent a sure and inexpensive method of measuring the amount of water sold to cultivators, he may perhaps set the pinnacle to his utility by suggesting also some crop for the canal banks, in the place of "guinea grass," which shall not be condemned by the Irrigation Branch Secretary to Government.

The Hyderabad-Pachpadra Line.—It is understood here that the Bombay Government have resolved to undertake the construction of the first portion of the Hyderabad-Pachpadra Railway, extending from Hyderabad to Umarkote, a distance of ninety miles. The route has been surveyed. The country presents no difficulties, and it is estimated that the line could be made for about ten thousand rupees per mile. The North-Western Railway will supply a quantity of old rails which they have in stock, as their line is being re-laid with steel rails. It may not be generally known that a large amount of these disused rails are being sent to America for railway construction there.

The Ceylon Budget.—Customs and Railway receipt are improving rapidly, the latter being estimated (moderately) at Rs. 30,50,000 for 1888. Except land sales, the most important heads of revenue justify increased estimates. Rs. 1,95,000 are to be spent on fortifications, and various roads, bridges, &c., are to have votes. But perhaps the most interesting item is that of railway extension. Nothing daunted by the snubs which he has received from the Colonial Office, the Governor has inserted in the estimates a vote of Rs. 90,000 for interest on the loan authorized by the Ordinance, for the extension of the railway to Haputale and to Bentota, so that when the Secretary of State *does* sanction the extension, no time may be lost. Sir Arthur also states his belief that no other scheme but extension on the present gauge will be considered by the Colonial Office.

Railway Items from Burma.—The Burma State Railway will be open for through traffic on the new line of the Tounghoo-Mandalay extension as far as Mingyan in April. This will be about half the distance to Mandalay. As they are also laying the line from Mandalay it is probable that by the close of next year, or the commencement of 1889, the iron horse will run into the ex-King Theebaw's capital. The public look for the connection of Mandalay by rail with longing eyes, for not only will a journey by train be performed much quicker than by the river, but the expense of travelling will be considerably less. It now takes about 12 days in the Irrawady Flotilla flats to go to Mandalay, but by train the place can be reached in a day-and-a-half, at, perhaps, something like one-half the cost. The Burma State Railway are laying rails with steel facings, as an experiment, in the renewal of the railway line between Kemendine and Rangoon.

Gup from Burma.—The Public Works Department is apparently at a discount. Mr. W. A. Robinson, a Supervisor in Burma on Rs. 200 per month, has resigned that appointment to take up a Police Inspectorship in Upper Burma on Rs. 100 per month! We learn that the Rangoon outlet for Shone and Ault's sewage system is to be the Pazoondoung creek instead of Rangoon river, but should it prove a nuisance in that locality it is to be shifted elsewhere at the expense of the Municipality. The Rangoon steam tramway has quite monopolised Pagoda road, as the double line of rails on that road are an inch and more above the road surface, except at crossings, thus rendering the road useless for pony or horse conveyances. Mr. Hoyne Fox, Executive Engineer, who, while on furlough lately, obtained the Diploma of Associate of the Royal Institute of British Architects, has been appointed to the charge of the Ruby Mines Division in Upper Burma.

THE HYDERABAD (DECCAN) COMPANY.—The Chairman and some of the Directors of the Hyderabad (Deccan) Company recently inspected the machinery manufactured by Messrs Davey, Paxman and Co., at Colchester, which is about to be dispatched to the Company's diamond fields in the Nizam's Dominions, together with an efficient European staff. The machinery consists of six rotary washing machines of 14 feet diameter, with elevators, driving engines, and the necessary pumping machinery. This is the first instance of any important machinery being sent to India for diamond mining. The old workings, which were formerly the principal source of the diamond supply of the world, were carried out in the most primitive way by native hand labor without any machinery, and it is fully expected that the machinery now being sent to India will deal with in one day more earth than the unassisted native industry could have handled in several years.

THE PROPOSED NILGIRI RAILWAY.—Mr. R. Woolley has to be congratulated on the dogged perseverance with which he has at last brought to a successful issue his negotiations with the State on behalf of the Nilgiri Railway Company, for the necessary concession to raise the required capital for the construction of a line of railway from Mettapollium to Coonoor, with a projected extension to Ootacamund. The difficulty of successfully floating the undertaking consisted in the fact that the project could not be thrown upon the London market, on account of the Company being domiciled in India, and the technical legal difficulties arising therefrom under the Indian Companies Act, the removal of which the Government at first refused to effect. But these difficulties having been waived, the project is, therefore, to be launched in the London market, and, as it is reported that it finds favor among capitalists there, our readers will be glad to learn that the long talked of railway up the Nilgiris, though on the adhesive and not rack-rail system, promises shortly to be an accomplished fact.

WANTED—A RATIONAL SYSTEM OF PUBLIC WORKS.—An American authority commenting on the disadvantages of the present "mixed" system of conducting Civil Public Works in the "Union," says that the permanent remedy for the undoubted evils and injustices of that present system lies in the organization of a Department of Public Works, in which military officers as such shall have no more influence and no higher positions than their technical acquirements give them. Until wars and rumors of wars cease altogether there must always be a corps of military engineers to which the country will look for its defence, and there will be full employment for a very considerable corps of such men, but the present plan of turning over to this corps works of peace likewise, works evil and injustice in several ways. In the first place, it makes the bulk of the corps of engineers more civil than military officers. There are many of them whose experience has been almost solely in civil works. In the second place it cuts off the young military officers from the best possible training for their profession.

THE TRICHINOPOLY DRAINAGE AND WATER-SUPPLY SCHEMES.—The important question of sanitation has been occupying the earnest attention of the Trichy Council for some years past. It is evident that the two most vital points connected with the subject are an efficient drainage and a proper supply of pure water; but both these bristle with difficulties owing to the large and extended area over which they have to be carried, the comparative poverty of a large mass of the population, and inability to obtain professional advice. Major Drake-Brockman, R.E., in 1881, by request, and at a cost of Rs. 2,500, drew up an elaborate drainage scheme; but as his estimate amounted to nearly three lakhs of rupees it had to be received with great caution. Another scheme for the water-supply was suggested by Mr. C. E. Crighton, of the South Indian Railway, but by a recent Government Order he was prohibited from rendering any further assistance. The last move made was to advertize for a Sanitary Engineer, but no satisfactory application was received. The attempts, therefore, have so far been unsuccessful.

MADRAS MUNICIPAL WATER-WORKS.—Notice is given that on and after the 1st April next the charge for water for non-domestic purposes will be annas six per thousand gallons and no water for non-domestic purposes will be issued without such application. It appears that the Red Hills Tank, after the recent copious showers of rain, is not yet quite full. Up to about a fortnight ago, the water was so low that it had to be pumped into the pipes. In the course of pumping, the filth at the bottom of the tank was disturbed and rose to the surface and was pumped into the pipes, reaching Madras to be used as drinking water. Now that the rains have set in, the water in the tank has reached within four feet of the calingula, and there is no need of the pumps, the surface water finding its way freely through the pumps. It is said that the Municipality are anxious to have a good stock of water, and suggest that the tank be allowed to fill up to the brim—some three or four feet above the calingula, making a depth of 34 feet of water in the tank. Government, however, it appears will not allow so much water to accumulate for fear of the bund bursting, and when water does rise above the calingula, Government at once direct sluices to be opened in order that surplus water may escape.

THE POSITION OF THE MILL INDUSTRY IN INDIA.—A Bombay paper says:—Now that the Cotton Manufacturing Industry in India is becoming racy of the soil, and its working has come to be a matter of domestic concern to us all, an account of its present position as ascertained from the Mill reports recently published, cannot fail to be of interest. There are 45 mills in the island of Bombay which may be described as going concerns. Of these, eight are privately owned, and as their owners evidently wish the outside public to leave them alone, we are bound to respect their scruples. This leaves 37 mills to inquire into, but of these five more are out of the running for one reason or another, so that we have before us 32 of these concerns to point the moral of our tale. These 32 mills may appropriately be divided into four groups according to the nationality of their management, namely, (1) English, (2) Parsee, (3) Hindoo, and (4) Hebrew and Mahomedan. The propriety of this division will be evident to those who have a general knowledge of the internal working of our mills, at any rate, the management in each case takes its tone from the nationality of the managing or directing heads of these concerns, theirs being for the most part the largest stakes in a pecuniary point of view.

THE NORTH-WEST FRONTIER ROADS.—We learn from the *C. M. G.* that the new military road now in progress from Dera Ghazi Khan, across the Suliman Range, by Fort Monroe, and through the Rakhni and Bori Valleys to Pishin, will effectually cover the right flank of the Hurnai Railway; open out suitable ground for additional cantonments; materially shorten the distance for troops from the Indus; and afford an alternative and much shorter route or routes to the Khwaja Amran Passes. A bridge of boats is to be at once established over the Indus at Dera Ghazi Khan, and in all probability the road will be sufficiently advanced during the cold season to be available for troops on relief, to and from the new cantonments of Loralai and Pishin. Hereafter it may not improbably become a popular trade-route. The old frontier track—for it deserved no better name—from the railway terminus at Khushalgarh by Kohat to Bannu, and from Bannu to Dera Ismail Khan, is being rapidly converted into an admirable military road fully bridged and metalled throughout; the bridges over the more important streams, like the Kurram and Gambila rivers being all made suitable to carry a broad gauge railway, in case the future should prove an additional line to be necessary. Further surveys for a similar road from Kalabagh on the Indus to Lachi, the first stage out from Kohat, also forms part of the more immediate programme.

DISTRICT BOARDS IN THE PUNJAB.—The following Rules are promulgated by the Punjab Government under the Punjab Municipal Act of 1884:—I.—(*a*). No scheme or work estimated to cost Rs. 10,000 or over shall be undertaken before the Local Government shall have been satisfied—(1) that the scheme or work is one of public utility; (2) that a project has been drawn up in a satisfactory way, (3) that the professional aid at the Committee's disposal is adequate to carry out the work. (*b*).—General schemes of drainage, sewerage and water-supply, projects for roads which are intended to connect places situated in different districts, and other large works requiring engineering skill shall be submitted for the approval of Government in the Public Works Department. II.—(*a*). No expenditure shall be incurred on any work involving an outlay of more than Rs. 2,000, save with the previous sanction of the Commissioner of the Division. (*b*). No original engineering work involving an expenditure of Rs. 1,200 or upwards shall be undertaken until the plans and estimates shall have received the approval of the Superintending Engineer or Executive Engineer. III.—No original work shall be undertaken by any Committee on an estimate for a portion of the work unless the whole work has received the sanction or approval required by these rules. IV.—Whenever a Committee shall desire to appoint any person to an office, the proper discharge of the duties of which requires such person to possess some professional skill, the following rules shall be observed:—(*a*.) No person shall be appointed as Engineer, Assistant Engineer, or Overseer to a Municipality without the sanction of the Local Government in the Public Works Department, unless he is professionally qualified for such appointment according to the rules prescribed by that Department.

Current News.

THE Viceroy inspected the Sukkur Bridge works on the 10th instant.

AN allotment of twenty-three lakhs has been made in the Public Works Department budget for expenditure in this Presidency on Civil Works in 1888-89.

THERE will be a Photographic Exhibition in Calcutta in January next. Lord Dufferin has offered a medal for the best photograph from any part of the world.

THE Secretariat buildings have been destroyed by fire and the E. I. R. Co. are willing to buy the High Court buildings to be used as a Central Station, at Allahabad.

MR. COTTON has drawn up and recommended to the Calcutta Corporation a scheme for making a direct thoroughfare from the Hooghly floating bridge to Sealdah station.

THE Burmese propose to re-gild the Shoay Dagon Pagoda at Rangoon. The estimated cost of gold leaf necessary for the operation is put down at a lakh of rupees.

WE learn that last week a fire broke out in the Egerton Woollen Mills, Dhariwal, in which the roof of the new worsted mill suffered. The injury to the machinery is believed to be small, and the building is fully insured.

THOUGH the Indian Midland, as yesterday announced, has now completed the section from Cawnpore to Jhansi, it will be some little time before the line is opened for traffic. Probably, however, the new year will see a regular train service running.

OWING to the melancholy death of Mr. T. A. Payne at Bhosawul, on Thursday, Mr. S. Jackson, the Locomotive Superintendent of the G. I. P. Railway, who was to have left for England by the S.S. *Victoria* yesterday, has been obliged to defer his departure.

THE Viceroy and Sir Frederick Roberts, while at Kurrachee last week, had a long cruise round the harbor. The defence works at Manora were inspected, and some torpedoes were exploded, but not very successfully. The new bridge to Keamari was formally opened by the Viceroy.

MR. RAMSAY, Under-Secretary to the Government of India in the Railway Branch of the Public Works Departments, goes as Engineer-in-Chief of the Bannu Railway Survey. His place in the Secretariat will be taken by Major Brackenbury, R.E., who returns from leave shortly.

THE Board of Directors of the Rohilkund and Kumaon Railway Company intimate that the accounts for the half-year ended 30th June have been received, and, subject to audit, admit of the payment of a dividend for the half-year of £2 5*s.* per cent., free of income tax, Indian and English.

MR. F. N. THOROWOOOD, the Superintendent of the Madras Harbour Works, who recently proceeded to European on a few months leave, has returned to Madras from Bombay, and resumed charge of his appointment from Mr. Lee Pogson who had been acting for him during his absence.

THE section of the Assam-Behar State Railway line from Dinagepore to Ryegunge, a distance of about 37 miles, is likely to be made over to the Northern Bengal Railway in January next, and the subordinate officers and men now employed there will be transferred to the Koosye Extension Section.

THE appointment of an Imperial Agricultural Chemist, and the extension of the Dehar Forest School into a School of Agriculture as well, are questions which are under the consideration of the Government. The latter measure will supply a much felt want in Northern India, which has no agricultural institution of any kind.

LIEUTENANT-COLONEL L. CONWAY-GORDON, Director-General of Railways with the Government of India, makes a tour, visiting Karachi, Bombay, and other places, before joining the Government at Calcutta. Colonel Conway-Gordon has been taking short leave in Simla on account of his eyesight, which has again been giving him trouble.

THE Municipal Commissioners of Panwell are about to undertake a scheme for bringing water into the town, and with that object in view they have applied to Government for permission to raise a loan of Rs. 10,000, by the issue of twenty debentures of Rs. 500 each, for which interest will be paid at the rate of 6 per cent. per annum.

COLONEL A. LE MESURIER, Superintending Engineer in the Railway Branch of the Indian Public Works Department, has arrived at Merv for the purpose of inspecting the Russian system of railways in the trans-Caspian territory. He has been most hospitably received by the Russian officials, who have promised to render him every assistance.

WORK on Cannington Church, Allahabad, will be suspended till the sum of six thousand rupees due to the contractors, Messrs. Frizzoni, and the architect's fees have been paid. The next stage will be the erection of six bays of the nave, which will be closed in with a temporary wall at the west end until the rest of the nave and the west towers can be taken in hand.

Upon the recommendation of Colonel Pennycuick, R.E., the officer in charge of the Periyaur Project, Madras, the Government have been pleased to sanction a hill allowance of one-third salary to all employés engaged in these gigantic irrigation works, in consideration of the high rate of living and the hardships the men are put to by a residence at the site of these works.

The head of the Ceylon Forest Department, Mr. Thompson, who recently arrived from India to take charge of it, has unfortunately been obliged to resign owing to ill-health, his constitution being unable to stand the exposure and hardship which the duties of his post entail. Colonel Clarke has been gazetted to the acting appointment, and a better choice could scarcely have been made.

The destruction of the whole of the Sardha Canal project in the late Allahabad Secretariat fire is perhaps the most serious among other losses. The estimates, surveys, drawings, plans, &c., for this great irrigation work—which was to have run through Kheri and Sitapore to Lucknow from Katya in the Pilibhit district, with branches to Azimgurh and Jaunpore, and by which the whole of Oudh was to have been watered—which had just been brought to completion after years of labor by Colonel Forbes, and his department, and was ready to be started the moment the order was given,—every paper has perished, it is understood, in the flames. The loss cannot be less than 2½ lakhs, taking into account only the actual cost of the work.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

INFORMATION WANTED.

Sir,—Will you or any of your readers kindly inform me as to what are the best hydraulic hauling and pumping engines for dip workings in coal mines. The pressure to be taken from lift pumps.

Iron.

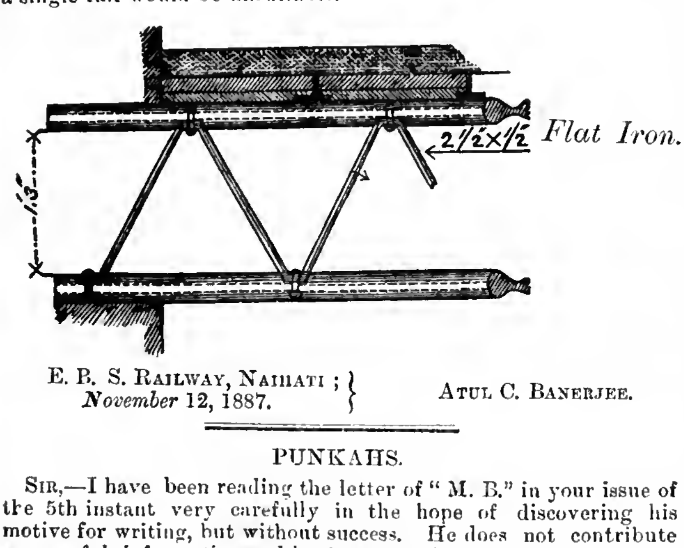
THE BOMBAY P. W. D. AND LORD REAY'S VAGARIES.

Sir,—Referring to the letter under the above heading in your last, I hear that Mr. Doig himself got his orders to be ready to proceed to Belgaum to act as Superintending Engineer from the *Chief Engineer and Secretary to Government* (not from the Governor as it is generally believed), and that the cancelling of the appointment was by the Governor, who put in Mr. Pottinger. The position of the Acting Chief Engineer and Secretary (the Governor's own selected man) is therefore a pleasant one! and I quite expect he and any other Chief that may be appointed will object to their anomalous position. Such an appointment is, in fact, under the circumstance, not worth having.

Anti-jobbery.

STRENGTH OF OLD RAILS.

Sir,—Of the various ways in which old rails are utilized in building construction, perhaps the most common is their use in place of wooden beams or rolled joists. I should be much obliged if you or any of your readers would give me the best method of calculating the strength of a rail girder of the form shewn in the annexed sketch, which is often used for spans where a single rail would be unsuitable.



E. B. S. Railway, Naihati; November 12, 1887. Atul C. Banerjee.

PUNKAHS.

Sir,—I have been reading the letter of "M. B." in your issue of the 5th instant very carefully in the hope of discovering his motive for writing, but without success. He does not contribute any useful information and he does not ask one definite question. His statement that the punkah season is over I regret to have to deny, and the conclusion he draws from his statement that the proper time for the study of my experiments (on the effect of punkahs) is during the period when they are not wanted, I also deny. In one part of his letter he recommends the Mortimer system of punkah with a downward draught and in another part he tries to discredit the means I used to obtain a downward draught by hazarding a surprise that it resembled a ship's punkah. My lecture was delivered in Bombay before an audience composed largely of Engineers, and the experiments were made exactly as described in your columns. A very delicate indicator, designed expressly for the purpose, was used to compare the effect of each style of punkah; and the comparative trials were all made under exactly the same condition, with the same falling weight, and with punkahs of the same size.

"M. B." knows so little of his subject as not to have observed that one pull of a punkah rope means two swings of the punkah, and thus his calculation on the movements of a pendulum are worthless.

I have invented nothing new in punkahs; my study of the subject was made with a view to discover the simplest and most effective forms among many types and to ascertain the best methods of constructing and of mounting them.

"Putting the whole air of a room in gentle motion" is not the object of a punkah; its real function is to promote co-operation and radiation from the surface of the skin by producing a current in contact with the human body, and it is only the air which comes *within reach* of the body that does any good; consequently a punkah which sets all the air of a room on movement is simply wasting power.

Bombay; *November* 10, 1887. John Wallace.

New Books and Reprints.

ART AND ARCHITECTURE.

Denyer (A.) Linear Perspective. For the Use of Schools of Art Part I. sd., pp. 22. Hockliffe (Bedford). Simpkin 1/

ASTRONOMY AND METEOROLOGY.

Philips' Revolving Planisphere. Showing the Principal Stars Visible for every Hour in the Year. Philips. 2/

Scott (Robert H.) Weather Charts and Storm Warnings. With numerous Illusts. 3rd ed., Revised and Enlarged. Post 8vo, pp. 234. Longmans 6/

CHEMISTRY, PHYSICS, &c.

Durrant (R. G.) Laws and Definitions connected with Chemistry and Heat. With Notes on Physical and Theoretical Chemistry; also Special Tests and Examples for Practical Analysis. Cr. 8vo, pp. 112. Rivingtons 3/

Student's (The) Handbook to the Microscope: A Practical Guide to its Selection and Management. By a Quekett Club Man. Post 8vo, pp. 72. Roper and Drowley 2/6

ELECTRICITY.

Kempe (H. R.) A Handbook of Electrical Testing. 4th ed. Adopted by the Postal Telegraph Department. Post 8vo, pp. 550. Spon 16/

ENGINEERING AND MECHANICS.

All about our Railways. Edit. by Arthur Montefiore. (All About Series, No. 1.) 8vo, pp. 140, Carr and Co 1/

Bemrose (Wm.) Manual of Bupl-Work and Marquetry. With Practical Instructions for Learners, and 90 Coloured Designs. 3rd ed. 4to. Bemrose 6/

Bemrose (Wm.) Manual of Wood Carving. With an Introduction by Llewellyn Jewitt. 16th ed. Roy. 8vo. Bemrose 5/

Decorater's Assistant: A Modern Guide for Decorative Artists and Amateurs, Painters, Writers, Gilders, &c. 2nd ed., revised. Post 8vo, sd., pp. 160. Crosby Lockwood 1/

Gas Works Statistics, 1887. Compiled from Special Returns Received from Engineers and Secretaries throughout the United Kingdom. Edit. by Charles W. Hastings. Ninth issue. Demy 8vo, sd., pp. 97. Scientific Publishing Co., Lim. 3/6

Graham (W.) Brassfounder's Manual: Instructions for Modelling, Pattern Making, Moulding, Alloying, Turning, Bronzing, &c. 7th ed. Fcap. 8vo. Crosby Lockwood 2/6

Hasluck (P. N.) The Pattern Maker's Handybook: A practical Manual on patterns for Founders, embracing information on the Tools, Materials and Appliances employed in their Construction. With upwards of 100 Illusts. (Handybooks for Handicrafts.) post 8vo, pp. 144. Crosby Lockwood 21

Thropp (J.) Repairs of Roads: Suggestions to Surveyors of Highways on the Management of Main Roads and other Highways. 8vo, sd., pp. 24. Akrill (Lincoln.) Simpkin 1/

Waterworks Statistics, 1887. Edit. by Charles W. Hastings. 7th Issue. Demy 8vo, sd., pp. 38. Scientific Publishing Co., Lim. ... 2/6

GEOLOGY, MINERALOGY, MINING.

Geological Survey of the United States. Bulletin No. 34: On the Relation of the Laramie Molluscan Fauna to that of the succeeding Fresh-Water Eocine and other Groups. By Dr. Charles A. White. 5 Plates. 8vo. sd., pp. 54. Washington ... ... 10 cents.

——Bulletin No. 35: The Physical Properties of the Iron Carburets. By Carl Barus and Vincent Strouhal. 8vo, sd., pp. 62. Washington. 10 cents.

——Bulletin No. 36: Subsidence of Fine Solid Particles in Liquids. By Carl Barus, 8vo, sd., pp. 58. Washington... ... 10 cents.

——Bulletin No. 37: Types of the Laramie Flora. By Lester F. Ward. 57 Plates. 8vo, sd., pp. 354. Washington .. ... 25 cents.

——Bulletin No. 38. Peridotite of Elliott County, Kentucky. By Joseph S. Diller. 1 Plate. 8vo. sd., pp. 31. Washington .. 5 cents.

——Bulletin No. 39: The Upper Beaches and Deltas of the Glacial Lake Agassiz. By Warren Upham. 1 Plate. 8vo, sd., pp. 84. Washington ... ... 10 cents.

Merivale (J. H.) Notes and Formulæ for Mining Students. Cr. 8vo. Crosby Lockwood 2/9

General Articles.

THE TRUE CAUSE OF THE BREAKS IN THE NORTH-WESTERN RAILWAY.

By J. E. Hilton, M. Inst. C. E., Executive Engineer, P. W. D., Punjab.

The annual floods, which have recently occurred, and since 1884 in the neighbourhood of Umballa and Jagadri, have generally been ascribed to the denudation of the outer ranges of hills of forest trees and under-growth. This would be sufficient to account for sudden floods over a limited area, but is quite insufficient cause to explain the marked increase in the rainfall which has taken place. In 1884 a very heavy downpour occurred north of Umballa causing destructive damage in Umballa Cantonment; on two or three separate occasions long breaches have been made in the North-Western Railway on both sides of Umballa; and in the present year heavier rain has been experienced in the neighbourhood of Kussauli than has been known for years.

The true cause is to be found in the large increase in irrigation which has taken place, south-west of the site of these floods, (in the districts of Sirsa and Ferozepore, 130 to 150 miles) since the opening of the Sirhind Canal.

To explain fully the action which probably brings about this increased rainfall in the month of August particularly, it will be necessary to make use of figures: first, to get an idea of the amount of water evaporated in one day; and, secondly, to obtain an approximate of the quantity of water which could be absorbed by dry air, such as would generally be found over a sandy desert, before condensation took place.

Take any area 50 miles by 20 miles in the neighbourhood of Sirsa, and suppose that of this 1,000 square miles one 400th part is daily under irrigation; then allowing $\frac{1}{3}$th of an inch for daily evaporation, we obtain the large quantity of one million cubic feet of water drawn up into the atmosphere daily.

A cubic yard of dry air at 80° Fah. will absorb the same number of grains of water. Allowing that the air already contains 50 per cent. of full saturation, a cubic yard will further absorb 40 grains Troy; after allowing for decrease of absorption due to decrease in the temperature in the upper strata of air, a cubic mile will absorb not less than 350,000 cubic feet of water, and the atmosphere to one mile in height over 1,000 square miles is therefore capable of containing 350 millions of cubic feet of water. A sudden decreased temperature of 10 degrees would precipitate 70 millions of cubic feet. In April, May and June the hottest belt of country in India is to the south of the district of Sirsa, extending across the Rajputana desert from Delhi to Bahawalpore.

The hot air over this part rises and is replaced by a current of air on the south from the Indian Ocean, bringing with it the south-west monsoon; and on the north by a current of air from the north and north-east, carrying with it the more highly vaporized atmosphere which has generated over the Sirsa district. This vapor at this time of the year is dispersed, and only raises slightly the degree of moisture in the air over the desert.

Towards the end of June, and beginning of July, a change takes place, the belt of greatest heat passes over Sirsa and extends from Saharunpore to Jhung and Montgomerry, constant changes of the wind occur, caused by greater heat on the one side or the other. The million cubic feet of water which is daily evaporated over the irrigated district is wafted hither and thither east or west, and for some days may accumulate; finally, the belt of greatest heat advances to the north of Sirsa, and the wind follows it.

Instead, however, of being drawn directly north, it deviates to the east, under the laws affecting currents of air passing from the south to the north, owing to the rotatory motion of the earth.

The wind becomes a south-west wind, carrying with it the accumulated moisture of several days; passing over Putiala and Umballa, it meets with a colder air coming from the hills, and by the sudden decrease of temperature the vapor of water is precipitated in floods of rain.

The same action probably takes place during a break in the rains. After a heavy fall of rain under the low hills, the belt of greatest heat is drawn back to the south of Sirsa, then gradually advances again to the north, and a repetition of the flood occurs.

It may be argued from this, that the larger the break in the rains in the neighbourhood of Umballa and Lahore, and the greater the heat, the greater and more severe the flood of rain will be when it at last bursts.

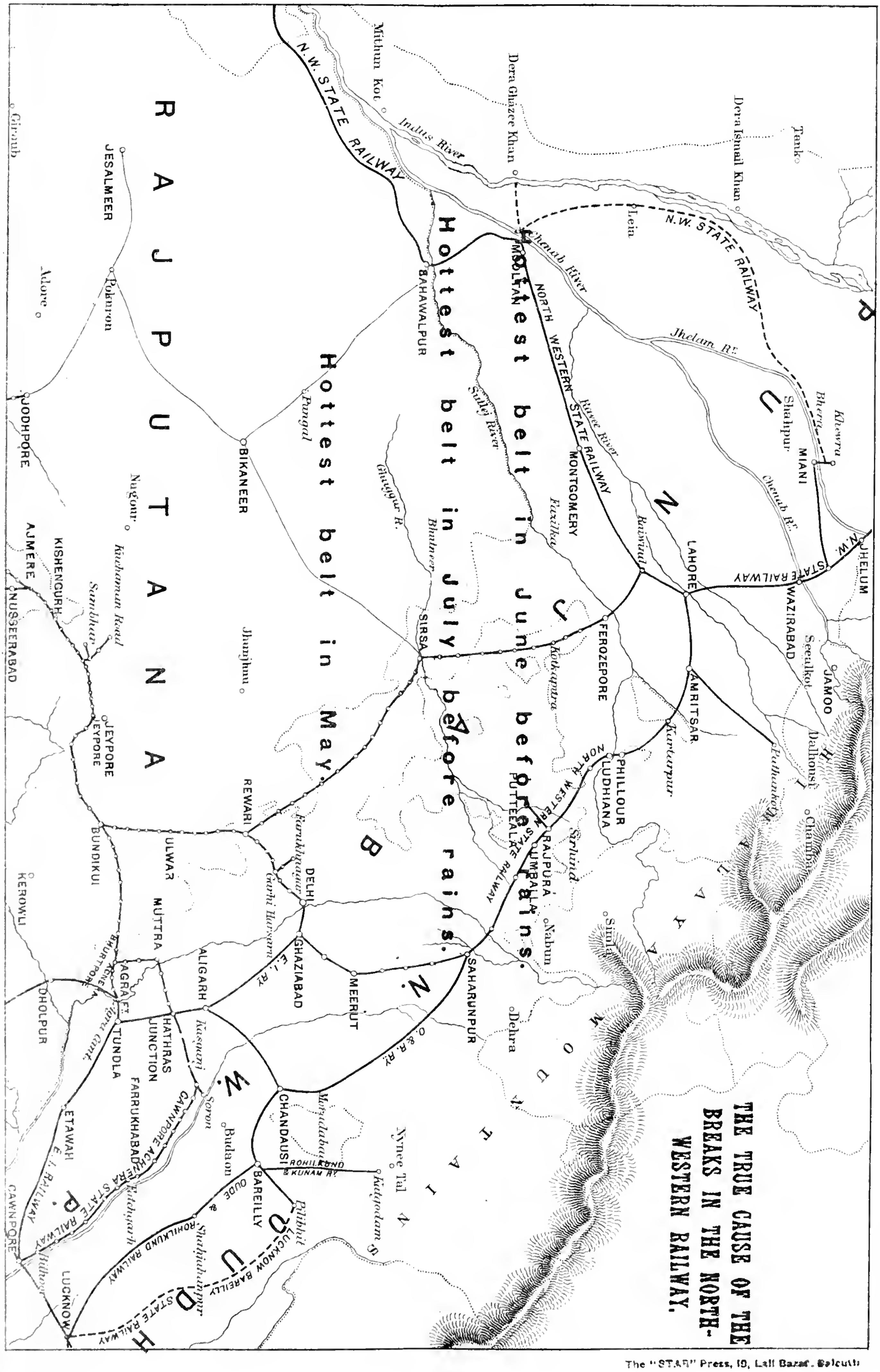
November 10, 1887. J. E. H.

BUILDING CONSTRUCTION IN HONGKONG.

(An Engineer's Notes going Home East.)

In ordinary civil buildings the town of Victoria, in the colony of Hong-Kong, shames the large cities of India, not excluding Bombay and Calcutta. There are few public buildings in Victoria—a Custom House, Court House, and Prison are about all. The prison is on one face the *beau-ideal* of a prison—a massive dead wall, 40 feet high, with a *chevaux-de-frise* of glass bottle ends that would puzzle a crow to sit on. Bye-the-bye, our ubiquitous Indian friend *Corvus Splendens* is conspicuous by his absence. In Hong-Kong there is a wealth of building material in granite that adds in no small measure to the appearance of the work. Brick and lime are all imported from the opposite mainland in and about Kowlūn. The superiority, however, by no means lies in the material granite alone, it is equally in the superiority of the workmanship and in the use of European materials for works of finish. Tile floors are the rule in the numerous private dwelling-houses, and marble mantel shelves and ornate ceiling ornaments and friezes. In Hong-Kong Island, in the suburbs, so to speak, of Victoria, the joiner's work is often more of the nature of cabinet work in quality and finish. The crude timber *chowket* of India is almost unknown with its accompanying equally roughly made venetian and sash or panel doors; there the door openings are all lined and the windows either sashes or French casement. Wooden dados are also in many cases used, the miserably stinted $1\frac{1}{4}''$ or $1\frac{1}{2}''$ door, too, is not found in good work, which partakes more or less of the richness of Queen Anne style of work. Admitting the material at hand in Bengal is brickwork only, there is no excuse now for the wretchedly poor woodwork prevalent. Whether the early builders in India adopted a style of woodwork that they found prevailing or adopted it owing to the want of skilled labour, there is no reason why it should still be persevered in. With Chinese labour available, it should now be changed for some such style of work as prevails in Victoria, Hong-Kong.

Queen's Road, Victoria, in its show of shop fronts might be some street in a large provincial town at Home. The fact of the houses being arcades, as are in fact the principal streets throughout the city, is not the only point in which it differs from a main street in Calcutta, or any other Indian city. The shop fronts are often imposing with large single plate glass windows and a good show of goods. The roads are the perfection of roads, granite concrete as smooth as an asphalte foot-path and clean enough for a city Arab to roll in without soiling his skin. It is true that this is partly due to the fact that there is no horse traffic and that the vehicular traffic is only jinrickshaws. The fact is the same. The roads are the perfection of cleanness and smoothness. These roads are made thus: The aggregate is composed of small well broken granite of the size of a walnut, and is about 6 inches thick, laid over a foundation of rough stone. At the outset sufficient to lay about 200 feet by 30 feet is prepared by thoroughly mixing in a large wooden box about 15 feet square and a foot deep sand and lime. Broken granite, sand



THE TRUE CAUSE OF THE BREAKS IN THE NORTH-WESTERN RAILWAY.

and lime. When thoroughly mixed the stuff is taken out and laid in a heap to one side and a fresh lot prepared, and so on until sufficient is prepared to lay the given surface. It is then spread out quickly by an "army" of men, and a granite roller weighing about 4 tons run over, hauled to and fro by about 150 hands, men and women, working at the same easy pace that a crowd of Bengalee coolies would work it. This rolling is continued for about four to five days, the only water added being some sprinkled over the roller to keep it clean, a man being constantly employed at this operation. In five days the road is complete and perfectly set. It would pay to try this in the Street roads of India, adding a little Portland cement with lime.

The granite work of Victoria in some of the buildings is of a quality of finish ordinarily put into Indian cemetery or public memorials. A very fine bit is to be seen in the circular clustered pillars on octagonal basis of the arcaded portion of the Chartered Bank of India building and again in the piers and arches of the arcade of some private offices of a building immediately opposite it; that in the new buildings of the Hong-Kong and Shanghai Bank whilst very effective and good, is not so highly finished. Granite is used almost throughout Victoria in the ground floor work, and always as the side jambs of all shop fronts, tall complete slabs 12 feet to 14 long and 16 inches wide on moulded bases being used for the purpose.

The entire island of Hong-Kong is mainly composed of granite; the upper surface being composed of immense boulders of hundreds of tons weight in size down to stones of but few pounds weight, lying imbeded in a matrix of disintegrated granite clay and sand. These latter are largely used for inferior work—gutters, foundations and such like. When this *débris* is removed, the lower bed is exposed and wedged out and quarried and worked up into ashlar and used also for lintels, door or window jambs, &c. The general character of the granite is a very light grey, the granite itself being almost the character of Cornish granite and is comparatively easily worked. There are some boulders interspersed about of a very dark blue and exceedingly hard, too hard to dress; it is used for revetment walling, either laid dry or in mortar in random work, and as such looks very grand and Cyclopean. The ordinary kind does not keep its colour well, and is subject to stains of iron developing, while the latter keeps its dark blue tint well. The roads already alluded to have fine saucer drains of granite pitching laid and pointed in Portland cement, so that they are, as may be imagined, very perfect as drains; they are often as much as three and four feet wide to carry off the great rush of water coming down their steep slopes in the tropical rains.

The hill-side is often cut back and quarried out to make a site for a building, so that often the edge of a slope is far above the house top. Houses are more generally built in rows and are often four stories in height, let as flats sometimes. The floors are all of timber of the ordinary type in Europe, herring bone strutting between them to stiffen them, lathed and plastered below and boarded above. The almost universal type of street house is two parallel brick walls, two-brick thick; two, three or four stories high with a frontage of from 16 feet in the poorer localities to 25 or 30 feet in the better class, and very deep. The native China house, has an inner court above the ground floor and the back portion forms the depôt or godown to the front, which is generally a shop. A good feature, and one that without exception is adopted from the 16 feet front shop to the isolated country seat, is a perforated wooden cornice round all rooms, giving free air access to the floor timbers and ventilation to the rooms; this is let in on the ceiling surface and cut like a bit of fret work into varying patterns and adds in no slight degree to the look of a room, especially when there is a plaster cornice below it.

The timber generally used is a pine from China mainland, the *Pinus longifolia.* Large scantlings come from Oregon or San Francisco.

In Hong-Kong two bricks are made use of—one a well burnt yellow brick like an ordinary English stock, the other a brick quite black at first sight, like a sun dried brick; it is, however, kiln burnt, most perfect in shape, with faces perfectly flat and edges clean and sharp. Of this brick the walls of the ordinary work is made, and proof is shewn of its hardness by the fact of four story walls 30 to 40 feet high and 60 feet long being built only two bricks in thickness of it; but it weathers badly and has to be plastered, and where unplastered it may be often seen weathered in to a depth of an inch, the mortar bed standing out that much between the bricks. Both bricks are 9″ × 4″ × 2½″. The brickwork is particularly well done, all the joints and beds being most completely filled in with good mortar. There is no lime in the island of Hong-Kong; it is all imported from Kowlün and the mainland. The greater portion of the lime used is made from shells. Immense quantities of Portland cement are used on work, even in cases where in India its cost would preclude it. The price, however, is practically the same as in India.

The foundation work of the buildings on the level strip of land bordering the sea is generally pile work and large blocks of granite, the soil being all water-logged.

All the roofs in Victoria and Hong-Kong are tiled two and three courses thick, the tile being a thin curved tile, and these are laid single, double, triple and even in four layers with the reverse tile in each layer.

The finest building in Hong-Kong is the new Hong-Kong and Shanghai Bank, a four story building, with three of the faces of granite work. The Public Rooms is a detached building, square on external plan with an octagonal centre portion domed on polished red Aberdeen columns, lighted from the dome, the latter carrying a very pretty lead covered lantern, also domed. This portion of the Bank is well designed, of good proportion, detail and finish. The woodwork is splendid; the floors all encaustic tiles; and in part it is glazed with stained glass. The private portion of the Bank is not so good in design; it is four stories in height, the three upper stories trabiated. The entrance porch from the sea face is a fine bold massive bit of granite work. The pillars of the arcading are polished Aberdeen granite, and all the Corinthian capitals are of cast iron of Macfarlane's perfect bits of castings. The China mason is as yet incapable of doing so elaborate a bit of work as a Corinthian capital. The sea façade is not as imposing as the front to Queen's Road. All the fittings of the interior, dado linings to the larger rooms and corridors and the staircase are designed on a scale found in some of the old Queen Anne and the Elizabethean mansions of the Old Country, and are a most creditable bit of work to all concerned.

Few of us in India have any idea of the trade and importance of the British colony of Hong-Kong. As many as 30 to 35 steamers lie in the Port in a single day, and often as many as 75 come and go in a week, steamers of all nations trading to the surrounding ports, from the splendid steamers of the P. and O. and M. M., now supplemented by equally fine steamers of the German Lloyds, down to small 100-ton steamers plying in the immediate neighbourhood of the Settlement. The port in Tonnage is the fourth in the world, standing in the order of London, Liverpool, New York and Hong-Kong. The trade of 1877 was in and out over 7 million tons.

Building in Victoria would appear to cost much about the same as building in India, a six-roomed detached residence of one story in height costing 15,000 dollars or about Rs. 34,000. This includes the preliminary cost of levelling site, and in many instances some heavy work of terracing, which terracing is made up of the material obtained in the levelling. Such a house would have a raised basement story of 6 to 7 feet high of rough rubble granite work on which the upper walls, built of the cheaper black brick, would be raised 12 to 15 inches thick. In this cost of 15,000 dollars would be included the extras, as ceiling, ornamentation, tiles, marble mantels, etc., as well as the extra finish of doors and windows.

B.

REPORT ON THE WATER-SUPPLY SCHEME PROVIDED FOR THE CITY OF JUBBULPORE.

By J. G. H. Glass, M. Inst. C.E., Executive Engineer.

VI.

Excesses occur on other items of iron work, in some cases for articles not provided for in the estimate, and in others where the quantities or the rates were insufficient. Bolts and nuts were not allowed for. All flanged joints under water were fitted with lead washers, and all other flanged joints with washers of vulcanized rubber; for these no provision was made. The number of sluice and scour valves was increased owing to the construction of the strained water chamber, the addition of a second pipe through the culvert, and for extra scouring appliances on the pipe line; and 24 clearway hydrants were given in addition to the number allowed in the estimate, so as to protect the town more efficiently from fires, and to give greater facilities for the escape of air from the pipes. The amount provided in the estimate for iron work, which includes pipes of all kinds, valves, hydrants, &c., is Rs. 2,78,584, and the actual cost came to Rs. 2,93,908, shewing an excess of Rs. 15,324; but if the usual 5 per cent. for contingencies be added to the estimated value, the total excess is only Rs. 1,395.

The cost of laying the pipes was much under-estimated. In the report attached to the original estimate it is mentioned that: "The only one (rate) about which I have any doubt, is that for laying the pipes; I have had no experience of this description of work, and have therefore been compelled to seek for information from other sources. The rate I have fixed on is about the same as was found to answer in the laying of the pipes for the Calcutta Water Works project, and it may therefore be considered at least sufficient."

The rate allowed was Rs. 8 per ton. This included unloading at Railway station, carriage from thence to site, the supply of all materials for jointing, the putting up of all specials, such as hydrants, air and sluice valves, and the excavation of trenches for the pipes. Tenders were called for from several firms at Calcutta and Bombay, but the lowest received was at Rs. 14 per ton, exclusive of the trenching. This appeared to me excessive, and I accordingly asked for permission to go to Bombay to endeavour to come to an arrangement with some plumber to undertake the work on more moderate terms. Through the courtesy of Messrs. Richardson and Cruddas, I secured the services of an intelligent and energetic Parsi, who agreed to do all the laying of the pipes and specials for Rs. 9 per ton, but he would not include the trenching in that rate. As it was considerably lower than any other received, and as I saw no other way of getting the work done cheaper, I was forced to recommend that it should be accepted. The total number of tons laid was 2,185, and at a rate of Rs. 9 per ton the cost came to Rs. 19,665 against the estimated cost of Rs. 16,059.

The cost of the trenches, and of embankments, where circumstances did not permit of the pipes being laid under ground, as will be explained hereafter, amounted to Rs. 4,232, and in addition to this a further expenditure of Rs. 4,270 was or will yet be incurred in the construction of viaducts for the pipe line across the several nallas that are met in the length between the Reservoir and the City. The necessity of these viaducts had not been considered when the original estimate was prepared, but their construction could not well be avoided. Had the pipes been laid in the bed of the streams as is very often the practice, very grave results would have followed from a burst occurring whilst the stream was in flood, as it would have been impossible to repair it till the flood had subsided, and serious inconvenience would have been caused to the townspeople by a cessation of their water-supply. It cannot be doubted that it was not only expedient, but absolutely necessary to adopt such measures as would render a contingency of this kind practically impossible. There are in all four large viaducts on the pipe line, one of 4 spans of 23 feet, two of three spans of 23 feet, one of 4 spans of 12 feet, and the fourth of 4 spans of 23 feet, and 6 spans of 12 feet. There are besides 4 smaller viaducts across minor streams, and where the main enters the City the pipe is carried under the parapet wall of the Umti nalla bridge for which special arrangements were necessary. Each of the viaducts is provided with a footway, so that the pipes can be readily inspected at all seasons. This is of much importance, as in high floods, which are of constant occurrence during the rains, the nallas are unfordable, and there are no other means of crossing available.

The total cost of trenches and viaducts for the pipe line amounted to Rs. 9,253, and adding to this the expenditure in connection with the laying of the pipes the total cost of the item pipe-laying amounted to Rs. 28,967, or Rs. 12,908 in excess of the provision made in estimate.

This is the only rate in the whole scheme which has been largely exceeded. As previously mentioned, I was not quite certain from the first that it would prove sufficient. The data from which it was arrived at were obtained from the printed report of the Calcutta Water Works, and according to the details given there the rate allowed appeared to be sufficient. But results have shewn that it was not. I can only say that every care was taken to arrive at a correct rate at first, and that when it was found insufficient no trouble was spared to do the work as cheaply as possible. Comparing the rate paid with that given in Captain Marryat's book of Rates and Specifications, it would appear that the work was done at a moderate cost, as the following will shew :—

Cost of laying pipes as per Captain Marryat's book of Rates, &c.

	Rate per ton.	Rate per chain of 100 feet.
	Rs.	Rs.
10" Pipe	19·30	55·81
6" ,, ...	17·92	32 25
4" ,, ...	31·87	25·50
3" ,, ...	27·50	16·50

Actual cost, Jubbulpore scheme.

	Rate per ton.	Mean rate per chain of 100 feet.
	Rs.	Rs.
Pipes from 16" to 2" ...	13·26	36·70

In the latter the cost of the viaducts is included, a charge for which no provision is made in the Bombay rates; and if it is deducted the comparison is much more in favour of the rates paid at Jubbulpore.

The total amount of the sanctioned estimate is Rs. 6,75,000, and the total cost of the completed scheme amounts to Rs. 6,91,140, thus shewing an excess of Rs. 16,140, or just 2½ per cent. If from this excess the cost is deducted of such items as were not contemplated when the estimate was prepared, and as are not properly chargeable to contingencies, the total excess over the estimate is only Rs. 6,000, or about 1 per cent., and even this disappears if the amounts spent in the removal of trees from the Reservoir area and in taking up additional land round the Reservoir are not debited to contingencies.

The scheme is designed to supply 88,423 persons at the rate of 15 gallons per diem per head, and on this basis the capacity of the Reservoir was fixed. The capacity to the 61·25 contour (the evel of crest of waste weir) is close on 203,000,000 cubic feet. The Dam has, however, been built to a section that will admit of its being raised to the 65 feet contour should necessity arise hereafter for an increased storage, at which level the capacity is about 239½ millions of cubic feet. It is assumed that the draft from the Reservoir will only be for 9 months of the year (280 days), for during the monsoons, which usually prevail from $3\frac{1}{2}$ to 4 months, *i.e.*, from the 15th June to end of September, the quantity drawn from the Reservoir in the previous season will not only be replaced, but the requirements of the City, &c., will be supplied whilst they continue.

The yearly draw on the storage for supply is therefore $280 \times 88,423 \times 15 =$ 371,377,000 gallons, or 59,420,000 cubic feet. The quantity contained by the lowermost ten feet of the Reservoir is deducted from the available storage, as it is not intended to draw from that portion, the space being left for siltage. An evaporation and absorption are allowed for as being represented by a vertical depth of 6 feet, taken on a mean area between highest level and the calculated L. S. level of stored water.

The catchment area is clean, is free from villages, the few huts that formerly occupied it having been bought up and removed, and is cultivated to only a small extent. It embraces an area of 5·26 square miles, and the soil is principally rocky. The lowest observed rainfall in any year since registration was commenced in 1850, occurred in 1868, when it amounted to only 24·47 inches. The quantity found by Mr. A. R. Binnie, M.I.C.E., to flow from the catchment of the Nagpur Water Works was two-fifths of the observed rainfall, and as the catchment of this scheme is very similar as regards the configuration of the ground, (the only difference being that it is perhaps more precipitous,) and the nature of the surface to that of the Nagpur scheme, the same proportion was adopted in calculating the available storage. I may mention that from observations made in the two seasons that the Reservoir has filled since its construction, the proportion of two-fifths is found to be very fairly correct. The quantity available for storage calculated on the lowest observed monsoon rainfall in a period of 35 years is therefore—

$5{\cdot}25 \times 640 \times 43,560 \times \frac{49}{24} \times \frac{2}{5} = 11,95,28,640$ c. ft. Tabulating the results obtained in the preceding paragraph and in this we get:—

Quantity available from the catchment c. ft. 1,19,528,640

Deduct—

Supply for 280 days ...59,420,000
Evaporation and absorption ...47,415,786
Lowermost 10 feet in Reservoir 548,413
——————— 1,07,384,200

Surplus over requirements c. ft. 12,144,440

The average monsoon rainfall for the same period is 51·42 inches, and this at the same proportion of off-flow would give 2,50,863,782 cubic feet as the quantity available for storage. In years therefore of average rainfall the quantity available is largely in excess of requirements, and the lowest rainfall in a period of 35 years is more than enough. It may further be mentioned that as the consumption of a season including loss from evaporation and absorption, is calculated to be represented by a vertical depth of $12\frac{3}{4}$ feet from high stored level, there would still remain above the level of the lowest inlet pipe 85 millions of cubic feet, which in event of an entire failure of a monsoon, a very improbable contingency, would suffice for the supply of the ensuing season at a somewhat reduced rate. In other words, the storage is practically sufficient for the requirements of two consecutive seasons without replenishment.

The masonry dam is very favorably situated on the Khundari nalla before it descends from the plateau in which it has its source. The site is to the east of Jubbulpore, from which it is distant about 8 miles. The bed of the stream at crossing of dam is 1389·67 above mean sea-level, and is composed of a good description of basalt rock which is met along the whole alignment of the dam, generally close to the surface. Immediately above the site chosen for the dam, the nalla turns at very nearly right angles to its former course, so that the dam is nearly parallel for a considerable portion of its length to the direction of the stream. On the left bank high ground rises abruptly from bed of nalla to a height of over 70 feet, and the dam abuts on it and is carried into it for a length of 130 feet, sound rock being met for the foundations throughout not far from the surface. On the right bank there is an outcrop of basalt rock which has an ascending slope from the nalla bed to the hill forming the right flank of the dam. Owing to the change in direction which has already been mentioned, this outcrop forms the right bank of the stream from where the dam crosses it. In cross section the outcrop has an abrupt fall on the nalla side and a long slope on the other. A good description of basalt is met in abundance around the site of the dam, from which building material was obtained. It is thus evident that the site is a very good one, and presents great natural advantages for the construction of a masonry dam. The calculations for the masonry dam are given *in extenso* in the Appendices. A somewhat less section would have been obtained by taking a higher value for the weight of the masonry, and no doubt it would have been right to do so, as the weight of basalt in hydraulic mortar is more than what I have taken it to be, *viz.*, 125 lbs. per cubic foot. But in a dam of moderate height, such as this is, the extra thickness resulting by assuming too low a weight for the material is not of much importance, excepting as a matter of cost.

(To be continued.)

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XIV.

Brickwork in lime. 2nd class work intended to be plastered.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Bricklayers No. ...	2			
Do. „ ...	$2\frac{1}{2}$			
Coolies „ ...	3			
Do. „ ...	$1\frac{1}{2}$			
Do. „ ...	3			
Bhistie „ ...	$1\frac{1}{2}$			
Grinding mortar, c. ft.	26			
Sundries	...	Variable.	Do.	Do.
Materials.—				
Bricks 2nd class including waste, c. ft. ...	1,300			
Lime slaked dry, c. ft...	$12\frac{1}{2}$			
Sand „ ...	$12\frac{1}{2}$			
Surkhi „ ...	$12\frac{1}{2}$			
Sundries	...			
Scaffolding ...	...			
Petty Establishment ...	...			

Specification.—Bricks to be of the second selection, sound, free from cracks and fairly well burned. The joints may be a little coarser than in first-class brickwork.

X.

South African Railway Extension.—A special session of the Orange Free State Volksraad was opened on Monday to consider the railway question. Sir John Brand, in his speech on the occasion, urged the imperative necessity of a trunk line through the Orange Free State, connecting the Delagoa Bay and Pretoria line with the Cape railways. The President advocated a conference of the independent States and the Colonies in South Africa to consider the matter, and expressed the hope that the overcoming of the objections in the Transvaal to railway connection westward would be conducive to a federal union between the Republics, which would be the forerunner of a general federation of South African States. President Kruger and the members of the Transvaal Commission were present.

BUILDING CONSTRUCTION.

II.

THE cost of centring is an expensive item in the construction of vaults. It is perhaps not generally known that this cost can be avoided in case of semi-circular vaults for spans up to 16 feet, and probably more, by adopting either the light construction of Syrian roofs in which hollow hexagonal tiles are used for voussoir, or by resorting to what is called *Tajerbi* work, in which bricks gauged to the required form are laid with spiral coursing joints skew to the walls as in the half width of a skew arch.

In both cases portions of haunches are at first brought up in the ordinary way, but without centre, or are built up with the side walls, for about $2\frac{1}{2}$ feet from springing, so far as the voussoirs could be safely held by the cohesion of mortar joints, the object being to reduce the span of the remaining work. The end walls are then raised to the required height and shape of the intrados of the arch and the work of laying hexagonal tiles or working courses of brick on the principle of skew arches is then commenced from the two corners towards one of the end walls and carried on until completed towards the other end wall. In *Tajerbi* work the arching is sometimes carried on both end walls and finished in the centre. Plate II shews details of the above works. The curve of the intrados is preserved by applying a curved plank to the cornice or the springing line inside and tested by strings stretched from the curved top of one end wall to that of the other.

In Sind this work is done with mud, and plastered both inside and out; also with mud mixed with wheat *bhoosa;* but in places with greater rainfall than here, lime mortar would be necessary for the cementing material.

The cost of *Tajerbi* work is not greater than that of the ordinary arch, while that of Syrian roofs with hexagonal tiles is slightly higher, but there is the saving of centring in both cases which is a great advantage, especially when high walls have to be connected by a vault.

It will be apparent that the weight of the vaults in the above two constructions is more or less borne by walls on all sides, instead of by the side walls only as in the ordinary arch. Part of the thrust of the upper portions of the arch also apparently acts in the length of the wall, in which position it can easily bear it. There is also less fear of a crack appearing in the centre or of its proving dangerous if it occurs.

Calculations for the mould of Vousoirs in Syrian roofs and the mode of Construction.

In Syrian roofs the faces of voussoirs on the extrados are regular hexagons, the sides of which are generally 3″ and diameter of the circumscribing circle 6″ long. The length of voussoirs being generally 9″ the size of the faces on the intrados is found by reducing the height in the proportion of the radius of the extrados to that of the intrados, the width remaining the same.

In the case illustrated in Plate II., the sizes of different parts are ascertained by single trigonometrical formulæ with the help of mathematical tables. They can also be obtained by geometrical construction as shewn in *Fig.* 5.

The mode of construction is as follows:—The haunches being raised for about $2\frac{1}{2}$ feet on the intrados, the end walls are then raised to the required shape of the arch on the intrados. The first voussoir is then laid on the crown of one of the end walls, half projecting from the wall. Other voussoirs are then arranged at proper distances from crown towards the springing and the exact point where the brick arch should end and the work with hollow hexagonal voussoirs begin is determined. In Plate II., *Fig.* 4, voussoirs 1 to 8 are first arranged, No. 9 is then laid on and No. 10 is inserted between Nos. 7 and 8; No. 11, between Nos. 8 and 9 and so on, and No. 12 laid on the same level with No. 9. Other courses are similarly worked from top to bottom to avoid possibility of any mistake at the crown and the work completed in the opposite end wall.

In the present case, the length of the semi-circular arch on the intrados is $15'8\frac{1}{2}''$, and the length of the work with hexagonal voussoirs being $15\times5\frac{1}{4}''+14\times\frac{5\frac{1}{4}''}{2}+2\times5\frac{1}{4}''\times\frac{3}{4}=10'3\frac{3}{8}''$, the length of brick haunches on both sides$=(15'8\frac{1}{2}'')-(10'3\frac{3}{8}'')=5'5\frac{1}{8}''$ and the height on each side $\frac{5'5\frac{1}{8}''}{2}=2'8\frac{3}{4}''$ nearly, which gives 16 courses of brick work of nearly 2″ on the intrados.

The voussoirs in the above description are supposed to be placed at right angles to the side walls. As however the construction is somewhat on the principle of *Tajerbi* work, the best position for voussoirs would probably be at right angles to the direction in which they are laid or at right angles to the line *ab*, in *Fig.* 4, Plate II. This arrangement would require the cutting of the faces at a very acute angle and cause inconvenience in moulding. Consequently a middle course is adopted in practice and a departure of only about 2″ to 3″ from the perpendicular to the face walls is allowed in the length of voussoirs as shewn by line *bd*, and the advantage of obtaining sufficient hold on the end wall at starting and reducing the slipping force at the side walls as much as possible is thus secured.

G. R. T.

THE HAULAGE EXHIBITS AT THE NEWCASTLE EXHIBITION.

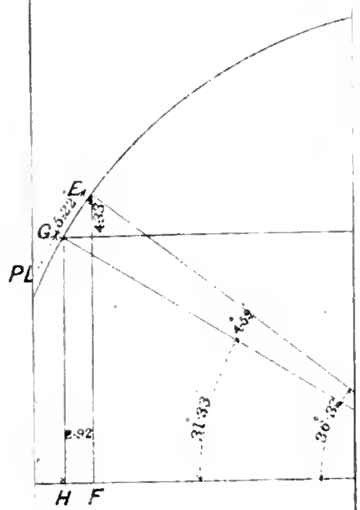
AN area of nearly five acres of ground is occupied at the Newcastle Exhibition by an exhibit of several of the systems of haulage employed in mines, which have been found to be practically successful. The arrangement of this exhibit was undertaken by a small committee of the Mining Engineers of the Newcastle coalfield, under the presidency of Mr. George May, Manager of the Harton Collieries. In the selection of the systems to be shewn, the committee insisted upon the conditions that they should work automatically round a curve not exceeding 66 feet in radius, with an enclosed angle of $82\frac{1}{2}°$.

The systems shewn by the various exhibitors may be classified as follows:—

	Double Roadway Systems.
Rope or chain over tubs ...	(1) Tyne Coal Company, Limited.
	(2) Bedlington Coal Company.
	(3) Seaton Delaval Coal Company.
Rope under tubs ...	(4) South Durham Coal Company.
	(5) Castle Eden Coal Company, Ld.
	(6) Whitburn Coal Company.
	(7) Hodbarrow Mining Company.
	Three Rail Systems.
Rope under tubs ...	(8) Harton Coal Company, Limited.
	Single Roadway Systems.
Rope under tubs ...	(9) Moresby Coal Company, Limited.
	(10) Tredegar Coal Company.
Main and Tail Rope ...	(11) Helton Coal Company.
Locomotive Engines ..	(12) Earl of Durham.

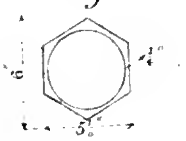
In addition to the above systems, there is a double road system worked by an electro motor, and another operated to shew the action of various modes of attaching the tubs to the rope, and an exhibit of Otto's overhead wire rope way, used for transport of minerals, &c., upon the surface.

(1.) The Tyne Coal Company, owners of Hebburn and the famous Walls-end Collieries, shew the endless chain system, in which there are two roadways from the shaft to the landing or station, one being used to convey the empty tubs and the other for the full tubs. In the present case, the tubs are attached to the chain by a notch in an iron plate placed on the top and at one of the ends of the tubs, and are spaced about 20 yards apart. The tubs pass round the curve in the usual way, by releasing the tubs from the chain when approaching the curve, and causing the tubs to run automatically round the curve, which is of 30 feet radius by inclined planes of suitable gradients. The tubs re-attach themselves as soon as the chain is allowed to fall low enough for the purpose, and no manual labour is required at the curve. In this system the tubs cannot be filled more than



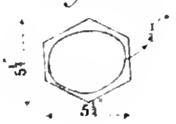
s Section of Hollow
ssoirs near Extrodas.

Fig. 6.



Cross Section of
Hollow Vossoirs nea
Introdas.

Fig. 7.



Scale for Figs. 4 &

Scale for Figs. 6, 7 & 8

Scale for Figs. 1, 2, 9, 10, 11,

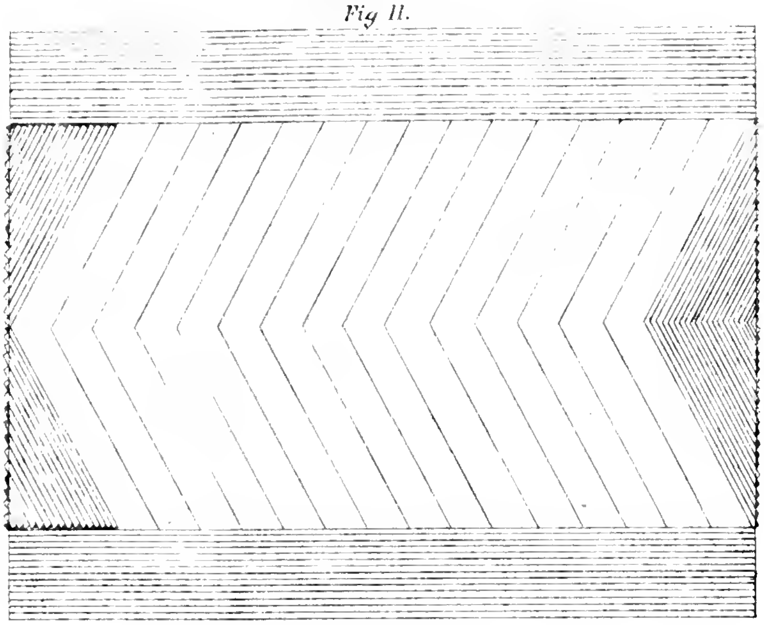
WING SPECIMENS OF TAJERBI WORK.

PLATE II.

Work commencing from one end wall
and ending in the other.

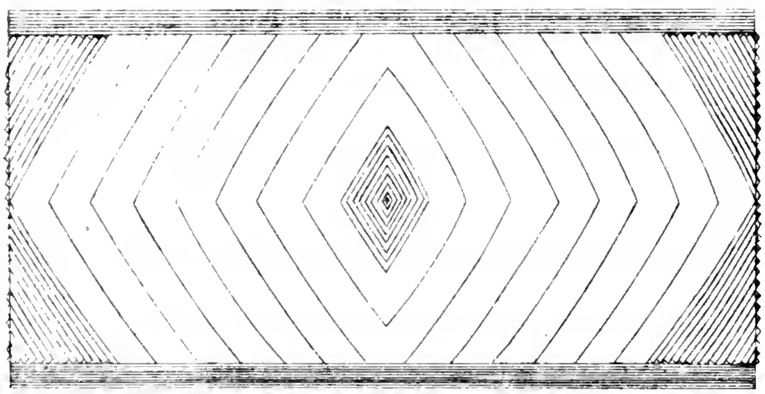
Development

Fig 11.



Plan of Introdus

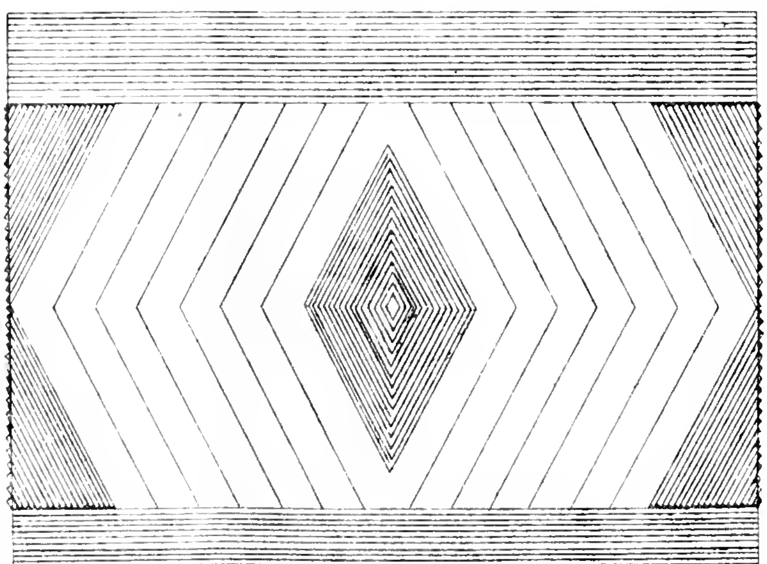
Fig. 12.



Work commencing from both end
walls & ending in the middle of room.

Development

Fig. 13.



NOTE.—The layers in the central rhombus are
better worked parallel to abutments
when only 12 to 18 wide.

The "STAR" Press, 10, Lall Bazar, Calcutta.

streak full. A small engine is also provided by the Tyne Coal Company to drive this system.

Messrs. Walker Brothers, of the Pagefield Iron Works, Wigan, provide a hauling engine, which is all that can be desired for the work of haulage in mines. It is used to drive all the systems from 2 to 8 inclusive, by means of two pulleys, actuated by means of Fisher and Walker's patent friction clutches. No. 7 system is driven direct by one of the pulleys; the other pulleys being used to drive the other systems, each of which are fitted up with a fast and clutch pulley upon their terminal shafts. The rope from the main driving pulley passes round and drives all the clutch pulleys, and all or any of the systems can be operated by putting the respective clutch pulley into gear.

(2.) The Bedlington Coal Company shew a form of the endless rope system, with the rope over the tubs, and double roadways. The tubs are attached singly to the ropes by a fork or jockey fixed to the centre of one end of tub, and of sufficient length to permit of the tubs being filled above the level of the edges. The tubs are placed from 15 to 20 yards apart according to the quantity of coal to be conveyed. The speed is usually about 2½ miles per hour. The rope is suspended round the curve on a series of 16 large horizontal pulleys, which are placed so as to bear against the forks. The success of this system of passing round a curve is due to the satisfactory working of the automatic surveying "gates," carrying a conical roller which prevents the rope from falling out of the horizontal pulleys. These gates, one of which is placed at each end of the curve, are kept in position across the roadway by means of balance weights. When a tub approaches the curve, it strikes the arc or bow on the lower portion of the gate, and throws it open; and as soon as the tub has passed, the gate returns by the action of the balance weights to its former position across the roadway. The action of these gates is so sure that the roller always goes under and supports the rope before it can fall to the ground after the passage of a tub. The Bedlington Coal Company have applied this system very extensively, as they have 8,500 yards of 2½ inches steel wire rope in use to convey about 900 tons of coal per day, from various stations to the shaft, the greatest distance being about 1,600 yards.

(3.) The Seaton Delaval Coal Company have erected their system of endless rope haulage, with the rope upon the side of tubs and double roadways. In this instance the tubs are attached singly to the rope by two forks placed in iron sockets near the corners of one side of the tub. The tubs are usually placed from 10 to 15 yards apart, and the rope has a speed of about 2 miles per hour. A point of interest in this system is the passage of the tubs around the curves without being detached from the rope: this is effected by means of a series of small rollers placed vertically, so as to carry the rope close to the forks, and by another series of small rollers placed horizontally and beneath the rope and forks, which prevents the rope falling to the ground. In practice with this system, it is usually found advisable to keep the roadways as straight as possible, and to detach the tubs in passing around curves, or in working branch ways. It may also be pointed out that this system permits of the tubs being filled above the level of the sides. The life of the rope under this system has been found to be at least 5 years.

(4.) The South Durham Coal Company shew a system in which the endless rope is carried (upon rollers) underneath the tubs. It requires a double roadway, as the tubs are attached in sets of 14 tubs at varying intervals, as may be required. The sets are connected to the rope by means of a bogey travelling in front of the tubs. The bogey carries a fixed clip or gripper actuated by means of a right and left-handed screw. The clip is placed in the centre of the bogey, and readily passes around the curve, where the rope is kept in position by means of very flat shaped sheaves. The working of the tubs and bogey around the curve is performed in a most satisfactory manner. The driving gear upon this line is fitted up with an automatic arrangement which disconnects the rope from the pulley should any accident occur to the system, by which the strain upon the rope is in any degree increased. This system is working at Eldon Colliery over a length of more than 4,000 yards.

(5.) The Castle Eden Coal Company, Limited, are the exhibitors of a double roadway system in which the endless rope is carried underneath the tubs on small rollers. In this instance, however, the tubs are attached singly to the rope by means of Fisher's patent clip, which is hung upon the drawbar, and grips the rope by deflection of the clip from the vertical. It is very simply attached to the rope, and may be relied upon in all cases, where the roadways are subjected to great variations in the gradients. A very ingenious arrangement is in use for automatically detaching these clips from the rope. The rope is kept in position around the curve by means of small sheaves attached to the sleepers.

(6.) The Whitburn Coal Company's exhibit is in many respects similar to the preceding one, and consists of a double roadway, with endless rope carried on small rollers underneath the tubs. The tubs are attached singly to the rope by means of Morgan's patent clip, which grips rather than deflects the rope. These clips are used at Marsden upon gradients exceeding 6 inches to the yard. The rope is carried round the curve by means of small bell-shaped sheaves. The tubs are usually placed from 30 to 40 yards apart, and run at a speed of about 3½ miles per hour.

(7.) The Hodbarrow Mining Company shew another of the double roadway systems in which the endless rope is carried underneath the tubs, which are attached to it by means of Rice's and Fisher's patent clips, both of which depend for their action upon the deflection of the rope. The leading feature of the system is the slow continuous motion of the rope, which travels at the speed of about 2½ miles per hour. The rope can be loaded with tubs placed 6 feet apart, and under these conditions it can deliver 2,000 tubs per hour. T. W. B.

(To be continued.)

JOTTINGS FROM THE BENGAL COAL-FIELDS.

(From a Correspondent.)

I HAVE just got some information about the Equitable Coal Company and the Bengal-Nagpur Railway. The former have withdrawn their claim, which was heavy, and agree to take anything for the land which the line runs over between Raghunathpur and Sitarampur; but if the line goes into Asansol, it still crosses a lot of Equitable land. For this they will ask the full claim, and take nothing less. All the coal companies are in favor of the line coming into Sitarampur now, for it opens a deal of coal land over the river near Pachete Hill, especially the large lime quarries which are now shut out.

I hear that the telegram which came to stop work and survey on the Asansol route was caused by a letter which was in your paper three weeks ago.

There are now heavy coal stocks at all the collieries.

The Coal trade has become very dull. Now that the rice harvest has failed the miners work better and raisings at all collieries have got up 50 or 60 per cent. over this time last dry season.

It is thought that as the line is coming through to Sitarampur collieries they will be able to send coal upcountry like Giridhi collieries do on about the same rates, for no doubt Sitarampur coal is of much better quality.

The Iron Works are rather slack for want of orders.

It appears to be settled now that the East Indian Railway, Barrakur Branch, is to be carried over the Barrakur River to the collieries beyond and also some distance further on to a place called "Nirsha," where the Bengal Coal Company are looking out for coal. This Company are now very energetic since the return of the Superintendent from England.

The E. I. Railway collieries are now working only about half time. No orders for their coal for full output.

I see that the native collieries here are all doing well, but have reduced their coal rate very much. They are now putting coal into wagons at Rs. 2-10, good Sitarampur!

NOTES FROM MADRAS.

(From our own Correspondent.)

I HAVE been so busy lately that I have not been able to keep up my correspondence with you as regularly as I could wish. There has been another reason also in the fact that until the other day, when His Excellency Lord Connemara inaugurated the works of the Periyaur Project, by cutting down a tree on the site of the proposed dam, no item of any great interest in your line was available. The fact is this is our heavy monsoon time, and we have been having such moist, not to say *juicy*, weather lately that Engineering operations have been almost at a standstill. The history and details of the great work above-mentioned have now been published, and I have much pleasure in sending you the following particulars regarding it.

The Periyaur river rises in the Western Ghats, in the State of Travancore, and flows in a north-western direction into the Arabian Sea. The Vigay is a river which also rises in the Western Ghats, but in British territory, and flows in a south-easterly direction through the district of Madura into the Bay of Bengal. Travancore always has an excessive rainfall, the annual average being 100 inches; whereas Madura suffers from a scanty and capricious rainfall—so much so that I am sure its ryots would excuse me if I were to say that there is no average at all. Well, at one part of its course the Periyaur approaches to within a few miles of the Soorooly, a tributary of the Vigay; and the scheme is to divert its water, or as much as accumulates up to that point, into the Soorooly, and thus into the Vigay—after which the ryots will know what to do with it. A stupendous dam of concrete is to be thrown across the valley of the Periyaur, and the impounded water led partly by open channels and partly by a tunnel through the high ground to the east into the bed of the Soorooly. The catchment basin is in the Travancore State and the Government have taken a 999 years' lease of the land required for the works, paying Rs. 40,000 per annum for it and the water drawn off. The scheme is estimated to cost nearly 60 lacs of rupees, and to yield a profit of between 8 and 9 per cent. per annum. It is expected that sufficient water will be got to irrigate 150,000 acres. The tunnel is to be 6,650 feet in length, and to have a sectional area of 80 square feet and a fall of 1 in 75. The question which occurs to me is, will this tunnel be able to discharge sufficient water to irrigate 150,000 acres of land? Assuming it to be equivalent to a cylindrical pipe 121 inches in diameter, I calculate that it will discharge 100,000 cubic feet per minute, and my opinion is that this is not sufficient to irrigate 150,000 acres of land: and if you have ever seen the way the ryots use the water in irrigating the delta of the Cauvery I think you will agree with me. It appears to me, too, that the off-take is placed at too high a level. It is 113 feet above the bed of the stream! So that there must always be this depth of water lying idle in the basin. I do not lose sight of the fact that it will gradually silt, but I question if it will silt so much in the 999 years. Besides this is a question for posterity and I am not one of those who care to do much on their account. For, as Sir Boyle Roche very pertinently asks—What has posterity done for us that we should do so much for posterity? You see this 113 feet high up off-take necessitates a dam 153 feet high. The level of the two overflow channels, one on each side of the dam, is 144 feet above bed of stream. These levels also require some special provision for the discharge of the water either through or over the dam while it is building. I do not know what the objection is to building a hole in it, but that is not what they are going to do. The plan to be adopted is to have three wrought iron siphons, each about 9 feet in diameter, to carry the water over it. These siphons are to be raised higher and higher as the dam grows—the Executive Engineer or a duly authorised assistant shouting *Excelsior* on each occasion of a lift. This brings me into personalities, and although as you know I avoid them as much as possible, I must tell you that the work is the joint outcome of the labours of Major Ryves, Colonel Pennycuick, R.E., and the late Mr. Richard Smith: the final elaboration being the work of Colonel Pennycuick. The Executive Engineer to whom the work has been entrusted for execution is Mr. H. S Taylor. This gentleman and his staff are now on the ground and are living in grass huts. Ah, the world at large little thinks of the hardships we Engineers go through to give it all the good things it gets! Fancy being awoke at night by a wild elephant stirring you up with his trunk, or a herd of bison stampeding over you, or even a python swallowing you and your camp cot together. All these animals grow in that part of the world. The work has been commenced and is being carried out departmentally. I do not suppose any contractors would care to go there.

I hear there have been several failures of bridges on the newly opened Cuddapah-Nellore State Railway. The traffic has had to be stopped. The failures are due, I believe, to insufficient waterway. Nothing has yet been done towards starting work on any of the numerous State lines which have been surveyed in this Presidency. I believe the Vellore-Villapuram line is the first to be taken in hand, but it has not yet been decided by what agency. The land plans are being prepared, but ground is not likely to be broken before next official year.

The Government have prohibited Railway Officials from doing private work. This is as it should be. Railway officials are very highly paid, and have quite enough work within the sphere of their legitimate duties to satisfy any reasonable man.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, November 5, 1887.

Burma State Railway.

Mr. H. Groves, Executive Engineer, 2nd grade, made over, and Mr. F. R. Bagley, Executive Engineer, 3rd grade, received, charge of the 5th Division, Toungoo-Mandalay Extension, on the forenoon of the 24th October 1887.

With reference to this office Notification, of the 3rd November, Mr. H. Groves, Executive Engineer, 2nd grade, is attached to the office of the Engineer-in-Chief, Toungoo-Mandalay Extension, from forenoon of the 24th October 1887.

Madras, November 8, 1887.

Special leave on urgent private affairs for six months is granted to Mr. A. M. Hayes, Executive Engineer, 4th grade, temporary rank.

Mr. A. M. Foord, Executive Engineer, 4th grade, temporary rank, from the V. Circle, Chingleput Division, to the VI. Circle, Tanjore Division. To join at the public expense.

Bombay, November 10, 1887.

Mr. A. S. M. Ritchie, Assistant Engineer, 1st grade, is reported to have passed the colloquial examination in Kanarese in accordance with the Public Works Code.

Punjab, November 10. 1887.

Mr A. E. Orr, Assistant Engineer, 1st grade sub. *pro tem.*, from the Patiala-Bhatinda Railway Survey to the Dera Ghazi Khan Provincial Division.

Mr. W. J. Greer, Executive Engineer, 4th grade, from the office of Joint Secretary, which he left on the forenoon of the 12th October 1887, to the 2nd Division, Bari Doab Canal, which he joined on the forenoon of the 14th October 1887.

Mr. R. W. Rowland, Assistant, Engineer, 1st grade, 5th Division, Sirhand Canal, passed the Lower Standard Examination in Hindustani on the 3rd October 1887.

Central Provinces. November 12, 1887.

Rao Sahib Ishwari Pershad, Assistant Engineer, 2nd grade, reported his arrival at Nagpur, on forenoon of the 8th current, from the two months' privilege leave granted him in Central Provinces Public Works Department Notification, dated 19th August 1887.

Rao Sahib Ishwari Pershad, Assistant Engineer, 2nd grade, is transferred from the North-West Road Sub-Division to the Kanhan Division.

India, November 12, 1887.

The services of Colonel W. Jeffreys, R.E., Chief Engineer, 3rd class, temporary rank, North-Western Provinces and Oudh, are replaced at the disposal of the Military Department, with effect from the 9th November 1887.

The following reversions are ordered, with effect from the 24th September 1887:—

Colonel D. Ward, R.E., from Chief Engineer, 1st class, temporary rank, to Chief Engineer, 2nd class.

Colonel J. P. Steel, R.E., from Chief Engineer, 2nd class, temporary rank, to Chief Engineer, 3rd class, temporary rank.

Mr. F. J. Johnstone, from Chief Engineer, 3rd class, temporary rank, to Superintending Engineer, 1st class, temporary rank.

Colonel B. Lovett, R.E., Superintending Engineer, 1st class, temporary rank, to Superintending Engineer, 2nd class.

Major W. G. Nicholson, R.E., Superintending Engineer, 2nd class, temporary rank, to Superintending Engineer, 3rd class.

The services of Colonel A. M. Lang, R.E., Chief Engineer, 1st class, North-Western Provinces and Oudh, are replaced at the disposal of the Military Department, with effect from the 16th November 1887.

Colonel D. Ward, R.E., Chief Engineer and Joint Secretary to the Chief Commissioner, Central Provinces, in the Public Works Department, is appointed Chief Engineer and Secretary to the Government, Public Works Department, North-Western Provinces and Oudh, *vice* Colonel A. M. Lang, R.E., whose services have been replaced at disposal of the Military Department.

Colonel J. P. Steel, R.E., Officiating Chief Engineer and Secretary to Government, Punjab, Public Works Department, is appointed to officiate as Chief Engineer and Secretary to the Chief Commissioner, Central Provinces, in the Public Works Department.

Military Works Department.

The undermentioned officers passed the examination for promotion to Assistant Engineer, 1st grade, prescribed in the Pulbic Works Department Code, on the 21st August 1887 :—

Lieutenant M. L. Tuke, R.E., Assistant Engineer, 2nd grade, sub. *pro tem.*

Lieutenant R. J. H. L. Mackenzie, R.E., Assistant Engineer, 2nd grade, temporary.

Director-General of Railways.

Mr. R. Sivewright, Executive Engineer, 4th grade, sub. *pro tem.*, is transferred, in the interests of the public service, from the Bellary-Kistna State Railway to the Bannu Railway Survey.

With reference to Public Works Department Notification, dated 4th October 1887, the following Assistant Engineers, 2nd grade, are posted to the Bannu Railway Survey :—

Mr. R. R. Gales.
Mr. J. Woodside.
Mr. F. D. Couchman.

Mr. E. H. Tuck, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Bannu Railway Survey.

Mr. T. Michell, Executive Engineer, 3rd grade, sub. *pro tem.*, is transferred, in the interests of the public service, from the Bellary-Kistna State Railway to the Bannu Railway Survey.

Mr. H. B. Addis, Executive Engineer, 1st grade, sub *pro tem.*, is transferred, in the interests of the public service, from the Bellary-Kistna State Railway to the Bannu Railway Survey.

Mr. P. P. Dease, Executive Engineer, 2nd grade, is transferred in the interests of the public service, from the North-Western Railway to the Bannu Railway Survey.

Mr. G. Cowper, Executive Engineer, 3rd grade, sub. *pro tem.*, is, on return from furlough, posted to the Bannu Railway Survey.

Mr. J. W. Parry, Assistant Engineer, 1st grade, is, on return from furlough, posted to the North-Western Railway. Director General's Notification, dated 28th October 1887, is hereby cancelled.

N.-W. P. and Oudh, November 12, 1887.

Buildings and Roads Branch.

Mr. A. H. Ashton, Assistant Engineer, Allahabad Division, is appointed to officiate as District Engineer, Jalaun, during the absence of Rai Mohan Lal Kateha Sahib, on three months' privilege leave.

Rai Mohendranath Chakravarti Sahib, Assistant Engineer, is granted one month's leave on medical certificate in extension of the one month's sick leave granted to him in this office Notication dated the 24th October 1887.

Mr. W. E. Parry, Executive Engineer, 1st grade, on return from the privilege leave granted him assumed charge of the Benares Provincial Division from Mr. W. E. T. Bennet, Assistant Engineer, on the forenoon of the 3rd November.

Irrigation Branch.

With reference to Government of India, Public Works Department, Notification, dated 5th November 1887, replacing his services at the disposal of the Military Department, with effect from the forenoon of 9th idem, Colonel W. Jeffreys, R.E., made over, and Colonel J. G. Forbes, R.E., on return from furlough, received, charge of the office of Joint Secretary to Government and Chief Engineer, Irrigation Works, North-Western Provinces and Oudh, on the forenoon of that date.

Assam, November 12, 1887.

Mr. O. G. Smart, Executive Engineer, 4th grade, and Manager Jorhát State Railway, who was appointed to officiate as Executive Engineer, Khási and Jaintia Hills Division, reported his arrival at Shillong on the afternoon of the 29th October 1887, and received over charge of his duties from Mr. Kench, Executive Engineer, on the afternoon of the 31st October 1887.

Mr. H. Kench, Executive Engineer, 5th grade, temporary rank, who was transferred to Burma in Government of India Notification, dated the 25th October 1887, reported his departure from Shillong on the forenoon of the 5th November 1887.

Bengal, November 16, 1887.

Establishment—General.

Mr. J. R. Swinden, Executive Engineer, returned on the afternoon of the 27th ultimo from the privilege leave granted to him in Notification of the 25th July last.

Establishment—Irrigation.

Mr. A. Monies, Executive Engineer, 3rd grade, has been granted by Her Majesty's Secretary of State an extension of one week's leave without allowances.

Indian Engineering Patent Register.

Specifications of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 31st October 1887

63 of '87.—Everard Richard Calthrop, of Malabar Hill, Bombay, Noor Mahomed Khan, of Bombay, and Tajbhoy Abdool Hoosain, of Bombay.—*For an improved apparatus or means of extracting or expressing oil, juices or other fluids from substances containing them.*

115 of '87.—William Macnab, Senior, Engineer, and William Macnab, Junior, Analytical Chemist, both of 74, Windsor Road, Forest Gate, in the County of Essex, England, and James Donald, of Paisley, in the County of Renfrew, North Britain, Engineer.—*For improvements in apparatus for separating by subsidence solid matters from the liquids in which they are suspended.*

124 of '87.—Edmundson Scholes, of Hollinwood, in the County of Lancaster, England, Corn Miller.—*For improvements in apparatus for cleansing and drying grain, seeds, and other substances.*

146 of '87.—The Grand Envelope Machine Company, Limited, of London, England.—*For improvements in Envelope machines.*

150 of '87.—Percival Everitt, of London, England, Engineer.—*For improvements in completing electric circuits.*

159 of '87.—Charles Maries, of Durbungah, in the Province of Bengal, Horticulturist.—*For a new, cheaper and more efficient process of extracting and preparing rhea fibre.*

PATENTS, TRADE MARKS, DESIGNS.

INDIAN ENGINEERING now offers to Inventors generally the advantages of its Patent Department.

Patents procured and Designs and Trade Marks registered in all parts of the world.

The sale or working of inventions negotiated.

Correspondents or representatives in all countries.

Advertisements.

AMRITSAR MUNICIPALITY.

The Amritsar Municipality intend building a "Victoria Jubilee Hospital" and is willing to spend 70,000 or 75,000 Rs. on it, but as these sums would have to be spread over several years it is desirable that the design should be one admitting of additions as funds become available. Rs. 40 to 45 thousand would be spent the first year, and so far the design should be complete.

One prize of Rs. 500 is offered for the design which may be approved by a Committee consisting of the President and Secretary, Municipal Committee, and two Executive Engineers. The design should be complete with working plans, estimate and specification. The "nom-de-plume" used by the gentleman submitting a design should be written on it, and his name and address should be written on a separate piece of paper enclosed in a sealed envelope and attached to the design, the "nom-de-plume" being written on the face of the envelope. The Committee does not bind itself to return rejected designs. The design approved of and its annexures shall become the property of the Committee.

Attached is a specification of the accommodation required.

Designs should be addressed to the "Secretary, Municipal Committee, Amritsar," and should reach him not later than the 15th January 1888.

The style of architecture to be early Roman so as to harmonize with the surrounding buildings.

The following are the details of the accommodation required.

Any other particulars can be supplied on application to the Secretary, Municipal Committee.

ACCOMMODATION REQUIRED FOR HOSPITAL TO HOLD 100 PATIENTS.

Administrative block to occupy centre of Building.

GROUND FLOOR.

1	Dispensary Room	15 feet by 15 feet.	
1	Dressing Room	12 ,, 12 ,,	
1	Consulting Room	12 ,, 12 ,,	
1	Room ...	20 ,, 20 ,,	for Medical Stores.
1	Do. ...	16 ,, 16 ,,	for Clothes and Furniture Godown.

UPPER FLOOR.

Operation Room .. 20 feet by 24 feet (to be well lighted).
Civil Surgeon's Room 20 ,, 20 ,,
Office ... ... 20 ,, 20 ,,

Wings for Patients.

GROUND FLOOR.

Medical ward to accommodate 20 male patients.
Ditto ditto 10 female do.
Small ward for 10 serious cases with offensive discharges.

UPPER FLOOR.

Ward to accommodate 20 ordinary Surgical cases.
Ditto 10 important Surgical cases.
Ditto 10 Opthalmic eyes.

DETACHED.

10 quarters for family patients.
A separate ward divided into two for male and female infectious cases.
Each Medical patient to have 80 sup. feet of floor space and each Surgical patient 100 sup. feet.

ESTABLISHMENT BLOCK.

Quarters for 1 Assistant Surgeon with family accommodation, to consist of 1 sitting room 20 feet by 16, 1 bed room 16 feet by 16, 1 bath room 10 feet by 8, 1 cook cook room 10 feet by 10.
Quarters for 2 Hospital Assistants with family accommodation, each to consist of 2 rooms 12 feet by 10 and small yard.

Do.	2 Compounders.	1 room 12 feet by 10	with Verandah.
Do.	2 Dressers	do.	do.
Do.	2 Cooks	do.	do.
Do.	1 Peon	do.	do.
Do.	2 Ward attendants	do.	do.
Do.	2 Bhishtis	do.	do.
Do.	3 Sweepers	do.	do.
Do.	1 Matron	do.	do.
Do.	2 Apprentices	do.	do.
Do.	2 Dhobies	do.	do.
Do.	1 Chowkidar	do.	do.

Cook House. 1 Verandah 12 feet by 6.
Lavatory 2 rooms 12 ,, 10.
Latrine separate.

Dead House separate to consist of 3 rooms,—1 room, 20 feet by 14 feet, and 2 rooms 10 feet by 14, with Skylights and Verandah.

NOTE.—The designer is not strictly limited to the dimensions given above; he may, where necessary, exercise a discretion if larger dimensions are necessary to give architectural proportion to the different parts or to the whole block.

Notices.

The Office of Publication of Indian Engineering *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

CONTENTS.

ANSWERS TO CORRESPONDENTS.

C., F.E.R., M. E., Chips and C. G.—In our next.

Obituary.

MORETON.—On the 25th October, at Thabyadoung. Upper Burma, Thomas George Moreton, Honorary Assistant Engineer, Toungoo-Mandalay State Railway, of fever, aged 49 years.

BLACKER.—On the 9th instant, B. H. Blacker, Assistant Engineer, P. W. D., Upper Burma, from malarious fever.

INDIAN ENGINEERING.

SATURDAY, NOVEMBER 26, 1887.

SUDDEN COLLAPSE OF A WHITE ELEPHANT.

INDIAN ratepayers will heave a sigh of relief on perusing the decision of the Government of India in regard to the proposed railway from Umballa to Kalka with extension to Simla. Its doom which had been anticipated for years past by an intelligent public has now been finally sealed. We may confidently hope it will not be revived for another generation or two, by which time the annual exodus to the hills will be numbered with the institutions of the past. The community from whose pockets the costs of the scheme were to have been disbursed, owe a debt immense of endless gratitude to Sir Theodore Hope for his advice which has helped the Government to arrive at a satisfactory solution of the difficulty. It is, therefore, a matter for congratulation that the ghost of another White Elephant has been exorcised, and taxpayers will now go to sleep without the nightmare of another strategic railway haunting their peaceful slumbers. We have had enough of such tomfooleries for years past, and it is time we woke up to the responsibilities of our position that will not admit of further waste under any specious excuse. It is not that the scheme has expired of inanition, or for want of advocacy, as the official organs have been hard at work at it for years past, preparing the public for a surprise. But it is rather curious to observe how their arrangements have all been upset, and the surprise is on their side, at least so it appears from the way they have denounced the Government Resolution. Although it is a twice told tale to which reference has frequently been made in these columns, we will once more, trusting to the indulgence of our readers, and for the last time cite them here in support of our position. We will try to be as brief as possible. Mr. T. B. Morris, M.I.C.E., occupies a central figure in the survey of the line, and from the report submitted by him for a line of railway on the 5′ 6″ gauge, it appears that his estimate gave the following figures:—

		Rs.
Direct charges	...	... 29,59,749
Indirect "	...	... 2,74,420
	Total	... 32,34,169

It includes no provision for rolling-stock, as the line was expected to be worked with the North-Western Railway plant, under special arrangements. Going into statistics of traffic, they were said in the report to be "conspicuously inaccurate," as shewn by the item of liquor alone ; which, according to the returns supplied by the two firms of Messrs. Meakin and Dyer, gave a down traffic in the period included in the returns, of 145,000 maunds, while the registered down traffic at Kalka for this item was entered as 1,554 maunds, and at Lalru as 17,288 maunds. The estimate of returns per mile framed by Mr. Morris, who had surveyed the line through which the railway would have to pass, was Rs. 9,997. Deducting from this amount 60 per cent. for working expenses, the balance Rs. 3,990, gives a return of 4·39 per cent. on the estimated capital outlay, and 4·79 per cent. on the direct charges alone. The Punjab Government in reviewing Mr. Morris' report observed that on a comparison with the rates prevailing on the neighbouring line, where the third-class passenger rate was only 2½ pies per mile, and the average rate of goods was supposed not to be much more than ¼ pie per maund. The rate assumed by Mr. Morris for both goods and third-class passengers—an average of 1 pie per maund per mile and 4 pies per mile respectively—were too high. The capital outlay was further increased by that Government to 38 lakhs to provide for rolling-stock. Proceeding on this basis the gross returns were calculated at Rs. 7,000 per mile and the net return on capital to 2 per cent. With regard to the registration of traffic at Lalru and Kalka, the Local Government remarks—"in some respects these statistics, as registered at the various posts, involve some anomalies that tend to shake confidence in their value, and seem to require further analysis and enquiry." The most zealous advocate of the scheme is forced to "recognize the somewhat uncertain prospect of an adequate direct financial return." Of course some stress is laid on the dictum of Mr. J. B. Lyall, that the want of effective communication between the station which has become the Head-Quarters of the Government of India for several months of the year, and the railway system of the country is commonly regarded at the present day as a *reproach to the Administration*. Moreover, there can be no doubt that its construction would be not merely a great public convenience but would in many ways result in a considerable saving to the State of both time and money. On the grounds of public policy, therefore, His Honor would desire to record his sense of the desirability of the construction of such a line. If the absence of railway communication between Umballa and Simla is now a reproach, it would be ten times worse and a huge scandal if the rate-payers' money were wasted in a scheme that is neither useful nor ornamental. If Mr. Lyall had similar experience on such question as his immediate predecesor in the Government of the Punjab his opinions would be certainly entitled to respect. It is, therefore, no matter for wonder that the Government of India should not be prepared to undertake the construction of either the Umballa-Kalka or the Kalka-Simla line as a State Railway or to offer any guarantee or subsidy on their concession to private enterprise. But should any private substantial Company be willing to prosecute the work the Imperial Government would be prepared "to permit the construction of the Umballa-Kalka railway on terms similar to those which have been arranged with the Tarakeswar Railway Company, *viz.*, that the Company make the line at their own expense and that it be worked by the North-Western Railway, which will receive ¼th net profits as remuneration and also five per cent. on the value of rolling-stock supplied."

BEHAR: PAST AND PRESENT.

It is a hard saying that out of evil good comes: but it has been abundantly verified in Behar since 1874. Not in Southern Behar, which is not much of a rice-growing country, but all over the northern parts of the division there was that year total failure of the rice crop—the one crop on which the peasantry of the north had, at that time, to depend, for sustenance, life. And there would have been something very like depopulation in Northern Behar at that time, had not Government come to the rescue; for the people, about to be starved, were, through want of communications with the outer world, practically isolated from sources of food-supply—even if they had had money to pay for the food.

Roads were far between, ill kept, unbridged; save a few that the Ferry Fund and the Durbungah Raj looked after. An adult coolie's daily wage was one anna; the people were grossly ignorant, and stupid, and perverse. Behar was admitted, even officially, to be a backward province. The famine came: the famine-stricken people were set to work road-making: in an incredibly short space of time a narrow gauge State Railway was constructed from Barh Ghaut to Mozufferpore and Durbungah; and by means of it grain was poured into the empty land, and hundreds of thousands of lives were saved. The good done did not stop there. A beginning having been made with a railway line, the useful work was carried on. Every year since 1874 it has been more or less added to. Until now Behar can rejoice in a network of railways that, if Indian districts had mouths might well make many a Bengal one water. We have before us the local Government's Resolution on the General Administration Report of the Bhagulpore Division for the year 1886-87. It records the Kosi extension of the Tirhoot State Railway, and the opening of the Purneah section of the Assam-Behar State Railway.

We are told in this Resolution that, over and above railways a considerable number of useful original works were undertaken by the various Road Cess Committees, during the year, and—in the very same sentence—that "the state of existing roads in Monghyr, Bhagulpore and Maldah is unsatisfactory." This unsatisfactoriness appears to be a result of the vaulting ambition of 'Lokil Sluff,' anent which matter the Lieutenant-Governor is of opinion that "the attention of the new District Committees should be directed rather to the up-keep of existing roads than to undertaking new works, at the expense of the maintenance of present lines of communication."

With regard to the material condition of the people, we are told that "the price of food fell throughout the division: the fall was particularly marked in the Bhagulpore district, at the sudder station of which rice was cheaper than it had been during the last 10 years. A corresponding tendency to rise in the rate of wages is noticed in Bhagulpore and Maldah, while the returns o registered emigration show a decrease. The remarks made by the Deputy Commissioner of the Sonthal Pergunnahs with regard to abuses in the system of free emigration to the tea districts have been read by the Lieutenant-Governor with attention, but it is observed that no mention is made of specific instances of fraud or kidnapping, or of any other criminal offence. It is important that it should be borne in mind that a policy of non-interference with free emigration to the labour districts has been definitely accepted by Government on the ground that greater evils would be caused by interference with a view to stop possible abuses than are involved in the relatively small number of instances in which abuses occur."

We find that the most serious difficulties between landlords and tenants exist apparently in North Bhagulpore, where *the remedy of a survey* and record of rights is to be applied.

The trade of the division was generally brisk during the year under review, and from it we gather that the heathen Chinee has not a monopoly of "ways that are dark." The Lieutenant-Governor was asked to make enquiry into the bad quality of the European piecegoods supplied to the Sonthalis; but declined. Above all things Sir Steuart Bayley is by way of being what is known as a "safe" man. The timber trade from Nepal suffered from an overstocked market; but the demand for Nepal jute was maintained. The indigo industry is reviving both in Purneah and Maldah. The manufacture of silk fabrics is a declining industry in Bhagulpore and Maldah.

In the interests of humanity we regret to hear that the manufacture of muzzle-loading guns in Monghyr has increased. Experiments made in slate quarrying have not proved very successful. Is not that because they have been carried on in a dilettante way rather than for any other reason? And why, under the heading "manufactures and mines," is there no reference to Kurruckpore? Has the Maharajah of Durbungah put a stop to exploitation there on account of some astrologer's augury, or has it been proved that there is nothing worth exploiting in the mineral line?

THE ADMINISTRATION REPORT OF THE IRRIGATION BRANCH, P. W. D., NORTH-WEST PROVINCES AND OUDH, 1887.

THIS is one of the most lucid and exhaustive Official documents which we have noticed for some time past. There is scarcely any item of principal expenditure omitted for the reader to evolve out of his inner consciousness. Even the minutiæ of accounts have been carefully given so as to remove all trouble in calculation. From the figures given we find that the capital outlay of all kinds, direct and indirect, on all the canal systems to the close of the official year, shew a total of Rs. 19,08,791 and Rs. 7,70,58,386 to the end of the year. We are told that between the sanctioned estimates and the actual amount expended during the latter period there was a difference of Rs. 44,32,429 less than the estimate. The only excess being in the case of the Lower Ganges Canal, reckoned at Rs. 67,655, due to the heavy costs which have been incurred on the new Nadrai Aqueduct, the revised estimate for which was not ready when the report was compiled, but it has been prepared and is almost ready for submission. The revenue actually realized during the year, including direct and indirect, was Rs. 57,17,108. The total charges against the revenue in the same period, both direct and indirect, came up to Rs. 25,64,096; leaving a net revenue of Rs. 31,53,012. The interest charges for the year on the capital outlay on "Productive" and "Protective" works amounted to Rs. 27,41,352: deducting this amount from the net revenue there is a clear surplus of Rs. 4,11,660, including the interest charges on "Protective" works, amounting to Rs. 1,50,297, and the surplus is Rs. 5,61,957. The percentage of net revenue on capital outlay (3·34) shews a very considerable falling-off, and is the lowest obtained for a number of years. The explanation given is, that the percentage is calculated on the total capital outlay of all kinds, including "Minor" and "Protective" works, the revenue derived from which does not for the present cover the working expenses. By a comparison with the previous years all canals shew a falling-off, due entirely to the exceptionally favorable nature of rainfall. The figures for the year under notice include for the first time the outturn of the Tarai and Bhabar Canals, estimated at 114,187 acres. The area watered by the canals under the direct control of the Irrigation Department was 1,363,816 acres, and is the smallest obtained for the last ten years. Compared with 1885-86 the decrease is 345,855 acres or about 20 per cent. The revenue obtained on the Agra Canal has more than doubled, while that on the Upper and Lower Ganges Canals has remained stationary, the net result being an increase of Rs. 5,852. The traffic shews an increase of about 11,000 tons, but on the other hand the ton mileage and value of goods carried has slightly decreased. The provincial grant, which originally stood at Rs. 25,32,700, was, at the desire of the local Financial Department, reduced by Rs. 1,00,000. The actual expenditure came up to Rs. 23,47,282, a saving as compared with the original grant of Rs. 1,85,428. The chief work in hand during 1886-87 was the new Kali Nadi Aqueduct at Nadrai. All preliminary works such as the branch railway and sidings, temporary buildings, workshops, temporary shelter for work-people, &c., were completed. The earthwork of foundation pit and the surrounding embankments were also finished. Nearly the whole of the 268 well-kerbs required were made and placed in position, brickwork of all pier wells practically completed, and that of abutment well commenced. The wells of ten out of fourteen piers were sunk through the 32 feet of sand overlaying the clay, and fourteen wells were sunk through the clay stratum. The delay in the works was caused in the time required for getting out from England certain lime-grinding plant. The Machua escape, which was completed and opened during the year under review, has worked most efficiently. On the main line no fresh important works were taken in hand, as very few new lines are now required in the Upper Ganges Canal. The repairs to it cost Rs 3,36,742 as against Rs. 3,43,338 in the previous year. The repairs on the Lower Ganges Canal cost Rs. 3,03 690 as against Rs. 2,81,695 in 1885-86, and on the Agra Canal repairs cost Rs. 1,44,785 as against Rs. 1,14,415 during the latter period.

MR. COLQUHOUN'S PROPOSED RAILWAY.

II.

In a late issue we referred to some of the commercial advantages likely to accrue to England as a result of constructing the line of railway Mr. Colquhoun wants to see laid down through Burma, to Seumao, the south-west gate to China. Into the argument based on commercial advantages, the argument that takes political considerations for text dovetails, and has now to be considered. Mr. Colquhoun's proposed railway would greatly strengthen the military position in Burma strategically, would help British prestige, would impress with respect for British power the minds of a rural population, now imposed upon by the mistatements of men who are hostile to British dominion, and who retail to ignorant, credulous villagers various malicious stories discrediting British might, and British good faith. It would do more towards the extinguishment of *dacoitee*, and the restoration of order in the newly annexed territory than half-a-dozen regiments of soldiers. Partly because it would be in itself an evidence of power, possessing faculty to bring home to the minds of ignorant men—with whom seeing is believing—the futility of kicking against the pricks. Partly because it would so greatly facilitate the movement of troops, when needful. Partly because it would give employment to a number of men who are lawless and predatory now, more because they lack employment than because of any innate propensity on their part to lawlessness.

There is another consideration. In a despatch advocating a railway to Mandalay which Lord Dufferin addressed to the Secretary of State for India more than a year ago, he wrote: "From a political point of view the effect of opening a railway to Mandalay cannot fail to be most important both on Upper Burma, and on the Shan States bordering it by removing conclusively all doubts as to the conquest of the country, and as to its having been finally annexed, facts which have not yet been fully realized by a considerable proportion of the people."

In another paragraph of the same despatch the Governor-General writes:—"Sir Charles Bernard shews conclusively to our minds that no system of road communication which it is possible for us to make will bring the districts along the Shan border within reach of a profitable market for their produce. The distances to be traversed, and consequently the cost of transport by cart, will be too great to allow of the necessary margin for profit, in competition with the produce of more favored localities. The State cannot find continuous employment for a population which has no incentive to work in its own interests, and, lacking employment of a sufficiently lucrative character to keep the masses occupied and content, civil administration would, we fear, be impossible without the constant presence and support of a large military garrison scattered in strong detachments over the face of the country, and maintained at a cost far beyond the capabilities of the provincial finances to bear. A railway to connect Mandalay with Toungboo may, therefore, on the grounds above set forth, be looked upon as a necessity of economical administration." Lord Dufferin's argument obviously applies with equal force to the proposed railway line to Yunnan; and it appears to us a sound and statesmanlike argument.

Mr. Colquhoun reminds readers of his article in the *Asiatic Quarterly* that those old world masters of Imperial Government, the Romans, always laid down roads as the first essential of a newly conquered country; that General Wade, in the last century, pacified the Scotch Highlands by the same means, that latter-day Russian conquests in the Caucasus were never free from insurrectionary outbreaks until the country was intersected with roads, by order of Prince Warontzoff. But he says, "the total pacification of Turkmenia, due to the Trans-Caspian Railway, is the most striking illustration of the value of communications as a pacifying agent in a country presenting many difficulties." Even the Chinese understand the value of communications in a new country, and at the present time are busily engaged in Formosa in laying down roads and railways. The French are no less actively employed in the same direction in Tonquin. With wise rulers, roads and railways are the inevitable corollary of conquest; its safeguards. Mr. Colquhoun deems an alliance between Great Britain and China a growing necessity of the times. It should be cemented, he suggests, by inter-communications and the friendly relations they engender. Given such an alliance, and fear of further Russian aggression would cease, he thinks. And there would be a guarantee for the preservation of the interests, and the extension of the commerce of the two empires, as well as for the peace of Asia.

Lower Burma began to pay as soon as its communications began to be developed. During the last decade it has paid into the Imperial Exchequer, after defraying all expenses of Local Government, &c., over eight millions sterling. Upper Burma will turn out to be quite as satisfactory an acquisition from a financial point of view, as soon as the country is opened out by a network of communications. Mr. Colquhoun is quite certain as to the value of railways as agents of pacification, as to the superiority for that sort of work of the shovel over the sword.

He has reason and the teachings of experience on his side, over and above the corroborative opinions of such men as Sir Herbert Macpherson, Sir Charles Bernard, and Lord Dufferin. The Government of India is of opinion that Burmese railways are certain to become rapidly remunerative, both directly and indirectly. Russia is extending her railway system to the north of China. France is about to lay down two separate lines for the purpose of tapping the trade of South-East and South-West China respectively. A third line is designed later to compete against us in the British and Siamese Shan States. It behoves British enterprize to be up and doing, and to lose no time about it.

We will conclude this writing in the words in which Mr. Colquhoun concludes his article in the *Asiatic Quarterly.* "It is to be hoped that this railway, so vital for the extension of our commerce, will be undertaken without delay."

Notes and Comments.

RAILWAYS IN THE PHILIPPINES.—An English Engineer has arrived at Manila to superintend the works of the Manila-Dagupan Railway.

COLOMBO HARBOR.—The most considerable single work upon the Ceylon Budget list is the proposed commencement of an extension of the reclamation of the foreshore of Colombo Harbor.

THE PUBLIC WORKS DEPARTMENT.—The rumor is current in Calcutta that considerable reductions are contemplated in the *personnel* of the Public Works Department, but it is not yet known on what basis this report rests.

THE IRON PONTOON BRIDGE ACROSS THE BACKWATER AT VIZAGAPATAM.—Messrs Burn and Co. were contractors for the construction of this pontoon bridge, which was commenced after the close of the official year 1885-86 and expected to be completed by the end of August 1887. We learn that this expectation has been realized.

exceed one-and-a-half times the width of the street on which it is built. A local paper thinks that this should not be introduced into the Bill without warning or preliminary discussion. It is not an accepted fact all over the world that the height of houses fronting streets should be limited to a certain height proportionate to the width of each respective street. Assuming for the purpose of argument that such a restriction is desirable, how is the proper ratio between the height and width to be ascertained ? Why should one-and-a-half times be fixed ? Why not twice, or five times, or a ratio equal to the simple width of the street ? It is necessary that detailed information with cogent reasons should be forthcoming on this point. Nowhere in England is any such

VIZAGAPATAM AGENCY WORKS.—The Government are not prepared to assign a larger amount than Rs. 30,000 on account of the Vizagapatam Agency Public Works pending disposal of the general question of the extension of roads in the Agency tracts, which is now under consideration in the Judicial Department. This grant is exclusive of the Maharaja's contribution of Rs. 4,000.

SHIPMENTS OF BATOUM OIL FOR INDIA.—The first shipment of Batoum oil to Calcutta discharged at Budge Budge from the steamer *Castle Eden*, consisted of 73,000 cases, and the second shipment, by one of the same line of steamers, is on the way. A shipment was recently landed at Madras, which was at first objected to, as being below flashing test. A shipment has also been received at Rangoon.

THE CHINESE SQUADRON'S VISIT TO INDIAN PORTS.—Two of these ships, the *King Yuen* and the *Lai Yuen*, are armoured cruisers which have been built in Germany ; two others, *viz.*, the *Chih Yuen* and *Ching Yuen*, are swift protected cruisers which have been built for the Chinese Government by Messrs. Sir W. Armstrong, Mitchell and Co., of Newcastle-upon-Tyne, whilst the torpedo boat is the work of Messrs. Yarrow and Co., Poplar.

A COMMENTARY ON THE TIMES !—There is a vacancy at the College of Engineering, Madras, for an Assistant Master, to teach Surveying in all its branches. The appointment will be a temporary one, lasting probably until November 1888. The salary will be Rs. 50 a month for any man who holds no substantive appointment under Government. No notice will be taken of applications from men who do not hold First-class Certificates as Surveyors and who have no practical experience.

MARINE ENGINEERING ENTERPRISE IN BOMBAY.—A work of some interest to marine engineers has just been completed in Bombay. Messrs. Shepherd and Company, who own the line of coasting steamers, some of which were built many years ago, have converted the whole of the engines of their fleet into triple expansion engines. The whole work of conversion was designed and carried out by native workmen under European supervision. This is said to be the first time such work has been done in India ; one of the steamers so treated made a trial on Thursday with very satisfactory results.

GUP FROM BURMA.—One of our correspondents writes : In my last I made a mistake about the Rangoon sewage outlet ; it should be " Rangoon river " instead of " Pazoon doung Creek," but I fancy it is too late to make the correction. Mr. B. H. Blacker, Assistant Engineer, died in Upper Burma, on the 9th November, from malarious fever. Mr. J. Leonard, an Assistant Engineer, has been suspended for making over payments to a contractor at Myingyan in Upper Burma. The Monkey Point defences at Rangoon are to be controlled by the Special Defence Committee and are to form a separate Military Works Division.

THE COLONIAL ENGINEER AND THE SURVEYOR-GENERAL, CEYLON.—In the opinion of His Excellency and his advisers, Mr. MacBride, the Director of Public Works, has shewn no want of ability and energy, since his appointment some two years back and has effected savings which have enabled the Government to undertake the construction of roads, bridges and other public works of general interest, which it would have otherwise been impossible to commence. As to the efficiency and value of the Superintendent of Surveys' Lieutenant-Colonel Clarke's, services there cannot, His Excellency believes, exist two opinions in the Colony.

A MUDDLE.—Colonel Ward, R.E., has, it appears, been appointed Joint Secretary and Chief Engineer in the Buildings and Roads Branch of the Public Works Department of the N.-W. Provinces and Oudh, and not Chief Secretary. Colonel J. G. Forbes, R.E., succeeds Colonel Lang, R.E., as Secretary in the P. W. D., besides holding his substantive appointment as Chief Engineer, Irrigation Branch. The mistake has now been rectified. We may add that the instances of a Chief Engineer for Irrigation holding the Chief Secretaryship in the manner here notified are few and far between. We think that it occurred in the case of Mr. Levinge in Bengal.

THE KARACHI RAILWAY.—The following will be, we expect, the probable outcome for the moment of the efforts which Karachi has been making for a local Railway. The Commissions' scheme for the " Hyderabad-Umarkot " line will go through as a local measure ; the N. W. Railway giving old rails and rolling stock. The cost of the earthwork and bridges is put down at about £400,000 in Mr. Lambert's estimate, that is to say the cost of construction without rails or rolling stock. The Hyderabad Local Funds give $1\frac{3}{4}$ lakhs towards this without asking for interest or return, and the Bombay Government can hardly refuse to give the balance, however much they would like to.

COMMUNICATIONS IN THE PRESIDENCY DIVISION, BENGAL.—The roads of the division have suffered severely in the last two years from floods. The want of funds has also prevented their being maintained in an efficient state. For the latter reason it is said that both the provincial and the district roads have deteriorated in the

24-Pergunnahs. It is suggested that either the rate of the cess should be increased (it is levied at the highest rate permitted by the existing law) or that new sources of income should be made available. This important subject will be considered in the Municipal Department. After execution of necessary repairs very little money has remained for the construction of new roads in any district of the division.

STRATEGIC RAILWAYS.—A morbid Correspondent writes: Adverting to the notice published in the *Gazette of India*, sanctioning surveys for a railway line to Bannu, which is considered in military circles an indispensable adjunct to the frontier strategic system, I wonder whether our strategists ever consider that, in war time, a railway sometimes aids foes as well as friends. That it does so was made very manifest during the Civil War in America, a quarter of a century ago. And, I wonder where the money is to come from for this Bannu strategic line? For with regard to other lines, construction of which the Government of India admit to be desirable, it is pleading overwhelming poverty as excuse for an inactivity that does not strike one as by any means "masterly."

OBITUARY.—We regret to have to announce the death of Lieutenant-Colonel A. R. Seton, R.E., which melancholy event occurred at about 5 A.M. on Saturday, the 12th instant, at the residence of Major Le Breton, Malabar Hill, whither he had been removed from his own house on the first symptoms of danger appearing. Lieutenant-Colonel Seton had but recently returned to India from furlough, and had been appointed to the charge of the Special Defence Works now being undertaken on this side of India. He was perhaps less well-known in Bombay than others of his family, as he had served principally at up-country stations, but his death has been felt here as if he had been much longer amongst us. He had seen thirty years' service, having joined the army in 1857. Colonel Seton was buried at Sewree with military honors.

THE WEST DECCAN SECTION OF THE SOUTHERN MAHRATTA RAILWAY.—This line is fast drawing to completion, and Poona will be in direct communication with Belgaum and Dharwar ere many months are out. The bridge over the Krishna river is not yet completed, but the line will be opened probably on a diversion, with a temporary girder bridge at the bottom—this bridge and diversion were run over all last hot weather by the material trains. The bridge over the Ghatpurba river, 45 spans of 40 feet girders, is almost complete, and when this is done through communication will be established, and officers and others transferred to Belgaum will be able to reach that station in about seventeen hours, instead of going round by Hotgee, Gadag and Dharwar. The line passes within a short distance of the Gothak Falls, which are well worth a visit to the tourist and sketcher who can spare the time.

PARAFFIN.—The Chemical Examiner, Burma, reports: Forty-two samples of imported oil were tested, representing seven cargoes, six of American and one of Russian oil. The Russian oil resembles the Rangoon refined oil; like it, it requires a special lamp and wick. It smokes badly in lamps designed for American oil, but it is much cheaper and retail dealers pass it off as American. There were 15 samples of Burmese crude petroleum tested for export. The flashing point is variable, but generally over 100° Fahrenheit. There was no instance of a specimen flashing below the legal flashing point. The new pattern testing machine has been received. It appeared to give more uniform results than the old one, but it was very troublesome to work, as the test lamp was continually being extinguished by the jerk with which the slide closes. It broke down altogether after testing six samples.

THE MILL INDUSTRY OF BENGAL.—In 1886-87 there were in the 24-Pergunnahs 45 mills, giving employment to over 40,000 hands, at work during the year. The depression in the jute and cotton industries continued to be felt, though less severely than in the previous year. There was some improvement in the gunny market and the number of working days in the jute mills was raised from four a week to nine a fortnight. About 76,800 tons of jute were worked up during the year, against 46,662 in the preceding year. In the cotton industry the main features of the year are stated to have been a steady fall in prices all round, a fair demand at the decline in prices for yarn, and an increased production, with a gradual transference of spindles to manufactures of lower counts

stand the value of communications in a new country, and at the present time are busily engaged in Formosa in laying down roads and railways. The French are no less actively employed in the same directien in Tonquin. With wise rulers, roads and railways are the inevitable corollary of conquest; its safeguards. Mr. Colquhoun deems an alliance between Great Britain and China a growing necessity of the times. It should be cemented, he suggests, by inter-communications and the friendly relations they engender. Given such an alliance, and fear of further Russian aggression would cease, he thinks. And there would be a guarantee for the preservation of the interests and the extension of the commerce of the

Port Courbet. This point situated in the Bay of Hone-gay has as its outer roads the Bay of Along. It is connected with the fluvial network of streams, and is besides in the centre of an important coal basin. The railway which is to connect Hanoi with the sea will terminate at Port Courbet, passing through Bacninh, the Seven Pagodas, Dongnien, and Quangyen. This line avoids the loose muds of the Delta, and two-thirds of its course are in a fertile and populous country.

ITEMS FROM THE N.-W. FRONTIER.—One of our correspondents writes: The portion of Railway in which the Abt system is going to be applied is the line from Hirok to Kotal. This was before a meter-gauge line and will be now changed into 5′ 6″ gauge. There are several tunnels, dams and small bridges on this portion. The formation way work is in the hands of the Executive Engineer. The laying of permanent-way, cogged rack, and the fitting of the locomotives, as well as the driving of the same, are under Mr. Fred. Graf, who has been practising on the Railway of the same system near Berlin. Hirok is 4,709 feet and Kotal 5,912 feet above mean sea-level. The building of these Railways has not great difficulties to overcome and there is no scarcity in labor. The Pass is no more so bad as it used to be, The locomotives are from Esslinger Maschinen Fabrik, near Stutgart. The other parts for the working of the system are from a firm in Dortmund.

INDIAN MIDLAND RAILWAY.—Jhansi is the headquarters of the Indian Midland Railway and the great junction station. It throws out four distinct branches to Bhopal, Gwalior, Cawnpore and Manickpore, exclusive of the Etawah-Saugor Branch. The total length of the Railway, at present, is about 621 miles, as will be seen from the following:—Jhansi to Bhopal section 180 miles, Jhansi to Gwalior section 62 miles, Jhansi to Cawnpore section 145 miles, Jhansi to Manickpore section 182 miles, Etawah to Saugor section 52 miles. Total length 621 miles. The junction station of Etawah is on the Jhansi-Bhopal section of the railway. Some very large and remarkable rivers are crossed by the line of railway in its different directions. The Jumna and Betwa class foremost followed by the Dessaun, Sindh and Ken. The Betwa is crossed by the railway at intervals of more than fifty miles apart, four times. This railway connects the Bhopal State Railway at Bhopal, the East India Railway at Cawnpore and Manickpore-Sindia Railway at Gwalior and the proposed Kutni-Saugor Railway at Saugor.

The Height of City Buildings.—The Select Committee of the Legislative Council now at work upon the revised draft of the Bombay Municipal Bill has decided upon introducing a clause relating to buildings to the effect that the height of any new building shall not exceed one-and-a-half times the width of the street on which it is built. A local paper thinks that this should not be introduced into the Bill without warning or preliminary discussion. It is not an accepted fact all over the world that the height of houses fronting streets should be limited to a certain height proportionate to the width of each respective street. Assuming for the purpose of argument that such a restriction is desirable, how is the proper ratio between the height and width to be ascertained? Why should one-and-a-half times be fixed? Why not twice, or five times, or a ratio equal to the simple width of the street? It is necessary that detailed information with cogent reasons should be forthcoming on this point. Nowhere in England is any such clause admitted into Acts administered by Municipalities or the local Government Board.

A Good Record.—Colonel A. M. Lang's term of service as Secretary to the North-West Provinces' Government, in the Public Works Department, has ended, Colonel Lang's services as a soldier and civilian have been equally distinguished. He remains in India another year, visiting Kashmir next summer. The history of his service runs as follows: Arrived in India in July 1854. He was Assistant Engineer in the Punjab, November 1855; Superintendent, Civil Buildings, Lahore, August 1856; Executive Engineer, March 1857; Assistant to Chief Engineer, Oudh, April 1858; Assistant Secretary, Public Works Department, to Chief Commissioner, Oudh, July 1865; Principal of Thomason College, March 1871 to May 1877; Superintending Engineer, 1st grade, Deputy Inspector-General Military Works, and Secretary of the Defence Committee, February 1879; Secretary to Agent to Governor-General, Biluchistan, Public Works Department, February 1881; Chief Engineer, 3rd class, and Secretary to Chief Commissioner, British Burma, Public Works Department, January 1883. As explained above, his busy and useful service of 33½ years has concluded with the Public Works Secretaryship to the North-West Provinces' Government.

Mysore Extension of the Southern Mahratta Railway.—A correspondent writes: Labor, both skilled and unskilled, is coming in freely from all sides, and the earthworth is being thrown up as fast as possible. Some miles of embankment have been completed and it now only remains for the numerous small gaps to be connected by bridges and culverts, sanction for the erection of which has not not yet been accorded. The country from Tiptur down to Harihur abounds in granite of very superior quality and within easy reach of the line. Orders were previously given by Mr. Buyers, the then Superintending Engineer, for collection of stone at sites of bridges, but this order was subsequently cancelled by Mr. Scott immediately after taking over charge of the division.

Now, evidently your correspondent is ignorant of the fact that the lands on the other side of the Damuda are *bonâ fide* the property of the Raja of Pachete, who has given the Equitable the right to bore and otherwise explore the said lands, and further

Inspector of Works. Some of the Inspectors have been in charge of sub-divisions from the time of starting work, now six months ago, and on which there has been a great quantity of work executed. It is nothing short of a marvel, especially when economy on this Railway is the order of the day, that the whole length is not worked by Inspectors alone. This agency under the keen eye and able, firm hand of Mr. Peter Scott—combined with this gentleman's extreme kindness, courtesy, and consideration towards his subordinates—could complete the whole length in a comparatively short period. By this means also a substantial saving under the head of establishment would be effected of at least Rs. 3,000 per month or a total sum of Rs. 50,000 by the time the line is completed.

Another U. C. S. Meeting.—A meeting of Officers of the Uncovenanted Civil Services was held at Lahore on the 24th October, to support Mr. H. S. King, M.P., and the other members of Parliament, who are interesting themselves in the grievances of the members of these services. The P. W. D. was represented by Messrs. Horace Bell, J. R. Bell, W. H. Cole, G. H. List, G. V. Martyn, F. Reilly, V. Rigby and others. Mr. Horace Bell having been voted to the chair, the following resolutions were proposed and unanimously adopted:—1. That the thanks of this meeting be conveyed to Mr. H. S. King, M.P., and other members of Parliament who have interested themselves and the Committee of the Uncovenanted Civil Service Association, London, for the partially successful efforts they have been making on behalf of the Uncovenanted Civil Service in India. 2. That a Central Committee for the Punjab shall be formed at Lahore, which shall place itself in communication with the Association in England, and shall invite and forward subscriptions in aid of its efforts if upon enquiry such a course is deemed necessary. 3. That the statement given in the pamphlet of the Uncovenanted Civil Service Association London, as to the disabilities of the Uncovenanted Civil Service in India are endorsed by this meeting. 4. That this meeting recognizes that by far the most important and urgent matter in the programme of the Association is the plea for the payment of pensions and furlough allowances in sterling at par or at least at some equitable and fixed rate of exchange. That the present loss in exchange is gradually tending to pauperize the service, and has already produced wide and serious discontent. 5. That a copy of the proceedings of this meeting be forwarded to the Committee of the Uncovenanted Civil Service Association, London, to H. S. King, Esq., M.P., and to the President and Secretary of the Public Service Commission, and that the proceedings be circulated generally among members of the service in the Province. At a meeting of the Committee held the same evening it was resolved that Mr. J. A. E. Miller be requested to act as Secretary to the Committee and that Mr. Duthy carry on the duties of Secretary till the return of Mr. Miller from leave.

Current News.

THE Telegraph to Lundi Kotal is now completed.

THE question of the exploration of the country between the Chittagong frontier and Upper Burma still awaits decision.

OWING to financial reasons the Government have for the present postponed the survey of the Raniganj coal-fields which it was at one time intended to make.

STRATEGIC RAILWAYS.—A morbid Correspondent rites: Adverting to the notice published in the *Gazette*

UNDER the orders of the Defence Committee at Bombay, a new battery is being erected in the grounds of the Governor's residence at Malabar Point, on level ground in part reclaimed from the sea.

WE learn that the Government of India have sanctioned a former request of the Ameer Abdur Rahman, for the loan of the services of Mr. C. L. Griesbach, C.I.E., of the Geological Survey, for two years.

THE President, Madras Municipality, has represented that he had not available either an officer or the professional staff necessary to undertake an engineering work of such magnitude and importance as the widening of a Bridge!

THE Kurachee Chamber of Commerce has received a telegram assuring it of the full support of the London Chamber and intimating that a letter has been addressed to the India Office, urging consideration of the Hyderabad Pachpadra Railway scheme.

HIS HIGHNESS the Nizam has given sanction to the construction of a tramway which will connect the city of Hyderabad with its various suburbs and with Secunderabad. A company has been formed; and it is understood operations will be almost immediately commenced.

THE formal opening of the "Dufferin Bridge" over the Ganges at Benares, by His Excellency the Viceroy, will take place at noon on the 16th of December—a *dejeuner* to follow. A special train will run from Lucknow to Benares on the 15th, and return on the 17th.

THE Public Works Department of the Government of India has just issued some general rules defining the powers of Managers of State Railways in the matter of granting complimentary special trains and reserved accommodation on the lines under their charge.

Mr. H. F. Blandford, Meteorological Reporter to the Government of India, now in England, will retire at the end of his furlough, leaving Mr. John Eliot, who is officiating for him, an open field for the prosecution of the changes and reforms which he proposes in the working of his Department.

SOME experiments conducted in the Rawalpindi district of the North-Western Railway, as to the relative value of coal from the Umaria and Beerbhoom Collieries for locomotives, are said to have resulted entirely in favor of the latter, coal from the Umaria Colliery being considered almost useless for steaming purposes.

IT is officially reported that the Calicut extension of the Madras Railway will be completed by the end of the year, and every effort is being made by the railway officials to have the line complete in all the details required by the Government of India, so as to secure its being opened for public passenger traffic on New Year's day.

LIEUTENANT-COLONEL L. CONWAY-GORDON, Director-General of Railways with the Government of India, makes a tour, visiting Kurrachee, Bombay and other places, before joining the Government at Calcutta. Colonel Conway-Gordon has been taking short leave in Simla on account of his eyesight, which has again been giving him trouble.

THE *Indian Nation* remarks adversely on the subject of the inquiry that has been ordered by the Lieutenant-Governor of Bengal into the revenue administration of the Sone Canals. The Irrigation Commission consists of Mr. H. J. S. Cotton, President; Mr. Odling, Superintending Engineer, Sone Circle; and Baboo Jai Prakash Lal, Dewan of Dumraon.

MR. RIBBENTROP, Inspector-General of Forests, who has just returned from three months' privilege leave in Europe, has proceeded to the Central Provinces in order to assist in the investigation now being made as to the capabilities of the forests in the south-eastern section of the Province for the supply of sleepers for the new railway from Calcutta to Bombay.

ON the 20th instant the Right Rev. F. Pesci, the Catholic Bishop of Allahabad, blessed the new convent, near the Cathedral, which has recently been constructed for Allahabad. It is a commodious, neat building, erected on the simplest plan by Messrs. Frizzoni and Co., and is intended to afford shelter for about a hundred boarders and the necessary staff of nuns.

CAPTAIN KUNHARDT, R.E., has been attached to the office of the Director-General of Railways with the Government of India on special duty in connection with the Railway Conference, which it is proposed to hold during this cold weather. Mr. H. P. Burt, assistant to the Director-General of Railways, has, on return from his leave, also joined the Calcutta Branch of the office.

THE Imperial and Provincial roads in Chota Nagpore with the exception of the portions of the Ranchi-Hazaribagh and Ranchi-Purulia roads in Lohardugga, for which funds were wanting, were maintained in tolerable order during the year 1886-87. District roads were kept in fair order in Hazaribagh and Manbhoom, but were not well maintained in Lohardugga and Singbhoom for want of money.

THE liability to accident from floods which forms so serious an impediment to the utility of the Bolan line will, it is expected, be before long almost entirely obviated by the re-construction, on the new alignment, of a portion of the line from Khundalani gorge downwards. This is at present a most dangerous part of the line. The survey is now being made of the new route, which involves a long tunnel.

THE Upper-Burma Secretariat, with the exception of the Public Works Branch which, for special reasons, it has been decided to locate for the present in Mandalay, has been transferred to Rangoon. For the future the distinction between the Upper Burma and the Lower Burma Secretariats, except in the case of the Public Works Branch, is to cease, and the head-quarters of the administration of the whole province is to be in Rangoon.

IN the rural parts of the Presidency Division, Bengal, the principal manufactures are sugar, indigo and silk. The outturn of sugar in the Jessore district is estimated at 4,00,000 maunds, as against 3,36,000 maunds estimated for 1885-86; no estimate of outturn has been attempted for the other districts. The number of indigo factories and the outturn of indigo increased during the year, and in Moorshedabad the silk industry was extended.

WHEN the work of repainting and gilding the Madras Kirk dome was undertaken by the Public Works Department a few months ago, the officer in charge of the work suggested to Colonel Vibart, the Superintending Engineer, the advisability of piercing the dome in order to break the echo, for which this edifice is noted. Colonel Vibart gave his sanction to this experiment being carried out, an aperture of some 12 inches was accordingly made. The end in view has, however, not been attained.

THE orders of the Government of India have been received for the reorganisation of the office of the Madras Revenue Survey, and to the grading of the employés. Under the new scheme the number of hands will be reduced, but a better class of technical workmen secured, and their salaries graded as an incentive to work.

THE Office of the Consulting Engineer to Government for State Railways will shortly be transferred to Jubbulpore from Agra. Mr. Mallett has already arrived in the station and is making arrangements for the accommodation of the office.

THE construction of the Southern Mahratta Railway, Mysore Extension, from Gubbi to Harrihar is progressing so rapidly that the office of the Superintending Engineer, Mr. Peter Scott, is, we are given to understand, to be moved next month, from Bangalore to Arsikere, in the Harnhalli taluk of the Hussan District, so that he may be nearer the works. The line will, in a very short time, be opened to Chickmaglur, and it is expected that by this time next year it will be possible to run down to Bombay over the Southern Mahratta Railway system.

COLONEL DAVID WARD, R.E., the new Joint Secretary, N.-W. P. and Oudh, P. W. D., became a Lieutenant, Bengal Engineers, in September, 1854; joined the Public Works Department in February, 1859, as Executive Engineer, Oudh; Chakrata division, N.-W. Provinces, August, 1868; transferred to Military Works, 1873; Superintending Engineer, Lahore, March, 1877 and subsequently at Meerut; Superintending Engineer, 1st class, September, 1882; and subsequently Public Works Secretary in the Central Provinces.

THE section of the Bolan Railway from Hirok to Darwaza, which is now a narrow gauge line, is likely shortly to be converted to a broad gauge on the Abt system. On this system, which is in use on many mountain railways in Europe, a third rail is laid down which is grasped by a cogged wheel on the engine. To convert the narrow gauge part of the Bolan line, all that is needed, is to lay down this third rail on it, and get out locomotives constructed on Abt's design. No change is required in rolling stock. An experimental trial of Abt's system has been ordered on one mile of the Bolan line, and the conversion of the remainder of the line may confidently be anticipated.

THE PANAMA CANAL COMPANY.—According to the Paris *Bourse* M. de Lesseps has again assured the Administrative Council of the Panama Canal Company that "large vessels will pass from the Atlantic to the Pacific by way of the canal within the period fixed." The means by which the Engineers propose to fulfil this promise are "to be made known shortly." The Belgian Engineers who have been at work on the Panama Canal express most unfavorable opinions as regards the position of the enterprise, and consider the difficulties still to be overcome as almost insuperable. It is denied that the board of the Panama Canal Company have adopted the lock system. The canal at first will not be made either of its full depth or full width, but will be navigated by large vessels before it has been entirely completed. It is claimed that in this way, in three years at the latest, the canal will be opened to navigation, and its immediate revenue will suffice to partly pay the interest of bondholders, which now amounts to 70,000,000f. per annum.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

NEW TYPES OF CHEAP ROOFS.

Sir,—Your correspondent from Bombay seems to have got hopelessly mixed. *ud* naturally means sectional area x depth. The rest was thoroughly explained in my last reply.

November 17, 1887. W. G. Bligh.

PUNKAHS.

Sir,—As I am one of those who intend altering my punkahs, I would be very glad if one of your numerous readers would describe the "Mortimer system" mentioned by "M. B." in your issue of 5th November.

W. A. M.

ARTESIAN BORINGS.

Sir,—I was both amused and surprised on reading Mr. Frank Agabeg's letter on the above subject in the last issue of your valuable Journal. The amusement arose from his cool assurance, and the surprise from the ignorance which he betrays in *trying* to find fault with others.

In the first place, I would like to know what experience your worthy—*wordy ?*—correspondent has had beyond that acquired at Port Canning in "Artesian Borings"? and in the second, is he wholly innocent of the fact of the boring operations in Fort William, conducted in 1837, having attained the depth of 392 feet? I might say more, but perhaps it would be best to leave Mr. Agabeg to answer these enquiries in the interests of Sanitary Science and Hydraulic Engineering, which he so strongly advocates.

Delta.

THE BOMBAY P. W. D. AND LORD REAY'S VAGARIES.

Sir,—I read with much interest your able leading article on the subject of the injustice done to Colonel C. Goodfellow, R.E., by the Government of Bombay in not making him Chief Engineer, 1st class, in the room of Mr. J. Hart, and I am sure every member of the P. W. D. agrees with you in what you have written. There is another hardship, however, to which I would draw your attention, which affects a large number of the Department, which is as follows:—

Although three Executive Engineers, 1st grade, *viz.*, Messrs. Howard, Little, and Whiting have been promoted to be Chief or Superintending Engineers, and though four Executive Engineers, 1st grade, have been transferred for Defence Works under the Government of India, no corresponding promotions have been made in the lower grades.

Now in January or February 1885 the proportion in each grade of the Executive Engineers' rank was *fixed*, and I do not see how the Government of Bombay can avoid keeping up the same *proportion*, although the total *numbers* may be reduced by those officers who have been transferred to the Government of India.

The effect of this would be that some four or five Executive Engineers, 2nd grade, would become 1st grade, three or four 3rd grade would rise to 2nd grade, and one or two 4th grade to 3rd grade.

As matters stand at present there are only two 1st grade Executive Engineers available for duty, and it has been necessary to select a gentleman near the bottom of the 2nd grade to officiate as Superintending Engineer, S. D. Surely this shews that matters have been allowed to become very much tangled?

The G. R. of January or February 1885 says, I believe, that acting promotions are not to be made in the same *rank* when men go on leave, that is, if an Executive Engineer, 1st grade, goes on leave it does not promote the top man of the 2nd grade, but such is not the case in the present instance. Three vacancies have been caused by the promotion to higher rank of three 1st grade men, four vacancies by the entire removal from the list of four others, and I hold that the non-promotion of men of the lower grades is a tangible hardship and that a certain number of men are being mulct of what is really their due. Will you not try to rectify this matter?

November 9, 1887. A Reader.

JOTTINGS FROM THE BENGAL COAL-FIELDS.

Sir,—I am inclined to think that the "Jottings from the Bengal Coal-Fields," from a correspondent, which appeared in your impression of the 19th instant, are, apart from dealing with the matter of the alternative position of the junction of the Bengal-Nagpur Railway with the E. I. R., in an unfair and disinterested manner, largely drawn from a stock of information more imaginary than real. This is not the first time, Mr. Editor, that you have allowed unreliable information or intelligence to find a place in your otherwise excellent Journal, and this circumstance, coupled with others, helps to mislead rather than guide the minds of the interested public in general, and the Government of the country in particular. For instance, it is declared by your correspondent, or rather a correspondent, that the Equitable Coal Company have withdrawn their claim, and they are now willing to receive what the Government may be pleased to give them. If that is so, why is the matter kept secret? I have not been able to find any confirmation of this important statement of your correspondent, who *naïvely* informs you that in the event of the Government not adopting the original route from Sitarampur, the said Company will demand *full compensation* for the lands on the other side of the Damuda river, through which the alternative line passes.

Now, evidently your correspondent is ignorant of the fact that the lands on the other side of the Damuda are *bonâ fide* the property of the Raja of Pachete, who has given the Equitable the right to bore and otherwise explore the said lands, and further it may be stated for the furtherance of his (a correspondent's) knowledge of the actual state of things, that the land through which the alternative line passes is, comparatively speaking, barren in the mining sense of the word, except perhaps a few unimportant seams of coal, varying in thickness from a few inches to about four feet, which occur in a short distance of the line.

The Equitable's threat, therefore, as to this latter or Asansol-Ragunathpur line is nullified by the fact that they not only are not *bonâ fide* owners of the land, but that they cannot under the exploratory lease claim any compensation from Government for such lands. And, further, even if they succeed in securing the lands before the Government notify their intention of taking them up, the Government need not fear as to the carrying out of the threat referred to, as they (the Equitable) must not only convince the Government as to the existence of a *good* workable seam, but must needs work the seam in a business-like manner. I have had occasion lately to visit the field, and the enquiries made and investigations carried out by me there, lead me to conclude that an attempt is being made by some interested people to lure Government into a serious mistake, which it must be very careful to avoid.

As to the up-country traffic,—it is a well-known fact that in the best of seasons it is small and limited, and can be as easily carried on from Asansol as from Sitarampur, the mere position of the junction making no appreciable difference. As to the benefit derivable from the adherence to the orignal route,—the fact of the present state of the coal trade, as reported by your correspondent, is against it. There is a limited demand for coal, and when the maximum wave line is touched or attained, the trade shews a downward tendency. More collieries mean more coal, and more coal means dull trade when the consumption is constant or nearly so Apart from these considerations, the position of the alternative line is such that both Sanktoria and the congregation of collieries in that neighbourhood, and over the river, can be easily served by a branch line from either the Bengal-Nagpur or the E. I. R.

Thus you will see that there is much ado about nothing in the matter of future everntualities *re* the Equitable and the Government, and the fact still remains undeniable that Asansol, in more points than one, is the best and most suitable locality for the Bengal-Nagpur Railway terminus.

I was informed that past and present Engineers, with only one exception, are in favor of the latter junction.

Before concluding, I may correct a statement which appeared some time ago in your columns, that the amount already expended on the original site of the Railway from the point of diversion to Sitarampur station was represented as being Rs. 7,00,000, whereas the figure has virtually not exceeded Rs. 70,000!

Fair-play.

[It is scarcely "Fair play" to make us responsible for the statements of our correspondents.—Ed., *I. E.*]

New Books and Reprints.

MATHEMATICS.

Aldis (W. Steadman) A Text-Book of Algebra. Post 8vo, pp. 602. Frowde 7/6

Casey (J.) Key to a Treatise on Elementary Trigonometry. 12mo, pp. 80. Hodges (Dublin). Longmans 3/

Maccregor (Jas. Gordon) An Elementary Treatise on Kinematics and Dynamics. Post 8vo, pp. 526. Macmillan 10/6

Proctor (R. A.) Easy Lessons in the Differential Calculus. Indicating from the Outset the Utility of the Processes called Differentiation and Integration. 12mo, pp. 120. Longmans 2/6

——First Steps in Geometry: A Series of Hints for the Solution of Geometrical Problems. With Notes on Euclid, useful Working Propositions, and many Examples. 12mo, pp. 186. Longmans . 3/6

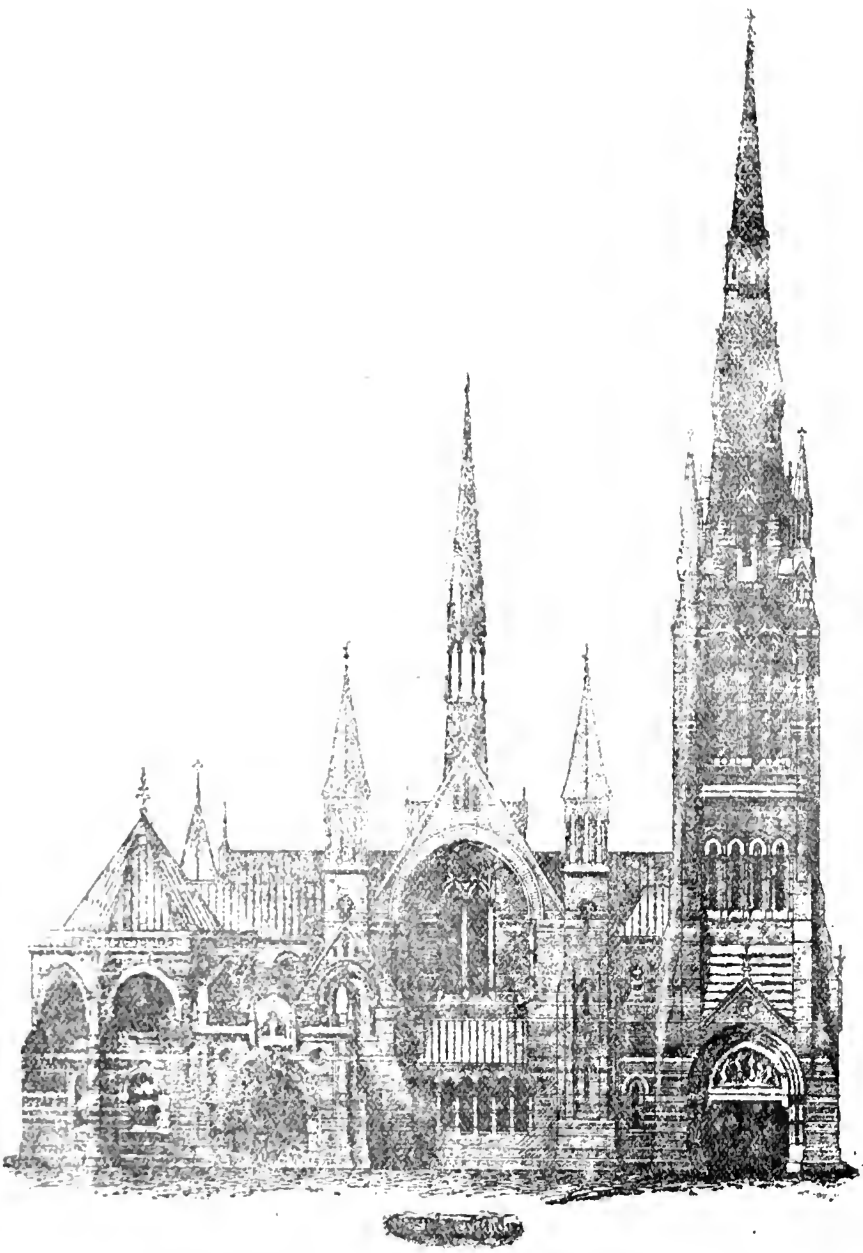
Todhunter (I.) A Treatise on Analytical Statics. With numerous Examples. 5th ed. Edited by J. D. Everett. Post 8vo, pp. 364. Macmillan 10/6

Todhunter (I.) Solutions to Problems contained in a Treatise on Plane Co-ordinate Geometry. Edited by C. W. Bourne. Post 8vo, pp. 170. Macmillan 10/6

TRADE, COMMERCE AND MANUFACTURE.

Yeats (John) Manuals of Commerce, Technical, Industrial and Commercial. Illust. with Maps. Statistical Charts and Tables. 3rd ed., Revised and Enlarged. Vol. 1, The Natural History of the Raw Materials of Commerce; Vol. 2, The Technical History of Commerce, or the Progress of the Useful Arts; Vol. 3, The Growth and Vicissitudes of Commerce in all Ages; Vol. 4, Recent and Existing Commerce. Cr. 8vo. Geo. Philip and Son. ... ... ea. 6/?

General Articles.



RANGOON CATHEDRAL.

Our illustration—another attempt at photo-typing—represents the West Elevation of the Rangoon Cathedral now under construction from designs of Mr. Chisholm. The view is taken from the original drawings, which have been somewhat modified, so as to increase the accommodation. The walls will be of brick, pillars of Palaveram granite, decorations of (Raniguuj) terra-cotta, and floor of Minton's tiles. The style is a modified Early English, midway between the Norman and the Decorated. The spire will be 190 feet high. The estimated cost of the building when completed is about six lakhs of rupees. Messrs. Robinson and Drury are the Contractors.

INUNDATION CANALS.

Special Methods for the Earthwork.

In two previous articles the remodelling and the working of a particular canal were described. *Fig.* 1 gives in more detail the branches of this canal.

Though the average rainfall is less than seven inches in the year, there are at long intervals violent but very local downpours. In the particular tract commanded by this canal, the land is so divided and sub-divided by branches and water-courses that each little plot absorbs its own rainfall to its benefit rather than its injury. The want of drainage lines is not felt even in the case of exceptional falls of rain as more than a passing inconvenience. As the sub-soil water surface falls from the river inland water logging is not possible. The headstraight lined channels F I and G J do not therefore harmfully interfere with any drainage lines. The advantages of having them along public roads are great. They are far better looked after, and the channels get the proverbial "*Stitch in time.*" It is also obvious that there is too much publicity in any act for an irrigator to be easily tempted to break the canal regulations. Four years ago trees were planted along the road F I. They already give a little shade. In a few years it will be possible to patrol in the hottest part of a day in June in the shade of these trees.

Fig. 2 gives a cross-section of a channel in digging where the water level is below natural surface. The triangular section for spoil bank stands far better than the usual section with flat tops. In the latter the rain sinks in and great cavities are formed. In the former a fall of rain, when they are freshly thrown up, will make them look all the neater. The long slope outside gives the minimum wash into the channel.

It is the invariable rule on these canals never to allow burrow pits to be made outside. If the land is cultivated deep burrow pits are adopted. In one case the burrow pits were 10 to 12 feet deep. Here, however, thorn bushes had to be put along both sides to prevent access to the channel and the danger of man or animal being drowned in such deep cuttings. The channel F I passes in one place through very low ground for about 4,000 feet. In five successive clearances these deep burrow pits have been re-dug and now the water is carried between substantial banks of clay deposits with its surface 5 to 6 feet above the ground surface.

This depression coming below a 5 feet fall the gradual annual rise in the water surface does not affect the draw at the take-off at all. At the same time the higher land below the depression is commanded and lift irrigation converted into flow.

In one part of this depression there are great pits from which the earth for the bricks for the adjacent town and great buildings has been taken. The owner of this land has now asked for the East Bank to be shifted back so that this portion may be washed up too.

The mistake in this section is putting the flat slopes on the outside. In embankments one wants good broad silt hems on the water slopes and the flat slopes catch the silt more readily.

In waste land the banks may be placed as far apart as may be considered convenient. In one case when a salt plain 2 miles long was crossed, on which nothing would grow, the bed level was above the natural surface. The banks were placed one hundred feet and burrow pits made within 10 feet distances of the water slopes. The 100 feet strip is now covered with dense jungle. Had the banks been placed 1,000 feet apart some valuable land could have been given back to the people, the ordinary cunette being re-cut through the newly built up alluvion,

INUNDATION CANALS.

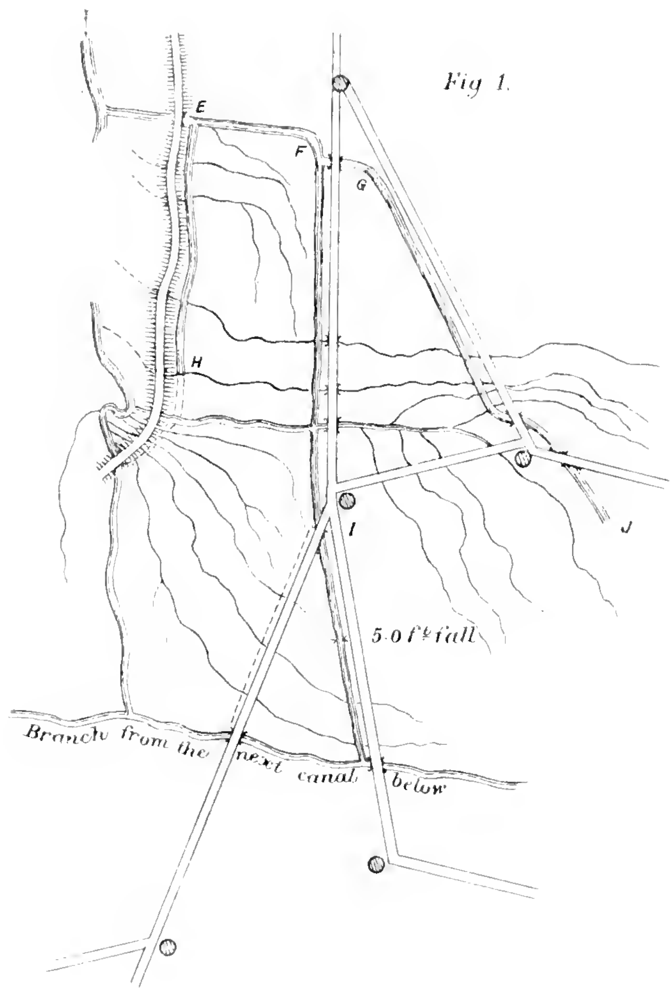


Fig 1.

CROSS SECTIONS OF CHANNEL F. I.

Fig. 2.
In deep digging

Fig. 3.
In shallow excavation (In cultivated land).

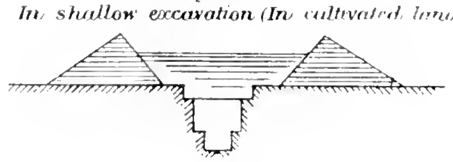


Fig. 4.
In shallow excavation. (In waste land).

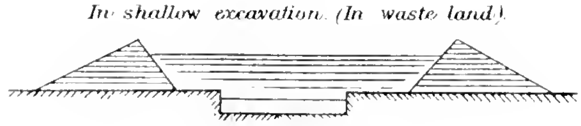


Fig. 5.
Cross section of channel E H.

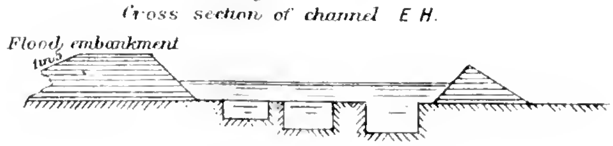
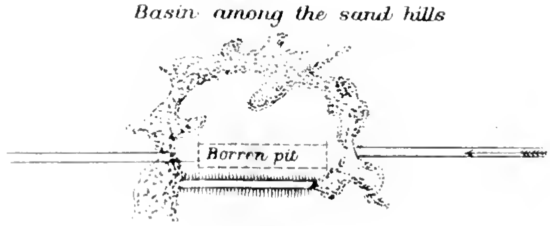


Fig. 6.
Basin among the sand hills



The "STAR" Press, 19, Lall Bazar, Calcutta.

In the case of the flood embankments it was found that when flood water stood against the bank a strip of the protected land from 1,000 to 6,000 feet became water logged and no *kharif* crops could be grown therein. The inside burrow pits were turned into stinking pools of stagnant water. The channel E F was cut chiefly to shorten the lengths of channel exposed to the flood waters and to silt up the burrow pits. In addition to attaining these objects this channel has stopped all water logging and *kharif* corps are now grown right up to its banks. On two other canals the same symptom of water logging behind flood embankments has disappeared on cutting inside channels. It is said that if the supply in these channels is cut off the water logging re-appears.

Fig. 6 shews how the channels F I and G J were run through sand hills. The water was left to enlarge small cuts made in the ridge. The basin and burrow pits secured a good rush of water.

This method of making the water, as it were, build up its own embankment, can only be applied when the water contains a considerable amount of silt or mud. On these canals the amount of clay held in perfect solution is great and is deposited readily. If a glass of this muddy water is taken it will be found to take a considerable time to clear and to deposit all the clay in suspension. This clay is highly fertilizing and with high land irrigation can be thrown on to the fields. On this canal new straight *non-silting* branches are gradually superseding the worst of the old branches and in their case the unsightly lumps from constant silt clearances are avoided and where there are embankments there are no troublesome outside excavations.

KOREISHI ; *November* 14, 1887. E. A. S.

NATIVE ARCHITECTURE IN THE PUNJAB.

BY RAI BAHADUR KANHYA LALL, M.I.C.E.

Ranjit Singh's Tomb, Lahore.

THIS structure, situated near the Hazari Bagh, is a mixture of both Hindu and Mahomedan architecture and is a compromise between a Hindu smadh and a Mahomedan tomb, but is comparatively inferior in dignity to a Mahomedan tomb in its petty details.

The doors are a finished example of inlaid work of the same character as that in the Maharaja's Palace. The ceilings are highly ornamental with tracery in stucco, or "*gutch,*" inlaid with small convex mirrors. The marble arches of the interior were in a dangerous state in Sir Donald MacLeod's time, one of the Lieutenant-Governors of the Punjab, when I was Executive Engineer; and I had them strengthened with additional brick and lime pillars and arches and iron clamps. Had they not been strengthened in this way, the whole edifice would have come down with the concussion of the salutes fired from a neighbouring bastion of the Fort, but it is now strong enough, and will last for centuries to come.

A huge volume of the Garanth Sahib, over which a *chowry* is respectfully waved, is being chanted with the *sitar* and other musical instruments inside the building, under the main dome.

In the centre is a raised marble platform, on which is a marble lotus flower, surrounded by eleven smaller ones. The centre flower covers the ashes of the Maharaja, the others those of his four wives, and seven slave girls who perished on his funeral pyre. In small niches in the side walls are placed images of the ordinary Hindu gods, to abolish which was one of the original objects of the Sikh faith.

The tomb is surmounted with a huge cupola around which, in a square form, run small domes all surmounted with a pointed top called "*kalusses.*" That of the large dome in the centre is a huge thing, and is gilt. On the other side of the tomb are two other domed buildings, which contain similar, but less expensive, memorials of the Maharaja's son, Kharik Singh, and the latter's son, Naim Nihal Singh. The tomb is situated close to the Raushnai Gate, and below the walls of the Badshahi Musjid, and is an architectural monument of the Sikh Empire.

Jahangir's Tomb at Shahdera, near Lahore.

This is a huge structure of brick and mortar, faced with red sandstone and ornamented with white marble, situate on the west side of the Ravee.

It is square in plan, with four towers, one at each corner, built of brick and mortar faced with white marble and red sandstone strips alternately and placed diagonally on each side of the tower. Each tower is surmounted with a dome of white marble, supported on white marble pillars and fitted with a railing of pierced white marble slates, fixed between the bases of pillars. Each tower has four marble platforms in its height, supported on white marble brackets, which were originally fitted with white marble railing, now removed. Access to these platforms is given by means of doors in the staircase in the towers.

The centre block of masonry contains the tomb itself; it has a verandah on pillars and arches all round, which is divided into separate domes and is plastered with lime and "*gutch,*" the lower part up to a length of three feet being ornamented with a dado of *kunsi-ka-kam,* which looks bright in places up to this day. The above block of masonry has four passages in it leading to the tomb, which is in a small room in the centre of a block. They have a floor of white and variegated marble and the sides are covered with different patterns of *kunsi-ka-kam,* the ceilings being painted in different patterns. The tomb itself is covered with marble inlaid work, most of the small precious stones of which have been removed by people.

The roof of this square block is fitted with floors of different patterns of white and black marble. In the centre part of this square, and over the tomb, was a marble *baradaree,* which is said to have been removed by Ranjit Singh to the Hazari Bagh, or pleasure gardens, to the west of the Fort of Lahore.

At present light is admitted on to the tomb by means of a wooden sky-light constructed by the Railway officers. Four stone staircases lead to the top of this square block of masonry, which is said to be solid between the passages and the verandahs. The tomb is surrounded on all the four sides with high trees in the garden, so no photograph of the *entire* tomb can be obtained from *any side.* The high towers are seen from a distance, and they, with part corners of the tomb only, can be photographed. The outside of the tomb is faced with sandstone and white marble in different patterns and was repaired and restored some time ago by the British Government.

The tomb is on all the four sides surrounded with a high brick and mortar wall, now in a dilapidated state, and has a gateway on each side divided into rooms and faced with sandstone and white marble ornaments in different patterns, which look very neat and bright up to this day. The east wall and gateway have been destroyed by the river. The north and south gateways are in a dilapidated state, and closed; the only gateway at present in use is that on the west side, which is in a good state of preservation.

A wide road from the tomb leads to Lahore (over the bridge of boats) which is about three miles from it.

K. L.

UBBULPUR DIVISION.

THE most remarkable railway bridge in Netherlands India, that over the Qualla Deli, is now approaching completion. So far as the difficulties to be overcome are concerned it has hardly any match in that quarter of the world. The last bolt has been driven. The sanction of Government is only awaited to open it for traffic.

REPORT ON THE WATER-SUPPLY SCHEME PROVIDED FOR THE CITY OF JUBBULPORE.

By J. G. H. Glass, M. Inst. C.E., Executive Engineer.

VII.

The pipes are calculated to deliver at the rate of ten gallons per head per 12 hours. The formulæ given in Box's Practical Hydraulics were employed in determining the several diameters, &c. The method is very simple, but it may perhaps be of advantage to work out one or two of the pipes here. The first thing that had to be done before the sizes of the pipes could be fixed, was to lay down the lines of distribution on the City map, and to mark on it the population of the several mohullas into which the City is divided. In this case the circles into which the City was broken up when the Census was taken in 1881 were adopted. From this was obtained the duty of each pipe in train. That is, it shews the number of persons to be supplied from each pipe. These necessary details being settled the calculations for the diameters of pipes were then proceeded with. Before the main enters the City it has to deliver water into the tank-house of the Great Indian Peninsula Railway running shed, which has an elevation of from 50 to 80 feet above the general level of the City.

The hydraulic mean gradient was therefore fixed at this point. The height of the top of tank in running shed reduced to M. S. L. is 1,376, but the H. M. G. was placed at 1,378. The calculations for the City pipes are all based on the H. M G. at this point, *viz.*, 1,378. Take first pipe T. M. (City distribution.) As the number drawing from T. M. is 2,500. The rate of supply is as above mentioned 10 gallons per head per 12 hours. The discharging power of the pipe is therefore $\frac{2500 \times 10}{12 \times 60} = 34{\cdot}72$ gallons per minute. The distance of M. from N. in yards is 3,852. The level at which water is to be discharged at M. is 1313·00; and the H. M. G. at N. is 1378·00. The differerence of level or 'Head' is therefore 65 feet. Box's formula for the diameter is $d = \left(\frac{G^2 \times L}{H}\right)^{\frac{1}{5}} \div 3$

in which d= Diameter in inches.
G= Gallons per minute.
L= Length in yards.
H= Head in feet.

For the pipe T. M. we have—

$$d = \left(\frac{(34{\cdot}72)^2 \times 3852}{65}\right)^{\frac{1}{5}} \div 3 = 3{\cdot}116 \text{ inches.}$$

The head lost in friction in the pipe T. M. has now to be found.

Box's formula for this is $H = \frac{G^2 \times L}{(3d)^5}$

Where H=head lost.
G= discharge of the pipe in gallons per minute.
L=length of the section, *i.e.*, the pipe T. M. in yards.
d=diameter of pipe in inches.

The length of pipe T. M. is 250 yards. The value of H is found to be 4·22 feet. This quantity is added to the level of discharge at M., and the sum is the H. M. G. at T.

Then $\frac{}{12 \times 60}$ = 66 gallons per minute.

H. G. at N. = 1378·00.
H. G. at T. = 1317·22.

Head available in feet = 60·78.

The diameter of the pipe is found to be 4·03 inches and the loss in friction 4·53 feet.

Then H. G. at T= 1317·22.
Loss on S. T= 4·53.

H. M. G. at S= 1321·75.

The calculations for the remaining pipes of the system are similar. As the calculated diameters are not generally of the dimensions which manufacturers keep on stock, it is necessary to alter them to suit what is termed 'practical diameters.' With every alteration of the diameter the loss in friction is naturally affected, and also consequently the H. M. G.

Nothing further need be said here regarding the calculations for the pipes.

(To be continued.)

ON RIVER SCOURS.

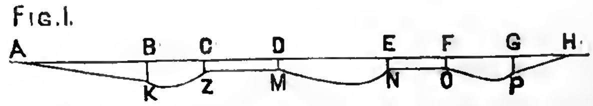
By A. Ewbank.

I.

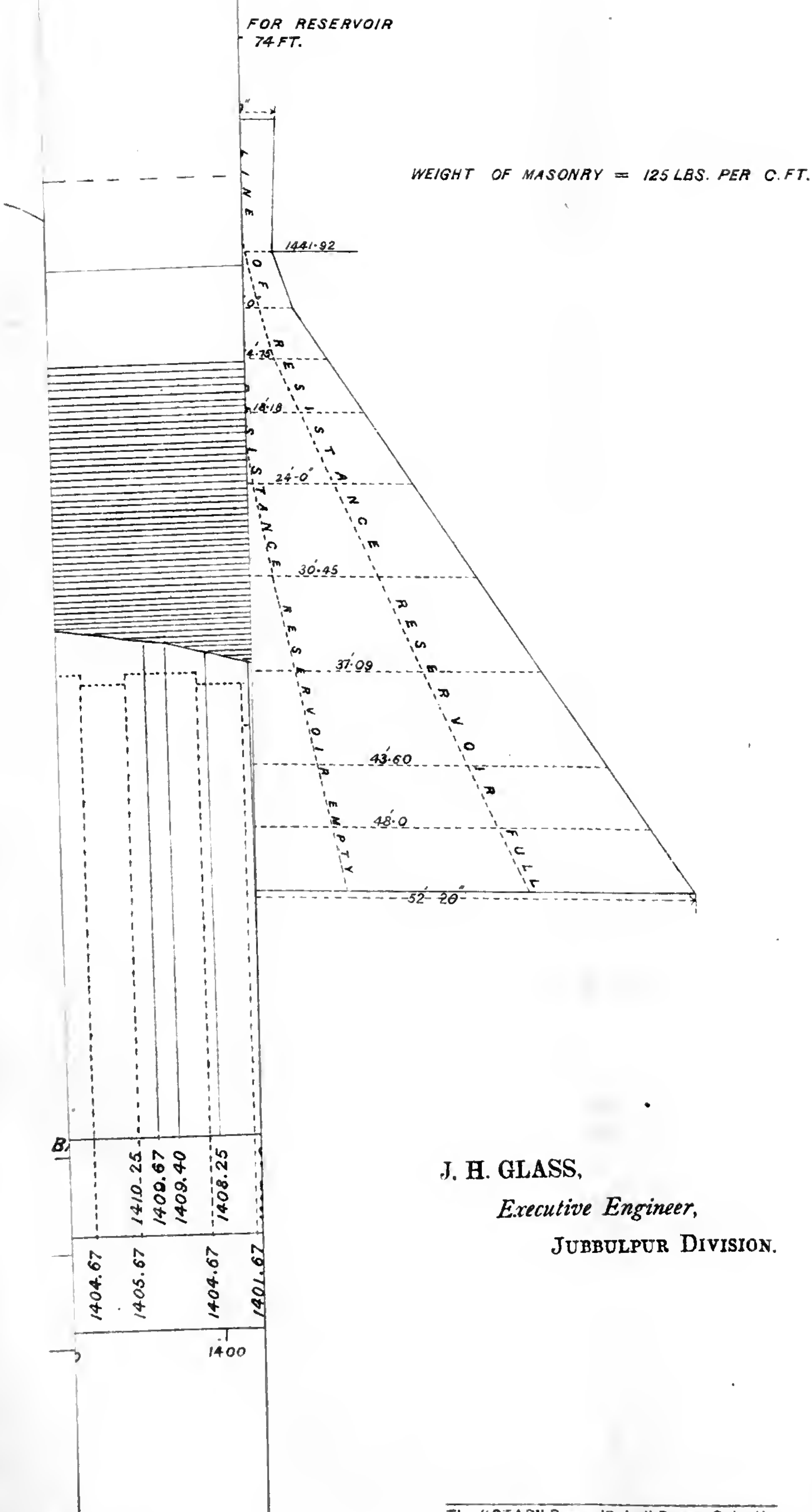
Some discussion having lately arisen respecting the action of scours, and their effect in carrying off a surplusage of water, it seems worth while to consider the problems involved in an elementary but scientific manner. The question may arise as follows. A river has a wide bed over the greater part of which the water is shallow. There may be but one deep channel or there may be several with shallow breadths intervening. Let us take the general case and suppose the existence of one principal channel and of several minor or subordinate channels. It is desired to construct a roadway over the river. It is not thought necessary to go to the expense of bridging the whole stretch of water, accordingly an embankment is laid across the greater part of the breadth and a bridge is thrown over the principal channel.

The water which of old flowed in the principal channel finds its course unimpeded. But all that water which flowed over shallows and the water also in the minor channels would thus be dammed up. Instead, therefore of leaving all this mass of water to find a passage under the bridge some outlets are made for it at several places under the embankment. In this way parts of the embankment are really made into simple bridges. We may suppose that the sites of these simple bridges are chosen at the minor channels. If these additional outlets are not thought sufficient we may have some more distributed over the shallow spaces. The original waterway at the site of the embankment may be illustrated by *fig.* 1.

FIG. I.



Here A H is the whole breadth of the river and the figure denotes a vertical section of the original waterway. D M N E is the principal channel and we have shewn two subordinate channels B K Z C and F O P G. Suppose that these subordinate channels are also left open. Then that mass of water which formerly reached the areas A B K, C Z M D, E N O F and G P H is denied its old exits. The immediate consequence of this partial choking of the waterway would be that the level would rise on the up-stream side of the embankment. The next consequence would be an increased flow through the areas left open. By an increased flow it is meant that water passes through these areas with a greater velocity than before. For instance, let the areas left open aggregate 1,000 square yards while those closed up give 500 square yards. Then if the original mean or average velocity was four miles an hour the new average velocity must be six miles an hour. Unless the new velocity reaches this amount the river will rise continuously until it overflows the embankment or escapes laterally. But when the stream velocity under the embankment has attained a mean velocity of six miles an hour, the



J. H. GLASS,

Executive Engineer,

JUBBULPUR DIVISION.

The "STAR" Press, 19, Lall Bazar, Calcutta.

level on the up-stream side has become higher than it was before the river was disturbed. The attainment of the six-mile velocity prevents the further rise of level, but it does not reduce the extra rise already reached. As much—but not more—water is passing under the embankment with the partially closed area and the six-mile velocity as passed with the whole area and the four-mile velocity. This prevents the water accumulating further arrears—so to say—but it does not work off the old arrears. These old arrears accumulated while the stream velocity was changing from four miles to six. That there is such an accumulation of past arrears—that there is a rise of level—may otherwise be put in evidence. Those particles of water which would in the natural course of affairs—before the embankment was built—have passed through the unclosed spaces will still pass through these spaces. But they will not of themselves intelligently appreciate—or anticipate—the necessity of moving faster to make room for those other particles of water which find their old passages blocked. The former particles will not move faster till they feel behind them an increased pressure.

This increased pressure can only proceed from an additional head of water. Unless this additional head of water is permanent the increased driving pressure cannot be permanent and the increased velocity cannot be sustained.

To see more clearly what must happen let us take an illustration. Imagine the water all removed and that an army of small insects is flying along the old waterway. Behind any particular insect A follows at a certain distance x another insect B. Behind B and at the same distance x follows a third C and so on. The path that A takes will B pursue and afterwards C will travel over it. As long as the whole area of *fig.* 1 is undiminished and unchanged the velocities of the insects may be unchanged and the interval x keeps constant up the file A B C, &c. Abreast of A we have a set of insects that make what we may call the A rank. Behind this follows the B rank and so on. The distance between any two ranks is the quantity x. On nearing the site of the future embankment let the A rank begin to fly faster. Let the accession of velocity be given to the A rank as this rank passes through a section Q R S fixed in space and parallel to the future embankment section. As the B rank reaches this section Q R S (but not before the section is reached) let the B rank take the same increase of velocity. Similarly let the C rank augment its velocity at Q R S and so on. Then all the ranks that have passed Q R S will be flying with the same augmented velocity and between any two of these ranks there will be an interval y which is greater than x. Thus a little way above Q R S we have close files with a constant distance x. A little way below Q R S we have more open files with a constant distance y. Near to Q R S we have the files opening to change the interval from x to y. When the A rank shall reach another parallel section T U V below the embankment site let this rank resume its initial velocity. Let all succeeding ranks resume the initial velocity at the same plane T U V fixed in space. Then a little below T U V we shall have the army of insects travelling with the same close files as they had originally.

Now suppose such an army of insects to be flying down the old river waterway and to be officered by commanders of ranks. Let the embankment be made and so some of the exits closed up.

Suppose those insects of the A rank who are opposite the unclosed passages to be ordered to increase their speed as they pass Q R S. Suppose the files exactly behind these insects also increase their speed—not at the same time but—at the same place Q R S. Immediately these files open out. Then into the increased spaces thus left may pass those other insects whose proper exits had been stopped. Also these insects inserting themselves into the vacant spaces between the other insects must fly with the same enhanced speed as do these other insects so as to avoid a jam in the procession. When the whole body of insects—made up of the above-mentioned two bodies—have passed through the diminished exits at the enhanced speed, the intruding insects can escape laterally and so form a set of ranks travelling with the enhanced speed and with the enhanced distance y between two ranks. Then each rank as it passes the fixed plane T U V can slow down and so finally the formation and the rate of travel have regained their original values.

Now what these insects have performed intelligently the water particles do unintelligently. The former, anticipating a block, provided for it and prevented it. The latter take no new steps till the block is established. They are then by the intensified pressures driven pell mell through the remaining openings. It is thus that near bridges we find eddies, cross currents and those diving-down currents, which are so dangerous to swimmers.

(To be continued.)

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XV.

Brickwork in mud mortar.

Items per 100 c. ft. (1)			No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—						
Bricklayers	No.	...	1	Variable.	Do.	Do.
Do.	"	...	2½			
Coolies	"	...	2			
Do.	"	...	2			
Do.	"	...	1			
Bhistie	"	...	1			
Sundries ...		...				
Materials.—						
Bricks	No.	...	1,250			
Clay	c. ft.	...	30			
Sundries ...		...				
Scaffolding		...				
Petty Establishment ...						

NOTES FROM TENASSERIM.

Nothing very stirring to communicate since my last. The old "Avagyee" wharf has been dismantled, and arrangements being made for erecting the new swing bridge and jetty.

The B. I. S. N Company have put on the extra steamer promised so long ago. It is called the *Ramapoora*, and does the voyage from Moulmein to Rangoon in eight hours. Passengers leaving Moulmein at 7 A.M. are in Rangoon before 3 P.M. the same day. The *Rangoon* still plies, so that we get two mails a week now.

I see that Messrs. Jessop and Co. of Calcutta have a representative here. Many will probably take advantage of this to obtain their requirements on a better and cheaper scale. You are probably aware that we had a very large fire in town, some time ago. Well, it is surprising how soon all the houses which were burnt down have been replaced by others. Had your correspondent's "Notes on Cheap Roofs" been out a little earlier, many would probably have taken advantage of the cheap methods of roofing given in them. As it is, timber has been extensively used again in the roofs, though corrugated iron has been substituted for tiles. The cheap roofs of concrete with iron rails as girders would have answered admirably here, neither could there have been any objections to them on the score of expense, for excellent concrete could have been made from the *débris* of the fire. The walls that withstood the conflagration had all to be dismantled, and when I was driving past the scene once I saw sufficient material before each house to make at least a new roof for it. I wonder what has been done with all this broken brick—thrown up behind the houses to prevent encroachments of the river I suppose.

The public commenced to grumble at the Municipality over the Jubilee Park, as nothing had been done towards commencing it. That august body has replied by submitting a statement of the "Jubilee Accounts" for publication. Moulmeiners are now surprised to find that there is only a balance of Rs. 443 left, after all the *tamasha* that occurred on the 15th and 16th February last had been paid for. Rather a small sum to construct a park—I think. As it is scarcely likely that fresh contributions will be made, it may be considered certain that nothing more will be heard of the park.

The correspondent at Thatone however, evidently gloats over the superior manner in which things regarding the "Victoria" Park there have been managed. He states that, work is being "vigorously pushed on" there. I stated in my last that there was some talk about extending the Strand Road north-wards, with the object of completing the present drive along the river. I regret to learn that, this has been allowed to drop. It is a need, but not so necessary or important a one as waterworks. One of the members of the Municipality intends putting the subject of an "Octroi" before it at the next meeting. It is to be sincerely hoped that he will say something about waterworks also—suggest, for instance, that the money raised on the octroi be devoted to constructing waterworks instead of being expended on other things.

The "furore" created by the discovery of that alleged precious stone by an Additional Commissioner has subsided. The stone has been sent to Calcutta, I hear, for examination and report. You may probably be able to see it and give us the benefit of your opinion in your next issue. I am inclined to believe that there has been "much ado about nothing" over this stone, but the Calcutta experts will decide. The foundation stone of our Cathedral was laid a month ago, but still the walls are at the same level they were a year ago. What the delay is owing to nobody knows. Our local *Advertiser* has said a good deal about the requirements of our Province. It is astonishing how many things one gets to want when he sets himself to find out what he wants. The *Rangoon Gazette* very tritely remarks, anent our requirements, that the world cannot be made to wait till we are served. Rather a hard hit, but still given in a friendly spirit, and I think we cannot do better than take the advice offered. Moulmein is considered to be such a hole-and-corner place, that nobody, except a new comer, perhaps, would venture to suggest something for its benefit. The energy of the new champion would soon have to subside, for no heed will ever be paid to his appeals.

It is a popular belief here, that our Chief Commissioner is a strong advocate for opening out more Railways in Burma. The Moo Valley is now on the *tapis*, and not to be behindhand our local paper steps in and asks for a line from Moulmein to China, *viâ* Zimmay.

I sincerely hope our Moulmein champion will obtain his wishes, but it is a guinea to a gooseberry he does not. The weather is getting pleasant and a ride in the morning would be enjoyable, were it not for the dust on our roads. To give your readers an idea of how much dust there is in Moulmein, I will mention the reply made me by a gentleman who lives in the Lower Main Road. Having asked him once if he had breakfasted, he said, Yes, but it was the usual thing—a mouthful of dust washed down by a cup of tea.

MOULMEIN, *November* 9, 1887.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, November 12, 1887.

Under the concessions granted in Government of India, Home Department, dated the 22nd August 1887, Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, Public Works Department, Burma, was granted privilege leave from the afternoon of the 6th August 1887 (the date of his arrival at Calcutta) to the forenoon of the 4th November 1887 (the date of his return to that station).

This cancels Notification dated the 1st August 1887.

With reference to *Burma Gazette* Notification above, dated the 10th November 1887, Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, reported his arrival at Rangoon on the forenoon of the 7th instant, and is transferred to Upper Burma, with effect from that date.

Hyderabad, November 15, 1887.

In supersession of that part of Hyderabad Public Works Department Notification dated 3rd ultimo, cancelling the transfer of Mr. D. M. Scobie, Assistant Engineer, 1st grade, from Melghat Roads Sub-Division to South Berar Division, it is hereby ordered that the transfer be now effected in the interests of the public service.

With reference to this Department Notification of 21st October 1887, reproducing Government of India Public Works Department Notification of 14th idem, transferring Rai Saheb Faker Chund, Assistant Engineer, 2nd grade, State Railways, to Hyderabad, that officer is posted to Melghat Roads Sub-Division.

Madras, November 15, 1887.

The following promotions and reversions are ordered :—

Mr. C. J. Peters, from Executive Engineer, sub. *pro tem.*, 1st grade, to Executive Engineer, 1st grade, with effect from 3rd June, permanent rank.

Captain O. V. Boddy, R.E., from Executive Engineer, sub. *pro tem.* 2nd grade, to Executive Engineer, 2nd grade, with effect from 3rd June 1887, permanent rank.

Captain W. L. C. Baddeley, R.E., from Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, with effect from 3rd June 1887 sub. *pro tem.*

Mr. S. B. Murray, from Assistant Engineer, sub. *pro tem.* 1st grade, to Assistant Engineer, 1st grade, with effect from 12th October, permanent rank.

M. R. Ry. S. A. Subrahmanya Aiyar Avargal, Rai Sahib, B.A., B.C.E., from Assistant Engineer, sub. *pro tem.* 1st grade, to Assistant Engineer, 1st grade, with effect from 12th October, permanent rank.

Rai Bahadur S. Subharaya Chariyar, B.C.E., from Executive Engineer, sub. *pro tem.* 3rd grade, to Executive Engineer, 4th grade, with effect from 12th October 1887.

Mr. C. J. Ussher, from Executive Engineer, sub. *pro tem.* 4th grade, to Executive Engineer, temporary rank, 4th grade, with effect from 12th October.

Mr. G. E. Manson, from Executive Engineer, sub. *pro tem.* 4th grade, to Executive Engineer, temporary rank 4th grade, with effect from 12th October.

Mr. J. H. Medlicott, from Executive Engineer, temporary rank, 4th grade, to Assistant Engineer, 1st grade, with effect from 12th October.

Mr. A. T. Mackenzie, from Executive Engineer temporary rank, 4th grade, to Assistant Engineer, 1st grade, with effect from 12th October.

Captain W. L. C. Baddeley, R.E., Executive Engineer, sub. *pro tem.* 2nd grade, to Executive Engineer, 3rd grade, with effect from 1st September.

Bombay, November 17, 1887.

In accordance with instructions from the Government of India, Lieutenant M. Nathan, R.E., appointed by the Secretary of State for three years' special duty on Indian Defences, is graded on the Bombay List as an Assistant Engineer, 1st grade, and his services are placed at the disposal of the Government of India for employment as Executive Engineer, 4th grade, on the Military Works Eetablishment.

Khan Saheb Ali Akbar, Assoc. M. Inst. C.E., Assistant Engineer, 1st grade, has passed an Examination in Gujarati according to the standard laid down by Government.

India, November 19, 1887.

Colonel D. Ward, R.E., Chief Engineer and Secretary to the Chief Commissioner, Central Provinces, in the Public Works Department, is appointed Chief Engineer and Joint Secretary to Government, North-Western Provinces and Oudh, Public Works Department, *vice* Colonel A. M, Lang, R.E., whose services have been replaced at disposal of Military Department.

Colonel J. P. Steel, R.E., Officating Chief Engineer and Secretary to Government, Punjab, Public Works Department, is appointed to officiate as Chief Engineer and Secretary to the Chief Commissioner, Central Provinces, in the Public Works Department.

This cancels Public Works Department Notification dated 5th November 1887.

Mr. C. C. B. Knapp, Executive Engineer, 3rd grade, Burma, at present Officiating Deputy Consulting Engineer for Railways, Madras, is granted furlough for two years, with effect from the 10th December 1887, or such subsequent date as he may avail himself of the same.

Mr. H. Groves, Executive Engineer, 2nd grade, State Railways, is temporarily transferred to Burma Provincial Establishment.

Mr. P. Duncan, Executive Engineer, 3rd grade, State Railways, is on return from furlough placed at disposal of the Director General of Railways.

Military Works Department.

Lieutenant H. V. Biggs, R.E., Assistant Engineer, 1st grade, passed the Departmental Standard Examination prescribed in the P. W. D. Code, on the 6th October 1887.

North-Western Railway.

Mr. J. A. Anderson, Executive Engineer, 2nd grade, is granted furlough for five months, with the usual subsidiary leave, with effect from the 5th August 1887, or such subsequent date as he may be permitted to avail himself of the same.

N.-W. P. and Oudh, November 19, 1887.

Irrigation Branch.

Captain J. Clibborn, S.C., Executive Engineer, 2nd grade, on return from privilege leave, received charge of the Agra Canal from Mr. E. A. Carswell, Executive Engineer, 3rd grade, sub. *pro tem.*, on the forenoon of thex 25th October 1887.

Mr. W. Ward Smith, Executive Engineer, 2nd grade, sub *pro tem.*, is, on return from furlough, posted the charge of the Betwa Canal.

General.

With reference to the Government of India, Public Works Department Notification, dated 5th November 1887, Colonel J. G. Forbes, R.E., Chief Engineer, Irrigation Branch, and Joint Secretary to Government, North-Western Provinces and Oudh, Public Works Department, is appointed Secretary to this Government in the Public Works Department, with effect from the 16th idem, *vice* Colonel A. M. Lang, R.E., re-transferred to the Military Department.

Buildings and Roads Branch.

Mr. J. W. Callaghan, Supervisor, 2nd grade, District Engineer, Fatehpur, is posted to the Farukhabad district as District Engineer.

Mr. W. E. T. Bennett, Assistant Engineer, 1st grade, attached to the Benares Executive Division, is posted to the Fatehpur district as District Engineer.

Mr. F. B. Henslowe, Executive Engineer, 1st grade, on being relieved of his duties in the office of Chief Engineer, Buildings and Roads Branch, North-Western Provinces and Oudh, received charge of the Kumaun Division from Mr. F. H. Ashhurst, Executive Engineer, on the 1st November 1887.

Mr. G. J. Joseph, Executive Engineer, 3rd grade, is, on return from leave, appointed District Engineer of Allahabad.

With reference to the Government of India, Public Works Department Notification, dated 5th November 1887, Colonel D. Ward, R.E., received charge of the office of Chief Engineer, Buildings and Roads and Railway Branches, and Joint Secretary to this Government in the Public Works Department, on the forenoon of the 16th idem.

Central Provinces, November 19, 1887.

With reference to Notification dated the 9th current, Rao Sahib Ishwari Pershad, Assistant Engineer, reported his arrival at Kamptee on the forenoon of the 14th idem.

Assam, November 19, 1887.

Mr. G. W. Winckler, Executive Engineer, 3rd grade, who was transferred to Cachar in orders dated the 5th October 1887, assumed charge of the Cachar district from Mr. D. J. Clancey, Assistant Engineer, on the afternoon of the 9th instant.

Bengal, November 23, 1887.

Mr. L. R. Roberts, Executive Engineer, 1st grade, has been granted by Her Majesty's Secretary of State an extension of furlough up to 1st September 1888.

Baboo Russick Lall Roy, Assistant Engineer, 1st grade, Eastern Bengal State Railway, is granted three months' privilege leave, with effect from the afternoon of the 4th October 1887.

Mr. J. P. Scotland, Executive Engineer, 2nd grade, has been granted by Her Majesty's Secretary of State an extension of seven weeks' furlough.

Irrigation Establishment.

Mr. C. H. DeMello, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State an extension of three months' furlough.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department:—

The 19th November 1887.

60 of '86.—Edward William Servell, Junior, of the City, County and State of New York, at present Commorant in Chabeuil Drome, France, Civil Engineer, memorandum of disclaimer in reference to his invention.—*For an improved mechanism denominated in French "lance boutt" employed for reeling silk.*

19 of '87.—James Walker, Contractor, William Brock, Junior, Wine Merchant, Peter McAra, Gentleman, and James Aitken Birrell, Marine Insurance Broker, all of Glasgow, Lanarkshire, Great Britain.—*For improved modes of and apparatus for raising and transmitting grain or granular materials.*

33 of '87.—Ambrose Shere Massey, and Alfred William Rosling, Engineers and Proprietors of the Napier Works, Madras.—*For the construction of ploughs upon a new design, securing simplicity, strength, lightness and adjustment.*

$57\frac{1}{2}$ of '87.—Thomas Quinlivan, Engineer, residing in Moulmein, Lower Burma.—*For the purpose of working saw-benches by rope.*

114 of '87.—Miles Postlethwaite of the Hollins, Whithaven, in the County of Cumberland, and Kingdom of England, Esquire.—*For improvements in or connected with stops for double gates or the like.*

131 of '87.—Harrie Malcolm Maxwell, A.V.D., Cawnpore.—*For the Army boot tree.*

165 of '87.—Arthur Andrews, of 5, Lyons Range, in the Town of Calcutta, Merchant.—*For a folding machine adapted for the construction of the metal tea chests known as "Andrews' Patent Metal Tea Chests."*

London Stock Exchange.—October 21, 1887.

INDIAN RAILWAYS.

Shr.	Name.		Closing Prices.	
Stk.	Bengal and North Western, Lim., 4 p.c.	...	96	98
10	Do. Shares (8*l.* paid)	...	7	8
10	Bengal Central, Limited, Shares, 5*l.* pd.	...	$4\frac{1}{4}$	$4\frac{3}{4}$
Stk.	Bengal Nagpur, Limited, gua. 4 p.c. ...	...	105	107
20	Do. (3*l.* paid)	...	$3\frac{1}{2}$	4
Stk.	Bombay, Baroda, & C. Ind., gua. 5 p.c.	...	165	167
...	Eastern Bengal, A Annuities, 1957 ...	...	$22\frac{1}{2}$	23
...	Do. B do., 1957 (less 1s. $8\frac{1}{16}$d. Sk. Fd.)	...	$23\frac{3}{4}$	$24\frac{1}{4}$
Stk.	Do. Guaranteed 4 p.c. Deb. Stock ...	...	106	108
...	East Indian, Annuity A, 1953 ...	...	$22\frac{1}{2}$	23
...	Do. An. B, 1*l.* p.a. (less 1s. 4d. S.F.)	...	24	$24\frac{1}{2}$
Stk.	Do. Def. An. Cap. Gua. 4 p.c. min....	...	112	114
,,	Do. Irredeemable $4\frac{1}{2}$ p.c. Deb. Stk....	...	118	120
,,	Great Indian Peninsula, gua. 5 p. cent.	...	154	156
,,	Do. 4 per cent. Debenture Stock ...	...	107	109
,,	Indian Midland, Limited, gua. 4 p.c. ...	...	108	110
20	Do. (12*l.* paid)	...		
Stk.	Madras, guaranteed 5 per cent. ..	...	128	130
,,	Do. $4\frac{3}{4}$ per cent.	..	120	122
,,	Do. $4\frac{1}{2}$ per cent.	...	113	115
,,	Oude and Rohilkund, Limited, gua. 5 p.c.	...	126	128
,,	Do. 4 per cent. Debenture Stock ...	...	104	106
,,	Rohilkund and Kumaon, Limited ...	...	100	102
...	Scinde, Punjaub, and Delhi, Annuities, A	...	$22\frac{3}{4}$	$23\frac{1}{4}$
...	Do. B	...	$23\frac{3}{4}$	$24\frac{1}{4}$
Stk.	South Indian, guaranteed 5 per cent. ...	...	127	129
,,	Do. $4\frac{3}{4}$ per cent.	...	...	..
,,	Do. $4\frac{1}{2}$ per cent. Debenture Stock ...	...	116	118
,,	Southern Mahratta, Lim., gua. 4 p.c. ..	...	108	110
100	Do. $3\frac{1}{2}$ per cent Debentures ...	...	...	...
Stk.	Do. 4 per cent. Debenture Stock ...	...	105	107
...	Do. 4 per cent. Bearer Bonds ...	...	...	...
Stk.	Nizam's State Railway Gua., Stock ...	...	112	114
100	Do. 4 per cent. Mort. Deb. Scrip ...	...	97	99
Stk.	West of India Portu., Lim., gua. 5 p.c.	...	108	110
,,	Do. 5 per cent. Debenture Stock ...	...	111	113

Advertisements.

AMRITSAR MUNICIPALITY.

The Amritsar Municipality intend building a "Victoria Jubilee Hospital" and is willing to spend 70,000 or 75,000 Rs. on it, but as these sums would have to be spread over several years it is desirable that the design should be one admitting of additions as funds become available. Rs. 40 to 45 thousand would be spent the first year, and so far the design should be complete.

One prize of Rs. 500 is offered for the design which may be approved by a Committee consisting of the President and Secretary, Municipal Committee, and two Executive Engineers. The design should be complete with working plans, estimate and specification. The "nom-de-plume" used by the gentleman submitting a design should be written on it, and his name and address should be written on a separate piece of paper enclosed in a sealed envelope and attached to the design, the "nom-de-plume" being written on the face of the envelope. The Committee does not bind itself to return rejected designs. The design approved of and its annexures shall become the property of the Committee.

Attached is a specification of the accommodation required.

Designs should be addressed to the "Secretary, Municipal Committee, Amritsar," and should reach him not later than the 15th January 1888.

The style of architecture to be early Roman so as to harmonize with the surrounding buildings.

The following are the details of the accommodation required.

Any other particulars can be supplied on application to the Secretary, Municipal Committee.

ACCOMMODATION REQUIRED FOR HOSPITAL TO HOLD 100 PATIENTS.

Administrative block to occupy centre of Building.

GROUND FLOOR.

1 Dispensary Room 15 feet by 15 feet.
1 Dressing Room 12 ,, 12 ,,
1 Consulting Room 12 ,, 12 ,,
1 Room ... 20 ,, 20 ,, for Medical Stores.
1 Do. ... 16 ,, 16 ,, for Clothes and Furniture Godown.

UPPER FLOOR.

Operation Room .. 20 feet by 24 feet (to be well lighted).
Civil Surgeon's Room 20 ,, 20 ,,
Office ... ... 20 ,, 20 ,,

Wings for Patients.

GROUND FLOOR.

Medical ward to accommodate 20 male patients.
Ditto ditto 10 female do.
Small ward for 10 serious cases with offensive discharges.

UPPER FLOOR.

Ward to accommodate 20 ordinary Surgical cases.
Ditto 10 important Surgical cases.
Ditto 10 Opthalmic eyes.

DETACHED.

10 quarters for family patients.
A separate ward divided into two for male and female infectious cases.
Each Medical patient to have 80 sup. feet of floor space and each Surgical patient 100 sup. feet.

ESTABLISHMENT BLOCK.

Quarters for 1 Assistant Surgeon with family accommodation, to consist of 1 sitting room 20 feet by 16, 1 bed room 16 feet by 16, 1 bath room 10 feet by 8, 1 cook cook room 10 feet by 10.
Quarters for 2 Hospital Assistants with family accommodation, each to consist of 2 rooms 12 feet by 10 and small yard.

Do.	2 Compounders.	1 room 12 feet by 10	with Verandah.
Do.	2 Dressers	do.	do.
Do.	2 Cooks	do.	do.
Do.	1 Peon	do.	do.
Do.	2 Ward attendants	do.	do.
Do.	2 Bhishtis	do.	do.
Do.	3 Sweepers	do.	do.
Do.	1 Matron	do.	do.
Do.	2 Apprentices	do.	do.
Do	2 Dhobies	do.	do.
Do.	1 Chowkidar	do.	do.

Cook House. 1 Verandah 12 feet by 6.
Lavatory 2 rooms 12 ,, 10.
Latrine separate.

Dead House separate to consist of 3 rooms,—1 room, 20 feet by 14 feet, and 2 rooms 10 feet by 14, with Skylights and Verandah.

NOTE.—The designer is not strictly limited to the dimensions given above; he may, where necessary, exercise a discretion if larger dimensions are necessary to give architectural proportion to the different parts or to the whole block.

Head Draftsman Wanted

FOR the Office of Superintendent, Way and Works, Sind Section, North-Western Railway. Salary Rs. 150 a month. None but really good men need apply. Copies of testimonials (which will not be returned) to be forwarded to SUPERINTENDENT, WAY and WORKS, Sind Section, North-Western Railway, Sukkur.

NOTICE.

TENDERS will be received by the District Engineer, Bijnor, N.-W. P., for the construction of the Karula Bridge up to the 15th December next. The Bridge is estimated to cost about Rs. 35,000 exclusive of the girders. The successful Tenderer will have to commence the manufacture of Bricks at once.

For further particulars apply to the District Engineer, Bijnor.

SAHIBGUNGE STEAM SAW MILLS.

THESE MILLS having recommenced work under New and Professional management. The Manager is prepared to undertake orders for—

Beams, Burgahs, Planks, Scantlings; Indigo Press Boxes, Tea Chests, Indigo Chests, &c., &c.

Apply to the MANAGER, *for Rates and Particulars.*

THE MADRAS ENGINEERING AGENCY.

THE sale of all descriptions of Engineering Plant and Stores undertaken. Patents obtained for Inventors. Designs and Estimates for Works furnished. Professional advice and local information given.

ADDRESS: THE MANAGING DIRECTOR,
MYLAPORE, *Madras.*

ASUTOSH AUDDY & CO.,

14 and 16, GOBIN CHAND DHUR'S LANE, CALCUTTA.

Type Founders, Stereo-Typers and other Printing Material Suppliers,

Electrotyping and Wood Engraving of the best class at moderate prices.

Particulars and references on application.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription:

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12 ...	Rs. 7 ...	Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.

An allowance is made for continuous insertions.

CONTENTS.

ANSWERS TO CORRESPONDENTS.

COMMOM-SENSE.—In our next.

INDIAN ENGINEERING.

SATURDAY, DECEMBER 3, 1887.

THE CONSULTING ENGINEER'S BRANCH OF THE P. W. D.

WE are moved by the letter of a correspondent on the Hughli Bridge, which appears in our columns this issue, to the consideration of certain anomalies in the Consulting Engineer's branch of the P. W. D.

It is a matter of common talk that the Consulting Engineer, who inspected the Hughli Bridge, does not consider some features of that structure quite satisfactory, and we understand that the matter has gone so far that a reference will be made to Sir A. M. Rendel and Sir Bradford Leslie.

Not being in possession of any details on the subject, we cannot advance an opinion as to whether the objections are well founded, but the incident points to the absurdity of the Indian Government maintaining a Consulting Engineer in England with a staff who spend their whole time in designing bridges, and then submitting these designs to the criticism of any stray officer of the Consulting Engineer's branch deputed to do the job, but who may never have had anything to do with bridge-work.

So far as regards the Hughli Bridge, it may be said that it was not officially designed by the Government Consulting Engineer, that is, it was designed by Sir A. Rendel in his capacity as Consulting Engineer to the E. I. R., not to the India Office. Still, the absurdity of the present position might have penetrated even the official mind.

But what can be said in defence of the practice on State Railways, of solemnly submitting the designs of bridges, drawn up by specialists employed by Government in England, to the criticism of an officer in India, who beyond a more or less rusty knowledge of elementary mechanics, has probably neither a theoretical nor practical acquaintance with ironwork?

And this, too, after the mischief has been done, the money wasted, if the bridge is not satisfactory.

Such criticism not only has no practical value, but tends to bring the whole system of Government control and working into contempt.

We will give a few instances of Consulting Engineer performances on bridge inspection. From one printed report of an important bridge, we learn that the deflections were x inches with no permanent set, and that the strain on flanges at centre with this load were calculated to be y tons per square inch—a truly valuable result, which any office boy could have arrived at by the help of the time-honored formula $\frac{W L}{8 D}$. The statement has as much value in relation to the safety of the bridge, as a note of the colour it was painted.

We know another case where the Deputy Consulting Engineer conscientiously went through the strains in all the members, but made out the stress in the tension members to be much more than was supposed. He could not make this out, and asked the Engineer of the bridge to check his calculations, which were perfectly correct so far as the figures went, only he had made an arbitrary deduction of 25 per cent. of cross section for rivet holes, instead of taking the actual facts of the case, which were before him on the working drawings.

As a contrary example, we know an officer sometime in the Consulting Engineer's branch, who is fully persuaded that if you only put a thick enough cover plate on, no section at all is lost at a joint.

Now none of these men were at all incompetent, being quite good enough Engineers at ordinary work, but they were put to do work of which they had no experience. The fault did not lie with them, but with the system. The heads of the Public Works Department are just beginning to recognise that an Engineer cannot know everything, as he was supposed to in the good old days, when a Locomotive Engineer, whom we happened to know, was actually put on his arrival in India to survey for a canal.

If it is necessary for the Government in India to check the design of a bridge got out by their Consulting Engineer in England, after it is built, let them in the name of commonsense select officers who have a practical knowledge of the subject.

Let the inspecting officer confine himself to the simple statement that the deflections and oscillations were so much with a certain load, and let him be instructed, as in some cases he does not know, that he need not expect to find permanent set in a girder over which engines have already passed.

If the tests are not considered satisfactory, the Consulting Engineer for State Railways can then examine the design, but to the ordinary mind it would appear preferable that the check, if necessary at all, should be applied *before* the construction of the bridge, not after, as the Government are dealing with their own money in the case of State Railways.

Nothing in the above remarks has so far any reference to the *personnel* of the Consulting Engineer's branch, for, as we have remarked, a man may be a very good Engineer for general work without having that intimate knowledge of ironwork which alone will enable him to design a good bridge, or to criticise it, which is the same thing.

But we cannot conclude without making some remarks on this head also. Can it be said that there are no men in the Consulting Engineer's branch who have been useless on works and failures on open line, and have been placed in that branch simply because they cannot do any active harm there?

If there are such, it would appear that to get rid of them first would be a suitable way of relieving the present congestion in the Department.

It is not to be supposed because a Consulting Engineer has no very active duties to perform, that anybody is good enough for the place, a notable example of the use and need of an able man as Consulting Engineer being the exposure of the S. P. D. frauds by the present Director-General, when Deputy Consulting Engineer at Lahore.

We maintain that it is a flagrant injustice to more deserving officers, and an injury to the public service, to allow men to remain in the Consulting Engineer's branch when they are not fit for anything else.

It used to be a complaint of the C. E's. that the Consulting Engineer's branch was reserved exclusively for R. E's. but, now that both are appointed, we can make these remarks without reservation or allusion to either party, between whom we always desire to maintain a strict neutrality. There may be R. E's. who are hard bargains in the P. W. D., but there certainly are C. E's. whose only claim to the title is the possession of a two-foot rule.

FAITHFUL TO HIS SALT.

A MEETING of the Bombay Municipal Corporation was held the other day at which there was a passage at arms between the supporters of Government and the representatives of the non-official class, remarkable for expression of strong language even in that land of pre-eminently stormy meetings. The acerbity with which the discussion was carried on is a lamentable instance of how men are carried away by the heat of argument to digress from the main point, and are betrayed into an exhibition of temper, which might have been avoided if party feeling had not been mixed up with the subject. The occasion of the debate was, in short, a proposal laid before the meeting by Captain Morland, Chairman of the Corporation, to the effect "that the Resolution of the Corporation passed on the 13th June last respecting the construction of a Municipal Hall and Offices on the Oval be rescinded. That Government be asked to obtain for the Corporation the site of the Cathedral High Schools, together with the buildings thereon, and to grant the Corporation such additional area of land with frontage on the Esplanade Main Road as may be requisite for the extension of the present buildings to adapt it for Municipal Offices; the buildings to be taken over at the price which they have cost, and the land required to be granted to the Municipality at the same price as that found for the previous sites at Boree Bunder and opposite the Sailors' Home. That *as the Cathedral High Schools have been designed by the Government Architect, Government will be pleased to allow the same gentleman to complete the design for the new Municipal Hall and Offices.* That its Acting Municipal Commissioner be requested to suspend any further action with regard to the preparation of plans for the site opposite the Sailors' Home, and that in the event of Government acceding to the request above-named the Acting Commissioner be requested to cause the extension to the building to adapt it for Municipal Offices to be taken in hand and proceeded with to completion at the earliest practicable date."

The sting in the proposition lay in the passage italicised by us. In conclusion, the speaker added, by way of a rider, that it was a proposal which had emanated from him, and not from the Government; although "he admitted that they (Government) had given him every assistance to put his motion before the Corporation, and that they had permitted the plans to be prepared which were absolutely necessary for him to lay before them to shew that a building, fulfilling all their requirements, could be had for the money which had been proposed to be spent for the purpose." We daresay the Chairman was perfectly sincere in his statement, but it often happens that followers of Government possess a happy knack of anticipating what is pleasant for Government to hear. But outsiders who are not in the confidence of the powers that be, are apt to disparage this gift of prophecy in the recipient of favors. Unfortunately, however, in this instance a little incident has occurred which confirms that popular belief. The meeting referred to above was held on the 7th November, and on the 12th October a letter was addressed to Captain Morland by the Architectural Executive Engineer of Government, from the opening lines of which we find that the Under-Secretary to Government, Public Works Department, sent a confidential demi-official order to the Architectural Executive Engineer to hand over certain drawings to the Chairman of the Corporation, which the Corporation never asked for. At first the mystery seems inexplicable, but read by the light of Captain Selby's speech the flimsy device is unveiled. Notwithstanding the special pleading of the Chairman, endeavouring to invest the proposal with an air of importance and authority, the whole thing lies in a nutshell and he who runs may read. The facts are simple enough. In July 1886 the Corporation had selected a site near the native town, suitable for every purpose, a design for which had been already made by Mr. Chisholm. So far everything went well. But it appears that shortly afterwards the affairs of the Corporation seemed to have been discussed by the Government of Bombay at Poona, behind the back of that body, and the outcome was that the Secretary to the Government in the P. W. D. addressed a communication to the Corporation offering the Oval site. The next day a Committee was appointed and the different phases of the question being considered, it was resolved to accept the offer. After everything had been "done in order," and the Corporation having accepted the Oval site, Mr. Chisholm was directed to modify his design and plans to suit the new site. Here it was where the shoe pinched the supporters of the Government scheme, and a change came over the spirit of their dreams. On consulting Mr. Ollivant it was found that Government were raising difficulties about the design. The letter intimating their wishes on the subject was dated 15th December 1886, but did not come before the Corporation till the 9th May of the present year, when another Committee was appointed. The members again recommended that the Oval site should be adhered to, and that new plans should be made out for the building with an initial cost of five lakhs, and capable of extension. The Corporation in accordance with this resolution authorised Mr. Chisholm to draw up new designs. Mr. Chisholm, naturally, asked what style he was to adopt, and was told by Government that until it was "in possession of the report of the City Extension Committee, and of the views of the Municipality as to any suggestions that might be made by the Committee, Government are unable to move further in the question of the proposed site, and that, in order to avoid giving unnecessary trouble, will prefer not to offer any opinion upon the style of architecture to be adpoted."

It is well known that the Extension Committee had recommended the Oval site and the Chairman had unhesitatingly acquiesced in the Report. "But," as Captain Selby very properly observed, "in the meantime, Government, doubtless to 'avoid giving unnecessary trouble,' settled the site and style and cost without waiting either for the Report of the City Extension Committee or the opinion of the Corporation. The Architectural Executive Engineer was ordered to design offices in a wholly different place, on the site of the Cathedral High School, which its owners wanted to get rid of, and these plans were then sent to the Chairman on the 12th October 1887, in obedience to a 'confidential demi-official' letter from the Under-Secretary in the Public Works Department." Captain Selby being made of sterner stuff than dreams are made of, told the meeting in the plainest of terms that "he thought there were many better architects than the Government architect, and if they were determined to throw over Mr. Chisholm, the best way was to have a public competition. If they would not have a competition, and if Mr. Chisholm was to be thrown over, they might go to Mr. Stevens, who had built by far the most successful public building in Bombay."

He then concluded his address by proposing as an amendment: that the Corporation having regard to the definite statements made in letter of 7th August 1887, from the Under-Secretary to Government, Public Works Department, to the address of the Municipal Commissioner, should not proceed further in this matter, until the report of the Bombay Extension Committee is before it; in the meantime, the plans and elevations forwarded by order of Government to the Chairman, under cover of the Architectural Executive Engineer and Surveyor's letter, dated 12th October 1887, be referred for report to the said Committee, which should be directed to take the opinion of the Municipal executive officers, with power to call for Municipal persons and papers, and to take such advice as they may deem necessary from architectural or engineering experts, to report in detail on the plans and on the configurations of the site.

After a warm debate, in which the supporters of Captain Selby had the best of the argument, the amendment, on being put to the vote, was carried by 17 votes to 14—a signal victory of commonsense and non-official independence over gubernatorial domineering.

"China's Sorrow" the Yellow River, is again causing serious mischief. In the middle of last month, it was reported that the river had burst its banks over a very long line, flooded an immense expanse of country in Honan, Shantung, and Chihli, and the flood had even reached Anhue. "The loss of life is enormous; numerous cities, towns and villages have been destroyed, and the ruin done is of incalculable amount. It is said the Huang-ho now tends to re-enter its old bed, which has been dry since 1832 or 1833 for the most part, and completely dry since 1837. The Chinese Government is much alarmed, as no remedial measures are possible."

Notes and Comments.

THE INSTITUTION OF CIVIL ENGINEERS.—A paper is to be read sometime this session on "The Jubilee Bridge over the River Hooghly on the Line of the East Indian Railway" by Sir Bradford Leslie, K. C. I. E.

ASSAM COAL.—*On dit* that the P. & O. Company has contracted with the Assam Railway and Trading Company for supply of 1,000 tons of coal monthly. It is not beyond the bounds of possibility that we may yet "send coals to Newcastle" and demonstrate the bumptious falsity of one more stock proverb.

PORT ARTHUR—AGAIN!—Mr. Thevenet, the French Engineer engaged to construct Port Arthur, denies the report that the wall of the dock is breaking down. He says the work will be completed within the time and that the ravages of cholera among the workmen, which retarded progress, have greatly decreased.

CEYLON RAILWAYS—AGAIN!—The all-important question of Railway Extension to Haputale or Badulla still continues to be discussed by the press and public. No further advices on the subject have arrived from home, and it seems pretty certain that nothing will be heard until the Governor has replied to the last despatch from the Secretary of State

BOMBAY PORT TRUST.—Prince's Dock Extension Works Progress Report No. 34 for October 1887 shews that Certificate No. 33 for Rs. 88,884-13-5 was passed on the 11th instant, the total amount paid to the contractors to date being Rs. 38,37,335-1-3. The daily average number of men and women working on the Dock and at the quarries for Messrs. Kirby & Co. was 2,563, the greatest number in one day (27th) being 2,788.

PROVINCIAL IRRIGATION WORKS, MADRAS.—His Excellency the Governor in Council has allotted a sum of Rs. 31,51,000 for Provincial Irrigation Works in 1888-89; and the budgets will be framed accordingly :—

	Rs.
Buckingham Canal and other minor works ...	3,51,000
Irrigation works, ordinary ...	21,50,000
Tank Restoration ...	6,50,000

IRRIGATION WORKS IN THE DECCAN.—Mr. A. J. Dunlop as Secretary of the Committee recently appointed in H. H. the Nizam's Dominion is making arrangements for expenditure of ten lakhs that have been sanctioned for the repair and up-keep of tanks, which sum has been placed at the disposal of the Committee. This will explain the advertisement now appearing in this Journal over the name of the P. W. D. Secretary, Hyderabad—Deccan.

THE HYDERABAD-PACHPADRA RAILWAY.—The character of the agitation that is being carried on at Kurrachee on behalf of the Hyderabad-Pachpadra Railway scheme is indexed for educated Englishmen by the title page prefixed to the latest *brochure* issued from the *Sind Gazette* Press in advocacy of that much discussed undertaking. Here it is. Comment would be work of supererogation. "Railway extension in Sind: remarks on reply of Public Works Department, with extracts of proceedings of public meeting, Frere Hall, Kurrachee, 3rd November 1887."

THE ARCHÆOLOGICAL SURVEY.—Dr. J. Burgess, writing to the Allahabad paper, says:—The work of this survey, in a word, is (1) an Archæological Survey—Architectural and Antiquarian—of all the old remains in India, whether they require conservation or not; and (2) to advise the Provincial Governments as to what should be done so as to preserve with least injury to their style those monuments that require conservation, that no monument of importance may be falsely "restored," as has been the case with some in recent times. The Department is official curator of ancient monuments.

THE BILUCH FRONTIER.—Writing from Sibi, a correspondent of the *Pioneer* says:—By the way, how is it so commonly said that the officers who made the Sind-Pishin received but scanty reward for their hardships? I know as a fact that one young officer of the Royal Engineers, with three years' service, drew on an average pay and allowances to the tune of very little less than Rs. 1,000 per mensem for a whole year! This seems almost incredible, but I refer you to the Examiner of Accounts for black and white. So, after all, I think most officers would have been glad to be on the Sind-Pishin, as this is no isolated case.

THE INCREASED OUTTURN OF COAL AND LIME IN THE BURDWAN DISTRICT.—The large increase in the exports of coal from Raneegunge, which rose to 783,517 tons in 1886-87, against 635,921 tons in the preceding year, is attributed to the revival in the jute trade in Calcutta, to an increase in the lime and brick industries, and to the use of this coal by some of the steamship companies. There was a great development in the lime industry, due to the resumption of works in the Kidderpore Docks; 611,051 maunds of lime were exported from Raneegunge during the year under notice, against 304,034 maunds in the preceding year.

THE EXTENSION OF BOMBAY.—The Government Resolution, thanking the Committee for drawing up a report in regard to the disposal of land and building sites in the town and island of Bombay, has been published. His Excellency the Governor in Council records his appreciation of the very able manner in which the Committee have given effect to the wishes of Government in the preparation of this most interesting and valuable report, and thanks all concerned for the great labor and care they have bestowed on this most important enquiry. The several suggestions of the Committee will be taken into serious consideration.

THE KHOJAK RAILWAY SANCTIONED.—The sanction of the Secretary of State for India has been received to the construction of the Khojak broad-gauge railway project. There will be a double line of rail running straight to the limit of the present frontier beyond which no extension temporary or permanent is contemplated. A tunnel two-and-a-half miles long is the main difficulty. The railway will take some three years to complete, as the engineering work is very heavy. The length is only twenty-seven miles, and the cost is estimated at a hundred and twenty lakhs of rupees. The work of construction will begin at once. Mr. O'Callaghan will be Engineer-in-Chief.

THE MYSORE RAILWAY.—Mr. Dixon Carter, Traffic Manager of the Mysore Branch of the Southern Mahratta Railway, has returned to head-quarters after many weeks' arduous labor in restoring traffic between Bangalore and Mysore. The recent breaches in the line necessitate its thorough repair, the cost of which is estimated at Rs. 50,000. This will fall on the Mysore Government. The Gubbi-Hurrihur Extension is being pushed on. The laying of the rails will commence within ten days. Telegraphic communication is already established, and it is stated that telegraph offices will shortly be opened at Tiptur and other important centres to receive and forward private messages.

ANOTHER NEW B. I. S. N. CO. BOAT.—There has just been launched from the shipbuilding yard of Messrs. R. F. J. Inglis, Pointhouse, Glasgow, a steel screw steamer of 1,200 tons for the Indian coasting and mail service of the large fleet of the British Indian Steam Navigation Company. Her principal dimensions are—length 240 feet, breadth 34 feet, depth to main deck 19 feet, and to shade deck 26 feet 6 inches. The engines (of 1,800 horse-power) are of the triple expansion type, working at a pressure of 160lbs. On leaving the stays the steamer was named the *Carogola*. She is expected to arrive in Calcutta about the end of January 1888, and is to be employed in the Chittagong trade.

CALCUTTA TRAMWAYS AND THEIR WORKING.—Tram-cars are products of modern progress estimable and convenient to town dwelling people. But a town's tram service might just as well be well managed as ill managed. We love horses; have had good reason to; should very decidedly object to indiscriminate flogging, any undue flogging of horses. But the public has a right to expect somewhat more than two miles an hour as regulation pace. Probably if tramcars were not persistently over-crowded more than two miles an hour might be accomplished. Again, some assurance of starting up to time would be desirable. Yet again, men who are not so young as once they were, and inept at gymnastic feats ought to have indisputable right to stop a car when they want to alight therefrom. The Tram Company professes to allow such right, but, as a matter fact, doesn't.

CIVIL ENGINEERING COLLEGE, SEEBPORE.—An examination for admission to the Mechanical Apprentice Department will be held at the College on Monday and Tuesday, the 16th and 17th January 1888. Candidates must apply in writing to the Principal of the College, not later than the 10th January 1888, for permission to appear at the examination, enclosing a certificate of good conduct and a certificate of age. For admission to this Department, candidates must be between the ages of 15 and 17 years. The subjects of examination are Arithmetic, the whole; Algebra, to simple equations; Euclid, Books I. and II.; with English Grammar and Composition. Every applicant, before admission to the College, will be examined as to his physical strength, fitness for manual labour. There will be one vacancy on the free list for Christian students in February next, and eleven vacancies on the reduced Rs. 5 per mensem fee list. For Natives there will be seven vacancies on the reduced Rs. 2 per mensem fee list. These vacancies will be filled up by the Board of Visitors.

THE SIMLA RAILWAY SCHEME.—The *Englishman* thinks that its readers will probably not be surprised to learn that the Government of India are not prepared to undertake the construction of either the proposed Umballa-Kalka or the Kalka-Simla Railway as a State Railway, or to offer any guarantee or subsidy on their concession to private enterprise. The fact is, as we pointed out some time ago, that there is no prospect whatever of the proposed railway proving a financial success. Although at first sight Mr. Morris' estimates of probable expenditure and receipts seemed plausible enough, they were too strongly colored by that gentleman's bias in favor of the scheme. There is far more probability of the return on the capital invested being something less than one per cent. than upwards of four per cent., and, as we hear so much of the urgent need for economy in all departments of the State, Government could hardly go directly against the principles it is so energetically preaching, and sanction the very large expenditure that would be required when there is no hope of getting anything like an adequate return.

THE NEW PUBLIC CLOCK AT BARODA.—The following is a description of the New Public Clock recently erected at Baroda by Messrs. Lund and Blockley:—The tower is of red brick with white stone enrichments, one hundred and twenty feet high, and prominently placed in the main road of the city. The four clock dials 6′ 6″ diameter have iron frames glazed with pure white opal glass, and both hands and dials being quite plain, the time is readily seen at a considerable distance during the day and when illuminated at night. The bells, five in number, are contained in a wrought iron bell frame specially designed with a view to economy of space and durability. Upon the biggest, weighing about half a ton, of deep and sonorous sound, the hours are struck, and the quarters are chimed upon the four smaller of about the same aggregate weight, and consecutive musical notes—one sequence at a quarter past the hour; one sequence and one change on four bells at the half hour; on sequence and two changes on four at the third quarter. The construction of the clock works is similar to those supplied to the Bombay University Clock, the Kolhapur Palace, and the G. I. P. Railway new Terminus.

ROYAL ENGINEERS IN THE PUBLIC WORKS DEPARTMENT.—The recent appointment of another Royal Engineer officer to the office staff of the Director-General of Railways, for employment in connection with the Railway Conference, gives four Royal Engineers, including the Director-General, out of five in all, in the railway branch of the Government of India Secretariat. It is contended, that this is only another and frequent instance of the way in which it seems to be assumed that a Royal Engineer officer knows everything. But that assumption is, and rightly so, not allowed in the case of Civil Engineers in the department, and they have been, and still are, put aside "for want of special knowledge," more particularly when the post to be filled involves residence at Simla in the hot season. The Royal Engineer seems always endowed with the requisite special knowledge for interesting functions at Milan, in Mexico, at Merv, and in Germany, and every possible good berth in the India Office is claimed by their Corps. When the office of Inspector-General of Railway Stores became vacant the other day, by the death of General Hyde, the India Office was besieged by applications from Colonels and Generals of Engineers, only one of whom had any approach to the requisite "special knowledge" for such a post.

ROYAL ENGINEER CORPS NEWS.—Colonel H. Locock succeeds Colonel R. N. Dawson-Scott as Deputy Director of Works (for Barracks), War Office. Colonel J. C. Ardagh has been appointed Assistant Adjutant-General, Intelligence Department, and will shortly take up the duties. The head-quarters of the Devon sub-district have been moved from Devonport to Exeter. The following movements of Companies abroad are now being carried out: 1st Company, Gibraltar to Bermuda. 6th Company, Bermuda to Gibraltar. 9th Company, Gibraltar to Hong-Kong. 18th Company, Gibraltar to Halifax, N. S. The 31st Company at Hong-Kong will, on being relieved, return home. Eighteen Lieutenants who were gazetted to the Corps on the 16th of September 1885, having completed their course of instruction at the School of Military Engineering, have left Chatham and proceeded on leave of absence. Ordered abroad:—To Mauritius: Lieutenant-Colonel J. H. Satterthwaite to Egypt. Major A. G. Clayton to India. Lieutenants G. M. Heath, S. H. Powell and E. H. de V. Atkinson. Ordered Home:—From Mauritius: Lieutenant-Colonel R. W. Stewart. From Egypt: Lieutenant-Colonel A. J. Happer. From South Africa: Lieutenant A. G. Drummond. Embarkations:—For South Africa: Lieutenant W. H. Hinde. For Sierra Leone: Lieutenants H. B. Mackay and W. du C. Luard.

Indian Guaranteed Railways.—The "Synopsis of transactions of Guaranteed Railways for and to end of the year 1886," shews that the system at date comprised 3,923 miles divided among five Joint Stock Companies, *viz.*:—The Great Indian Peninsular; Bombay, Baroda and Central India; Oudh and Rohilcund; Madras, and South India. With the exception of the latter, which is metre-gauge, the whole are broad-gauge lines. The total outlay at the end of the year was £55,517,215, and the average per mile Rs. 1,51,667; the broad-gauge having cost Rs. 1,68,392 per mile, against Rs. 67,945 for the narrow track. Compared with 1882 the net earnings of the Guaranteed Companies advanced from Rs. 2,89,35,246, to Rs. 3,65,26,392 in 1886, the increase being equal to nearly 26¼ per cent., and the net loss to the State, which in 1882 amounted to Rs. 28,32,035, was turned into a gain of Rs. 15,91,077 for the year 1886. But these figures do not include the State charge for control, nor the loss of land revenue on land made over to the Companies, amounting for the year to Rs. 3,72,164, and Rs. 15,773, respectively. The total cost to Government on these two accounts from the commencement of operations to the end of last year was Rs. 98,10,928. The loss by exchange on guaranteed interest paid by the State at the contract rate of 1s. 10½*d.* and the average for the year of 1s. 5·965*d.* amounted to the very large sum of Rs. 77,94,503.

Appointment of a Committee of Enquiry into the Working of the Sone Canal System of Irrigation.—While on tour in the Behar Division, the Lieutenant-Governor of Bengal received a memorial, numerously signed by leading residents of the Shahabad district, complaining of the system under which the Sone Canals are worked in that district. The complaints were general, and not only dealt with the rates, but pointed out numerous difficulties and imperfections in the system of assessment, as well as in that of collection, and included allegations of insufficient water-supply and of injury to the general health of the district. On enquiry the Lieutenant-Governor found that the allegations were such as could not be satisfactorily dealt with by departmental agency. The civil and departmental officers admitted that in many respects the system worked imperfectly, and added complaints from their own point of view of difficulties in securing the attendance of parties for assessment, in ascertaining the correct names of owners, in properly controlling distribution, and in promptly realising arrears. The Lieutenant-Governor came to the conclusion that it was necessary to examine into the working of the entire system, with a view to provide remedies where possible for admitted defects, and to improve the rules, and, if necessary, the law under which the system is administered. To carry out this enquiry, a Committee is appointed consisting of Mr. H. J. S. Cotton, B.C.S., as President, with Mr. C. W. Odling, M.E., M.I.C.E., and Rai Jaiprokash Lal Bahadur Members.

Our Rangoon Items.—A correspondent writes:—On the Burma State Railway Jones' flexible carriage couplings do not appear to be a success as they cause greater wear and tear to the flanges of the wheels of the vehicles. But as we hear that renewals to the permanent way are now made with steel rails this might cause the rapid wear in the wheel flanges. It is very possible that the next official year may find the P. W. D. of Upper and Lower Burma amalgamated under one Chief Engineer with three or four Superintending Engineers or Superintendent of Works. Perhaps the latter class of officers would be the cheapest in these days of financial pressure and better for the province as it would give the local officers who have more experience of the country a slight step of promotion without prejudicing the claims of their seniors in India. It would be quite a mistake to send to this province senior officers from India as Superintending Engineers as they would just come here for the step and take furlough and leave so as to work back to India, while with the Superintendent of Works, it is his interest to remain in the country till his turn comes for a Superintending Engineership, for if he takes leave he loses the allowance of a Superintendent of Works which is Rs. 100. As a rule officers transferred to Burma from India are very discontented owing to the high rate of living. An Executive Engineer of the 1st grade in Bengal, the North-West or Punjab is really better off than a 2nd or 3rd grade Superintending Engineer in Burma. Engineers who come to Burma on first appointment are content to remain and complete their service in it, but not so those who after some years service in India are transferred to Burma.

Financial Statistics of State Railways.—A recent number of the *Gazette of India* contains a statement of Financial Statistics of State Railways for the year 1886. It is divided into Imperial, Provincial, Imperials lines worked by Companies, and Native States. Of the first named the total length of line open to traffic on the 31st of December last were 3989·48, the length of line under construction on the same date being 1071·58 while 198·67 miles were under survey mainly in Burma. The total capital expenditure on open lines up to end of 1886 was Rs. 50,02,24,394, and of this the largest sum was appropriated by Sind-Sagar, Eastern Section, and North-Western Railways, *viz.*, Rs. 28,93,92,803 inclusive of Rs. 11,88,73,361 being capital outlay incurred by the late Sind, Punjab and Delhi Railway Company, in final heads of account up to 31st December 1885. These lines seem to be the least remunerative. Then come the Rajputana-Malwa, Cawnpore-Achnera, Rewari-Ferozepore, followed by the Nagpur-Bengal and Eastern Bengal lines. The Sind-Pishin, Sibi-Quetta Section, shews under the same head Rs. 3,36,62,369. Of the Provincial lines, the largest total capital expended was on the Burma State Railway, *viz.*, Rs. 2,85,59,213, shewing the net receipts for 1886, Rs. 9,45,049 after the deduction of working expenses for the same period. Next in importance is the Northern Bengal, and then come the Tirhoot and Nagpur-Chhatisgurh Railways. The total length of line open to traffic on 31st December 1886 was 1380·26 miles, making a grand total of State Railways of 5369·74 miles. The total Imperial lines worked by Companies were 783·19 miles. The total length of lines in the Native States was 468·68.

Current News.

THE Benares Tramway Scheme may be now pronounced extinct.

THE coal outcrops on the Sind-Pishin, between Sharigh and Kost, do not promise to be much of a find.

MR. FRANKLIN PRESTAGE, the Chairman of the Darjeeling-Himalayan Railway, returned to Bengal by the mail train yesterday, and alighted at Hooghly.

THE services of Major W. Peacock, R.E., have been placed at the disposal of the Foreign Department for special duty in connection with the demarcation of the Afghan Frontier.

WE understand that Mr. J. R. Bell, Executive Engineer, is shortly to be moved from Lahore to superintend the construction of the Bridge over the Chenab river, about six miles from Mooltan.

THE people of Kamptee have resolved to borrow six thousand rupees in order to rebuild the Public Rooms recently destroyed by fire. A local contractor has kindly offered to do the work at cost price.

MR. TOWNSEND, the petroleum expert, has succeeded in obtaining a supply of 300 barrels of oil daily from each of the two wells at Khatun. This will effect a great saving in the cost of fuel for the railway.

A PUBLIC hall or place of recreation for all classes of the community is shortly to be constructed at Umballa on a suitable site within cantonments, at a cost of Rs. 20,000, defrayable from Cantonment funds.

MR. LEES, Executive Engineer, Circular and Eastern Canals Division, Bengal, is likely to proceed on furlough early in March next, when Mr. Shawe, Cossye Division, will probably relieve him.

THE Eastern Bengal State Railway and its management seem to attract more attention than anything in Bengal. The Press teems with letters, describing the risks one runs, and the discomfort one suffers when a traveller on this line.

WE believe that the extension of the Madras Railway from Palghaut station to Palghaut town will be finished by the end of the year. Efforts are being made to have this as complete as possible, so as to open it for passenger traffic in January 1888.

WE hear that Rs. 16,000 in shares has been taken up for the promotion of the railway from Hardwar to Dehra and Rajpore project, and that there is every prospect that the company will be definitely formed in London within six or seven months.

THE works in connection with the construction of the Lighthouse on Short's Island, which were somewhat delayed owing to the late storm-wave, are now said to be fast progressing towards completion, but the light is not likely to be exhibited until June next.

SIR THEODORE HOPE'S visit to the oil wells at Khatun is likely to result in their very considerable development. The recent deep borings justify the expectation that a large and permanent supply can be relied on, and the chief difficulty, which now presents itself, is how to make this supply available.

BESIDES the technical education scheme, there is a proposal, we hear, to abolish certain classes of the Presidency College, Calcutta, and to create a few chairs of science professorships with the saving thus effected, for the purpose of preparing the graduates of the University for professorships in the district colleges.

IT is understood that the Indian Midland Railway Company has decided to take over and work the Itarsi line connecting Bhopal with the G. I. P. system. The section is in bad condition, but will be put in proper order before it is handed over. The details were practically settled at a committee meeting held at Jhansi last week.

ON the 17th November, the new Victoria Library building, Indore, erected within the Residency limits to commemorate the Jubilee year of the reign of her Most Gracious Majesty the Queen-Empress, was opened by Sir Lepel Griffin, K.C.S.I., Agent to the Governer-General for Central India, in the presence of the *élite* of the station.

WE hear that, notwithstanding the recommendation of the Committee that recently sat to enquire into the working of the Madras Railway, *viz.*, that the existing establishments should stand as they are, the subject of the cost of the audit establishment is again to be raked up and investigated chiefly in respect to the *assistants* and auditors of the department.

THE Director-General of Railways in India, the Consulting Engineer for State Railways, and all the officials of H. H. the Nizam's State line, including the Home Secretary, left Secunderabad for Kazipett, where after a short stay, the party proceeded to the Singareni coalfields and to the Dornacul section, which was to have been inspected before being finally made over for traffic.

THE latest mail steamer from home brought to Ceylon Mr Woodford Pilkington, M.I.C.E., who has come at the instance of the Harbor Department of the Board of Trade to superintend the erection of two new lighthouses, one on an island near Beruwela between Colombo and Galle, and the other on Dondra Head. These lighthouses are to be erected at the expense of the Imperial Government.

THE small men are faring better than the large companies. In the Minbyin oil fields, in the Kyouk Hypoo district, Moung Pan Hla, Moung Htoon Hla, and several others are making good profit, their expenditure being comparatively trifling. In the Boronga fields of the Akyab district Mr. Savage is working a small concession granted to him by the local Government, and with splendid success.

COLONEL KEITH, who came out last year as one of the new Surveyors in the Archæological Department and was attached to the North-West and Central India Circle, is, we regret to learn, likely to be compelled to leave India on account of ill-health. His retirement will leave Dr. Burgess the head of the Department with four officers, of whom one is in Madras, one in Bombay, a third in the Punjab, and a fourth in Bengal.

THE liability to accident from floods, which forms so serious an impediment to the utility of the Bolan line, will, it is expected, be before long almost entirely obviated by the reconstruction on a new alignment of the portion of the line from Khundalani Gorge downwards. This is at present the most dangerous part of the line. A survey is now being made of the new route, which will involve the construction of a long tunnel.

THE trains that run daily from Warangal and stations on the construction line of the Nizam's Guaranteed State Railway now convey to Secunderabad wagon-loads of coal from the Singareni fields. The conveyance of coal was stopped some months ago owing to the diversion having been washed away by heavy floods from the Palkar river, but at the suggestion of Mr. Molesworth, the District Engineer, a permanent bridge has been erected, and now completed.

IT is stated that the majority of the various Railway administrations consulted having expressed themselves in favor of August in preference to February for the next Railway Conference, it has been decided by the Government of India that the Conference shall be held at Simla next August, the exact date being hereafter fixed. Colonel Conway-Gordon, R.E., the Director-General of Railways, has been nominated as President, with Captain Wilson as his Secretary. Two delegates are to represent the State Railways, the delegates for Guaranteed lines being selected hereafter.

THE question of the abolition or retention of the office of the Director-General of Railways with the Government of India will be taken up this cold weather in Calcutta. The sanction to the office establishment expires on the 31st December, and if it is to be retained must be renewed. The India Office do not, we believe, object to the appointment of a Director-General of Railways, but to the large office which has gradually been got together for that official, and urge the plea that the work could be done more economically by the railway offices under the Provincial Government.

COLONEL AUGUSTUS LE MESSURIER arrived at Teheran on 31st October. The announcement that he had obtained facilities to inspect the new Russian line of railway from the Caspian *viâ* Merv towards Samarcand occasioned some natural surprise. In spite of the jealousy with which the Russian Administration is believed to regard the intrusion of foreign observers, he has traversed the greater part of the route. Starting from Bokhara, he has crossed the Oxus at Charjui, proceeded thence to Merv, and from that rapidly growing centre by the Trans-Caspian Railway to Askabad and the terminus on the Caspian.

THE proposed survey of the Eastern coast of the Madras Presidency, which was to have been carried out this cold season, has, after all, we hear, been postponed. The steamer *Madras* was to have been placed at the disposal of the Survey party, but the Government of India have stated that no funds have been provided in the Imperial estimates to meet the expenses of the steamer. Moreover, she would be required for use by the Survey party from the beginning of December to the early part of April, whereas she is also required for the pearl fishery at Tuticorin in the beginning of March. Under the circumstances, the Madras Government have been obliged to reluctantly postpone the survey operations, but have expressed to the Government of India the hope that nothing will be allowed to stand in the way of the much-needed survey of the coast being carried out during the cold season of 1888-89.

A REMARKABLE engineering feat has just been carried out in China in the face of unusual physical obstacles. This was the stretching of a steel cable of seven strands across the Luan river by Mr. A. de Linde, a Danish Civil Engineer, aided only by unskilled Chinese labor. The cable is strung from two points 4,648 feet apart. The height of one support is 447 feet above the present level of the river and the second support 737 feet above it. The vertex over the water is 78 feet. The Chinese cable is the longest but one in the world. The telegraph air cable across the Kistna has a span of 5,070 feet ; two similar cables cross the Ganges, one 2,900, and the other 2,830 feet. A third line of 1,135 feet crosses the Hooghly, and in the United States there is one over the Missouri of 2,000.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

ARTESIAN BORINGS.

SIR,—I note a letter in your Journal of 12th November from Mr. Frank J. Agabeg on "Artesian Borings in Calcutta." He appears to be very "sanguine" that plenty of fresh water can be got in Calcutta by artesian wells.

He tells us that the members of the Calcutta Municipality expressed an "absurd and hasty" opinion. Unless Mr. Agabeg can give us *more information* than he has done, we doubt whether he has not been hasty himself. He recommends a trial bore hole, and I quite agree with him there; but as he is now at work on a trial bore hole at Port Canning, perhaps it would be best to wait and see the results of *this* "experience" before entertaining any of his kind suggestions.

CHIPS.

BOMBAY, BARODA, & CENTRAL INDIA RAILWAY.

SIR,—With reference to your article on Winter's Block system, I observe you state that Preece's system, as applied to this Railway is that known as the "affirmative," *viz.*, that the normal position of the semaphore arm is at "*Danger.*" Permit me to set you right in this matter.

The system we now work is that known as the "Positive," the same as in use on the G. I. P. Railway, *viz.*, that the semaphore arm is at Danger when a train is in the section, and lowered when the section is cleared.

Trusting you will give this a corner in your esteemed Journal.

J. FRANKLIN,
Telegraph Superintendent,
B. B. & C. I. Railway.

SURAT; *November* 24, 1887.

"MELTING IVORY."

SIR,—In reply to Mr. Mukerji's enquiry in your issue of the 29th ultimo, I beg to offer an extract from a book on the subject of Ivory Cutting in my possession:—

"It is imagined by some that ivory may be softened so as to admit of being moulded like horn or tortoiseshell, but its different analysis contradicts this expectation; thick pieces suffer no change in boiling water, thin pieces become a little more flexible, and thin shavings give off their jelly, which substance is occasionally prepared from them. Truly the caustic alkali will act upon ivory as well as upon most animal substances, yet it only does so by decomposing it; ivory when exposed to the alkalies, first becomes unctuous or saponaceous on its outer surface, then soft, if in thin plates, and it may be ultimately dissolved, provided the alkali be concentrated; but it does not in any such case resume its first condition."—*Holtzapffel's Turning & Mech. Manipulation. Vol. I. London*: 1852.

November 20, 1887. C. G.

INDIAN COAL MINES AND COAL MINING.

SIR,—The application of the Mines Regulation Act to coal mines in India, again calls for the serious attention of the Government. The dangers and difficulties arising from the present system of working have already been fully discussed* by Mr. T. H. Ward, F.G.S., in his pamphlets, "The Indian Coal Mines and is Legisiation necessary to regulate their working?" and also his later production, "A Description of the System of Mining Coal adopted in India;" and every succeeding year proves conclusively, how imperative it is that Government should take immediate steps to remedy such a deplorable state of affairs, and devise some means for the better protection of life and property.

Legislation and inspection are admitted benefits all over the civilized mining world. The Government will surely no longer withhold those benefits from the 30,000 poor ignorant miners now working in Bengal! A perusal of the "Final Report of Her Majesty's Commissioners appointed to enquire into accidents in Mines of Great Britain, 1886," will clearly demonstrate the numerous sources of danger the miner is subject to and the carefully devised scheme of elaborate inspection, and all possible means to prevent the occurrence of accidents.

Here in India no such precautions exist. The Government have in the most inconsistent manner neglected inspection of one of its most important industries. The mines are worked in the most disastrous manner, and accidents and deaths occur from ignorance or neglect on the part of the management, which in other countries would be deemed criminal.

It would be impossible, indeed unnecessary, to introduce the Act in all its detail, but the principal subjects for legislation would be—

1.—All rules bearing on the safe working of coal mines.
2.—The appointment of inspectors.
3.—Enforced record of plans.

* There were two sides to this discussion, and Government after due consideration of the *pros* and *cons* wisely resolved to adopt one of them and let well alone—*i.e.*, not to hamper the industry with uncalled for restrictions.—ED, *I.E.*

The complete investigation of the present state of the coal mines should form the subject of a special commission composed of the Collector, a Government Engineer, and a Certificated Mining Engineer, who should take evidence from the various managers of any suggestions or modification of the Act they may have to make; and also visit the collieries for the purpose of placing the Government in possession of facts independent of all extraneous evidence. In their inspection the most important points for record would be—

1.—The plan of workings.
2.—The size of pillars and nature of roof.
3.—The protection of working faces and travelling roads.
4.—The ventilation.
5.—The proximity of other workings.
6.—The condition of shaft and fittings, ropes and machinery, generally.

With this information before them the Government will be in a position to frame a Mines Regulation Act eminently suited to the requirements of the industry and the country.

M. E.

PUNKAHS.

SIR,—I hope you can afford me a little space once more, if only to apologise to Mr. Wallace for having confused swings and pulls, but I was really more ignorant than he points out, and the mistake I made was in calculating an oscillation as two swings. The correct calculation, which is about 60 inches for a pendulum of 48 oscillations, would, however, have answered my purpose as well, which was to shew Mr. Wallace that I had taken all the trouble I could to find out how he arrived at 50 inches before I replied to him. I presume it was discovered by experiment, but in this case as the results would vary with every punkah, and indeed coolie, I think, the details might have been given.

But in addition to my apology I shall be obliged if you will allow me to try and make my object quite clear, as I appeared to have failed lamentably last time.

When Mr. Wallace's lectures appeared in your paper I read them with much interest, because in the Institution I have charge of there were a good many punkahs, and all worked very inefficiently, and I had often wished to improve these if I only knew how. I did not, however, think that Mr. Wallace's pattern would suit, because I at once saw its resemblance to the class of punkah one gets on boardship, which is a class I do not like, and happening to hear at the same time of the Mortimer system, I remodelled roughly on that with most satisfactory results. Then seeing that Mr. Wallace laid down with some tone of authority what was the correct system, and fearing that others might accept him without question, or consideration of other systems, I rushed unadvisedly to print, to show that his experiments did not prove everything, as his fundamental assumptions were open to question.

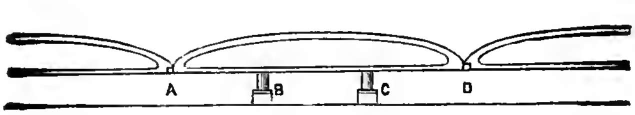
My issue then joins with Mr. Wallace before he commenced his experiments, on which I have no desire to throw the slightest shadow. My contention is that the result he desires, and the punkah he has most carefully and correctly designed to produce that result in consequence, are not the general desiderata. He wishes for a downward blast, and a strong one, and has experimented out a punkah which produces this, varying from 0 to a maximum, and to 0 again, the breadth of its swing, *i.e.*, 4 feet. At least this is how I understand him, as he says the effect is imperceptible two feet either side of the centre point. As a familiar example of what this is, I said it was very like a punkah in a ship saloon, and I do not think I am wrong in maintaining that, and surely I am within all limits in stating that I do not like a ship's punkah, or a downward draft, or a violent draft, or a variable and intermittent draft. So that as I said I join issue with Mr. Wallace from his very first expression of what he likes and has arranged his punkah for. I am perfectly aware that a punkah is only effective by its action on the skin, but my skin likes to have the air supplied to it gently, and in such quantity as it can evaporate, and my nerves resent all above this, particularly when the draft is variable and directed so as to throw my papers about. Therefore I prefer the more horizontally moving, and less fussily moving punkah, which somehow or other does, as I know from experience, create a pleasant soothing air about me. I may remark that I do not understand Mr. Wallace's statement, in his lecture, that a punkah with a long suspending cord—"which keeps it nearly always in a vertical position throws almost as much air upwards as downwards," unless he means that it throws none either way, or how the law of equal incidence and reflection applies to the case at all, neither am I quite sure how the draft is produced in all cases, whether it is driven by, or follows, the punkah. But for all this I do not feel inclined to apologise for my rough description of a good punkah as one that puts all the air of the room in motion, as that more or less expresses my idea of what a good punkah should do, and therefore in many cases, notably in an office, I still prefer the old board punkah.

I might further point out the practical inconveniences of Mr. Wallace's pattern, firstly in the provision of fixed points for suspension at so small a height from the floor, and secondly in the number of suspension points and punkahs required, since each punkah only protects four feet, and therefore for example a dining table must have two, and a very large drawing-room several. Mr. Wallace also makes capital of the saving in labour to the coolie, but it is only in very exceptional cases that the foot pounds is any matter to him. It is more the number of pulls to the minute which distresses him, and 24 is pretty smart work. Now the Mortimer system presents no difficulty of suspension points, and the punkahs can be most economically arranged just wherever they are required and can easily be made moveable. It is also exceedingly easy to pull, and if this correspondence gets it a hearing, and induces men to consider what they want, before they blindly accept Mr. Wallace, it will have answered my object. The requirements, and possibilities, are very varying and the arrangement must be adapted to meet the conditions, and the fancies of men, in each case; and as an example of individual fancies disagreeing, I conclude with expressing the hope that if I am put in a solitary cell Mr. Wallace may not be allowed to arrange his theoretically correct punkah for the single individual over me, which swings 20? inches and 120 to the minute, or assuredly the cell would need to be padded.

M. B.

HOOGHLY BRIDGE CANTILEVER.

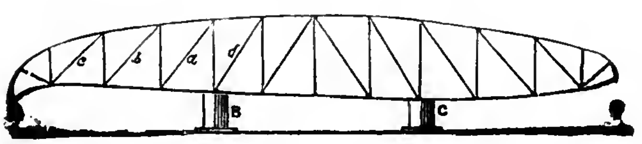
Fig. 1.



Sir,—As no correspondent has yet replied to the query in your issue of 23rd April regarding the rising of unloaded end of the cantilever of the Hooghly Bridge, I will send you my views on the subject.

Your correspondent "C. E." evidently has not given much thought to the matter, or he would see that the bars *a*, *b*, *c*, of his figure are simply in tension, and cannot therefore possibly buckle as suggested by him.

Fig. 2.



Bar *d* will be in compression, but there is no need to suppose that it will buckle.

The analysis of the primary strains on the framing of the cantilever is so simple, that I will not waste your space by giving a figure of the stress diagram; but as perhaps the elastic deformations and their effect are not so obvious, I will detail them.

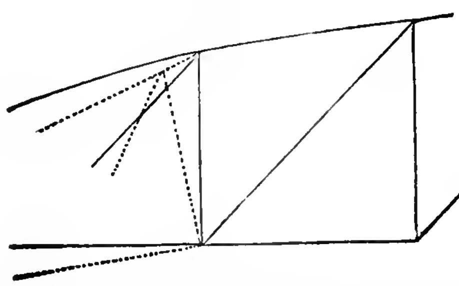
This analysis is best divided into three parts.

Firstly.—The vertical deflexion of the loaded end of cantilever.

Secondly.—The horizontal deflexion of the middle portion, due to the pull along the top chord.

Thirdly.—The behaviour of the unloaded end.

Fig. 3.

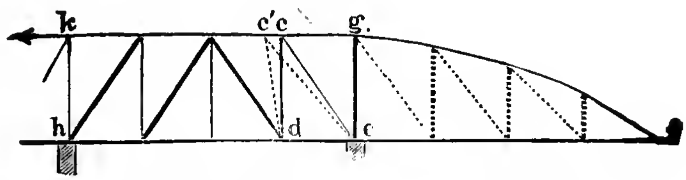


As regards the first section, the deflexion of cantilever nose can be easily ascertained thus. Let *fig.* 3 represent a panel of the cantilever. If any member of the chords alters in length, it will cause the forward part to revolve round a point found by drawing a line through the member concerned, that shall cut only two other members whose intersection gives the point of rotation. The vertical deflexion of nose due to alteration of length (Δ) of this member, is $\Delta \times$ distance from point of rotation to nose $\div$ perpendicular distance from member concerned, to point of rotation; and the sum of these in the different panels will be the total deflexion due to chord members. For Ties, the deflexion due to stretch in any tie is the elongation $\times$ ratio of length of tie to length of post from which it starts. And deflexion due to posts, is simply their compression.

The sum of all these, is the total deflexion of cantilever nose, supposing it rigidly held at the first support.

But though the bottom chord is rigidly fastened, the top is held back by the middle portion which is elastic, and must be treated as a horizontal cantilever, held at the piers and loaded by the pull along top chord, the details of calculation being the same as for the nose. This horizontal deflexion causes the forward part of cantilever to rotate round the support next the load.

Fig. 4.



Lastly, to consider the behaviour of the unloaded end: it is obvious that a pull along top chord in the direction of arrow in *fig.* 4, causes a distortion of the members *e c*, *d c*, as shewn in dotted lines, of a calculable amount, and that consequently the top chord will put a pull upon the unloaded end.

If the length *c f* does not extend in giving this pull, the vertical rise of *f* will be $cc' \times ef \div eg$.

We have then to investigate what resistance the forward part can offer to this pull. As all the tension members will now be in compression, it is obvious that they, being simple bars, can do nothing to oppose it, consequently the resistance of the unloaded part is simply that of the bottom chord *ef* considered as a beam, in which it is obvious that a very trifling load will cause a deflexion, the exact amount being ascertained on knowing the section. The members shewn in dotted lines not assisting in any way, we can then assume in general terms, that the elongation of *gf* will be practically nothing as probably calculation will shew that a load of even 2 or 3 tons would produce the observed deflexion.

Thus the whole of the elastic deformations can be exactly calculated, and from these the secondary strains ascertained. The most strained member will apparently be the post *h k*, because while its foot is held fast, its head suffers a lateral deflexion equivalent to the whole deformation of the middle part. This extra or secondary strain, can be estimated thus. Consider it as a cantilever fixed at *h* and loaded at *k*. Let P be the force required to deflect it an amount S (either calculated or observed.) Then $\Delta = \frac{Pl^3}{3EI}$, and, transposing,

$$P = \frac{3\Delta EI}{l^3} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad 1$$

Putting S for the unit strain and *y* for distance from neutral axis to most strained fibre, M. The bending moment at root $= Pl = S\frac{I}{y}$, from which $P = S\frac{I}{y\,l} \quad \ldots \quad 2$

and equating (1) and (2) we get

$$S = \frac{3\Delta y E}{l^2} \quad \ldots \quad \ldots \quad 3$$

S being the unit strain from deformation + or − the total thrust on post, on different sides.

Nor is this all, for the post being bent in an arc whose versin is *v*, the direct thrust T produces by virtue of this bending an additional bending moment T *v*. So that taking all things into consideration, the strain on one edge of the post must on one side be very much more than the primary strain based on the supposition that the structure is rigid and joints articulated.

It is interesting in this connection, to observe how extremely unscientific is the practice of Great George Street in general and the I. S. R. in particular, in persisting in the design of girders as if the material were inelastic. This particular post is a flagrant example, for if it were hinged, it would suffer no secondary strains, and it is not an extravagant supposition that the men who design such structures certainly do not provide for the secondary strains they wilfully incur, except by a lumping "factor of safety."

A girder to approach even approximately the calculated primary strains, should have all compression members with as large, and all tension members with as small a moment of inertia as possible, and all joints as frictionless as possible. Instead of this, the designers of State Railway bridges delight in making the tension members the exact counterpart of the compression ones, committing even the absurdity of heavily counterbracing *simple ties*, and making their gussets as large as possible, under the delusion that this pseudo-rigidity adds to the strength or durability.

A comparison of one of their designs for secondary strains, with the same truss properly designed would be instructive.

Indeed the case under discussion would be as good as any to take up, for if the Hooghly Bridge is designed after the usual I. S. R. style, it is probable that the secondary strains amount to 30 per cent. of the primary, and if they do not, it is only by reason of the excessive amount of metal allowed, which would not be required were the girders scientifically designed.

F. E. R.

General Articles.

PROPOSED SUSPENSION BRIDGE OVER THE VISHWAMITRI RIVER, BARODA.

Description.

The bridge to be 190 feet from centre to centre of towers and the distance thence to the anchoring bolts on each side to be 40 feet. The depression of the chain at centre to be 30 feet, and the camber of the roadway 1 foot. The roadway to be 20 feet wide from centre to centre of the suspension rods with a footway on each side 6 feet wide.

The piers to be of masonry, with wing walls, &c., as shewn in the drawings and as designed and specified by the architect.

P. R.

(To be continued.)

ON RIVER SCOURS.

By A. Ewbank.

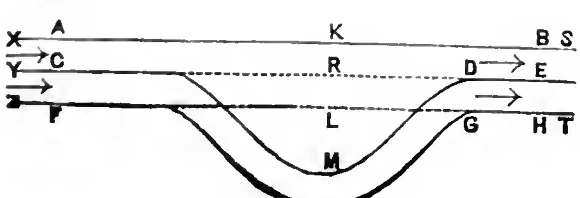
II.

In all the foregoing reasonings we have tacitly assumed that the water accepted the diminished outlets provided. In such a case we have seen that there is an increased head of water above the bridge and increased velocities through the actual channels. But by the increased velocities the waters will impinge with increased momentum against the unevennesses of the bed of the river. The original bed had been scoured out by some original momentum of water. The enhanced velocities are therefore likely to cause an additional scouring or deepening of the channel. This is exactly what happens. The water proceeds to deepen the remaining outlets. In this way it obtains an increased area of exit which partly compensates it for the area banked up or closed. This increased scouring will be felt as high above the bridge as the increased pressures and velocities are felt. The additional pressure and velocity reaches a certain distance upstream—the additions being less the higher we go; till we reach a section of the river above which the disturbance caused by the embankment is not sensible. Similarly, the water that pours through the bridge with enhanced velocity cannot at once part with the excess velocity. It is only at a certain distance below the bridge that the water has recovered from its excitement. Thus at a certain distance above the bridge the water begins to hurry. It attains its maximum of hurry at the bridge and then it slackens gradually. Over the whole extent of the bed from where the hurrying begins to where it has finally ceased there will be scouring agencies at work. To scour out or deepen its channel is the normal attribute of water. The depth at any time of a river channel simply implies a temporary equilibrium between the violence of the water attacks and the resisting strength of the bed. If the velocity of the streams is increased a new equilibrium is attained after the bed has suffered further depredations. If the soil gets harder as the depth increases a new equilibrium is easily obtained.

We have lastly to ask the following questions. Assuming that the scouring under the bridge and embankment has been so extensive as to give a total vertical section of outlets equal to the original vertical section of *fig.* 1, is the water now as well provided for as before the embankment was built? Does the water lose its extra rise above the bridge or its extra velocity under the bridge? All these questions must be answered in the negative.

To examine these points consider *fig.* 2.

Fig. II.



X K B E R Y represents in plan a pipe or other water channel which is partially filled with flowing water. Y R E H L Z is a similar channel. At X Y Z these channels are united but, beginning from C, we have a wall or separating surface. This separator ends at E, so that at S T we have one enlarged channel similar to X Z. To account for the flow of water down the whole pipe or the partial pipes let the line X S slope downwards to the right to the amount of a few feet in a mile or to any other amount that we choose. The water divides at C and one part takes the straight channel X K S E R C, while the other takes the straight channel Y R E H L F. This latter channel we will now suppose to be modified. At the plane C F let us form a new winding channel C M D G O F which rejoins the original channel at the section D G. Then if that part of the original channel F R H, which is indicated by dotted lines, be closed and the water which enters at C F be thus directed into the circuitous channel M O, we wish to inquire if this change of route is of any importance. It is assumed that the new route has the same cross section area as the old R L had. If the water will flow along this curved path with the same velocity as formerly it did along C L D, we can have at X Y Z the same forward movements of water as originally. But the water particles in M O having no regard for the convenience of the water particles at X Y Z will presently diminish their speed. For the new distance C M D exceeds the old distance C R D. Therefore the average slope downwards of the line C M D must be less than the slope of C R D. Now on this slope the water velocity partly depends. Thus the velocity in M O must become less than it was in R L. Moreover, the velocity in M O will be further lessened by continually having to round corners. Thus on the whole the velocity in M O will be less than it was in R L. Immediately enhanced pressure will establish itself in the winding channel and this will be propagated back to X Y Z. The water coming on behind X Y Z will then send forward an additional driving pressure, the level rising at the same time, and this additional pressure will hurry the water in M O. But this additional pressure will at the same time hurry the water in the other channel A B E C. Thus the water in M O is not quickened sufficiently to take off the block at X Y Z, but the water in M O is partially quickened and the remainder of the block is relieved by an accelerated motion in the other—the straight—channel.

Thus we see that the replacement of the straight channel R L by a winding channel of equal cross section throws additional work on the unaltered straight channel K R. Or, if no extra work is to be thrown on K R, the new winding channel must have a *greater* section than the channel it replaces.

Now *fig.* 2 is really the bed of a river. The wall C R D is merely an ideal wall. The channel K R represents that area in *fig.* (1) which was unchanged by the embankment. R L denotes that area which was blocked up without compensation and M O denotes the scoured out area under the embankment with which the river had provided itself as a substitute for R L. And we see that until the river has created scoured out cross sections under the embankment of a *greater* aggregate area than those of which the Engineer had deprived it, we must have enhanced velocities continuing through the unaltered outlets. In cases where the curvature of C M D increases the strain thrown on the straight channel R K increases. If M O were extremely deep we should at the bottom of it have the water nearly stagnant.

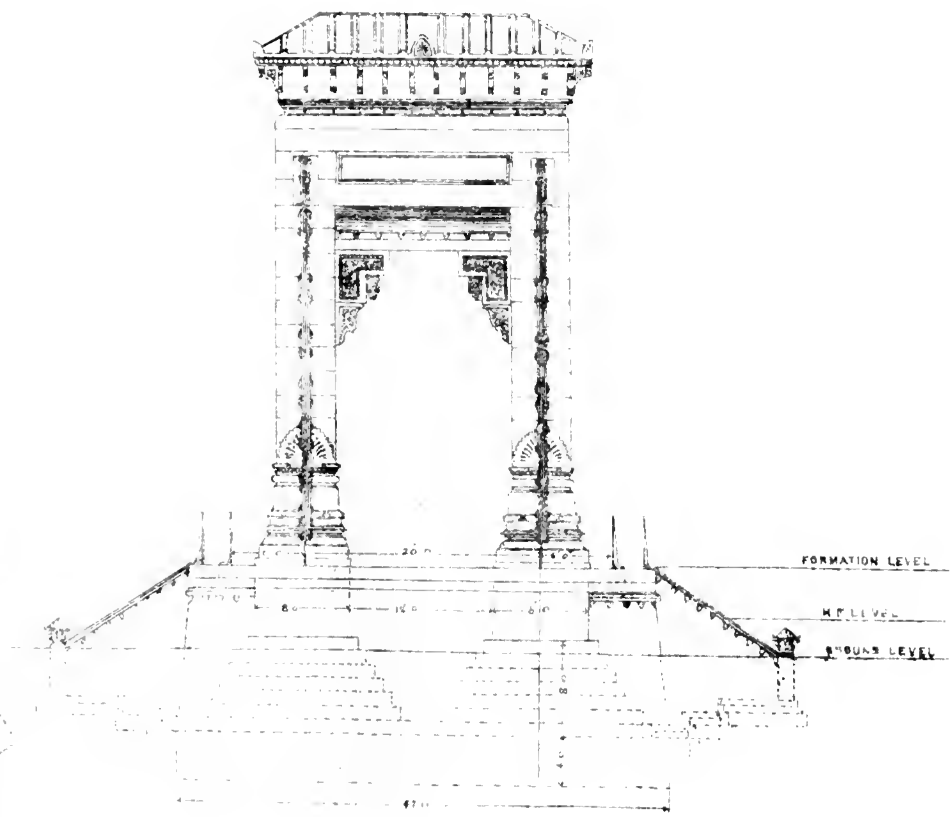
If a current of electricity were passing through the same channels now supposed of solid metal, the current would bifurcate at C. The longer we make the branch C GM, its section being constant, the less the proportion of electricity that travels along it and the greater the proportion that the straight branch A K D will have to take. A similar conclusion does we see apply to water, though the causes at work are different. In the

IAN EN

HALF

DESIGN FOR
VISHWAMITRI RIVER SUSPENSION BRIDGE
AT
BARODA.

SCALE 8 FEET = ½ INCH



CROSS SECTION AT CENTRE

The "STAR" Press, 19, Lal. Bazar, Calcutta.

[illegible] supplied the pipes [illegible]
[illegible] for all forces occurring [illegible]
[illegible] the [illegible]
[illegible] ing to the Reservoir not being [illegible]
[illegible] some means of [illegible] the
[illegible] they would [illegible]
[illegible] the expiry of that period [illegible]
[illegible] supposed to have [illegible]
[illegible] before being [illegible]
[illegible] it was thought desirable to [illegible]
[illegible] additional [illegible]
[illegible] casting the pipes to the full head [illegible]
[illegible] the dam was carried out [illegible]
and thus led to the following way.
[illegible] pipe was attached to the [illegible]
[illegible] the mouth of which was placed
[illegible] in Reservoir. The first
[illegible] the lower was closed and the
[illegible] When it was fully
[illegible] the pipe length and
[illegible] the vertical pipe was filled
[illegible]
[illegible] for some [illegible] and the
[illegible] joints were carefully examined whilst
[illegible]
[illegible] first length between
[illegible] no less than 37
[illegible] found to be
[illegible] had been very
[illegible] The cost
[illegible] of replacing pipes and pipes
[illegible] amounted [illegible] was paid
[illegible]
[illegible] the Reservoir [illegible] ground

case of water it is the diminished mean slope which produces the retardations in the circuitous channel; and yet in the case of electricity the acting cause could be expressed in a very similar manner.

REPORT ON THE WATER-SUPPLY SCHEME PROVIDED FOR THE CITY OF JUBBULPORE.

By J. G. H. Glass, M. Inst. C.E., Executive Engineer.

VIII.

In so far as was possible, the pipe lines were joined in, so as to do away with dead ends ; and if any extensions of the supply are made hereafter it is very desirable existing dead ends should be connected. The water is thus prevented from stagnating, and a full and free scour is secured.

The pipe system is supplied with air valves at all major summits, and at all well defined depressions a scour valve is placed. In the long length of 16-inch main there is a stop valve at intervals of one mile. This is very necessary, and in fact it would have been better to have had more of them, for when a burst occurs, or a leak in a joint necessitating new leading, the water has to be drained off before repairs can be made.

More air valves are also desirable in the 16-inch main, and I am now increasing the number to 4 in each mile, to be placed on minor summits. Experience has also shewn me that it would have added much to the safety of the pipe line to have provided two or three safety valves on the 16-inch main to protect the pipes from what is called the 'hydraulic shock' due to the flow being suddenly arrested by the too rapid closing of a valve. The pipe system in the City is well provided with air valves, as the hydrants act as such. and the standards also admit of the escape of air. The standards are of a very good pattern. In the Nagpur scheme water flows on pushing a spring. In those in use here the handle is attached to a weight which has to be lifted to open the valve, and when the handle is released the weight falls back to its original position. This arrangement works admirably, and gives no trouble.

The contractors who supplied the pipes and fittings were responsible for all bursts occurring within a year of delivery, and as the full head was not obtained in that time, owing to the Reservoir not being completed, it was necessary to devise some means of subjecting the pipes to the pressure they would ultimately have to bear before the expiry of that period. All the pipes were of course supposed to have been tested to a pressure of 300 feet before being despatched from England, but it was thought desirable to fix a period of responsibility besides as an additional safeguard. The arrangement for testing the pipes to the full head before the completion of the dam was carried out after the pipes had been laid in the following way.

A 4-inch pipe was attached to the 16-inch vertical pipe in the Tower, the mouth of which was placed 30 feet above the H. F. L. in Reservoir. The first sluice valve one mile from the Tower was closed and the pipe charged from the Reservoir. When it was fully charged the valve connecting the pipe length and Reservoir was closed, and the vertical pipe was filled to the top by a force pump.

This pressure was kept on for seme hours, and the pipes and their joints were carefully examined whilst the pressure was on.

In the same way the succeeding lengths between valves were tested. By this method no less than 27 16-inch and six smaller pipes were found to be defective, notwithstanding that they had been very carefully examined before being put down. The cost of the testing and of replacing burst pipes and pipes broken in transit amounted to Rs. 5,248, and was paid by the contractors, Messrs. Richardson and Cruddas.

For the first mile or so from the Reservoir the ground is rocky, and it would have been expensive to have put the pipes in trenches. They are accordingly generally laid on the ground surface, and earth is piled over them to a height of from 1 to 2 feet. Beyond that black soil, which cracks and opens out in the hot weather, is met. Here a trench 2 feet deep and of the same width was excavated and filled with good moorum, on which the pipe was laid, and an earthen bank was placed over the pipe. One advantage of this method is that in the event of leak or a burst, the waste water can be easily drained off and the necessary repairs rapidly executed; and it also permits of leakage being readily detected, another decided advantage. The pipes in the City are all laid under ground and at the side of the street, and the positions of the several hydrants are notified in the customary manner.

I may now briefly sum up what the Municipality has got for the outlay incurred by it.

1st.—A Reservoir containing 230 millions of cubic feet of water, or in other words, sufficient water to supply the City for two years without replenishment.

2nd.—A masonry dam and subsidiary works, all of which are, I believe, of sound and substantial workmanship and material. The dam is besides built to a section that will admit of its being raised 3¾ feet, by which the storage will be largely increased.

3rd.—A system of pipes representing a weight of 2,185 tons and a length 12½ miles. The pipes are calculated to supply a population 25 per cent. in excess of the present numbers. In addition, the system is so arranged that the greater part of the inhabitants have an abundant supply at their doors.

4th.—An efficient protection against fires.

5th.—A good road leading to the Reservoir and a substantial Bungalow at the Reservoir.

6th.—A large area of land round the lake from which a certain income is derivable by the sale of grass.

7th.—An income now of Rs. 6,700* from the sale of water, and the probability of an increased income hereafter. Taken on the population for which provision is made, *viz.*, 88,423, the actual cost per head is under Rs. 8, a rate which, compared with the cost of other schemes, is certainly not excessive.

The design was commenced under the orders of Colonel J. O. Mayne, R. E., who was then Chief Engineer of the Provinces, by him sanction was accorded to it, and during his tenure of office the works were well advanced. The whole scheme was practically completed under the direction of his successor, Colonel C. M. Browne, R. E. The report would be incomplete if I omitted mention of those who were more immediately associated with me in the preparation of the design and the construction of the works. I am much indebted to and cordially acknowledge the help I received from Captain J. C. Addison, R. E., Executive Engineer, for the valuable assistance he gave me in the preparation of the design for the masonry dam during the short time he was attached to the Divison ; to the Honorable L. M. St. Clair, C. E., Executive Engineer, by whom the calculations for the pipes in the design first submitted were chiefly worked out, and under whose charge the greator part of the pipe laying was done ; and to Mr. T. English, Honorary Assistant Engineer, to whose valuable and willing help the rapid progress made and the satisfactory work done on the masonry dam and head works are in a great measure attributable.

I consider myself fortunate in having been entrusted with the design and construction of so important a project as the Jubbulpore Water Works, and particularly so in that I have been connected with it from beginning to end. No effort has been wanting to secure sound and substantial workmanship and economy in cost, and I hope that the results may be considerd satisfactory and meet with approval.

---

*This does not include the amount payable by the Military Department when the system now under construction is complete, *viz.*, Rs. 5,500 per annum.

THE PAST OF PORTO-NOVO IRON WORKS.

By A. Pierre de Closets, C.E.

In the old times many industries were tried and abandoned in India. In metallurgy, for instance, numerous undertakings were started and discontinued. Ancient researches for diamonds, gold, copper, lead and iron were made in the Madras Presidency.

It is well known that Tippoo had a staff of European Engineers engaged in prospecting and mining. Numbers of old workings still to be seen testify that mining was carried on on a somewhat large scale. Since the death of that ruler these operations were discontinued, except the native process of iron making and a few gold washings.

About 50 years ago a company was started under the name of the "East Indian Iron Company" for the manufacture of iron in the Madras Presidency.

I will record the past history of this large concern. It may be of some interest to your readers, some of whom may have ideas of establishing iron works. They will be able to understand the causes of the "East Indian Iron Company's" failure, and the means the Directors should have employed to avert the ruin of their enterprize.

The southern portion of India, the Madras Presidency, is extremely rich in iron ores; there lay on the ground an inexhaustible supply of the best ores, such as the magnetic oxide, the hematites, and some other sorts very rich. Mining presents no difficulties, and it is to be wondered at that not a single blast furnace or rolling mill is in existence to turn to profit such wealth which will give better results than gold mining.

The reason, is simple, *viz.*, the gigantic failure of the E. I. I. Company has alarmed the capitalist, and still deters the public from investing in the iron industry.

But there is no reason to fear a reverse in such undertakings, provided that careful management and a prudent course of operating be resorted to.

It was about 1830 that Mr. Heath, then Agent for the Honorable East India Company, and Collector, turned his attention to the manufacture of iron, owing to the mineral deposit of magnetic oxide near Salem.

Mr. Heath was a man of great scientific knowledge, and failed not to see the advantage of manufacturing Swedish iron and steel. He applied to the Directors of the Honorable E. I. Company, who seeing the benefit to the country of such a manufacture, granted to Mr. Heath the exclusive privilege of manufacturing iron, by the European process, in the districts of S. and N. Arcot, Trichinopoly, Salem, Coimbatore and Malabar. They granted him the right of cutting in the jungles all the fuel required for the production of iron and also a grant in aid of £9,000, shewing the interest they were taking in such an industry.

After trials, which proved the ores to yield 72 per cent. of iron, and their excellent quality to make steel, owing to the presence of manganese, Mr. Heath started in London a Company, and erected the magnificent establishment of Porto-Novo on the Coromandel Coast at the mouth of the Vellaur river. The establishment had two blast furnaces, with a hammer and a rolling mill; besides there was some other machinery, and buildings for accommodating the European workmen, also a hospital and dispensary.

The charcoal for the works was obtained from an extensive tract of jungle near the mouth of the Coleroon, and from some forest tracts in the neighbourhood. The charcoal was delivered at the wharf of the works by boats at the cost of Rs. 8 per ton and the fuel for the boilers at Rs. 2 per thousand litters.

The ores prepared near Salem by contracts were conveyed also by water to Porto-Novo and the cost per ton paid at the wharf was Rs. 2.

The above rates were fair and were considered as a promise of success.

The Port-Novo Works were located upon a piece of ground about 6 acres in extent bordering the northern shore of the Vellaur river and half a mile distant from the sea. The river could be entered all the year long by native craft, affording thus great facilities for loading and unloading ships anchored in the roads.

Entering the works there was an extensive yard where pigs and castings were deposited; and on the right of this were the manager's and other offices, stores rooms and godowns; on the left the workshop, blast furnaces, the foundry and the forge.

The workshop was a large hall 100′ × 50,′ having all the machinery and implements for the necessary repairs.

Adjoining it was the boiler shed and the engine room. The engine was a 50 horse-power beam engine, which drove a double-acting pair of blowing cylinders, 20′ diameter, with an air pipe 15″ diameter running all along the furnaces. These buildings separated the workshop from the foundry hall and blast furnaces.

Originally only two blast furnaces were constructed, but two others were added afterwards. Above these furnaces was erected a loft bridge, to which access was afforded by a large brickwork staircase.

In front of the blast furnaces, along which a platform ran, the pigs bed and the foundry hall had been constructed. The foundry was 100′ × 60′ in size and had proper cranes, air furnaces, cupolas, and other foundry appliances, and was terminated by the drying stoves, with their tracks and railway.

On the west and south of the foundry and at the foot of the large staircase, were the depôts for the ores, which separated the foundry from the forge.

The forge consisted of several sheds—the first containing formerly the refinery, and afterwards the puddling and reheating furnaces. Another adjoining for the helve, (there were no steam hammers at the time.) Another shed contained the rolling mill, driven by an engine of 50 horse-power. The mill was provided with several sets of rollers for round, square and flat iron bars, bending gear, rolling plates, saws and shears.

The boilers were situated near the engine, and the flues communicated with a magnificent chimney 150′ high.

This chimney is still to be seen; it is the only thing that remains of the Porto-Novo Works, all the other buildings having been demolished, which has been ordered by Government to be kept as a landmark and beacon for ships at sea.

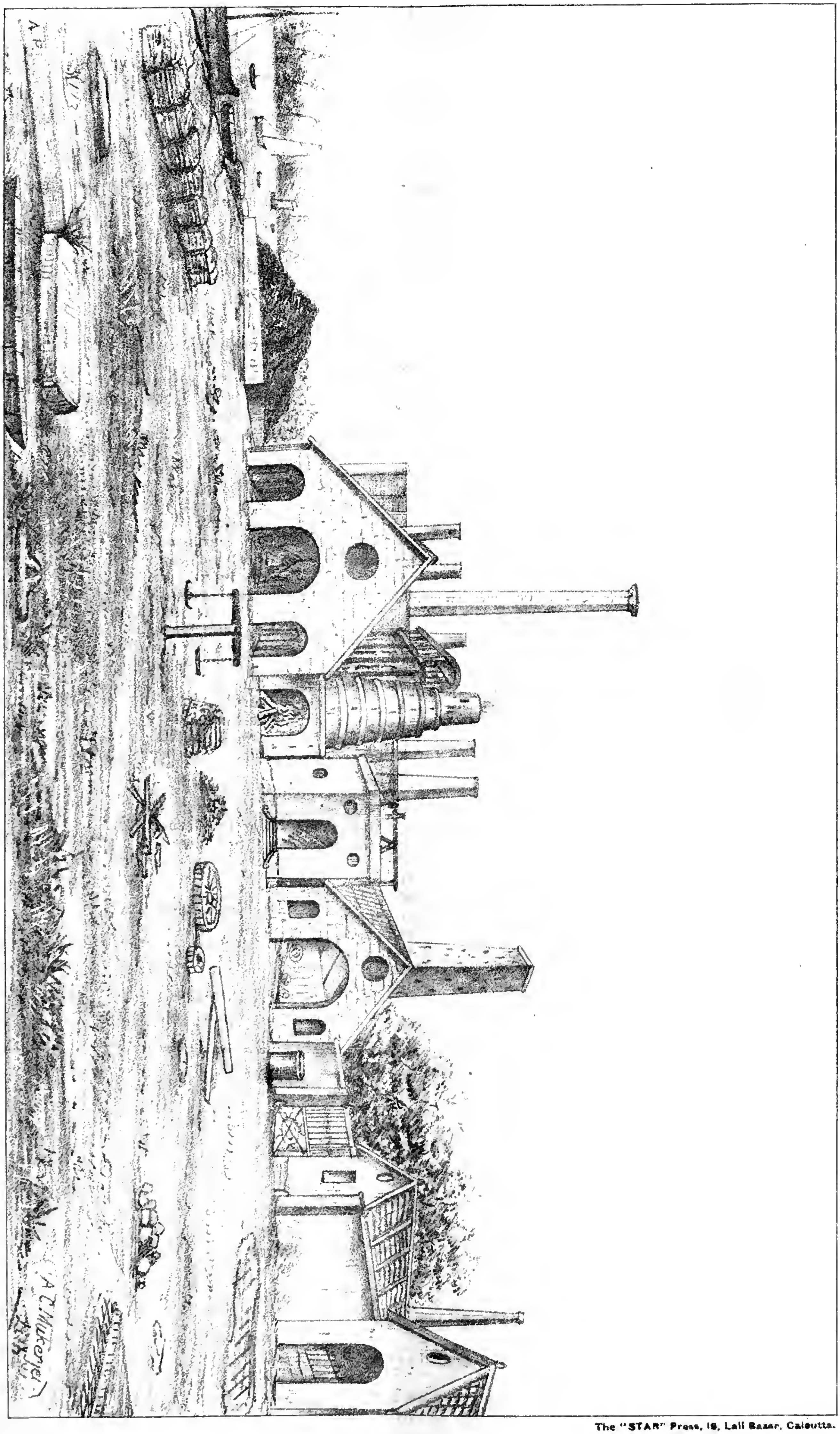
(*To be continued.*)

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XVI.

Brick Archwork in lime mortar, 1st class, in Buildings, including Centreing.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Bricklayers No. ...	$6\frac{1}{3}$	Variable.	Do.	Do.
Do. „ ...	$2\frac{1}{2}$			
Do. „ ...	1			
Coolies „ ...	$2\frac{1}{2}$			
Do. „ ...	3			
Do. „ ...	$2\frac{1}{2}$			
Bhistie „ ...	$1\frac{1}{4}$			
Grinding Mortar, c. ft.	25			
Sundries				
Materials.—				
Bricks, 1st class, including waste No. ...	1,400			
Lime slaked, dry, c. ft.	12			
Sand	12			
Surkhi	12			
Centreing				
Sundries				
Petty Establishment ...				



PORTO NOVO IRON WORKS. (1848)

The "STAR" Press, 19, Lall Bazar, Calcutta.

[illegible]

... and no enormous ... of water ... [illegible] ... place ... [illegible] ... The practical ... great ... difficult ... [illegible] ... irrigation ... [illegible] ... accompanying the ... [illegible]

... which has hitherto appeared ... will no longer be found ... These works are now ... in the early part of the ... which ... the irrigation ... the Fund by the ... "the ... " ... has been ... among the new ... believe that by the method now ... [illegible] ... is asked for the improvement of ... this is ... to the ... it is ... something to improve the ... as regards the ... Chinese ... opinion—which ... that no accident ... commanding ... such expedition ... large sums are to be ... between the North West ... there can be no doubt of the ... stand the construction of ...

[illegible]

... short article in our local ... purporting to be an ... of the London Globe of the ... for having ... the Wall of China.

... "A" ... to the ... further through a ... most people. Without ... he has exploded the ... [illegible]

... story ... are the ... years ago ... the day ... and ... who ... the world that ... and ... [illegible]

IRRIGATION WORKS IN CEYLON.

It is proposed to continue the Walawe-ganga irrigation works. These will probably be among the most successful and remunerative in the Island. The head works are now nearly complete, and the distributing channels have been cut for some distance; but it is unnecessary to observe that it is upon the extent and capacity of these channels that the value of the work depends, and it is to their extension that the votes of the present year will be devoted. The only other irrigation works of any magnitude, which it is proposed to undertake next year, are the restoration of the Kaliodai anicut, which owing to defective workmanship under inefficient supervision, has wholly collapsed, and which the Government cannot but replace; and the restoration of the Veragoda tank in the Eastern Province. Of this tank the Acting Government Agent writes that it is intended as an auxiliary tank to Chadayantalawa, the storage capacity of which has proved insufficient, and an enormous wastage of water from which accordingly takes place without benefit to the lands assessed for its construction. The proposed restoration is said to present no engineering difficulties whatever, and will benefit between two and three thousand acres of land. The Central Irrigation Board has therefore, after careful consideration, recommended the Government to propose a vote for this work to the Legislative Council.

The sum of Rs. 2,00,000 which has hitherto appeared for minor irrigation works, will no longer be found in this part of the Estimates. These works are now provided for under the Ordinance passed in the early part of the present year, and the probable approximate amount which will under that Ordinance be due to the Irrigation Fund will be found as a payment to the Fund by the Colonial Treasurer under the head "Miscellaneous Services." Some little difficulty has been experienced in adjusting the commencement of payments under the new system, but the Governor believes that by the method now suggested it may be satisfactorily met and overcome.

A vote of Rs. 14,000 is asked for the improvement of the Puttalam canal. As there is certainly no immediate prospect of Railway extension in this direction, it is absolutely necessary to do something to improve the condition of this waterway, so important as regards the transport of salt. At the same time, the Governor thinks it but right to record his own opinion,—which he trusts may be a mistaken one,—that no moderate expenditure will ever make this canal a commodious or easy channel for navigation, or one by which expeditious transport can be possible; while if really large sums are to be lavished on facilitating transport between the North-West Province and Colombo, there can be no doubt of the superior advantages which would attend the construction of a railway.

CHINA.

(From our own Correspondent.)

My attention has been called to a short article in our local weekly paper, the *Temperance Union*, purporting to be an extract from the columns of the *London Globe* of the 15th August, giving the Abbé Sarrien credit for having denied the existence of the Great Wall of China.

The article in question commences thus:—"All credit to the Abbé Sarrien, who has been able to see further through a burnt brick (*Alü* stone) wall than most people. Without roburite, melenite, or dynamite he has exploded the Great Wall of China. It does not exist."

Now, Sir, such assertions as those above given are flat contradictions of the assertions made years ago by the Jesuit Historian Martini, and others, of his day, as well as the assertions of a host of Europeans and Americans, who like the Jesuit Historian have declared to the world that they had visited the very same Great Wall, and found it in existence, and much in the same condition as Martini had said it was. Who is right? Martini or Sarrien?

I am neither a Jesuit priest, Protestant missionary, globe-trotter, or a learned historian. Neither have I seen Martini's account of the Great Wall, or Sarrien's denial of its existence. Nor been through the Nan Kou Pass to Kalgau, or to Shan Hai Kuan. I have, however, seen something very much more substantial and reliable in the way of proof that the Great Wall, did formerly, and does now exist.

In the winter of 1880, whilst the Marquis Tsêng was busy vindicating China's honor at St. Petersburgh, I was wending my way through the Province of Kan-Su to Chinese Turkestan. On the third or fourth day after leaving Lan Chou Fu, the capital of Kan-Su Province, I was rather astonished to see that we had something like the wall of a very large city on our right stretching along as far as the eye could see, and apparently in a very good state of repair.

The wall was built of a kind of brown chalk, scientifically called "loess," I believe, and appeared to be about 20 feet high, by as many feet wide on the top, behind the parapet. It had a number of small square bastions about 100 yards apart, projecting from its northern flank, each surrounded by a parapet, the same as on the main body of the wall. On making enquiry from the natives living in the neighbourhood, I was told that what we thought was a city, was in reality the famous Wan-li-Chang Chêng, or city wall of ten thousand *li*; in fact, the very identical Great Wall, built over 2000 years ago, by its enterprising originator Ch'in Shih Huang Ti, the first Emperor of China and creator of the Grand Canal.

During the following fifteen days' journey we occasionally passed within sight of the same wall and it always appeared in a pretty good state of preservation, although there were a few large breaches in it, and the parapet was gone in most places.

To the fine dry climate of Kan-Su, and the excellent quality of the material used, must be attributed the present existence of this stupendous monument, of Ch'in Shih Huang Ti's greatness. It is quite possible that at its eastern end, the wall may have disappeared almost altogether in many places owing to the effects of the climate throughout so many centuries, as well as to the less lasting qualities of the material of which it was built, and the operations of Tartar invaders, at various times.

On the nineteenth day's journey from Lan Chou Fu, we arrived at Chia Yü Kuan, a fortified Pass near the western extremity of the Wall.

The Fortress here is kept in a very good state, having been thoroughly repaired during the reign of the Emperor Kien Lung—A.D. 1736-1796. The material used is fine large blue burnt brick such as are found in the walls of all the most important Chinese cities rebuilt during the present dynasty. The wall at Chia Yü Kuan, is much thicker than elsewhere, that I have seen. The Fortress has a permanent Garrison, and is armed and provisioned in such a manner as to enable it to withstand a long and regular siege.

Everyone going in and out of the gates is strictly scrutinized, and questioned, and must produce a passport signed by the Viceroy, or by the General Commander-in-Chief of the Province. Baggage is also strictly searched, and arms and all munitions of war, I believe, are taken from all persons who have no authority to carry such.

If the wall did not exist, no one would submit to the trouble and expense caused by delay at Chia Yü Kuan.

Shanghai, *October* 27, 1887.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

The new Railway proposed for the Argentine Republic in South America by Griswold and Co. will be built on the following bases:—The main line to run from Pergamino westward crossing the province of Cordoba, through La Carlota, as far as Rio Cuarto. From Rio Cuarto it will strike out northward, through the Calamuchita Valley, formed by the Cordoba Sierras, will run through the Sierra Chica and terminate in Cordoba—334 miles. The branch line from Melincue to Bell Ville will be 103 miles. The line will thus have a total length of 437 miles.

The line will be of wide gauge, the same as the Buenos Ayres Western Railway, and the tracing and preliminary surveys will be completed in 18 months from signing of contract.

The works to be begun immediately on the conclusion of the surveys, and to be completed in four years.

The National Government to guarantee 5 per cent. on the capital employed in building the line, stations and accessory works at the following kilometric rate of cost : $22,000 gold for the Cordoba and Rio Cuarto section and $18,500 for the remaining sections. The guarantee to be paid half-yearly and per section of 50 kilometres or about 31 miles, opened to public service. Should the net receipts exceed 5 per cent. on the capital, the balance shall be handed over to the Government, until the amounts of the guarantee paid be completely covered. The working expenses must not exceed 55 per cent. of gross receipts.

Materials, etc., to be imported free of duty. All properties belonging to this company to be exempted from national and provincial taxes.

The company are authorized to expropriate all necessary land and to establish their own tariff until the net receipts exceed 12 per cent. per annum, when the Government will be privileged to determine the tariff. The new line will have junctions with the Central Argentine and Western Railways.

The Rapid Transit Commissioners for New York City have made their report and in some respects it shews that they have about the right idea of what an elevated railroad should be. It is practically the same as that recommended by some of the prominent Engineers as long ago as 1870 when rapid transit by means of elevated railroads was first spoken of. The report reads: "We are led to the conclusion that there is but one way to obtain rapid transit, and that is by the construction of a solid viaduct line through the blocks, as far as possible, and, when compelled to cross or follow the lines of streets to be constructed with much greater strength and solidity than the present elevated railroads. Such a viaduct road should be built in accordance with the following conditions : The structure should be built through the blocks of brick and stone in the most solid manner. The streets should be crossed by massive steel girders, with solid steel floors, having no openings. The track should consist of heavy steel rails on ties laid in an elastic material between floor and ties. There would be no jar or break of continuity of motion in such a structure and trains could be run at a high speed with little or no noise."

Another new line between New York and the East is under way. A large party of Civil Engineers and surveyors are now in Connecticut mapping out the road between New York, New Haven, Providence and Boston, the eastern terminus of the line to be at Portland. The enterprise is said to be backed by both American and English capital, and at Portland the railway is to connect with a line of European steamships. From New York to Providence the route surveyed is almost an air line and the grades quite easy. East of Norwich, Conn., the Preston Hills, hitherto considered to be an insurmountable obstacle to track laying, the Engineers say they have found an easy way around the hills.

The Engineers are very reticent as to their plans, but it is admitted that the road is to have two tracks and steel rails from New York to Boston and the running time between that City and New York is to be three hours.

Work on the Hudson River Tunnel has ceased. A few months ago, it started with a great flourish and it was said that enough money was on hand to prosecute the work towards completion. Now, however, the financial reports are that there is no more money to proceed, and the work has to be stopped.

The great Lachine Bridge, which carries the Canadian Pacific Railway over the Saint Lawrence river, has just been completed. The total length of the bridge is 3,573 feet. The designer of the bridge was the late C. Shaler Smith, M. Am. Soc. C.E. It consists of two cantilever spans of 408 feet, each 40 feet deep and 20 feet wide on the centres ; two deck flanking spans of 270 feet each, 35 feet deep and 20 feet wide on the centres ; eight deck spans of 240 feet each, 35 feet deep, and 16 feet wide on the centres ; and three deck plate girder shore spans of 80 feet each. The bridge was built by the Dominion Bridge Company of Canada.

The first cantilever bridge built in America was the Kentucky River Bridge on the line of the Cincinnati Southern Railway (now the Cicinnati, New Orleans and Texas Pacific). This bridge was designed and erected, without scaffolding, by Mr. C. Shaler Smith in 1876 and at that time the highest bridge in the world. The height is 276 feet and length 1,138 feet. Mr. Smith also built the Minnehaha cantilever near St. Paul in 1881. It is worthy of note that these two cantilevers were built long before the Niagara was mentioned.

The Kentucky River Bridge was the first continuous pin connected girder that was ever built in America, and is remarkable that instead of being continuous over four supports, it had its points of contra-flexure fixed by cutting the chords after the bridge was erected.

An immense irrigating enterprise has recently been formed in the territory of New Mexico, known as the Albuquerque Land and Water Company. The company contemplates the irrigation of 1,500,000 acres of the choicest fruit and farming lands of the central Rio Grande Valley. The water-supply is to come from the Rio Grande. The main canal, according to the survey already completed, will be 150 miles in length, and will follow the valley, running through the countries of Santa Fé, Bouquillillo, Valencia, and Socorro, to a point on the Rio Grande, opposite the city of Socorro. The head of this canal will be in the San Ildefonso Valley, 18 miles west of Santa Fé and thence the route leads south, on the east side of the river. Work is to be begun at once and pushed forward.

Professor L. M. Haupt made some remarks at a meeting at the Engineers' Club of Philadelphia upon his experiments with Current Deflectors at Five-Mile Bar, and shewed how urgently the city and river interests required a channel across it. He then suggested a plan whereby he proposed to create a channel, sufficient to meet the demands of commerce, upon the following principles :

1. If the *bottom velocity* of a stream be increased to the limit required by the character of the material forming its bed, it will scour ; if diminished, it will deposit.

2. If the *momentum* of a stream be suddenly arrested by an obstruction placed in its path, a reaction will be produced, its head will be increased, and the bottom will be scoured out.

3. If the *volume* of a stream be partially deflected by a trailing wall, from one side of a cross-over bar to the opposite side, the current over the bar will be quickened, and the crest lowered, above the line of the works.

4. If the *form* of the cross-section of a stream be modified by cutting at one point and filling at another point of the same section so that the area is not changed, other things being equal, the discharge will not be materially affected, and the part so deepened will remain open.

5. If a stream be compressed laterally into a smaller section, its velocity head near the banks will be increased, while that at the centre will be diminished, and consequently the channel will be bifurcated and the deepest water be found near shore.

If, by the application of these laws of flowing water a channel, sufficiently wide and deep for navigation, be cut across a bar, it will be self-sustaining and cost much less than if the entire bar were disturbed by the usual lateral dikes or by dredging.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Madras, November 22, 1887.

The following postings are ordered :—

Mr. G. B. Lambert, Assistant Engineer, 1st grade, to the 4th Circle, Coimbatore Division, to join on return from furlough.

Mr. L. L. Wickham, Assistant Engineer, 2nd grade, to the 6th Circle, for duty in the Periyar Project Division.

Mr. T. W. S. Smyth, Assistant Engineer, 2nd grade, to the 1st Circle, Ganjam Division, for duty on the Rushikulya Project.

Mr. M. Loam, Assistant Engineer, 2nd grade, to the 1st Circle, for duty in the Godavari Eastern Division.

The following intimation, received from the Secretary of State, is published :—

Mr. J. Hannan, from Executive Engineer, 1st grade, Madras, permitted to return to duty within the period of his leave.

Bombay, November 24, 1887.

His Excellency the Governor in Council is pleased to make the following appointments to fill existing vacancies :—

To be *Honorary* Assistant Engineers, 2nd grade—

Mr. W. B. Rix, Sub-Engineer, 2nd grade.

Khan Saheb Maneckji Cawasji, Sub-Engineer, 3rd grade.

Punjab, November 24, 1887.

Irrigation Branch.

Mr. J. K. E. Verschoyle, Assistant Engineer, 1st grade, from the 2nd Division, Bari Doab Canal, to the office of Superintending Engineer, Bari Doab Circle, which he joined on return from the one month's privilege leave granted him in Irrigation Branch Memorandum, dated 26th August 1887, on the forenoon of the 7th November 1887.

With reference to Punjab, Government, Irrigation Branch, Notification, dated 9th July 1885, Mr. H. F. Smallman, Executive Engineer, 2nd grade, whose services were placed at the disposal of the Foreign Department for employment in the Patiala State, returned to the Public Works Department, Punjab, and joined the Upper Sutlej Division, Inundation Canals, on the afternoon of the 30th October 1887.

Mr. Smallman took over Executive Charge of the Upper Sutlej Division, Inundation Canals, from Mr. L. M. Jacob, on the afternoon of the 31st October 1887.

N.-W. P. and Oudh, November 26, 1887.

Irrigation Branch.

With reference to Notification, dated 14th October 1887, posting him to the 1st Circle, Irrigation Works, Mr. G. T. Barlow, Assistant Engineer, 2nd grade, is posted to the Bulandshahr Division, Ganges Canal.

With reference to Notification, dated 25th October 1887, posting him to the 2nd Circle, Irrigation Works, Mr. E. Beilly, Assistant Engineer, 2nd grade, is posted to the Nadrai Aqueduct Division, Lower Ganges Canal.

Mr. G. P. Horst, Assistant Engineer, 1st grade, is transferred from the 3rd to the 1st Circle, Irrigation Works.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner of Oudh, is pleased to order the following reversions and promotions with effect from the dates specified :—

Mr. H. J. Strickland, Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, consequent on the expiry of the furlough granted to Rai Jogendronauth Mukarji Bahadur, Executive Engineer, from 15th September 1887.

Mr. M. Nethersole, Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, consequent on the return of Mr. Hill from furlough, from 9th October 1887.

Mr. M. Nethersole, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, *vice* Mr. Beresford, promoted to Superintending Engineer, 3rd class, temporary rank, from 15th October 1887.

Mr. J. H. A. Ivens, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary rank, on return from furlough, from 20th October, 1887.

Mr. M. Nethersole, Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, consequent on the return of Mr. Ivens from furlough, from 20th October 1887.

Mr. W. B. Gordon, Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, consequent on the return of Mr. King from furlough, from 1st November 1887.

Mr. C. H. Hutton, Assistant Engineer, 1st grade, on special duty, in the office of Chief Engineer, Irrigation Works, is retransferred to the Nadrai Aqueduct Division, Lower Ganges Canal.

Buildings and Roads Branch.

Conductor T. Chapman, on return from furlough, is posted to the Rae Bareli District as District Engineer.

Central Provinces, November 26, 1887.

Establishment.

With reference to Notification dated 16th September 1887, Rao Sahib D. S. Sathaye, Assistant Engineer, 1st grade, was relieved of his duties in the Hoshangabad Division on the afternoon of the 9th October 1887.

Mr. D. Wallace, Executive Engineer, 2nd grade, returned from the furlough granted to him by Central Provinces Notification, dated 9th July 1886, and reported his arrival at Bombay on the 14th instant.

Mr. H L. Cleaver, Assistant Engineer, 2nd grade, posted to these Provinces, *vide* Government of India Notification, dated 4th October 1887, is, on arrival at Bombay, posted to the Wardha Coal State Railway for duty.

With reference to Notification, dated 26th ultimo, Rao Sahib, T. N. Mukhopadhya, Assistant Engineer, surrendered, and Mr. J. B. Leventhorpe, Executive Engineer, assumed, charge of the Eastern Division on the forenoon of the 21st current.

India, November 26, 1887.

Mr. H. F. Storey, Superintending Engineer, 2nd class, sub. *pro tem.*, State Railways, is, on return from furlough, placed at the disposal of the Government of Bengal, Railway Branch.

The services of the undermentioned officers are temporarily placed at the disposal of the Agent to the Governer-General. Baluchistan :—

Mr. A. C. Evans, Executive Engineer, 4th grade, sub. *pro tem.*, North-Western Provinces and Oudh.

Mr. G. S. Morley, Executive Engineer, 4th grade, Punjab.

Mr. H. T. Geoghegan, Superintending Engineer, 1st class, State Railways, has been granted by Her Majesty's Secretary of State for India leave for six months on medical certificate, in extension of the leave for five months and nineteen days previously granted to him and notified in Public Works Department Notification, dated 14th October 1887.

The following transfers are ordered :—

Mr. H. Luckstedt, Executive Engineer, 3rd grade, State Railways, to Burma State Railways.

Mr. H. G. F. Smith, Executive Engineer, 4th grade, sub. *pro tem.*, Burma State Railways to Bengal Railway Branch.

The services of Lieutenant J. R. L. Macdonald, R.E. Assistant Engineer, 2nd grade, State Railways, are permanently replaced at the disposal of the Military Department.

Major S. B. Turner, R.E., Superintending Engineer, 3rd class, temporary rank, is appointed to officiate as Secretary to the Agent to the Governor-General, Baluchistan, in the Public Work Department, during the absence, on furlough, of Major W. P. Tomkins, R.E., or until further orders.

Military Works Department.

Lieutenant C. D. Learoyd, R.E., Assistant Engineer, 1st grade, is appointed to officiate as Executive Engineer of the Agra Division, Military Works, with effect from the 29th August 1887, during the absence on privilege leave of Captain A. C. Bruce, R. E., or until further orders.

Director-General of Railways.

With reference to Public Works Department Notification dated 18th November 1887, Mr. P. Duncan, Executive Engineer, 3rd grade, is posted to the Sind-Pishin State Railway.

Rai Bahadur Kali Podo Sen, Executive Engineer, 4th grade, sub. *pro tem.*, is granted leave on medical certificate for forty-five days, with effect from 4th November 1887.

Mr. R. F. Coppin, Asistant Engineer, 1st grade, is transferred, in the interests of the public service, from the Bellary-Kistna State Railway to the Bannu Railway Surveys. Director-General of Railways Notification, dated 22nd November 1887, regarding the transfer of Mr. T. Michell, Executive Engineer, 3rd grade, sub. *pro tem.*, is hereby cancelled.

Mr. R. W. Egerton, Assistant Engineer, 1st grade, is in the interests of the public service, transferred from the North-Western Railway to the Sind-Pishin State Railway.

Bengal, November 30, 1887.

Establishment General.

Rai Kali Prosonno Mookerjee, Sahib. Executive Engineer, 4th grade, *sub. pro tem.*, attached to the Darjeeling Division, is granted privilege leave for three monthts, with effect from such date as he may avail himself of it.

With reference to the Government of India's [Public Works Department] Notification of the 19th November 1887, Mr. H. F. Storey, Superintending Engineer, 2nd class, sub. *pro tem.*, is placed on special duty on the survey of the Chittagong-Chandpore-Kumilla section of the Bengal-Assam Railway.

With reference to Government of India, Public Works Department, Notification, dated 23rd November 1887, Mr. H. G. F. Smith, Executive Engineer 4th grade, sub. *pro tem.*, is posted to the Eastern Bengal State Railway.

With reference to the Government of India's [Public Works Department] Notification of the 4th October 1887, Mr. P. G. Jacobs, Assistant Engineer, from the Royal Indian Engineering College, who reported himself at Calcutta on the 29th instant, is posted to the Darjeeling Division.

Mr. J. A. Devenish, Assistant Engineer, Darjeeling Division, is placed on special duty under the orders of the Inspector of Local Works in the Rajshahye Division.

Mr. Sorabji Shavaksha, Assistant Engineer, is transferred from the 2nd Calcutta to the Darjeeling Division.

Mr. W. B. Christie, Executive Engineer, Hazaribagh Division, is temporarily deputed to Nepal on special duty.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 23rd November 1887.

91 of '87.—Dan Rylands, of Hope Glass Works, Stairfoot near Barnsley, in the County of York, England, Glass bottle Manufacturer.—*For improvements in glass sleepers.*

125 of '87.—James Watson, of London, England, Engineer.—*For improvements in presses for pressing cotton, jute, or other materials.*

164 of '87.—Nils Moe, formerly a Permanent Way Inspector of the Northern Bengal State Railway, but now residing at the Eastern Bengal Railway Hotel, Sealdah, in the Town of Calcutta.—*For grooving sleepers, called "the apparatus for grooving sleepers."*

194 of '87.—William Edward Rickard, Engineer, of London, England.—*For an improved tree-felling machine.*

Advertisements.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*

NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*

ROME.—LOESCHER & Co.

STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

CONTENTS.

ANSWERS TO CORRESPONDENTS.

Several of our News Letters and other Communications are held over for want of space.

Obituary.

MIDDLETON—At the Medical College, Calcutta, on the 30th November, 1887 Cecil Joseph Middleton, Executive Engineer, P. W. D., aged 45 years, deeply regretted.

INDIAN ENGINEERING.

SATURDAY, DECEMBER 10, 1887.

KARACHI AGAIN.

WE have before us a tract on Railway Extension in Sind. It is entitled "Remarks in reply of Public Works Department, with extracts of proceedings of public meeting, Frere Hall, Karachi, 3rd November 1887." The Chairman of the Karachi Chamber of Commerce is sponsor for it, and naturally he is all Karachi, for nothing short of the Hyderabad-Pachpadra Railway will suit or pacify him; and he goes in for it with all the enthusiasm of strong partisanship. The calculating machine at Simla had got out of gear when this Hyderabad-Karachi scheme first came on the tapis and over-estimated to the tune of 70 lakhs. Of course that was nuts for the Karachi argument. On the strength of it a good deal of writing has been put forward in the press, and the pamphlet we are considering has been issued. The moral seems to be that Secretariats are fallible, and that Chambers of Commerce can be captious.

Mr. McHinch is of opinion that a line from Hyderabad to Delhi would materially serve the interests of Delhi, Agra and the North-Western Provinces. That is possible. But the fact remains—the opposition avers—that as things stand Karachi is very sufficiently served by the existent North-Western Railway, and its feeder lines, and that any money the State can afford to expend now-a-days on railways will be more judiciously and economically expended in Burma rather than on the arid unprofitable deserts of Sind. It is alleged that there is no getting over those ugly sand hills and the utter incapacity of the tract to provide traffic, trade, or anything that can make an Indian railway pay dividends. If the Karachi Chamber of Commerce is so very certain that a Hyderabad-Pachpadra line of railway is a safe investment for money—the argument runs—let it go in for the speculation on its own account and rejoice over, and make a good use of the dividends therefrom accruing. Karachi more than deprecates the idea of being a decadent, down-in-the-world port. Let it then have the courage of its convictions: let it subscribe the money needful to construct this railway it so greatly desiderates: let it give tangible proof of ardour and solvency. Such a demonstration would be worth tons of pamphleteering and verbiage. Failing such wholesome manifestation of opinion we don't see our way to the support of a Hyderabad-Pachpadra Railway while so many lines in Burma are so much more urgently required, and appealing in vain for State assistance. Mr. Mc Hinch says, *àpropos* of the railway route he has set his heart on :—"There is not a bridge larger than is required for the crossing of a canal in the entire length and the country is generally flat." But that might mean that the country is an unwatered desert, too generally flat for a dividend paying railway!

It does strike us as as something strange that as regards the possible remunerativeness of the proposed railway "the communications received from the Commissioner in Sind, and the Governor of Bombay, exhibit a marked reserve." The authorities quoted doubtless had some cause for exercising this "reserve." It may, or it may not be desirable that Karachi should flourish as a rival port to Bombay, but it is assuredly undesirable that its inutile prestige should be bolstered up in manner done in the *brochure* here noticed.

THE MADRAS P. W. D.

THE Administration Report of the Madras Public Works Department for the official year 1886-87 lies before us. It is a well printed, stoutly bound, in every mechanical way well got up paper, embellished with five coloured maps, and crammed full with inane trivialities, *e. g.*, sundry trees planted in the compound of a divisional officer's kutcherry; a sum of Rs. 76 "spent on the construction of a well for the Punganur post office;" the compound of the Executive Engineer's office at Kadambady, metalled at a cost of Rs. 147; Rs. 108 expended in maintaining and laying out the ground near the senate house with shrubs and plants. And so forth. *Apropos* of Ootacamund we are told that outlay was incurred in improving the appearance of the land between the margin of the lake, and the carriage road, by clearing it of wattle and scrub jungle. Doubtless all these Engineering platitudes are in their way worthy and acceptable unto the powers that be. But, in days when all of us are perpetually being reminded of financial pressures, and the urgent need that exists for even parsimonious economy in all departments of State, one is tempted into wondering why this expensive State paper was issued. For it has absolutely no value, maps and platitudes notwithstanding, as a State paper. What on earth can it matter to 9,999 tax-payers out of 10,000 whether Colonel Hasted, or Colonel Shaw-Stewart, or Colonel Pennycuick administered departmental affairs and supervised the destinies of the Madras Public Works during the year under review? Wherein does it advantage anyone to know that during the year under review the apothecaries' quarters, at Bellary, were completed "with the exception of painting the doors and windows, or that repairs to the post office at Gudur could not be commenced till the quarters for the postmaster were finished?" Such small matters can have no possible interest for the public at large, and the public at large ought not to be made to pay for idle departmental verbosity, whether rendered in large type or small.

The one redeeming point in this record of Madras twaddle is the account given of progress made with the Madras Harbour Works; although even that, we are told "was much less than was hoped for." It nevertheless remains a fact that the Madras Harbour Works were subjected to severe strain and test on the 23rd of May, and again on the 8th and 9th of November when cyclones passed very near Madras, and made contingent seas rise very high. To the credit of the P. W. D., however, let it be recorded that no damage was done to the pier works. They were well foundationed and built, and solid; and they proved capable of resistance to all the elemental Titan war brought to bear against them. No mean triumph for Indian Engineering.

The Port Officer, Madras, is a man as polite as he is cautious. When, in March 1886, a Superintending Engineer proposed cutting off connection between the two rivers flowing into Mangalore harbour, by means of strong bunds thrown accross the breakwater, the Port Officer opined that this proposal provided a very complete solution of Mangalore difficulties "if only the intractable nature of the rivers, and the shifting propensities of the seasand could be kept out of sight." He was of opinion furthermore that the circumstances of the port of Mangalore, did not justify the large expenditure contemplated; and he considered the success of the proposed operations problematical. Possibly he had not heard of the Salvation Army and he lacked faith.

Here is an extract suggestive of the circumlocution department:—"The proposals of this Government for improving the water-supply of the troops at Bangalore, a brief sketch of which was given in the Administration Report for 1885-86, were laid before the Government of India in September 1886; and at the close of the year no reply had been received."

Here is another extract suggestive of the ineptitudes of 'Lokil Sluff.' In the Administration Report for 1885-86, reference was made to the resolution of the Government to transfer to the Municipality the care and maintenance of the bridges in Madras, which had previously been in charge of the Public Works Department. The transfer took effect from 1st April 1886, the Government making an annual grant to the Municipality of Rs. 3,381, being the average yearly cost of repairing the bridges. On the transfer being effected, it was found that the maintenance grant did not include the cost of repairs to the bridges over the Buckingham Canal within Municipal limits. These bridges were therefore retained in charge of the Public Works Department, during 1886-87, and their transfer to the Municipality was ordered to have effect from 1st April 1887, the maintenance grant being increased by Rs. 1,062. The Grant Duff and Revenue Board bridges within the Chepâk Park were retained in charge of the Public Works Department, their maintenance being entrusted to the Consulting Architect."

It may interest some of our readers to know, as authoritatively as an official Secretary can make known, that the second edition of the Madras Public Works Code having become much encumbered with standing orders the preparation of a third edition was ordered in 1885, and actually issued in 1886.

The only other noticeable point in this Administration Report is that all the light-houses on the East and West Coasts were inspected and reported on by the Chief Engineer in January and February 1887.

THE FOREST SERVICE.

In the *Asiatic Quarterly Review* for July, Sir Richard Temple, treating of India during the Jubilee reign, wrote: "This Indian Forest Department is now probably the largest in the world. It is to be reckoned among the achievements of our period." To the October issue of the same review Major-General Michael, C.S.I., contributes a sketch of the rise and progress of the department, and of the training given at Cooper's Hill to probationers for admission to the Forest Service of India. General Michael was one of its pioneers, inasmuch as he acted in 1847 as assistant to General Frederick Cotton, then Executive Engineer in Malabar, the initiator of forest conservancy in India. Between 1848 and 1853 its useful results began to be appreciated by the Government of Madras. In the latter year General Cotton retired, and was succeeded by General Michael. Anglo-Indian military men were practical in those days; now they go in for being Directors of Public Instruction; and so forth. In the nature of things we soon forget in India; and the little bit of departmental history we have given above will probably be new to the present generation.

General Michael's account of the course of study pursued at Cooper's Hill, and the general working of the Royal Engineering College is lucid and interesting, but more adapted to the needs and requirements of parents and guardians than of readers of INDIAN ENGINEERING. He is enthusiastic on the subject of forest life and forestry. Camp life in India, he says, "is always enjoyable to a young and healthy man, and a forest officer's tours are sure to lead him into beautiful scenery, and often into hill tracts where the climate is delightful and invigorating." He is sure either to be a sportsman, or to become one; and no one can have better opportunities for sport. His work naturally leads him into the haunts of both big and small game. If he is a botanist at heart as well as theoretically, who has better opportunities for botanizing? If he is a draughtsman, or a natural history student, he can indulge these tastes every day of the week. General Michael's own experience leads him to think that "a forester's time seldom hangs heavy on his hands; he has sufficient occupation as a matter of duty, and at the same time plenty of opportunity for recreation and study." A page or two further on our reviewer writes: "Apart from the free open-air character of its duties, the service is now one to which a man may be proud of belonging. It confers vast benefits on the country, and is attracting to its ranks a good, energetic stamp of men. The late acquisitions of territory in Burma open out a new and extensive field—vast forests will now come into the care of the State, and a considerable increase of the Forest Department will be needed." So far, well and good. Very few English people will incline to gainsay the pleasures and advantages to be derived from the full, free, sweet savoured naturalness of forest life. But then this is the Nineteenth Century; and it behoves the man who lives in it to be practical as well as sentimental. When General Michael retired after seven years of forest work in India, he retired on the pension due to his rank in the army. The Anglo-Indian forester of to-day does not belong to the army, and after twenty-five years of work is entitled to a pension amounting to one-half his average emoluments, provided they do not total up Rs. 5,000 a year. And this magnificent annuity is only available to the man who can put in a record of thirty years' service, including privilege leave and furlough! Yet the Forest Department is one of the very few Indian Departments that pays its way. Not only so; that can boast of a yearly progressing surplus of income over expenditure. General Michael does not seem to be conscious of the irony of his statement that "the retiring pension rules provide for all contingencies." Provide—yes. But what manner of provision? Enthusiastic although he is for the Department, General Michael is willing to admit that the Indian Forest Service does not afford anything like such good prospects as do the Civil and Political Services. He says naïvely: "I think that if I had to begin an Indian life again and *could not get into the Civil Service or the Army*, I would choose that of a forest officer." We have taken the liberty to underline a few words in this sentence. Foresting is the jolliest life in the world: only the Civil Service and the Army are very much better from a pounds, shillings, and pence point of view. That appears to be a fair interpretation for other people of the General's "if." And everybody knows what a lot of virtue there is in an if.

However, the almighty dollar is happily not the Englishman's god; and although we think that the Indian Forest Officer is ill-considered in the matter of pay and pension, yet doubtless there is germ of much truth in the argument General Michael builds up on enthusiasm. Interest in his work and its incidental scientific opportunities, the chances of sport, the freedom of forest life combine to make the Indian forester a more or less contented toiler in the service of the State. Let us hope that something good for a hardworking and most useful department may be found in that new Tom Tiddler's ground, Upper Burma. By all accounts it is pre-eminently a country where the labors of an organized forest department would prove valuable. General Michael has more regard for the Arcadian pleasures and departmental duties of a forester's life than for any values.

About the new arrival in India from Cooper's Hill; the man who used to be called a "griff" once upon a time, he writes: "The life on which he now enters is one which can hardly fail to be enjoyable to most English youths. His social status is good, his duties are highly interesting, and he at once finds himself in a position of some importance and responsibility . . . . the life of a forest officer in these days need no longer be dreaded as one of danger, as it formerly was. The Government do not expect or wish their officers to visit forests at unsafe times, and consequently it is a rare thing now-a-days to hear of men suffering from jungle fever to the extent to which the pioneers of forestry in India were liable through ignorance of the seasons at which the various tracts could be safely visited."

Notes and Comments.

PUNJAB NEWS.—Captain Abbott, R.E., has taken charge of the Peshawar Provincial Division relieving Mr. Bensley who has proceeded to Dera Ismail Khan to relieve Mr. F. E. Rose, Executive Engineer, going on furlough.

COPPER.—The Indian copper market is looking up; prices have risen considerably, and are still rising, being stimulated to upward action by advices from England reporting a considerable and almost daily rise in the price of the metal.

GOSALPUR MANGANESE ORE.—Arrangements are being made for a further examination of the manganese field of Gosalpur in the Jabbulpur District of the Central Provinces this cold weather by an officer of the Geological Survey of India.

A STANDARD OF LENGTH.—The Bengal National Chamber of Commerce have addressed a communication to the Government of Bengal on the subject of the proposed legislation for fixing a uniform and standard measure of length for the whole of British India.

PUBLIC WORKS IN CUTCH.—From the Administration Report of the Cutch Durbar for the official year 1886-87 we gather that no less than ninety-five new tanks were constructed over and above repair of several old ones, and construction of a canal to convey water from Artesian wells at Anjar, Mankua and Tuppar.

COAL SHARES IN BENGAL.—There has not been quite so much inquiry for coal shares, and Raneegunge Coals have dropped to 61. New Beerbhooms are steady at 199. Their half year closed on the 31st October, and the Company is reported to have done remarkably well. Equitable Coals have improved to 175. The Bengal Coal Company will pay a dividend of 6 per cent. for the half-year.

THE MADRAS RAILWAY COMPANY.—The post of Chief Engineer of the Company is to be a 5 years' appointment, and the pay is to be reduced after the retirement of Mr. Robinson. The stength of the Engineering staff is also to be revised. The present Locomotive Superintendent is to be left undisturbed in his post, but, on his severing his connection with the Company, his successor will draw a less salary.

ANOTHER BOAT FOR THE B. I.—The British India Steam Navigation Company have just launched from the yard of Messrs. William Denny and Brothers, Dumbarton, a steel screw steamship of 1,150 tons gross register. This steamer, which is named the *Kapurthala*, is intended for the coasting trade, and will be fitted with triple expansion direct acting engines. Special arrangements have been made for the carrying of native passengers.

H. H. THE NIZAM'S PUBLIC WORKS DEPARTMENT.—We understand that the Telingana Irrigation Department will for the present be placed under the immediate executive control of Mr. G. Palmer, the Secretary to Government in the Public Works Department. Mr. Lynn, C. E., Mr. Palmer's Assistant at headquarters, is to be deputed as a Special Assistant to Mr. P. Hudson, the Divisional Engineer of the Eastern Division, for Irrigation Works.

RAILWAY EXTENSION TOWARDS SIND.—The Jodhpur State, says the *Sind Gazette*, has been steadily pushing its Railway extension westward from Pachpadra towards the Sind frontier. The line has now been carried past Baltora, 12 or 13 miles towards Balmer. By the time the Public Works department have corrected their last letter issued on the subject, the Jodhpur section of the Haidarabad and Agra line will have been completed to the British frontier.

OPENING OF A BRIDGE IN VIZAGAPATAM.—The Pontoon Bridge referred to by us in a recent issue has been formally opened and named the "Turner" Bridge. It is the first iron bridge ever constructed in the District and a tribute was paid to the creditable way in which Messrs. Burn and Co. had finished the work in such a short period and so well. This satisfactory result was achieved by Mr. Wyndham, who represented the Howrah firm which undertook the contract.

THE INDIAN METEOROLOGICAL DEPARTMENT.—This important service is keeping its weather eye open, and induced thereto by the loss of the *Sir John Lawrence* has determined on the establishment of new observatories at Bimlipatam, Nellore, Cuddalore, and Tavoy. Increased facilities for telegraphic communication are promised, and an already most useful office is to be developed into further usefulness. Mr. Eliot has taken the matter in hand. His name is a guarantee for practicality and efficiency.

AN ITEM FROM THE DECCAN.—We learn that Mr. White, M.I.C.E., the new officiating Superintending Engineer and Secretary to the Resident, Public Works Department, is on his first iuspection visit to Berar. He has already inspected the works and offices in the South, and has gone on to the West Berar division, entering it at its furthest point, Hingoly. The establishment hands of the Public Works Department are loud in their praises of this new official, for he has "worked the oracle" in regard to many much needed reforms.

N.-W. FRONTIER ITEMS.—One of our correspondents writes:—I am just back from Quetta with Major C. C. Carter, R.E., Inspector of Sub-marine Defences. We have been examining the dynamite and blasting gelatine at Bostan and Kuch on the Hurnai route belonging to the Sind-Pishin State Railway and all was found in as good order as it was the day it left the factory—it was made in January-February, 1885. The Killa Abdulla and Chaman Railway has been sanctioned by the Secretary of State and operations will be commenced forthwith. The tunnel through the Kojak range will be over 4,000 yards long.

THE NALHATI STATE RAILWAY.—We are told in the last official Report on Railways that this line was maintained up to the standard necessary to permit of a speed for trains of—ten miles an hour. Also, that "nothing of any importance occurred during the year." Why not make next year important and memorable by converting this slow rolling stock into wheelbarrows and perambulators and employing ayahs to propel them? There are general store dealers in Indian Bazars who would buy up the engines now in use as old metal. And only think what an appeasing sacrifice that would be to the dominant genius of economy!

LIGHTING OF RAILWAY CARRIAGES IN INDIA.—The *Morning Post* says that inquiries have for some time been in progress regarding the sytems of electric lighting that have been introduced on English railways with a view to the possible adoption of one of them on some of the lines, notably the E. I. R. and G. I. P., in India. It is, however, thought that Pintoch's gas system is preferable to any electrical lighting system, because the latter is 50 per cent. dearer than oil lamps, whilst the gas costs only ·326 of a penny per hour per lamp, as compared with ·625 of a penny in the case of oil lamps. Why, then, have we not Pintoch's gas on all our great lines?

MORE RAILWAYS.—The *Pioneer* says that the Puttiala Durbar have agreed to construct 100 miles of broad-gauge line, from Puttiala to Bathinda. The line will serve the traffic of the more important Cis-Sutlej States and furnish the nucleus of an eventual extension to Bahawulpur, giving a large area of well-irrigated tracts an outlet to Karachi. The Punjab Government will construct the line, which will probably cost about Rs. 80,000 a mile, and the North-Western Management work it. That Government, we believe, originally proposed to join hands in the undertaking with the Puttiala people: but they preferred to tackle it alone. The line should pay well.

GOVERNMENT COMPETITION.—A Committee is now sitting at Madras to consider a proposal made by Messrs. Groves and Company of the Ashley Works, Coonoor, to lease from Government the buildings and machinery of the Brickfields at Chetput. We are glad to hear that the Local Government seem very desirous of giving Messrs. Groves and Company's proposal a trial, as we think it is high time that the Government retired from such trades, and gave local industries a fair chance of success. The Public Works Workshop ought, also, to be leased out or sold to private parties, for as at present constituded, it is only a drain on the public purse. Its charges are so high that they frighten even P. W. officers who seldom or ever give the shop any of the work.

KARACHI *versus* BOMBAY.—One of our correspondents writes:—When Lord Dufferin visited Karrachi the other day, the local Chamber of Commerce indulged in tall talk depreciatory to Bombay. The *Bombay Gazette* considers that "the off-hand reference to Bombay as a harbor which shares with Karachi a prominent position in the eyes of the commercial world shows that the Karachi Chamber of Commerce possesses a remarkably developed sense of proportion. It is as if Sussex patriotism were to speak of Brighton as the only city of any importance, with the exception of London, in the South-East of England." Would not Hayle in Cornwall be a much more appropriate and in every way fairer comparison? *Apropos* it is noticeable that last year the foreign export trade of Karrachi fell off to the extent of nearly a crore and a half of rupees. That meant a diversion to the more convenient port of Bombay; and means that the arid unprofitable deserts of Scinde do not attract either trade enterprize or traffic.

THE DARJEELING-HIMALAYAN RAILWAY.—This little line continues to increase in favor with the public, and in productiveness. From the official progress report on Bengal Railways for 1886 we gather that it paid a dividend of 8 per cent. for that year. As compared with the previous year there was an increase of about 5000 passengers, and of about 20,000 tons of goods. The rates for carriage of wool, bone-dust, and oil-cakes, judiciously lowered helped towards these results. The rates for baggage and parcels were also lowered. There was a decrease in Revenue expenditure. The total capital outlay to the end of December 1886 was Rs. 26,83,035, which represents a mileage cost of Rs. 52,608. This mountain tramway is of a type that has not hitherto been worked in any other country. Much of its success is due to Mr. Franklin Prestage. Government acknowledges the success as "eminently satisfactory," but does not compliment Mr. Prestage on it. An omission that in a private business concern would be considered ungracious, to say the least of it.

THE P. W. MINISTER'S TOUR.—A correspondent on the frontier mentions that Sir Theodore Hope has been making very laborious and unresting examination of the Public Works in progress along the Frontier. He has visited Pishin and Quetta, and expressed himself pleased with the progress that was being made in getting everything gradually into good order, and more especially at finding the railway traffic is improving beyond expectation. Sir Theodore gave three days to the Kattun oil works which involved some hard riding over the hills. On the 13th ultimo he rode from Babur Kuch station on the Sind-Pishin Railway to Kattun, a distance of forty-five miles, going over the line surveyed for a light railway for the transport of the oil-fuel. The route has been found too difficult for the purpose. On the 14th, Sir Theodore was nine hours on foot, looking for alternative routes and climbing peaks from which to get a view of the country. On the 16th, a ride of 65 miles by a difficult route brought him direct to Sibi, where he arrived in time to join the Viceroy and to accompany his Excellency to Pishin and Quetta, which he thus visited a second time.

THE TELEGRAPH DEPARTMENT.—After three years of consideration the Government has published its Resolution dealing with the scandalous block of promotion in the Telegraph Department. The remedies proposed are a mockery and delusion. Instead of peremptorily removing, with a pension, the 30 seniors, who have for upwards of 20 years sat like an incubus at the top of the list, they go through the form of *suggesting* only that these officers should retire on an extra 1,000 rupees pension! It hastens to add, that if the magnificent offer be not taken advantage of by the seniors then the unhappy "blocked" men, who have been out in the cold for 16 years, must sacrifice themselves. Verily the department has been begging for bread and is given a stone. It is safe to prophesy that not more than five, *at the outside*, of the seniors will relinquish the prizes they have held for so long, and the scheme of relief will prove as great a mockery as the previous ones. It is absurd to suppose that the blocked men who have been struggling so long to keep their heads above water can entertain the idea of retiring, when old age looms before them, on a pension manifestly inadequate to maintain their families.

BENGAL-NAGPUR RAILWAY.—A correspondent writing to us from Nagpur, under date 2nd instant, says:—The work of broadening the banks of the existing metre-gauge line is progressing very rapidly. Already 30 miles of B. G. rails have been laid for steel sleepers commencing from Nagpur end. The line will be run on diversions until the bridges are strengthened or constructed. Permanent way material is daily arriving by G. I. P. R. and the transhipment to M. G. trucks in the B.-N. R. yard keeps a number of coolies busily employed day and night. The permanent way is pushed on as fast as engine power will admit. It is regretable that there is a lax of engine power, but matters are so admirably managed—one locomotive being made to do the work of three—that there is no accumulation of stores in the Nagpur yard. A number of locomotive engines are standing in the railway shops requiring repairs. What is now wanted is a good energetic professional Workshop Manager, one who would stir up all his understrappers to a sense of diligence and conscientious outturn of work. As matters at present stand it is difficult to know who the responsible parties are, for most of the European and Eurasian workmen seem to go about with their hands in their pockets bent on doing or looking at nothing in particular. The Company is to be congratulated on having secured the services of Mr. P. Large as Superintending Engineer. This gentleman's high professional attainments and his twelve years' experience on the Punjab-Northern State Railway, make him more than competent for the appointment he holds. The Engineering works are being pushed on with a hearty good will, and everybody from Chief down to Inspector are busily engaged from early morning to nightfall.

Current News.

There is a project on foot for starting a Steam Flour Mill and Bakery in Chudderghaut.

Mr. Streeter, Jr., is expected in India shortly in connection with the leasing of the ruby mines.

Honorary Captain William Jackson, Public Works Department, has been pensioned on £216 per annum.

Mr. W. H. Cole, m.a., Deputy Superintendent, Computing Office, Survey of India Department, is granted furlough for 12 months.

An exhibition of agricultural machinery is to be held at Shikarpur on the 6th of January and following days during the Upper Sind Horse Show.

The Madras Government, on the recommendation of the Board of Revenue, have determined to establish a Government silk industry in that Presidency.

Mr Ribbentrop, who is now at Nagpur discussing the question of tramways for the supply by Government of sleepers to the Bengal-Nagpur Railway, returns soon to Calcutta.

The arrival in India of Mr. Ney Elias, the well-known explorer, is announced: it is stated that he will be employed on special duty in the Foreign Department of the Government.

Sanction has been obtained for the reorganisation of the Madras Revenue Survey Department, a large number of employés will, therefore, either be dismissed or pensioned and the remaining ones graded.

The Irrawaddy Flotilla Company are said to be getting out two new steamers of the latest construction. This does not look as if they feared the Toungoo-Mandalay Railway would greatly affect their business.

The average time occupied in the transmission of messages from Calcutta to the United Kingdom by the Indo-European Telegraph Company during the last fortnight in November was one hour sixteen minutes.

On return from leave Captain F. T. N. Spratt and Lieutenant O. M. R. Thackwell, r.e., are posted, the former to the Meerut Command, Military Works, and the latter to the Sirhind and Lahore Command, Military Works.

A new Meteorological Observatory has been established in the Cocos Islands, which is situated between Diamond Island and Port Blair, and close to the cradle of most of the violent storms that occur at the change of the monsoon.

Another serious collision between loaded and unloaded waggons is reported to have occurred at the Kidderpore Dock Works, owing to which several native labourers, men and women, were injured and one man and a woman were killed.

The following officers of the Corps of Royal Engineers have been placed under orders of duty in Bengal:—Lieutenants G. S. Cartwright, G. P. Lennox-Conyngham, Tomlin, G. A. Travers W. V. Scudamore, and A. J. H. Swiney.

The success of the Bombay cotton spinning industry is causing much excitement to Lancashire just now, and at the quarterly meeting of the Manchester Chamber of Commerce it was resolved to hold a full enquiry into the whole question.

Colonel J. G. Forbes, r.e., Secretary to the North-West Provinces, in the Irrigation Department, is to visit a place called Myerpore, where the gradual subsidence of the Ganges has disclosed some injury done to the canal head-works during the recent rains.

A Madras paper says:—"Mr. Molesworth, the Director-General of Railways, now at Hyderabad, is expected shortly at Madras, whence he proceeds, with the Consulting Engineer for Railways, to inspect the various Railway lines in this Presidency, especially the State lines."

An ingenious arrangement of punkah hanging, which is calculated to reduce the number of punkah-pullers in barracks to one-fourth of the usual establishment, has, it is stated, been submitted for trial by the inventor, a subordinate of the Public Works Department, at Campbellpore.

Lieutenant Colonel A. J. Filgate, r.e., Accountant-General, Public Works Department, has rejoined his appointment on return from leave. Major G. A. Begbie, r.e., Deputy Accountant-General who was acting for Colonel Filgate, has proceeded on furlough, and his place has been taken by Mr. R. G. Macdonald.

The Chief Commissioner of Burma, in considering the possibility of scarcity of food in Upper Burma, has applied to the Engineer-in-Chief of the Toungoo-Mandalay Railway to state the number of Burmans for whom he could find employment on the line. The reply guarantees labor for 5,000 men.

The result of the Committee which, we intimated some time ago, was appointed to inquire into the condition of the columns for the additional buildings to the Madras Civil Engineering College, cast by the P. W. Workshops, has been that most of the columns have been condemned and are to be replaced by stone pillars.

An important ruling has just been issued by Government, in which they have decided, in regard to a question raised by the Tanjore Municipality as to the amenability of the S. I. Railway Company to pay assessment under the Municipal Act for land held by them within Municipal limits adjacent and contiguous to stations, that, as the land is waste and accessory to a building for which tax is already paid, no tax can be admissible for such land.

An accident occurred lately near the Thull Ghat reversing station on the north-east line of the G. I. P. Railway. Several vehicles were derailed, owing either to a defect in the road or the carelessness of a pointsman. Three goods waggons and a brake were wrecked, but no further injury is reported or loss of life. The station water column was damaged. The line was cleared in eight hours, and the general traffic was worked on a single line. The mail trains were not delayed.

It will surprise people not acquainted with the salt trade to hear that Bengal manufactured only 66,000 maunds of salt last year, and imported 1,03,79,000 maunds more from the United Kingdom, Hamburg, the Arabian and Persian Gulfs, and Italy. Smaller quantities came from Bombay and Aden, and even from Cape Town. There was a falling off in the manufacture to the extent of 3,80,000 maunds, or about 85 per cent., but the increase of importation far exceeded that amount.

News comes from Toungoo that the temporary bridge over the Swa river, about 25 miles from Toungoo, has been completely carried away owing to heavy floods in the river. This will be the means of considerably delaying the work on the railway, as it will prevent construction trains from working. The Engineer-in-Chief of the Toungoo-Mandalay extension proceeded to Toungoo to personally inspect the works in connection with the Swa river bridge, and to estimate the full amount of damage caused by the floods, which have been unusually heavy of late.

Mandalay will soon be in direct telegraphic communication with Calcutta. The work of laying down the different sections of the line has already been begun. The line between Mandalay and Alon has been complete, that from Alon to Myingyan is now being laid. The second line from Myingyan to Kendat will soon be commenced, to be followed by a third section from Kendat to Thaumboo, a station not far from Manipur, in Assam, whence the whole extension to Calcutta will be completed, the whole of the line being constructed in five or six months.

The Director-General of State Railways, Colonel Conway Gordon, the *Pioneer* reports, is to be confined in a dark room at Delhi with inflamed eyes. It is feared this will cause him to go home. Sir Theodore Hope, whom he was to have accompanied to Jhansi, left Lahore for Delhi on Friday evening, to visit him. Sir Theodore will probably arrive at Jhansi on Tuesday, accompanied by Mr. A. C. Cregeen, Chief Engineer of the Indian Midland Railway. He may be expected a few days later in Calcutta, and will hand over office to Sir Charles Elliott on the 23rd of this month, the due arrival of the mail at Bombay permitting.

Apropos of the Lancashire cotton manufacturers' concern at the competition of the Indian mills in the Eastern trade, the *Times of India* remarks:—"There is one remedy, and one only, for the present state of things. Let the Manchester capitalists bring money out here and meet the native manufacturers fairly on their own ground. The more of them that come, the better will it be for Bombay and the Bombay working-classes—and the better, we imagine, for Manchester itself." The Lancashire mill hands would perhaps scarcely understand how the transfer of capital from Manchester to Bombay would benefit them.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondens.*]

OUR RAILWAY POLICY.

Sir,—It appears to me that the time is opportune to discuss this subject in all its aspects. The Government is drifting along aimlessly—selling some lines, leasing others, working others, and generally aiming at apparently no other object than playing into the hands of the "Railway King" in London.

Observer.

SPIRAL STAIRCASES.

Sir,—In answer to "B.'s" query in your paper of the 22nd October, to which I have seen no reply as yet, I would ask permission to give a few remarks on the subject.

In the first place, wood, especially teak, should be sawn in the direction of the fibres, or it would lose its transverse strength and be unfit for this purpose. Again, with a special and peculiar saw it might be cut in a regular curve, but hardly with a twist.

For ship's timbers, carriage shafts, staves of barrels, hand rails, &c., the prevailing practice is to saw the wood in the direction of its fibres, then subject it to steam or heat, and keep it clamped in the required position or shape till cold.

November 20, 1887. C

"FREE TRADE OR FAIR TRADE"?

SIR,—I read with interest and endorse the views set forth in your article on the above topic in your issue of 29th October last.

We Englanders have struck oil to any extent in Burma; to some extent in the Himalayas. And yet Kerosine from Baku is being imported into the country in constantly increasing quantities. Why? Is British enterprize, British perseverance in trade a dead letter, an exploded tradition?

Growls about depression of trade are frequent now-a-days, from Manchester and Birmingham as well as from Calcutta and Kurrachee. Whose is the fault? Englishmen allow Russia to cut them out of the oil trade, the United States of America to cut them out of the cutlery trade, and to run them close in competition even in the matter of cotton stuffs and wheat. Herr Krupp's Berlin firm supplies us with big guns; our small arms have to be indented for on the Continent; for necessaries as well as for luxuries England is dependent on other countries after a fashion that would have made our forefathers who knew not Free Trade and its fallacies, blush for shame. Materials for construction of our railways are to be bought more cheaply in Germany than in England. We have worshipped the Fetisch Free Trade; and we have our appropriate reward.

The English Nation is rich it may be said, and can afford to trust to the wide world's markets for material supplies. How then about the Labour Agitation, the great protest of the unemployed in London, with which our files of English newspapers have been so sadly full of late? A new departure is needful. The *effête* shibboleth of free trade must make way for the commonsense of fair trading. The world of trade must be disassociated from a cant that has done it infinite harm. And when it does accomplish this new departure, we take it there will seldom be such stringency of monetary conditions as now obtains, and militates against development of the resources of India, and the carrying to practical issue of sound engineering projects.

It behoves every Engineer in India to set his face steadfastly against outcomes of the mischievous dogma of a one-sided unreciprocal dogma of what it pleases Empirics to call Free Trade; his energies should be employed in doing what so in him lies towards destroying it. If, as to this matter, the reciprocity were not all one side; if the United States and France and Germany and Italy, and other civilized nations, would follow the English lead and cordially adopt a free trade policy, there would doubtless be advantage in it; something recommendatory to be said for it from a wholesale point of view. But, as things stand, it is suicidal, fit only for denunciation—and because of it Indian engineering interests suffer. Ergo, let Indian Engineers lose no opportunity of protesting against it.

COMMON-SENSE.

GRIEVANCES OF THE UPPER SUBORDINATES, P.W.D., MADRAS.

SIR,—I shall, and so would the majority of the upper subordinates of the Madras Presidency, deem it a great favor if some of the subordinates of Bombay and Bengal would through your Journal tell us, of the benighted presidency, what are the duties expected of them in connection with the D. P. W. of their respective presidencies. We of Madras have a code of rules in which the duties of officers and subordinates are defined, but this code being a mystery to most if not all the Executive Engineers, the office clerks and especially the accountants have it all their own way and shuffle their legitimate work on to the poor unfortunate subordinate who has only a clerk on Rs. 15 per mensem to assist him. The office establishment of an Executive Engineer consists of an accountant and assistant, head clerk with an assistant, storekeeper, one draughtsman, one estimate maker, and one or two temporary hands. The subordinates of Madras have to design and draw, write reports and specifications, prepare comparative statements, take measurments and prepare bills for contractors. They have to keep a cash book, pay coolies, keep muster rolls and submit ten-day reports besides half yearly return of tools and plant. The above comprises the whole work of a division. Now what remains for this large establishment in the Executive Engineer's office to do is for the accountant and his assistant to check the accounts, the draughtsman and estimate maker to check the plans and estimate, the store-keeper to check the tools returns, and the Executive Engineers to countersign generally.

The subordinates who have all this office work to do must leave the supervision of work entirely in the hands of petty mistries and contractors. The result need not be mentioned, but can easily be guessed. In old Jack Company's time when there were scarcely any trained subordinates, the Engineers had to learn their work and attend to it themselves; the result was, a Cotton, a Rives, a Mullins and a Smith. With the present system of shuffling everything on to the subordinate, the Engineers leave the Department as ignorant as when they first joined as raw recruits. The present system suits the office clerks. With the subordinate always engaged in office, they with the contractors and petty mistries, who are generally friends or relations of the office clerks, soon accumulate small fortunes at the expense of Government; for bad work entails annual increase in the shape of repairs or pulling down and reconstructing what was a few years ago new work.

To shew how code rules are attended to when in favor of a poor subordinate,—the rule that any subordinate in independent charge of a section of canal or road is entitled to sub-division allowance, is only applicable in Madras when a subordinate is in charge of a constituted sub-division. To define the constituted sub-division Government, in a G. O. dated April last, named all the sub-divisions of this benighted presidency. On receipt of the G. O., subordinates who were in charge claimed the allowance, which was refused in some instances on the plea that the Executive Engineer's Head-Quarters being the same as the sub-ordinate, no allowance could be passed. The above will show how the orders of Government published for the guidance of officers and subordinates are attended to when they affect the welfare of a

POOR SUBORDINATE.

ARTESIAN BORINGS.

REPLY TO "DELTA" AND "CHIPS."

SIR,—I see my letter *re* "Artesian Borings," which appeared in your issue of 12th ultimo, has not only caused amusement to your correspondent "Delta," who accuses me of gross ignorance, but has also called forth a few remarks from another correspondent signing himself "Chips."

To begin with "Delta." I have carefully read his letter, and although he tries to make out that I was ignorant of the subject I had written about, still he does not quote a single paragraph or even a line from my letter that betrayed the so-called ignorance which he credits me with. This being the case, I must pass over the first part of his remarks with the silence they deserve. It is easy enough to make an assertion, but quite a different matter to prove it.

"Delta" asks me to answer two questions "in the interests of Sanitary Science and Hydraulic Engineering," as he says. I shall be most happy to do so, even though one question of his is very pert.

To begin with question No. I., in which he is desirous to know what experience I have had in borings other than at Canning. The reply to this is, that it is not generally the rule with companies having a sane management to place important operations in the hands of a man utterly ignorant of what has to be done. Perhaps "Delta's" experience has been to the contrary? *Verbum sap.*

In question No. II. I am asked if I was innocent of the fact that in 1837 a boring was put down in Fort William to the depth of 392 feet. No! I was perfectly aware of the fact, but at the time of writing my letter I had been led to believe that it had only proceeded 250 feet, hence my remark that the Canning boring was the deepest; but since then I have had the correct depth given me by a very reliable authority, and as "Delta" seems to be in just as big a fog as to the depth as I was, I hope he will not mind me correcting him. The Fort boring went down 481 feet and terminated in a stratum of fine sand and not 392 feet as stated by your correspondent. Now, as 481 feet is a comparatively shallow well, I do not think I betrayed any ignorance when I said in my last letter that no deep borings had been put down to prove the alluvium.

Having I think answered "Delta's" questions, I will now turn my attention to your correspondent "Chips" who accuses me of calling the opinion of the members of the Calcutta Municipality on the subject "absurd and hasty." I must ask him to read my letter over carefully once more, and he will find that the singular and not the plural was used as to it being "hasty and absurd."

I based the opinion given in my former letter by what has come under my notice up to date from practical results, and "Chips" will find that I have asserted nothing positively, but on the contrary remarked that time alone would shew future results.

I am glad to see that "Chips" agrees with me in regard to the putting down of a trial bore hole, but I don't see any reason why it should be delayed till results are shewn from the well now in progress down here, for even if the Canning borings were a success it does not prove that the Calcutta ones would be, and *vice versâ.* "Chips" ought to be aware of this fact if he has any idea of geology.

It might interest him if he compared the difference of the section passed through at Canning which appeared in your issue of 30th July last, with the section passed through in the Fort boring, a copy of which I daresay he could either obtain from the Geological Department or the Asiatic Society.

As my last letter was not written for the sake of having a long controversy with "Delta" or any other correspondent, I most respectfully decline to go into any further argument on a theory, the proof of which, as mentioned by me before, can only be arrived at from practical results; but at the same time I shall always be willing to keep you informed as to what is being done by us down here and with what degree of success.

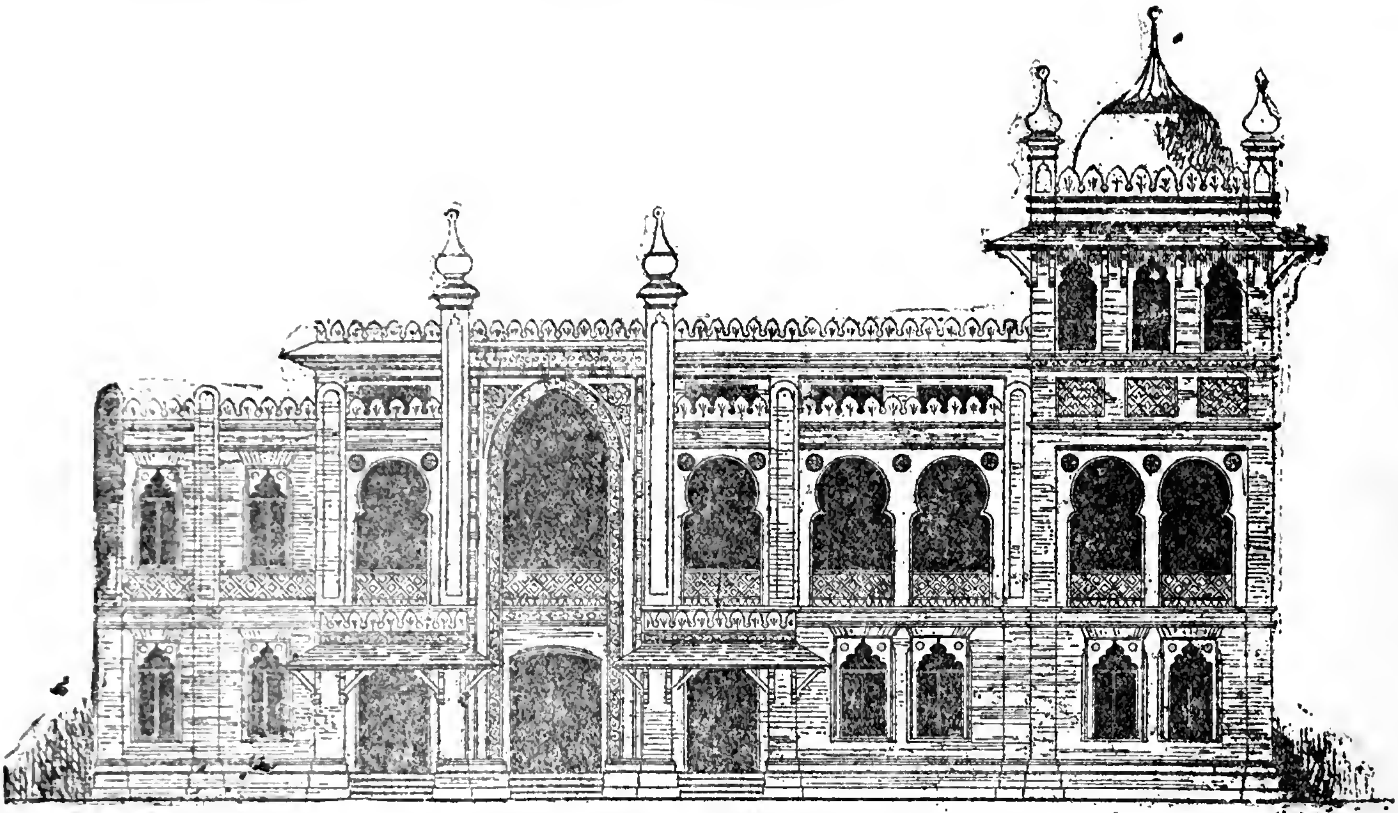
It is invariably the case in India that egotistical fossils are generally to be found, who come forward professing to know more than others, should any new scheme or project be advocated and try their best to make it die a natural death.

My former letter to you having given your correspondent "Delta" so much amusement, I sincerely trust this reply to him will be found still more amusing.

FRANK J. AGABEO,
Superintending Engineer,
Port Canning Boring Operations.

CANNING TOWN; *December* 4, 1887.

General Articles.



SIDE ELEVATION

LAHORE TOWN HALL.

Designs were invited for this building, and a response of twenty-two were received. The Committee met to decide on their merits at the Lawrence Hall, when 18 designs were at once eliminated, the remaining four (being those under motto—1. K.L.R.B., 2. Mayo School of Arts, 3. Akbar, 4. Queen's Head) were retained for further consideration. On the 18th September 1885, the Committee met and finally decided to adopt that under motto "Akbar" by Mr. W. N. Pogson, F.S.A., of Madras, to whom was awarded the first prize. The style of architecture ordered in the instructions to competitors was to be of Oriental character, and the author of the design chose Indo-Saracenic of the Mogul period.

The building accommodates on the ground floor the Municipal and District Funds Offices, and the Municipal Secretary and Engineer's Offices; and on the first floor the hall, two green rooms and verandah accommodations. The total cost of erection is Rs. 54,000. The design was submitted to the Public Works Department for approval and was commended for its architectural character.

The above illustration is from a photo-type of the original drawing executed in Calcutta.

[We hope to give a full page perspective view of this building in an early issue. The difficulty of obtaining good etchings of this class is what we are trying to overcome. The specimens produced by us must therefore be taken rather as representative of the present capabilities of the country than of advanced pictorial art.—Ed., *I. E.*]

THE ACTION OF SEA-WATER ON CAST-IRON PILES.

The Chief Engineer, B. B. and C. I. Railway in reporting on the condition of the superstructure of certain of that Company's wrought iron girder bridges, says, that having considered the question of the stability of those bridges, and as the condition of the cast iron columns forming the piers supporting them was necessary for the purpose and had to be satisfactorily ascertained, it was therefore decided to dismount and take up for examination, a pile column which had been erected during original construction, from one of the piers of the South Bassein Bridge. Accordingly the 3rd column of pier No. 37 of the South Bassein Bridge was selected as being one of the original and undisturbed columns of the bridge.

Mr. Hargrave, Resident Engineer, who conducted the examination states that this column was screwed into position in the year 1862, and hence its present age may be taken at 25 years, when the column was extracted. On examining the individual piles of which it was constructed, two of the piles were found almost as fresh in appearance as when originally put in place. In order to determine as far as possible the exact condition of the metal of the piles, he had specimens cut from each pile that was considered likely to be affected to any extent by corrosion. The specimens cut from the two piles, referred to shew no corrosion; of those specimens cut from a third pile immediately over one of the latter some shew no corrosion, while others have been corroded, but the greatest depth of this corrosion measured does not exceed $\frac{3}{32}$ of an inch. The corrosion is greatest in specimens taken as they approach low water mark. As to the pile bolts they are as good as the day they were put in place.

The lesson to be learnt from this experiment is that the greatest corrosion in the piles exists close to low water and does not extend to any considerable depth underneath it; the same has been observed in the case of the bolts and bracings. If this column can be taken as representing the average condition of the remainder of the columns in this bridge, we are in a position to state that after a period of 25 years other pile columns in a salt waterway are in a very good condition and that the piles where corrosion has been found are in a position which can be easily got at for examination or renewal. This experiment further sets at rest all groundless fears as to the speedy deterioration of pile columns from the action of sea water.

The result of these examinations of the Company's Bridges is, therefore, most reassuring and highly satisfactory.

The specimens have been put up in a case which will be kept in the Board room for future reference, when possibly 25 years hence another column may be examined and the results compared.

HOW TO CHOOSE A PIANO.

THE purchasing of a Piano is a matter fraught with more risks than perhaps most people imagine. To many, indeed, these risks are an unavoidable necessity: to those, for instance, who, living in the Mofussil, and having no friend in the Presidency towns, who could select an instrument for them, are forced to fall back upon the not unfrequently misleading descriptions of elaborately got up price lists; while others incur these risks from the general want of information on the subject, and are guided in consequence by the appearance merely, and the prices put upon the instruments. Reflecting upon this subject, it seems to me, that a few practical rules may be drawn up, with the help of which the most unsophisticated may be enabled to secure, if not a tip-top, at all events a fairly good instrument.

Four things go to make up a good Piano: "The *materials* used, the *manner* in which these materials are put together, the *result* of this putting together of parts, and the *form* or external appearance of the instrument;" and yet a fifth thing is the *estimate* in silver or gold of the *tout ensemble.* These five things suggest as many points for our consideration: 1st, strength of material; 2nd, improvements in the mechanism of the Piano; 3rd, tone; 4th, style; and 5th, its price.

1st.—To expect the ordinary intending purchaser to pry into every part of the instrument, and to test the genuineness of the material used in its make, would be merely ridiculous. To secure, therefore, soundness of the material originally used, and further, to insure, that that material has not deteriorated by age, it is desirable to heed that both the maker of the instrument and the vendor are persons of proved public *honesty.* I italicize the word as I do not wish it to be confounded with "reputation." For though I do not mean to insinuate that it does happen, yet I would caution my readers of the possibility of men, who, having reputation, can afford occasionally to act otherwise than consistently with principles of strict honesty,—secure in the certainty, that the defects of an odd instrument or so will be set down to causes other than the true ones. On the other hand, men who have their reputation yet to be made, may be trusted to see that their work is free from as many defects as possible. I mention no names, for obvious reasons. I merely enunciate a principle, and leave my readers to determine its application. There are other advantages in buying the instruments of rising makers, but this is hardly the head under which to enumerate them. The vendor, too, ought to be characterized for his public honesty, for it is on him you chiefly rely for the age of your instrument. For, were he a man of other principles, he might palm off an old instrument on you for a new one—not to say that this is ever done, but it is possible; and though an old instrument may, in some cases, as we shall see lower down, be preferable to a new one, yet in my hypothesis these advantages are not pre-supposed in the transaction.

2nd.—So many improvements in the internal mechanism of the Piano have been effected within the last decade of years, that any Piano of an earlier maker must necessarily be antiquated to a degree. It is not my intention to enter upon the nature of these improvements; they are hardly simple enough for the purpose of a general article like this. But this fact, taken in itself, supports what I have already said, about the necessity of dealing with honest vendors; for, an old instrument could hardly have the more recent improvements incorporated in it.

3rd.—The next thing to be attended to is, the Tone of the instrument. Here it must be remarked, that good "tone" is often the result of good playing; so that, while a bad player can evoke nothing, but grating, metallic sounds from an instrument, a good player will, by his masterly fingering, draw forth the most mellow tones, and from the same instrument. This mellowness of tone is often also the result of "age," so that, a piano, which may at one time ring out a most distressing jingle, may often after a year's use or so, tone down to the liquidity of the notes of an organ. But an invariable test of the efficiency of an instrument, is its powers of vibration. A good instrument ought, when a note is struck and held down, to continue to vibrate for from fifteen to twenty-five beats.

4th.—Another thing to be taken into account in purchasing a Piano is the "style" of the instrument. But this is rather a question for common sense and taste to determine. The size and make of a Piano ought to be in keeping with its surroundings. A "Grand" would be just as much out of place in a 20 feet sitting room as a "Cottage" would be in a room of larger dimensions. Neither ought price to be a factor controlling style. Better have no Piano at all than have one offending by the vastness of its proportions, or one lost by the smallness of its dimensions in an apartment unsuited to its size.

5th.—What I have just said, however, in no way affects the last point to be considered—the *price* of the instrument. The main thing regulating the price of a Piano is often its "finish," and so, where money is an object, I would sacrifice finish to the qualities already enumerated. But a finished instrument may yet be secured, if it is purchased at second-hand. Let me not be misunderstood. The fact of a Piano being second-hand, though it will decrease its market value, will often not only not tell on its intrinsic worth, but will often even enhance it. For, as I have said, use not unfrequently tones down an instrument, and in such a case, a second-hand instrument would possibly be preferable to a brand new one. But, let it be distinctly understood, that by a second-hand instrument I do not mean a necessarily old one.

I am aware that I might have treated this subject more scientifically, but hardly, perhaps, with more practical utility to the general reader. It is for the benefit of such that this paper was written, and for the benefit of such I repeat: In buying a Piano, see that both the maker and vendor of the instrument are parties of proved public honesty; that the instrument was made in recent years; that it possesses good vibratory powers; that it is suited to your apartments; and, where money is an object, you may occasionally, with decided advantage, purchase a second-hand instrument in preference to a new one.

CATHOLIC CATHEDRAL, MADRAS. JAS. DOYLE.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XVII.

Brick Arching in Bridges when Centring is separately Estimated.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Bricklayers No. ...	5			
Do. „ ...	2			
Do. „ ...	2			
Coolies „ ...	2½			
Do. „ ...	3			
Do. „ ...	2½			
Bhistie „ ...	1½			
Grinding Mortar, c. ft.	26	Variable.	Do.	Do.
Sundries	......			
Materials.—				
Bricks, 1st-class, No. ...	1,400			
Stone lime, c. ft. ...	12½			
Sand „ ...	12½			
Surkhi „ ...	12½			
Sundries	......			
Petty Establishment ...	......			

N.B.—The labor detailed is for bonded brick arch-work. For arching in rings it is 10 % less.

X.

PROPOSED SUSPENSION BRIDGE OVER THE VISHWAMITRI RIVER, BARODA.

II.

SPECIFICATION.

Chain Links.—To be four in number, two at each side of the bridge, and placed immediately above one another and to consist of forged iron bars 8″×1″ with distance pieces at the joints. Each link to be made of such length that when the chains shall have assumed the curve of equilibrium, the vertical suspenders shall measure 10 feet between centre and centre. The two chains on the same side shall be so arranged that the centres shall be relatively equi-distant from one another, so that the suspenders measure 5 feet apart centre to centre horizontally.

The links to be forged from best boiler plate scrap and made in one piece with the ends solid. The pin holes to be drilled out, and the pins are to be accurately fitted into them; no slogger will be allowed. Pin holes of each link, consisting of four bars, to be drilled through in one operation, so as to insure absolute accuracy.

The short links shall be treated in like manner and drilled in sets. The short links to be of steel plates, 1 inch thick and cut to template to carry the suspension rods. Those of the upper chains to be long enough to reach through the lower chains, as shewn in drawing.

The anchor links to be 9″×1″ and to pass through a metal guard and to be cottered with keys, as shewn in drawing.

Pins.—To be of forged iron accurately turned to fit the links.

Saddles.—To be as shewn in drawing; those on the tower to have steel rollers, with a steel roller way fixed in the masonry.

Suspension-rods.—To be of iron forged solid, and to have an eye at the top end for attachment to links, drilled out to $1\frac{1}{2}$″ diameter and fitted with turned bolts; the lower end of each suspension rod will pass through the transverse girders of the bridge and be screwed so far up that the camber of the roadway may be adjusted by means of nuts. Two nuts to be fitted to the end of each rod—one to act as check nut. A washer 3″ diameter and $\frac{3}{8}$″ thick to be supplied with each rod.

Transverse Girders.—To be of the form and dimensions shewn in drawing, the plates and angles to be of Staffordshire iron of the quality specified in the following "general conditions" and to be accurately and neatly finished.

Floor-plates.—To be of wrought-iron of Staffordshire or other approved brand, $\frac{3}{8}$″ thick, to be curved and flanged, as shewn on drawing, and rivetted one to another and to the transverse girders.

Cover-plates.—Cover-plates to be securely attached to the underside of lattice girders and ends of floor-plates.

Lattice Girders.—To be made of bars, tees, and angles, as shewn on drawing, great care to be taken that straightness and neatness be combined with strong and efficient work.

GENERAL CONDITIONS.

All bolt and rivet holes to be drilled, and where practicable the several thicknesses of material to be drilled in position. Rivetting, as far as possible, to be done by hydraulic pressure. The rivets to be Lowmoor or other approved quality of iron.

All bolts and nuts to have Whitworth's standard threads.

All forged iron to be made from boiler plate cuttings.

All steel in plates, bars or angles to be of the Siemens-Martin process.

All iron plates and bars to stand a tensile strain of 21 tons per square inch with $12\frac{1}{2}$ per cent. reduction of area at fracture.

The whole of the work to be put together in the contractor's yard, painted with two coats of oxide paint, marked, bundled, and packed in such way as may hereafter be directed and delivered free to the Chief Engineer of Baroda State on the siding of the Bombay and Baroda Railway belonging to the Baroda State, in good condition, within 6 months from the date of order.

The contractor to admit the Chief Engineer, or whomsoever he may appoint, to inspect any or all parts of the work as it progresses; and the Chief Engineer, or the agent whom he may appoint, shall have the power to alter, add to, or deduct from any of the quantities herein provided for; such alterations, additions, or deductions, to be calculated at the schedule of prices attached.

October 22, 1887. P. R.

THE PAST OF PORTO-NOVO IRON WORKS.

BY A. PIERRE DE CLOSETS C.E.

II.

BUT to return to the Company's proceedings; the first smelting operations of the blast furnaces were failures; in fact, it was not found at once what should be the best shape to be given to the hearth of a charcoal blast furnace to suit the nature of the ores and the quality of the charcoal, besides the workmen who were brought from England were not acquainted with charcoal as fuel, having had to deal with coal or coke, which imply quite another kind of process. They, therefore, found some difficulties in the beginning, but after two or three trials, pigs were run satisfactorily, and the process of converting began. The converting of cast into wrought iron was at first made in finery fires (sinking fires), as in some part of Germany and France. The quality of iron was good, and readily sold to the public and to Government for the use of their arsenals, but the quality was not always equal, owing to some defect in the working or for some other reasons. However, the production was continued for some years, but the expenditure was out of proportion with the receipts and the interest of the capital invested; in fact, the works were not paying. Finally, Mr. Heath after losing a great deal in his undertaking, was obliged to discontinue, and to seek the assistance of capitalists.

He, therefore, went to England and established in London a joint stock company under the name of the "East Indian Iron Company" empowered by Act of Parliament.

Mr. Robert Brunton, C.E., was sent to India to arrange and start the works again. Mr. Brunton was the brother of Wm. Brunton, an Engineer well known in England, and particularly in the iron line. On his arrival in India Mr. Brunton devoted himself for the first year to the improvement in the quality of pig, and to economical process of smelting. The pig produced and sent to England soon attracted the notice of iron masters, and was found to be unequalled for the manufacture of annealed castings, and of boiler plates. The plates made with this iron at Mr. Thornicroft's works were found of such good quality, that they were used in the construction of the "Britannia bridge" by Stephenson.

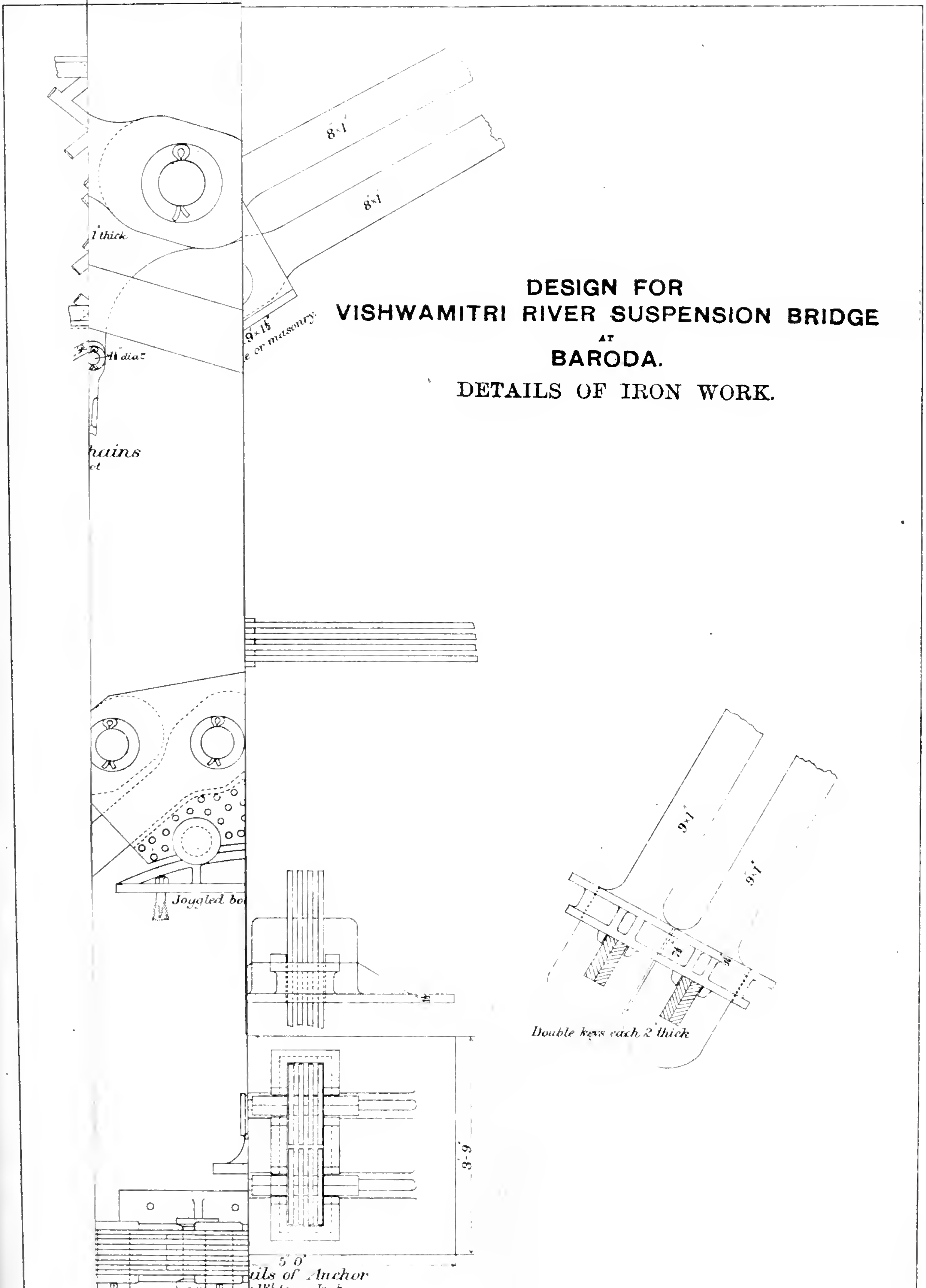
The wrought iron and steel obtained from the pigs were exhibited in London, in the shape of sword blades, cutlery, needles, and some other articles; and to shew the malleability of Porto-Novo iron, several quires of letter paper in wrought iron were also exhibited. It may be well to mention that the jurors awarded a gold medal of first-class to the articles exhibited as equal to the best Swedish iron.

The prospects of the Company's business were then very promising, the cost of their pig per ton (f. o. b.) was £3, and it was sold readily in England at the nominal rate of £6 per ton. The pig was taken as ballast by ships returning from India without freight or shipping charges.

This manufacture was, therefore, prosperous, and should have been continued in the same manner, but about 1840 a new process having been discovered in France for utilising as fuel the gas from the blast furnaces causing a great economy in generating steam and in iron puddling and reheating, the Directors of the E. I. I. Co. advised Mr. Brunton to return to England, and to put himself in communication with Messrs.

DESIGN FOR VISHWAMITRI RIVER SUSPENSION BRIDGE AT BARODA.

DETAILS OF IRON WORK.



The "STAR" Press, 19, Lall Bazar, Calcutta.

Thomas and Laurens, the patentees in Paris of the new process.

Mr. Brunton then went to France, and studied the new process at Tusey and Treveray (*mense*) where it was in full operation, and his report was so favorable that the Directors ordered the apparatus and machinery necessary to be constructed and sent to Porto-Novo.

A combined steam engine for rolling mill and blowing apparatus was, therefore, erected in Porto Novo forge. I was at the time assistant to Mr. Brunton, and was directed to build puddling and reheating furnaces suitable for gas works. These furnaees had no grate, the gas from the blast furnaces was supplied by a number of small tubes, surrounded, each of them, by a larger pipe leaving an annular outlet for the air so as to receive the gas and the proper quantity of oxygen. The effect of such arrangement was to produce the effect of several large blow pipes. The flames from the tubes acted on the sole of the furnace and the heat produced was very intense, so much so that it was necessary to blow upon the workmen at the puddling furnaces so as to protect them.

The conversion of iron in these furnaces was very rapid and the quality of the iron exactly like the best Swedish iron.

A defect, however, was soon discovered. The caloric developed by the new process was so elevated, that the furnaces were soon out of working condition and had to be repaired very often.

It was at the same time that the Directors ordered the establishing of another set of works at Beypore on the Malabar Coast, and Mr. George Brunton was entrusted with the construction. This gentleman very rapidly put up blast furnaces and a rolling mill for merchant iron and a train of rollers for railway rails. He managed to get charcoal from the extensive jungles leased to the Company, and began the manufacture of iron. The fuel used in his puddling furnaces was wood in a raw state. This establishment would have succeeded fairly, but by some misunderstanding between one of the Directors and Mr. G. Brunton, this gentleman had to resign, and unfortunately after him the business was left in other hands.

The Directors of the Company decided at the time, that the process of puddling by gas was to be discontinued, owing to the addition of a gas engine, which was supplying the puddling furnaces independently from the blast furnaces. This gas engine, in fact, was using a good portion of the charcoal available, and there was not in the end any economy, and therefore coal as per the old method was substituted for converting iron in the puddling furnaces.

Notwithstanding the presence of sulphur in the coal, the iron produced was of excellent quality, but not so good as the iron made with the gas, but it was, however, of the same quality as the Swedish iron; and the iron turned out every day was sold immediately to the native merchants of the neighbourhood.* It could be said that this period of the Porto-Novo Iron Works was the most favorable to the Company, as not only funds were never wanted, the produce of the establishment paying its expenditure, but even a surplus was put to the credit of the Beypore Works. We had managed so that all the workmen were natives and so to reduce to a great extent the general charges. However, there was more difficulty experienced in the supply of charcoal, justifying the use of coal; and the causes of the diminution of the supply of charcoal were these:

There was at the time no Government Department of Forest. All the jungles leased to the Company were under the superintendence of the Collectors of the districts. When a rayyet applied for a *pattah* of a piece of jungle, he was allowed to clear the jungle for cultivation, having his crops free of any tax during two years. The consequence was that after two years' cultivation the rayyet was fouud applying for a new tract of jungle. All the clearings he was making were converted into charcoal and the jungles disappeared year after year. He was in the meanwhile reaping a profit from the sale of the charcoal to Porto-Novo Works, and had besides the profits from his crops.

* A large quantity was supplied to the Madras Gun-carriage Factory.

It is easy to understand that with such a system the forests were disappearing rapidly. At last Government attention having been directed to this state of things, instituted the Forest Department; and evidently if this Department had been in existence at the time, it is to be supposed that the Porto-Novo Iron Works would be still in a flourishing condition.

(To be continued.)

METAL *VERSUS* TIMBER SLEEPERS.

THE question, which sleeper, metal or wooden, is *the* one for Indian Railways, is one of the very first importance, alike, to the Indian Government—as consumers—and to the producers. Advocate as I am (after many years of Indian Railway experience) of what is technically known as a "timber road," and the question in this instance requiring an answer so far only as the Railways of Northern India are concerned, I will endeavour by stating certain facts to make it clear that the "timber road" is *the* one for Northern India, and that consequently the Government should secure, for its Railways, every wooden sleeper, answering a really practical specification, that can be produced at a reasonable price.

For purposes of comparison, I will subdivide the question as follows :—

(1.)—Cost of a wooden sleeper 10′ × 10″ × 5.″
Its weight.
Cost of required fittings for sleeper.
Their weights.
(2.)—The same points for a metal sleeper.
(3.)—The age of a wooden sleeper.
(4.)— Do. metal do.
(5.)—Cost of maintaining a "timber road."
(6.)— Do. "metal do."
(7.)—Effects of each class of road, on the Rails and Rolling-stock.
(8.)—Effects of accidents on each class of road and on Rolling-stock.
(9.)—Value of each class of sleeper, when unfit for Permanent Way work.
(10.)—Encouragement to capitalists to invest money in the products of this country.
(11.)—A *resumé* of the foregoing.

I premise,—my Indian Railway experience is one of some years, I have had an intimate knowledge of both "timber" and "metal roads," and I have had to deal with the following descriptions of sleepers :—

Timber. (1.)—Norwegian Creosoted Pine.
(2.)—Babool.
(3.)—Deodar.
Metal. (1.)—Greave's round bowl.
(2.)— „ oval „
(3.)—Denham and Olpherts.
(4.)—Steel trough sleeper.

The limit of space makes it impossible for each description of metal sleeper being compared with the wooden sleeper, and for the same reason, the question, as regards metre-gauge sleepers, cannot be considered. I confine myself, therefore, to one gauge of Railway—the 5′ 6″— and to one description of metal sleeper, and compare it only with the deodar 10′ × 10″ × 5″ sleeper.

The prices must be understood as Lahore prices—Lahore being a good central position as regards Northern India Railways completed and projected.

1. A first-class deodar 10′ × 10″ × 5″ sleeper costs from Rs. 3 to Rs. $3\frac{1}{4}$. An average of Rs. $3\frac{1}{8}$ is taken.
Its weight is 140lbs.

An iron chair, to carry rail, costs	Rs.	0	8	0
Its weight is 22lbs.				
A spike, to fix chair to sleeper, costs	„	0	0	9
Its weight is 1lb.				
A wooden key, to fix rail in chair, costs	„	0	0	9
Its weight is 1lb.				

Therefore, a fully equipped wooden sleeper, with 2 chairs, 4 spikes, and 2 keys, costs Rs. 4-6-6 and weighs 190lbs.

2. Taking the oval bowl sleeper as the representative of the metal class,

A pair of bowls cost	Rs.	6	7	0
Their weight is 165lbs.				
A tie bar costs	„	0	14	0
Its weight is 31lbs.				
A gib costs	„	0	0	3
Its weight is ¼lb.				
A cotter costs	„	0	1	0
Its weight is ½lb.				
A wooden key costs	„	0	0	9
Its weight is 1lb.				

Therefore, a fully equipped oval bowl sleeper, with 1 tie, 2 gibs, 2 cotters, and 2 keys, costs Rs. 7-9-0, and weighs 199½lbs.

To this price of Rs. 7-9-0—the least that can be added to represent the breakage, which occurs in carriage of metal sleepers, in excess of that which occurs with wooden ones, is 2 per cent., or say Rs. 0-2-6 per sleeper. The cost may, therefore, be taken as Rs. 7-11-6. We have, therefore, a gain of Rs. 3-5-0 in cost and say 9½lbs. in weight in favor of the timber sleeper.

No advantage of the gain in weight will be taken, though this would to some degree improve the case of the timber sleeper. The question of Ballast here naturally comes in, and must in fairness to the metal sleeper be considered. A "timber road" demands at the least 12 cubic feet of brick or stone ballast per foot, forward of "way." A "metal road" requires only 3 cubic feet of similar ballast, but demands in adddition 15 cubic feet of sand ballast per foot forward of "way."

Taking, for purposes of comparison, that each sleeper represents 3 feet forward of "way" (it does not as a matter of fact), we must add to the cost of a timber sleeper

36 cubic feet of ballast at say Rs. 6-4-0 per 100	Rs. 2	4	0	

and to the cost of a metal sleeper

9 cubic feet of ballast at say Rs. 6-4-0 per 100	Rs.	0	9	0
45 cubic feet of sand at say Rs. 10-0-0 per 1,000	„	0	7	2
	Rs.	1	0	2

This necessary outlay reduces the saving in favor of a wooden sleeper from Rs. 3-5-0 to Rs. 2-1-2.

3. The age to which a wooden sleeper will do its work, is, in common with the metal sleeper, dependent to a great degree on the description of maintenance it receives. Taking a first-class deodar sleeper, the road it is laid in, well maintained, the traffic—the average traffic of a Northern India line—I fix the age to which it will attain before demanding removal at 20 years.

4. The age of the metal sleeper under exactly similar conditions may, I think, be taken at 40 years.

In many parts of Northern India traversed by Railway, where the quantity of salt in the earth is very excessive, this 40 years of life I have given is liberal to a degree. Salt is disastrous to the metal sleeper, so much so, that in these salt plains I am confident a wooden sleeper would outlive a metal one. I will, however, to strengthen my case, take no advantage of this fact, but will allow the age of the metal sleeper to be 40 years.

5. The cost of maintaining a timber first-class road, from figures collected by me, is as follows:—

The age of the maintained road being 10 years.
The unit of maintenance one mile.
The period of maintenance one year.

Labor—

2 men	@ Rs. 6 = Rs. 12 per month	× 12 = Rs.	144	0	0
⅓ mate	„ „ 12 = „ 4 „ „	× 12 = „	48	0	0
⅓ keyman	„ „ 6 = „ 2 „ „	× 12 = „	24	0	0
Material—					
Brick ballast 1,000 c. ft.	@ Rs. 6-4-0 per 100	= „	62	8	0
	Total cost per mile per annum	= Rs.	278	8	0

6. Under exactly similar circumstances, for a metal road the following is the cost:—

Labor—

2½ men	@ Rs. 6 = Rs. 15 per month	× 12 = Rs.	180	0	0
⅓ mate	„ „ 12 = „ 4 „ „	× 12 = „	48	0	0
⅓ Keyman	„ „ 6 = „ 2 „ „	× 12 = „	24	0	0
Material—					
Sand ballast 8,000 c. ft.	@ Rs. 10 per 1,000	= „	80	0	0
		Rs.	332	0	0

From the foregoing accounts it will be seen that there is a saving of Rs. 53-8-0 per mile per annum in favor of the timber road.

To have made the comparison quite fair, I should have taken the cost of maintaining a 20 year (or half age) old "metal road," but for want of figures I am unable to do so. This constitutes another point of advantage I have conceded to the "metal road." BLITZ.

(To be continued.)

PRINCIPLES OF MECHANICS.

By A. Ewbank.

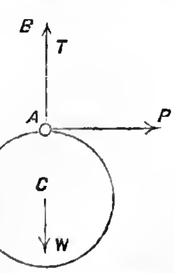
I.

One of the London weekly papers contains from time to time a summary of the existing political situation. This summary is expressly prepared for tyros in political lore and "well informed persons are warned off." A similar spirit underlies the preparation of this series of articles on the principles of mechanics or the laws of force. Experienced mechanicians are warned off. The invitation is to that class of men to whom the calculation of the intensity of a force—antecedent to actual experience of the force—seems a matter abstruse and mysterious.

The reader of these articles will not find his progress barred by any hedges of mathematical formulæ. No knowledge of mathematics is presumed in the reader. He is only supposed to have average ability for following an argument and to be willing to give that sustained attention to the development of the reasoning without which no scientific knowledge can be acquired. At the same time every effort will be made on the part of the writer to open out—to lay bare—to make plain and simple—the exposition of the laws of force.

We commence by defining force as that which tends to set in motion a body which is at rest. The force not only tends to set the body in motion, but it will actually produce motion unless at the same time one other force or several other forces should exert a counter-influence. A good example of the influence of force is furnished if

Fig. 1

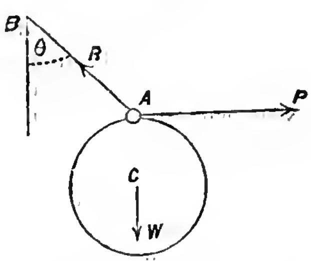


we take, as in *fig.* 1, a heavy sphere or other heavy body and suspend it, from a fixed point B, by a string B A which is fastened to a ring A of the body. This body then remains at rest and is under the action of two opposing forces. Let W, the weight of the body, be 12 pounds. Then T, the pull or tension of the string A B, is also 12 pounds. The intensity of any force may be described by saying that it is a force of so many pounds weight. A force of 25 pounds or 25 pounds' weight is a force such as the hand must exert if it sustains a weight of 25 pounds; and *if* this weight is kept at rest. To lift such a weight from the ground something more than 25 pounds is required. And if the hand proves unable to sustain the weight, and this weight begins to descend, then at the moment the weight begins to descend the force exerted by the hand on the weight must be less than 25 pounds. Thus we may, for the present, consider any force fully described as regards its magnitude, or intensity, if we can say it is a force of X pounds and if the numerical value of X is known or discoverable.

Now, while the body C is resting under the equal and opposite forces of T and W, let us tie another string to the ring A, and let us pull along this new string in some horizontal direction with a force of P pounds. For example, let us pull in the due north direction. Then the body C will commence to move, that is, it will actually move in the due north direction. How far it will move depends on the intensity or magnitude of P. And the movement does not depend on the actual magnitude of P, but on its magnitude relative to that of T or W. If W is 12 pounds and P is 6 pounds a certain movement will be commenced. Exactly the same movement will be set up if W $=24$ and P becomes 12. If the reader does not see this, or does not believe it, he is recommended to spend a little thought over the point. If finally he is unable to convince himself of the truth of the statement, he must reserve it as a doubtful point, and meanwhile, assuming its correctness, he must go on with his studies of force. If he does see that the ratio of P to W is the sole important question, he may be prepared to believe that if any number of forces—or as we often say any system of forces—act on a body, these forces may all be halved or all be doubled or all be trebled without altering the direction or velocity of the movement which the body has acquired by reason of the combined action of all the forces. Here the weight and mass of the body must be halved, doubled or trebled as the case may be. We shall for some time have no dealings with cases of actual movement. We shall for some time be dealing only with forces which like T and W in *fig.* 1, neutralise, destroy or as we generally say, balance each other.

To return to *fig.* 1. If $W=12$ and $P=6$ a certain displacement of the body C is produced. We do not now study the suddenness of the motions produced. We merely suppose the force P continually applied, always being horizontal, and always due north, and we ask what will ultimately happen. We ask what position the body C will finally reach, and permanently keep. The new position is in-

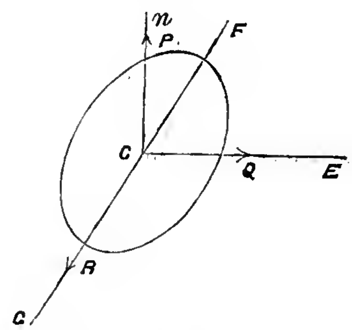
Fig. 2



dicated in *fig.* 2. The reader is advised to illustrate this figure for himself by suspending a box, book, or other article and then pulling it out of the suspended position by a new force P superadded. In *fig.* 2 the suspending string B A has taken an inclination to the vertical denoted by the Greek letter θ (theta), This θ denotes some number of degrees. Thus if the angle is half a right angle θ means 45°. The force W has not altered. The force P is by hypothesis unchanged. But we may ask if the tension of the string B A has been changed. As the tension *may* have changed it is now denoted by R. R means a force equal to the weight of R pounds and R is some unknown number. For we must not assume, without inquiry, that the tension of the string B A has remained unchanged. T was originally called into action simply by the existence of W. But R possibly may depend on P as well as on W. Therefore, we provisionally denote the tension of the suspending string by a letter differing from T. We are not at present inquiring into the actual value of R. We only say that the force P has had effect in disturbing the original position of C. We proceed to state that the magnitude of the angle θ in degrees will depend on the magnitude of P in pounds. That is, if P be increased θ will certainly increase. If P be diminished the body C will make a partial return to its original position. Suppose that, W being 12 and P being 6, (measured in pounds weight,) we have $R=13$. Then we assert that had W been 24, P been 12 and R been 26 we should have the *same* angle θ. In other words, the new position depends on the proportions between P, W, R, and not on their actual magnitudes. A little later on we shall calculate the value of R for the case when $P=W$.

We proceed to define the phrase "resultant of forces."

Fig. 3



In *fig.* 3 let A B be any body. For example, let it be a slab of wood or stone resting on a moderately smooth horizontal floor. At some point C of the body, let there be fixed in the body a ring or peg or some other arrangement by which strings can be attached to the body. Let a string C N be so attached and be pulled horizontally in the direction due north. Let the pulling force or tension in the string be great enough to make the body move in spite of any friction which the floor may exert. Then the body will move towards the north. Let the force along C N be discontinued and let another string C E be pulled horizontally and due east with a force Q sufficiently great to induce motion. Then such motion will be due east. Now let both these forces be applied. That is, let them act simultaneously. In what direction will the body move? The reader is supposed from mechanical insight or instinct—or it may be from experience—to feel perfectly convinced that the body will not move towards the north-west or the south-east or the south-west. He is supposed to be also convinced that the body will not move due north.

He should also see—by mechanical insight or it may be experience—that the body cannot move due east. As to the exact direction in which the body would move he should see that it must depend partly, if not wholly, on the ratio between the two forces. As a matter of fact, the direction of movement depends wholly on this ratio provided the floor and the body are in contact along a horizontal surface which has no grooves or other inequalities. If we say that P is 8 pounds and Q is 6 pounds the reader is not expected at this stage of his studies to have any precise idea of the line of movement of the peg or ring at C. As a matter of fact, the point C will start in a direction which makes with C N a smaller angle than it does with C E. If C F be the direction of initial motion the reader should feel convinced that the angle F C N is less than the angle E C N. He should also feel sure that if P were equal to Q the line of motion would bisect the angle N C E, and conversely he should feel sure that if the line of initial motion does make 45° with the north line then the forces P Q must have been equal.

Suppose now the angle N C F is 30.° Then E C F is 60.° Thus one angle is double of the other. But whether one force is double of the other is a question the reader is not yet expected to answer. He may say that certainly Q is not double of P, but that it is uncertain whether P is double of Q. And generally if we know the ratio which the angle F C N bears to E C N we cannot yet give the precise ratio of P to Q.

If C F is the line of initial motion and we produce F C back to G then along the line C G it is conceivable that some extra force R may be made to act. It is also possible that this force R may be just great enough to prevent P and Q from causing in the body either motion along C F or tendency to motion along C F.

In other words, R destroys the influence of P *and* Q without R deriving any assistance—or experiencing any opposition—from the roughness of the floor. If R be *slightly* increased beyond the necessary value the floor will aid P and Q to prevent movement towards G. If R be slightly decreased, the friction of the floor must help R to prevent the body moving towards F. Thus the mere fact that R keeps the body from actually moving is not enough to help us to estimate the value of R. We can, however, still guess approximately at its value, and the smoother or more slippery is the floor the nearer is our guess to the true value of R. But if we postulate that the existing roughness of the floor shall not act or tend to act either towards C F or towards C G then there is only one value of R which neutralises P *and* Q. The magnitude of this value is called the magnitude of the resultant of P and Q. We should then have three forces P, Q, R acting simultaneously on the body and the body has no tendency to move in the direction C F, along which P and Q without R would have taken the body. Nor has the body any tendency to move in the opposite direction C G. But will the body in this case move or tend to move in some direction differing from C F and from C G. To answer these questions we reflect that since the body under the action of P and Q would begin to move along C F, we might dispense with P *and* Q if we took some other force S acting directly along this line C F. Then S represents the combined effect of P and Q. But R completely destroyed the influence of P *and* Q. Therefore R completely destroys the one force S. Therefore S must be numerically equal to R. Thus when P, Q and R all act together, we practically have two forces R and R acting in opposite directions along the line F G. As these forces destroy each other we have absolutely no force left. Therefore the body will neither move nor tend to move in any direction whatever. Now, when a force equal to R is considered to act along C F this force is called the resultant of P and Q. In any inquiry into the effect of P *and* Q we may remove both if we put R instead, acting along the line C F. If when P was given say 8 pounds and Q was given say 6 pounds, we could determine the numerical value of R, and also ascertain the exact value of the angle N C F, then our science of force would be a real science. We shall shew in the sequel that we can thus determine the magnitude and direction of the resultant of two given forces. Let O be a point in a body and let two equal forces, each equal to the weight of P pounds, act at O. These forces may be produced by the tension of strings, by the thrust of stiff rods or in any other manner. Let the forces act along the lines O A, O B. We call O A the line of action of one of these forces. If the body on which a force acts is a small body—though it may be a heavy body—we may say that the body will move along the line of action of the force. If the body is not small, we must say that a certain point of the body tends to move or begins to move along the line of action of the force. For simplicity—and for the present—we will say that equal forces P, P are acting on a small heavy body. Then the reader is expected to understand that if these forces induce motion in the body, the body begins to move along a certain line O D. The reader is expected to see that this line O D lies midway between the lines O A, O B. This midway direction of initial motion obtains only because the forces are equal. If we produce D O backwards through O we get a line O C. Then along O C we might introduce another force R, which would completely neutralise the other two forces. If now each of these equal forces be doubled how must R be changed that the three forces may continue to neutralise each other. The reader is supposed clearly to see that R must also be doubled, similarly if each P be trebled R must be trebled. Generally if each P be multiplied x fold, R must be multiplied x fold. Here x is any number 4, 5, 6, &c. But x may also be any fraction such as $\frac{2}{3}$, $\frac{5}{4}$, $\frac{12}{7}$, &c. The force R is in magnitude the resultant of P and P. If we say that R is the actual resultant of P and P, we consider R as acting along O D. If each P be multiplied x fold we shall have the effect equal to a force x R acting along O D. We have been developing the theory of force in great minuteness, because we shall have to reason on our ideas and we must be sure that these ideas are absolutely true. We can now apply the preceding preliminaries to determine the actual magnitude of R in

Fig. 4

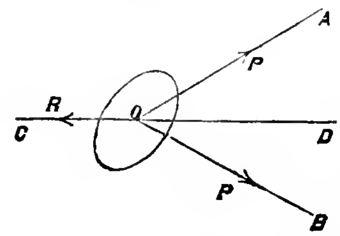
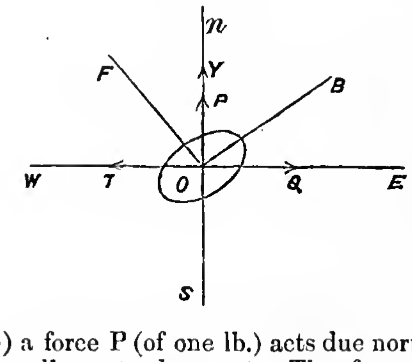


fig. (4) for a particular case. The particular case is when the angle A O B is a right angle. Thus we propose to determine the actual resultant of two forces, each equal to the weight of one poond avoirdupois, when one of these forces acts horizontally due north and the other acts horizontally due east.

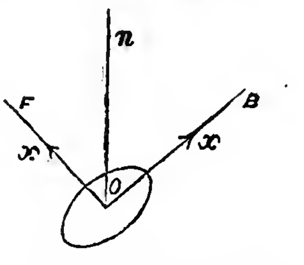
Fig. 5



In *fig*, (5) a force P (of one lb.) acts due north. A force Q, also of one lb., acts due east. The forces are equal, but they have different letters for distinction. It is required to measure numerically the combined effect of P and Q. These forces act on a body at a point O of that body. That is, strings may be fastened at O or other means adopted. Now, we will add two more forces. Let a force of T, equal to one lb., act at O due west. Let a force of Y, also 1lb., act at O due north. To estimate the final result of these four forces we may couple them at first in any way we choose. Thus we observe that there are two forces acting due north. We observe also that of the remaining forces one acts due east and the other due west. What is the result of the east and west forces? Will they move the body or tend to move it? The reader is expected to see that these forces cancel each other as far as making the body move is concerned. If they were not fixed at one point O, but at two points of the body, *viz.*, at H and K (not shewn in the figure) they would tend to stretch the body between the points H and K. But they would have no power or tendency to move the body as a whole in any one direction. Therefore, in the matter of moving the body as a whole, we say that Q and T destroy each other and we leave them out of account. As to the forces P and Y they act both due north. In other words, they give a force of 2lbs. acting due north. Thus the four forces P, Q, T and Y are really equivalent to one force of 2lbs. acting due north. This may seem simple enough, but the reader is now expected to take note of the fact that if we couple P and Q together and get their resultant, say U, and couple T and Y together and get their resultant, say V, then the resultant of these two resultants U, V, must be that same force of 2lbs. acting due north.

Now, the resultant of P and Q must be some force of X lbs. acting north-east. We do not know X, but we will find it presently. And the resultant of T and Y must be a force, also of X lbs., but acting north-west. Thus our four original forces P, Q, T and Y are equivalent to some force X along the north-east direction and some force, also X, along the north-west. This is indica-

Fig. 6



ted by *fig.* 6. And we have to find the resultant of these forces, X and X. Now on examining the *fig.* (5) we discover that these forces are at right angles. We then argue as follows: 1lb. and 1lb. at 90° produce some force X,

$\therefore$ 2lbs. and 2lbs. at 90° produce 2X,

X lbs. and X lbs. at 90° produce x times X or X^2

Therefore in *fig.* 6 we must have a force X^2 lbs., along the line O N which bisects the angle B O F. But we already know that the final resultant of P, Q, T and Y should be 2lbs. along this same line O N. We therefore conclude that $X^2 = 2$. This gives $X = 1{\cdot}4142$ to four places of decimals. We now know that a force of 1lb. acting due north *and* a force of 1lb. acting due east are equivalent to a force of nearly 1·4142lbs. acting north-east. Thus two forces, each of 10lbs., acting at right angles give a resultant = 14·142 nearly. Or if the equal forces are each 100 the resultant is greater than 141 and less than 142. What the resultant precisely is *in decimals* we do not attempt to state. But we do give a close approximation to the value of the resultant. It has before been pointed out that mathematics (including mechanics) are not exact sciences, but sciences of just or well-considered approximation.

(To be continued.)

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, November 26, 1887.

Upper Burma.

With reference to *Gazette of India* Notification, dated the 10th August 1887, Maung Po Thine, Assistant Engineer, 3rd grade, reported his arrival at Mandalay on the forenoon of the 11th September 1887, and is posted to the Taungdwingyi Division, which he joined on the forenoon of the 23rd idem.

The following officer is placed on special duty under the Superintending Engineer, Upper Burma, for the purpose of preparing plans and estimates, and taking levels for the re-construction of the embankment from the Mu river to Shwebo :—

Mr. P. B. Roberts, Executive Engineer, 2nd grade.

With reference to *Burma Gazette* Notification, 24th October Bhagat Singh, Sirdar Bahadur, Executive Engineer, 3rd grade sub. *pro tem.*, is appointed to the charge of the Taungdwingyi Division, Upper Burma.

Lieutenant C. N. Beevor, R.E., Assistant Engineer, 2nd grade, Shwebo Division, has passed the departmental examination prescribed in Public Works Code.

Mr. A. D. Anthony, Assistant Engineer, 3rd grade, Mandalay Division, has passed the departmental examination prescribed in Public Works Code.

With reference to *Burma Gazette* Notification, dated the 21st October 1887, Mr. H. Hoyne Fox, Executive Engineer, 4th grade, sub. *pro tem.*, reported his arrival at Mandalay on the forenoon of the 27th instant, and is posted to the charge of the Ruby Mines Division. Mr. Fox assumed charge of the Ruby Mines Division on the forenoon of the 27th October.

With reference to Lower Burma Public Works Department Notification, dated the 10th November 1887, Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, reported his arrival at Mandalay on the forenoon of the 14th instant, and is posted to the Mandalay Garrison Division, which he joined on the same date.

Lower Burma.

With reference to *Gazette of India*, Public Works Department, Notification, dated the 25th October 1887, Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, reported his arrival at Rangoon on the forenoon of the 21st November 1887, and is posted to the charge of the Toungoo Division.

With reference to Notification, dated the 22nd November 1887, Mr. A. T. Dodsworth, Executive Engineer, 4th grade, sub. *pro tem.*, is transferred from the Toungoo Division and temporarily attached to the Rangoon Division.

Punjab, December 1, 1887.

The orders for the transfer of Messrs. A. Grant and F. Farley, notified in Public Works Department Notifications of the 22nd ultimo, are hereby cancelled.

Irrigation Branch.

Mr. E. A Sibold, Executive Engineer, 1st grade, from the Muzaffargarh Division, which he left on the forenoon of the 1st November 1887, to the Lower Sutlej and Chenab Division, Inundation Canals, which he joined on the forenoon of the 2nd November 1887, and took over Executive charge from Mr. L. F. MacLean, Executive Engineer, on the afternoon of the 5th idem. Mr. L. F. MacLean remains attached to the Lower Sutlej and Chenab Division on special duty.

Mr. L. M. Jacob, Executive Engineer, 3rd garde, from the Upper Sutlej Division, Inundation Canals, which he left on the afternoon of the 31st October 1887, to the Delhi Division, Western Jumna Canal, which he joined on the afternoon of the 1st November 1887, and took over Executive charge from Mr. G. M. R. Field, Executive Engineer, on the afternoon of the 5th November 1887.

India, December 3, 1887.

Mr. A. S. Gerrard, Executive Engineer, 2nd grade, sub. *pro tem.*, State Railways, is transferred from the Establishment under the Director-General of Railways to that under the Government of Bengal.

Lieutenant-Colonel G. R. Gibbs, S.C., Executive Engineer, 1st grade, Central India, is granted special leave for a period of two years.

Mr. J. C. Ledger, Executive Engineer, 1st grade, State Railways, is permitted to retire from the service, with effect from the 17th December 1887.

That portion of Public Works Department Notification, dated 29th April 1887, relating to the services of Mr. W. Drew, Assistant Engineer, 1st grade, State Railways, being placed at the disposal of the Government of Madras for employment on the South Indian Railway, is cancelled.

Military Works Department.

Lieutenant R. F. Allen, R.E., Assistant Engineer, 1st grade, is appointed to Officiate as Executive Engineer of the Fort William Division, Millitary Works, during the absence on furlough of Captain J. G. Day, R.E., or until further orders.

Director-General of Railways.

Mr. J. C. Ledger, Executive Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India, leave to 16th December 1887, in extension of the twenty-one months' furlough granted him in Director-General's Notification dated 11th February 1886.

Lieutenant Colonel E. N. Peters, R.E., Executive Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India, leave for one month, in extension of the leave on private affairs for one year granted him in Director-General's Notification, dated 27th January 1887.

Mr. D. F. Hogarth, Executive Engineer, 1st grade, is, on return from furlough, posted to the Toungoo-Mandalay Extension of the Burma State Railway.

Mysore, November 26, 1887.

Mr. J. B. Chalon, Assistant Engineer, has been granted privilege leave for 3 months, with effect from the forenoon of the 25th October 1887.

Mr. A. S. Nagavkar, Executive Engineer, Shimoga Division, is granted privilege leave of absence for one week, in extension of that sanctioned in Office Notification, dated 12th October 1887.

Central Provinces, December 3, 1887.

Establishment.

With reference to Notification, dated 22nd ultimo, Mr. H. L. Cleaver, Assistant Engineer, joined the Wardha Coal State Railway at Warora on the forenoon of the 26th idem.

Mr. D. Wallace, Executive Engineer, 2nd grade, returned from the furlough granted to him by Central Provinces Notification, dated 9th July 1886, and reported his arrival at Bombay on the 14th ultimo, from which date (afternoon) he has been placed on special duty. This cancels Notification of the 19th ultimo.

Bengal, December 7, 1887.

Rai Radhica Prosad Mukerji Bahadur, District Engineer, 24-Pergunnahs, returned on the forenoon of the 7th ultimo, from the privilege-leave granted to him in Notification of the 12th August 1887.

Rai Annada Prosad Sarkar *Sahib*, Assistant Engineer, passed the prescribed colloquial examination in Uriya on the 14th ultimo.

With reference to Notification, dated the 29th ultimo, Mr. C. P. Warde, Assistant Engineer, is appointed to officiate as Executive Engineer, Hazaribagh Division, during the absence of Mr. W. B. Christie, on special duty.

Mr. J. C. Hewitt, Assistant Engineer, is transferred from the Second Calcutta to the Jessore Division, which he joined on the forenoon of the 22nd ultimo.

This cancels the unexpired portion of the language leave granted to Mr. Hewitt in Notification of the 15th October last.

Assam, December 3, 1887.

The Chief Commissioner is pleased to appoint Mr. W. McM. Sweet, Executive-Engineer, 4th grade, temporary rank, and at present District Engineer, Sibsagar, to officiate as Manager of the Jorhat State Railway, in addition to his present duties.

The Chief Commissioner is pleased to appoint Mr. O. G. Smart, Executive Engineer, 3rd grade, sub. *pro tem.*, and Officiating Executive Engineer of the Khasi and Jaintia Hills Division, to officiate also as Manager of the open line, Cherra-Companyganj State Railway with effect from the forenoon of the 1st December 1887.

Mr. D. J. Clancy, Assistant Engineer, on transfer from the Cachar district, reported his arrival to the Executive Engineer, Khasi and Jaintia Hills Division, on the afternoon of the 21st November 1887, for employment at Companyganj.

Indian Engineering Patent Register.

Specifications of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

84 of '87.—Arthur Rollason, of 53, Queen Victoria Street, London, in the County of Middlesex, England, Engineer.—*For improvements in gas engines.*

161 of '87.—William Jackson, of Thorn Grove, Mansfield, Aberdeen, North Britain, Engineer.—*For improvements in or additions to tubular air heating apparatus or stoves.*

189 of '37.—John A. McLennan, of Chicago, in the County of Cook, and State of Illinois, in the United States of America. —*For grain elevators.*

193 of '87.—John William Henry James, of 9 Victoria Chambers, Westminster, in the County of Middlesex, England, Civil Engineer, and Frederick Ransome, of Norwood Road, in the County of Surrey, England, Civil Engineer.—*For improvements in and connected with furnaces for burning hydraulic lime, cement, and like substances.*

196 of '87.—Edward William Serrell, Junior, Civil Engineer, of New York, United States, temporarily resisding in Chabeuil, Department of the Drôme, France.—*For application of a solenoid for reinforcing electrical contracts.*

201 of '87.—Edward William Serrell, Junior, Civil Engineer, of New York, United States, temporarily residing in Chabeuil, Department of the Drôme, France.—*For improvements applicable to mechanical devices which are periodically started by means of electricity.*

209 of '87.—Walter Walker, of Dashwood House, New Broad Street, in the City of London, Engineer.—*For an improved method of automatic electric signalling for railways and apparatus therefor.*

Advertisements.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai*, and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.
An allowance is made for continuous insertions.

CONTENTS.

ANSWERS TO CORRESPONDENTS.

DELTA.—We have no space for purposeless and personal controversy.

Obituary.

WHITE.—On the 11th instant, Mr. George Preston White, C.E., of 13, Queen Anne's Gate, Westminster.

INDIAN ENGINEERING.

SATURDAY, DECEMBER 17, 1887.

THE RECENT PROPOSALS OF THE GOVERNMENT OF INDIA REGARDING PROMOTIONS IN THE HIGHER GRADES OF THE P. W. D.

I.

FOR some time past a note on the above subject has been in circulation amongst a limited number of the members of the Public Works Department throughout India. The note is signed by Mr. G. H. D. Walker, Under-Secretary to the Government of India in that Department, and the points considered therein are as under.

First.—That the number of superior posts being small, compared with the strength of the Department, it can be mathematically demonstrated that only a small proportion of officers can eventually obtain promotion beyond the executive grades.

Secondly.—This being the case, it is necessary that a system of rigid selection be put in force, so as to ensure that the best men are selected. Unless this is done, not only will the Department suffer in efficiency, but those men who by their abilities are especially fitted for the superior posts, and who, owing to the small number of appointments, cannot attain them, will have a real cause of grievance against Government for bringing about a state of things injurious to their prospects.

Thirdly.—It is probable that if a system of careful selection be applied, as opposed to that of seniority, the selection being limited between certain periods of service, the great majority of those fitted for the superior appointments of the Department will succeed in obtaining them.

Fourthly.—That the greater the sub-division of lists, the more nearly are the prospects of promotion reduced to the conditions of a lottery.

Many members of the Public Works Department will be disposed to agree with a good deal of what is stated in the above paragraphs and would cordially agree to any proposals which would tend to ameliorate the present state of things, provided they had an adequate guarantee that the proposed promotion by selection could be fairly and equitably worked. Let us, however, see what the Government of India propose to do. It must be admitted at the outset, that the age at which men are promoted to Superintending Engineer has been increasing rapidly and steadily of late years. The actual figures are as follows :—

Average age of men promoted to Superintending Engineer.

		Years of age.
Five years	... 1868—1872	... $36\frac{1}{4}$
,,	... 1873—1877	... 40
,,	... 1878—1882	... $42\frac{1}{3}$
,,	... 1883—1887	... $45\frac{4}{5}$
In the year	... 1886	... $46\frac{3}{4}$
,,	... 1887	... 47

The ages taken are those of permanent promotion.

The new fifty years' rule may do something to improve this state of things, but it is quite evident that a large number of deserving officers can never obtain the rank of Superintending Engineer, and the Government of India are perfectly correct in saying "but in order to serve the interests of the Department generally, and of the best men in the Department, it is necessary that local Governments should refain from recommending men for promotion merely because they are approaching the age of 50 at which, if not promoted previously, they can be made to retire; and they must make up their minds to sacrifice mere mediocrity in order to do justice to proved ability."

So far, we think, most men will agree with the Government of India, but it is when the proposals now made by them come to be considered that we begin to differ with the note. The proposals are as under:—

First.—That local Governments on the Government of India list, should divide all 1st grade Executive Engineers who are forty years of age and over into two classes to be named—A. and B.—and should forward every year a very full report as to the qualifications of each man in class A.

Secondly.—That the Government of India, taking the lists of class A. men from the several Provinces, should nominate men in their order for promotion, taking age and all the facts fully into consideration; it would probably be advisable, in every three selections thus made for promotion, to give preference to seniority, provided it is combined with fair ability, in one case; and in the other two, to select wholly by professional merit. The list of men so selected and placed in their order for promotion will form the final class A. list from which appointments will be made as in the third proposal.

Thirdly.—Local Governments will then be called upon to appoint to officiating or other vacancies, the men who are next on the Government of India list for promotion, irrespective of the local list to which they belong.

As our article has already exceeded the ordinary length, we propose to resume this subject in our next number, premising that although we cannot agree with the Government of India in their views of this subject, we are willing to give them credit for the best intentions to further the interests of the Department. But good intentions often do more harm than anything, and the results of carrying them out especially when they are injudiciously decided upon, are often disastrous. It would be most unwise for the Government of India to attempt to carry out such a drastic measure of reform, unless they feel that they have a large majority of the Public Works Department in cordial agreement with themselves. If this be not the case, the change cannot but accentuate the discontent of the most thoroughly discontented service in India.

A PROPOSITION has been made to the Egyptian Government to organise a force of 40,000 men, who would be taken away from their military duties for four months out of the year and employed on the canals and public works. The adoption of this scheme would, it is thought, while materially strengthening the defensive power of Egypt, relieve the Public Works Department of a heavy financial strain.

BENGAL RAILWAYS.

THE Progress and Administration Report of Railways in Bengal, for 1886-87, is a specially interesting State paper, as a record of steady, well-considered advancement of civilization. It should never be forgotten, it cannot be too frequently insisted on, that a railway in India is a potent agent in the cause of civilization, as well as an encouragement to, and a helpmeet for, trade. *Ex oriente lux* is a worn out, exploded axiom; light and guidance come now from the West, and in the guise of railway lines are able to assert their healthful influences on the body politic more usefully than any other educational machinery the world has ever known of.

The Report now lying before us takes into purview the last five years of work done on provincial railways in Bengal. To wit, 160 miles added to the Tirhoot State Railway, an accordant section of the Northern Bengal State Railway westwards from the opposite banks of the Kosi river, a Dacca State Railway successfully completed, 125 miles of new line opened by the Bengal Central Railway Company, the East Indian and Eastern Bengal systems connected by a bridge over the Hughli at Naihatti, Patna brought by the Bengal and Nort-Western Railway Company into through railway communication with North-Western Bengal and with Oudh. In Yankee land, where the power of energy is fabulous, and the rails laid down do not last long, the sum of results we have given above would doubtless seem small; but our readers, all men who have lived in India and understand the conditions under which engineering work is got through with in that country, will, we take it, agree with us in thinking that a considerable and satisfactory amount of good work has been done.

The ultimate, only satisfactory test of a railway's efficiency is its ability to pay dividends on capital outlay. As to that matter we are told the gross receipts from the State Railways of Bengal, which amounted to only 32¾ lakhs in 1881-82, have in the subsequent five years risen steadily as follows: 37¾, 41¼, 43, 45, and 53 lakhs. Working expenses have, of course, also risen as new lines were added and extensions carried out. From 19 lakhs in 1881-82 working expenses have risen to 21, 25½, 31¼, 31, and 32 lakhs in the subsequent five years, leaving the province a net revenue which from 13¾ lakhs in 1881-82 has been 16, 15¾, 11¾ 14 and 21 lakhs in the subsequent five years ending with that under review. The working results of some of the lines, such as the Patna-Gya, the Nalhati, and the Kaunia-Dharila have not exhibited that elasticity which might be desired, but others have steadily continued to bring in increased earnings year by year. The Northern Bengal for example has, since 1881-82, without any great extensions of mileage, given the following results as gross earnings, 19¼, 22¾, 21¼, 21¾, 23½, 26¼ lakhs. There is a steadiness about those figures which augurs well for future development.

There is more than steadiness. That the Patna-Gya line has not developed "elasticity" is due probably to the extraneous fact that a good many Hindu pilgrims still consider it more praiseworthy, more conducive to salvation, and (what amounts to pretty much the same thing with most of them) cheaper to go afoot across country than it would be to pay for a railway ticket. In a good time coming the knowledge that time is money will come to them; their conversion to more soundly economic and withal quite canonically religious views is mere matter of time; and who will say that the railway line which furthers such a desirable result is not a civilizing, fertilizing, humanity-serving influence? *Apropos*, the Commissioner of the Rajshahye Division writes:—"The opening out of lines of railway and their attendant feeder roads has given a great impetus to the extension of trade and commerce in the division, and this has reacted favorably in improving the condition of the people. The cultivators have a readier market for their produce, and can obtain better prices, and as a consequence cultivation has extended. During the last nine years a great change has taken place, and the effect of the impetus given to trade on the material condition and well-being of the people is very marked."

Effects on the Tirhoot State Railway have been more marked still: a result difficult to discount economically because of the great extensions of mileage by which this line has profited of late years. It remains a fact however that from $5\frac{3}{4}$ lakhs, in 1881-82, gross receipts have risen steadily to 16 lakhs during the year under review. It is noteworthy that the author of the Report we have taken for our text, considers that judicious reductions of rates are answerable for a considerable share of this steady and satisfactory development.

Here is a suggestive extract, about the Tarkessur (assisted) Railway: "The receipts on this line were as follows: Coaching traffic Rs. 2,38,444, goods Rs. 10,222, other traffic Rs. 337. Total Rs. 2,49,003. As compared with the previous year, there was a slight falling off in passenger earnings, and a decrease in goods earnings of about Rs. 9,000. It is significant that out of the receipts Rs. 2,16,004 were from third-class passenger traffic. The average earnings per mile open per week amounted to about Rs. 215. These figures refer to the calendar year 1886. The Provincial expenditure which had been incurred upon land for this line up to the end of March 1887 amounted to Rs. 1,52,577, and in addition, indirect charges amounted to Rs. 2,218. The shareholders are most fortunate in the arrangement under which their little line is worked by the great East Indian Railway as an integral part of the main system; such an arrangement would not have been possible had the original promoters, with a view solely to economy of first cost, built their line on any gauge, other than that of the main line, or had they, in the choice of their permanent-way and in the design of their works, sacrificed efficiency to cheapness. A dividend of $6\frac{1}{2}$ per cent. was distributed for the year 1886." We especially invite attention to the penultimate sentence of this quotation. Even Engineers are not infallible, and under Government pressure are often tempted now-a-days to let efficiency subserve cheapness. Let them take note of, and take heart from, the record of the Tarkessur Railway.

We leave the intrepretation of the following refreshing bit of self-assertion to our readers:—The Secretary of State and the Board of Directors of the Bengal Central Railway Company have arranged the terms of a new principal contract to supersede that originally entered into; under this new contract the Company are guaranteed a dividend of $3\frac{1}{2}$ per cent., subject to a number of provisions which need not here be specified. With this guarantee the Government of Bengal has nothing to do, as it has not been considered in the provisions of the quinquennial provincial contract which came into force on the 1st April 1887. The Imperial expenditure on account of land for the Company had at the end of March 1887 amounted to Rs. 7,30,402, and in addition indirect charges in connection with this land had amounted to Rs. 4,511. Heretofore the Bengal Government has had no financial interest in the Bengal Central Railway, but when, in the year 1887-88, the Eastern Bengal State Railway becomes provincialised, the local Government will be to some extent interested, inasmuch as the Company's line is worked by the Eastern Bengal State Railway under a contract by which the latter receives a percentage of the gross receipts of the former.

RAILWAYS IN CHINA.

EVER since the appearance of the remarkable article in the *Asiatic Quarterly Review* by Marquis Tseng on China's awakening after a prolonged sleep with her eyebrows slightly singed by the bombardment of the Taku Forts in the last China war, the eyes of the civilized world have been turned towards the Celestial Empire, on the look out for an agreeable surprise in the way of formidable preparations for defence, or large drastic reforms in the administration of the country. But as yet their curiosity has not been gratified with anything more sensational than a nine days' wonder from an American syndicate to start Railways and undertake Telegraph Extension in the country. "The wonderful superstructure of American exploitation of China" has been nipped in the bud, the Chinese Government have refused to ratify the concession made by Li-Hung Chang to Count Metkiewicz and his associates; and after all the haggling and the promised payment of fabulous sums of money, what has the Count received? Nothing more than what any private individual or firm would have obtained without going to a fraction of the trouble. China is no longer a country to be duped by the blandishments of Western speculators. She has not much faith in the gushing philanthropy of foreigners for her welfare, and with good reason. A well-known authority on the affairs of that country recently remarked:—"For a good many years past North China has been regarded as virgin soil for men with ideas. Reformers of all kinds have flocked into Tientsin and Pekin, and have laid their schemes for the regeneration of China before Viceroys and Ministers: projects for a new army and navy, for a reform of the administrative and fiscal systems of the Chinese Empire, for railways, telegraphs, and coinage, a paper currency, for dredging the canals, for fortifications, plans for campaigns, &c. . . . . It must have appeared to the Chinese as if all the wealth, skill and experience of the West were here brought and laid at their feet." But in the long run the intended recipients of their gifts have with their usual shrewdness and cunning avoided the tempting bait. Concessions and reforms are little known in that land of stolid conservatism; it is therefore no matter for wonder that they fight shy of the blessings of Western civilization. Whatever progress she might have made in other directions, it is certain that the era of Railway has not dawned there. However, as a beginning has been made in that direction it would be as well to give an account of the progress of the only scheme so far undertaken with some show of earnestness. In October last after the flood had subsided at Tientsin the railroad commenced there was pushed on with vigour. This line terminates near a village called Tongku, opposite the northern extremity of Taku. The site is most convenient as it enjoys immunity from the violence of the open sea and offers a safe anchorage for sailing vessels and steamers along a straight reach. The railway station is about 300 yards distant from the village of Tongku, about a mile from the Imperial Customs and the Dock at Taku, and nearly one mile and a half in a direct line from Pilot Town. Both ends of the Railway will meet in the stocks of native salt. At the Tongku end the Company have acquired land, a portion of which has been made over to the Kaiping colliery, to be used as a coal depôt, and at the Tientsin termination a large area of lowland has been selected as a base for operations. The Company have entered into a contract to raise this piece of land at a cost of over Tls. 60,000. The Tientsin-Taku railroad and its extension to Shanhai Kwan will ultimately reach Pekin for the purpose of taking up the enormous transport trade carried on between the two cities. But in order to obtain this concession a petition will have to be made to the Government, and to attain this object the Company are casting about on all sides for weighty reasons to support their proposal. But it is believed that the Viceroy who is to gain by the undertaking will not withhold his consent. Already there are signs visible that the monopoly is not to be encroached on, for a Chinaman who offered to construct the Tientsin-Pekin road has been ordered to be deported to his native land. But with all these good intentions on the part of the State, is it possible that large undertakings will be countenanced? There is not much hope here if what a British Consul, who has had ample opportunities of forming his opinions on the subject reports be correct. He says "It is already evident that the control of the railways will be in official hands, and that the public, who may be invited to subscribe, will have no voice in the direction of affairs. What the result will be can only too surely be forecast from the fate of the China Merchants Steam Navigation Company, which started with every advantage, and which in a few years became hopelessly involved through the incompetency and venality of the officially-appointed directors."

With such prospects before the foreign Syndicate the extension of railways in China might safely be postponed to the Greek Kalends.

Notes and Comments.

BOMBAY UNIVERSITY.—At the last Examination for Licenses in Civil Engineering we find that out of the sixteen candidates who went up ten passed. This contrasts favorably with like results in Bengal.

A TARDY ACKNOWLEDGMENT.—Mr. F. N. Thorowgood, Superintendent, Madras Harbour Works, has had his salary increased to Rs. 1,600, subject to the execution of an agreement and to the approval of Government.

MESSRS. A. AND J. MAIN AND CO., GLASGOW.—We are glad to learn that the expansion of the business of this firm in this country necessitates the opening of a Branch Establishment in India, which will be located from the 1st January 1888, at 5, Mangoe Lane, Calcutta.

RANGOON PORT TRUST.—Colonel Street, Commissioner of Pegu, has resigned his seat as Chairman of the Rangoon Port Trust Commissioners and Lieutenant-Colonel W. G. Cumming, R.E., has been appointed by the Chief Commissioner to the vacancy. This Port Trust has been without an Engineer Chairman since Mr. H. M. Mathews, C.I.E., resigned the appointment previous to his retirement.

HONORS TO A SCOTCH RAILWAY ENGINEER IN INDIA.—A Home paper referring to the appointment of Mr. D. W. Campbell, C.I.E., as Agent of the East Indian Railway Company, says that that gentleman received his professional training in the locomotive workshops of the Caledonian Railway, and before he left for India occupied an important position in that Company's locomotive department.

THE DUFFERIN BRIDGE.—We have been favored by the Consulting Engineer for Guaranteed Railways at Lucknow, with a neatly got up pamphlet containing an illustrated description of the Oude and Rohilkund Railway Bridge at Benares, received too late for utilization in our present issue. The Bridge was formally opened on the 15th instant by His Excellency the Viceroy after whom it has been named.

AN ACKNOWLEDGMENT.—Our latest budget from the Under Secretary, C. W. Branch, Government of India Secretariat, D. P. W., contains Mr. Fenner's "Report on Bridges of Boats used in the Punjab." We may deal with this subject in a future issue, but in the meanwhile would recommend a perusal of this Report in connection with the Articles on Boat-Bridges in the Roorkee Professional Papers, Vols. I. and IV. of the 1st Series, and VIII. and XI. of the 2nd Series.

THE AMIR'S ARSENAL.—Mr. Pyne, M.I.M.E., the gentleman lately in charge of the Amir's arsenal, is going to England, to bring out a complete set of machinery for making cartridges, the only important matter in which the arsenal is at present deficient. Another important work to which the Amir is directing his attention, is the bringing in of water to the Bala Hissar from a large natural spring. Iron pipes for this purpose are now being sent up in quantities from Peshawar to Cabul.

ROADS IN THE TRIBUTARY STATES OF ORISSA DURING THE YEAR 1886-87.—Some progress was made in the opening out and improvement of lines of communication, but much yet remains to be done. The completion of the new road from Baripada to Bamunghati is said to have fairly revolutionized the administration of Mohurbhunj by bringing these two places into proximity, and the

Manager, Mr. Wylly, and the Engineer, Mr. Morrow, deserve every credit for the successful completion of this undertaking.

MINING IN HYDERABAD.—A "Hyderabad (Deccan) Company, Limited," formed last year in London to develop the coal and mineral resources of the Hyderabad State, has been successfully floated. All correspondence between the Company and the Nizam's Government will pass through the hands of the Resident, who will exercise a certain supervision over the operations of the Company, and send to the Government of India periodical progress reports which will, it is to be hoped, be published for general information.

P. W. D. ITEMS FROM BURMA.—Mr. W. Robertson, Assistant Engineer, who has been on sick leave for the past six months, has intimated his intention of returning to duty, and has been ordered to report himself to Major Gracey at Mandalay, where, it is hoped, he may be placed on work involving difficulty and responsibility, which is most congenial to his adventurous spirit. Mr. A. T. Dodsworth, Executive Engineer, has managed to get himself into trouble while in charge of the Toungoo Division, as he has been relieved by Mr. Kench and, it has been whispered, placed under suspension.

THE INSPECTOR-GENERALSHIP OF RAILWAY STORES.—It has been decided not to fill up the appointment of Inspector-General of Railway Stores at the India Office, which was held by the late Major-General H. Hyde, R.E. The utility of maintaining this and like Branches of the India Office may be gauged by the fact of the flat refusal to furnish us with the smallest information relative to proposed Indian Works for which Tenders were called by the India Office, and this refusal was so couched as to leave but one impression as to the motive of the Whitehall bureaucracy in this matter.

WEST DECCAN DIVISION, S. M. R.—The last section of the Southern Mahratta Railway between Miraj and Belgaum, 86 miles, will in all probability be open for passenger traffic before the 25th instant. A through train is to leave Poona at 3-30 P.M. daily, reaching Wathar in time for dinner, and arriving at Belgaum at 7 o'clock the following morning, and at Dharwar about noon. The bridge over the Krishna is, however, not quite ready yet, but it is expected that it will be completed by March, the through traffic will cross the river in the meantime by means of a diversion through the bed of the river.

CALCUTTA PORT IMPROVEMENTS.—We have received from official sources a Ferrotype Plan shewing the progress of the Kidderpore Dock Works up to the 30th June 1887, as reported by Messrs. Vertannes and Cloete and published in our issue of the 29th October 1887. The percentage of the whole estimate executed is small, but under the circumstances mentioned, this cannot be taken as an index of the rate at which the work is now being done. The record of subsequent quarters will, we think, prove more satisfactory in respect to quantity, while the quality of the work will doubtless be found, as before, unquestionable.

COAL-MINING IN BENGAL.—There were 94 collieries in existence in Bengal during the year 1886, and of these 70 are in the Burdwan District, 4 in Hazaribagh, 4 in Manbhoom and the balance in the Santal Parganas. The out-put of coal during the year was largest in the following collieries:—Kurharbali 168,309 tons; Serampur 118,670 tons; Kuldiha 113,481 tons; Chunjka 76,274 tons; Laikdi 71,375 tons; Kamardobi 52,636 tons; Borea 51,005 tons; Khairabad 41,529 tons; Raniganj 38,085 tons; Sursote 34,270 tons; Dhadka 51,005 tons; Belrni 39,005 tons; Shibpur 31,994 tons; Jotejanak 33,346 tons; Naimatpur 23,511 tons, and Derigarh 23,449 tons.

"INDIAN ENGINEERING."—The *Englishman* says anent our last:—"The new number of INDIAN ENGINEERING is a capital reply to the old contention that India could not maintain a good scientific journal. The contents are well blended, being neither too exclusively technical nor popular. A new feature is introduced in the shape of an etching of Mr. W. N. Pogson's design for the Lahore Town Hall, which has been adopted. The etching is well done, and hardly calls for the Editor's somewhat modest note on the subject. If the Journal is able regularly to produce drawings of public works like the present one, it will have made a new departure in the field of periodical illustration."

REGARDING A VIZAGAPATAM HARBOR.—Many do not seem to be aware that the scheme for a trade outlet north of Coconada has been thoroughly threshed out already, and declared impracticable by those persons who were sent up to report on it. Whether those persons were capable of reporting satisfactorily on such a topic is quite another affair, and it can only be said that it is an unfortunate fact in this country that officials are supposed to know everything, so that the opinion of an R. E. Colonel and a retired sea-captain are thought to be capable of deciding questions which should properly be put before none but a Nautical Engineer of tried skill and proved ability. *Non omnia possumus omnes.*

COAL IN SUMATRA.—Appearances point to the certainty that, before long, the vast coal fields known to exist inland on the West Coast of Sumatra, will be brought within reach of markets. These deposits of the black diamond have, hitherto, remained untouched and unavailable for consumption, owing to their distance from the seaboard and consequent inaccessibility. They mainly lie in the Padang Highlands within the basin of the Obilien river. Hundreds of millions of tons of coal are said to await mining operations there. In the northern parts of this basin, seven or eight coal seams have been brought to light. The southern portion of the basin is said to shew only three seams, but they all display enormous thickness.

RAILWAYS, CANALS AND ROADS IN PATNA DIVISION, BENGAL, 1886-87.—The most important event of the year has been the union of the Tirhoot State and Bengal and North-Western Railways by the completion of the Gunduck Bridge at Hajipore and Sonepore. The question of the effect of canals on the health of the people and the fertility of the soil is considered by the Commissioner to be an open one, and the Lieutenant-Governor will be prepared to consider definite proposals with regard to the enquiry which is suggested as to the epidemic of malarious fever in Shahabad having been caused by or intensified by the canal system. There have been very serious complaints on the subject of the assessment and collection of water-rates in this district and the matter forms the subject of a special enquiry recently commenced.

BURMA SAPPERS AND MINERS.—The conditions of service in this Corps are—enlistment for five years, at the end of which time the men will be entitled to claim their discharge; but they may re-engage at the expiration of their five years. They must be artificers and 5 feet 4 inches in height and not less than 32 inches round the chest. The rate of pay and batta for Privates on joining is Rs. 8-8 per mensem, with good-conduct pay in addition. Working pay will also be given in addition when the men are employed at their trades at from 12 to 6 annas per diem; and when not employed at their trades, working pay will be given at the rate of four annas per diem. Free issues of rations and clothing will be granted. Under these conditions the lowest monthly pay a man will receive will be Rs. 16 when present and effective and Rs. 7 when on leave.

THE PORT OF CHITTAGONG DURING THE YEAR 1886-87.—As in the previous year, two vessels only were built; and the ship-building industry appears to be unable to contend against the various adverse influences which affect it. Rice shippers prefer European vessels, and competition has reduced the freights of country brigs for jute cargoes so low that construction of new vessels is discouraged. The waterworks, started shortly before the beginning of the year under review, are evidently appreciated and have paid well. The jetty, owing to increase in the depth of water at its head, is likely to become more useful. Changes in the channel have necessitated the relaying of mooring buoys and two river buoys. The Kutubdea light-house and Norman's Point beacons were in fair order, but new lights are wanted. The putting up of a new light at Kutubdea has been decided upon.

THE COLAR GOLD-FIELD.—November results shew that the Mysore Company stamped 1,500 tons 7cwt. of ore and obtained 1,471 ounces 15dwts. of gold exclusive of tailings. The Nundydroog Company stamped 90 tons of ore from Webb's shaft, and obtained 253 ounces of gold. It also stamped 31 tons of low grade ore, and obtained 15 ounces of gold. The Indian Consolidated Company (contiguous to and south of the Mysore) continued to stamp stone last month, and obtained, it is rumoured, nearly 1½ ounces of gold per ton all round. The Oregum Company (whose property is between the Mysore and Nundydroog) is said to have struck a lode that yields by assay 5 ounces of gold per ton of stone. The Nine Reefs Company is believed to be doing very well, but the results of its recent crushings have not yet transpired. The Balaghat Company continues to prove the existence of very high grade ore on its property, some of it assaying as high as 25 ounces per ton of stone.

MADRAS WATER-SUPPLY.—Pumping for the water-supply of Madras at the Red Hills Lake was kept up continuously during the four months ended September last (during which period the lake fell to 31·76, nearly 4 feet) with the aid of one 12-H. P. engine working a 10″ centrifugal pump and two 8-H. P. engines, each working an 8″ pump. A 6″ Pulsometer worked by a 16-H. P. boiler has been kept beside these engines in readiness to take the place of any which may break down; but there was no occasion to put it to work more than three times (for a few hours each time) during the period under review. There were several showers during August and September by which the lake received in all 20″ of water, *i.e.*, 2″ in August and 18″ during September, raising it on the 30th September to 32·88. By rains in October (over 8·97) the lake rose to 35·56 on the 14th of that month when pumping was stopped, but may have to be resumed shortly. Some repairs necessary after five months' continuous pumping are now being executed.

THE OXUS BRIDGE.—Some interesting letters have been published describing the construction of the bridge over the Oxus near Charjui. The town of Charjui itself is eight or nine miles to the south of the river; and round the Russian barracks and workshops, which are located only a short distance from the bank, a new settlement has grown up, called by the Russians the town of Amu Darya. The bridge will be a wooden one 2 miles 855 yards long, supported on no fewer than 200 piers, each consisting of five piles. General Annenkoff declares that his bridge will be open for traffic by the beginning of the new year. It will then be possible to transport across the Oxus the rolling-stock and other railway material which now lies accumulated on the left bank. According to the letters written from the Oxus a month ago, 100 piles had been sunk and over thirty yards of the bridge was already finished. With steam hammers working on four different points at once the whole will, no doubt, be finished within the time mentioned.

TECHNICAL EDUCATION AND SMALL INDUSTRIES.—"A native thinker" asks:—Why should the Jubilee subscriptions for the above purpose any longer lie unutilised? Surely it would be better to do something however small than to do nothing. An immense quantity of hides is exported every year. Why not teach different kinds of manufactures of that material? Why not improve fisheries carried on in India by means of more efficient appliances? An incalculable amount of muscular power is sadly wasted, or is lying idle all through India. If it be turned to useful account, poverty may be diminished, and wealth increased. Every person who devises and introduces such industries, with a view to utilising the aforesaid muscular power, will be a great benefactor. I mean such industries as making of lucifer matches; pin or needle manufacture; manufacture of twine, of buttons, of tapes, of ropes, of mats, of baskets; weaving of small sorts; toy making; bee culture; extracting of oil from different kinds of oil seeds by means of hand presses; making small things out of bones and horns, &c. Such things are not to be neglected because they are small. Because they are small, they can all the more readily be introduced, and all the more readily diffused.

PIGMENTS SUITABLE FOR HOUSE-PAINTING.—Various kinds of pigments suitable for painting buildings are sold in the Madras bazars, but only three of these are indigenous to the Presidency, *viz.*, (yellow ochre) gobi, (red ochre) kavi, (red ochre, concreted variety) kooroovi kal. A reddish-brown pigment is also obtained by roasting the yellow ochre. From the animal kingdom the well-known shell lime is obtained and used in Madras for white-washing houses; the vegetable kingdom contributes indigo, and a black pigment is produced by the burning of empty shells of the cocoanut; a yellow wash is obtained from yellow mixed with lime according to the shade desired; a red wash from red ochre used as above; a blue or grey wash from indigo and lime for internal work, and lime and burnt cocoanut shell for external work; a pink wash from lime and red ochre mixed in due proportions; a white wash from lime alone. In some parts the natives also use a whitish kind of earth, vellai-mannu, for white-washing their houses. With these colors any others can be obtained by their admixture in varying proportions according to the color desired. The current prices in the bazars of the three ochres are as follows:—Yellow from Re. 1 to Rs. 1-4-0 per maund. Red from As. 4 to

As. 8 per maund. Red (hard variety) 9 pies per Madras measure.

ROORKEE ENTRANCE EXAMINATION.—We have been favored with the papers set at the recent competition for admission into the Engineer Class of the Thomason College. The test occupied six hours a day for six days, from the 21st to 26th November last, and the result as compared with previous years is as follows:—

Year ...	1887	1886	1885	1884	1883
Candidates ...	44	38	31	20	21
Passed ...	29	15	16	10	15

The subjects for examination embrace English Literature and Essay writing, An Optional Language—Latin, French, or Hindustani, Drawing, Physical Science, and Mathematics—Arithmetic, Algebra, Geometry, Trigonometry and Mensuration. These facts and figures are, in our opinion, conclusive evidence in favor of an Alternative Entrance Course for Engineering Degrees in the Calcutta University, and the sooner the change is carried out, we think, the better. While on this subject, we may add that we cannot see why Seebpore should not be empowered to grant its own Certificates of Qualification for the P. W. D., like Madras and Roorkee. It is an anomaly to make a University License or a Degree the sole criterion of such fitness.

THE CEYLON ROADS.—In connection with the maintenance of roads, the Governor is glad to take occasion to repeat the expression of his confidence in the merits of the system of road upkeep introduced three years ago. That confidence is only strengthened by observation of its results, whether from the point of view of economy or that of efficiency. His Excellency has during the present year travelled over a large part of the principal roads in every Province of the Island. He has of course found here and there,—as who would not, in any country, or under any system ?—some roads out of repair and some insufficiently attended to. But, on the whole, the condition of roads in Ceylon very far exceeds that of the roads in any other colony similarly situated, and His Excellency is abundantly satisfied none can surpass those on which what is called the new system of maintenance is thoroughly and efficiently carried out. Its weak point, as His Excellency has before remarked, is that its success is greatly dependent on intelligent supervision, and this has in some cases been wanting; but it may be hoped that as indolent, inefficient, or insubordinate officers disappear from employment, complaints as to the condition of the principal roads will become more infrequent. They have indeed already become so, and not a fault is now found with many of those roads, the condition of which, though not due to the cause popularly assigned for it, was really some time since such as to excite not unnatural dissatisfaction.

SANITARY WORKS IN BURMA.—No large sanitary works were carried out in the province during the past year. In most towns expenditure of this kind was confined to maintaining existing conservancy arrangements, repairing existing works, and making small improvements. No progress was made during the year with the Rangoon drainage scheme, to which reference was made in last year's report. There has been some difficulty in obtaining the necessary funds for this work. As the Sanitary Commissioner points out, the drainage scheme is a necessary complement to the water-works scheme, which was completed in 1883, and until it has been carried out the sanitary condition of Rangoon cannot be regarded as satisfactory. Progress was made during the year with the scheme of land reclamation in Rangoon, which was commenced in 1885. Rs. 35,000 were spent on plant and machinery, and on granting compensation to squatters evicted from the land to be reclaimed. The result of the year's work was that 866,000 square feet of low-lying land were raised some 2 or 3 feet above high-water mark. The town which in proportion to its resources spent most on sanitary works during the year was Pegu. The principal works carried out were the drainage of the left bank of the Pegu river at a cost of Rs. 9,799 and the reclamation of a block of land at a cost of Rs. 6,009. In Prome Rs. 47,600 were spent on sanitary improvements. The largest item of expenditure was Rs. 16,738, which were spent in repairing the water-works. The works now yield an ample supply of good water.

SCHOOL OF ENGINEERING, CHATHAM.—The following regulations for the appointment of Royal Engineer officers who elect for continuous service in India to the School of Military Engineering at Chatham, have been sanctioned by the Secretary of State for India. Every officer of Royal Engineers who has elected to render continuous service to the Government of India under the terms of the Royal Warrant of the 20th February 1886 will be required, after he has been one year a Captain, and before he has been eight years in that rank, to join the School of Military Engineering at Chatham, to qualify himself for promotion. The course of instruction will last about eight months, commencing on the 1st of April. The number of such officers who will be appointed to the School of Military Engineering in any one year will not exceed 15. They will be selected by the Government of India. If in India the officer will travel at the public expense, and be provided with passage to England by troopship, and if he returns to India on completion of the course he will be provided with a return passage. From the date of leaving India to the date of return as above, he will receive the English pay and allowances of rank, and in addition, while at the School, quarters or the usual allowance in lieu, and be exactly on the same footing as other officers of Royal Engineers. In the case of an officer appointed to the School while on leave, the period of duty will commence from the date on which he joins at Chatham, and he will receive the above allowances, &c., from that date. He will have no claim to travelling allowances prior to joining, but if he returns to India on completing the course, he will be granted a free passage, and be considered on duty up to the date of his arrival in that country. Every officer is expected, while at Chatham, to pass the examination for promotion to the rank of Major. The whole period passed on duty will reckon as service for pension, and also, in the case of an officer under the Civil Leave Code, for furlough. An officer may be granted leave on the termination of the course of instruction, or, if on leave when appointed, be allowed to avail himself of any unexpired portion of that leave, but in either case his duty will terminate at the date of his quitting the School, and he will forfeit his claim to a free passage back to India.

Current News.

COLONEL LEMESSURIER, R.E., has accomplished his journey to Bokhara.

A BAD collision took place on Thursday near Jhansi between the two trains employed in constructing work. Five persons were killed and 11 wounded.

THE extension of the Sind-Pishin Railway through the Khojak has been commenced. Owing to the amount of tunnelling that has to be done, the work will take nearly three years.

IT is believed in official circles in Calcutta, that Mr. Guilford H. Molesworth, the Consulting Engineer to the Government of India for State Railways, will remain in office for about a year longer.

GENERAL THE HONORABLE G. T. CHESNEY, Military Member of Council, and Mr. Molesworth, Consulting Engineer for Railways to the Government of India, arrived at the Presidency by mail train yesterday.

SOME idea of the rate at which the industrial importance of Cawnpore is advancing may be gathered from the fact that everyone of the large mills and factories has extended its buildings during the current year.

IT is believed that as Colonel White, R.E., Mint Master of Bombay, intends shortly to retire, Major R. V. Riddell, R.E., Master of the Calcutta Mint, is likely to succeed him, should the Mint at this Presidency be abolished.

WHATEVER may be said to the contrary, we understand that the question of the continuance, on its present scale, of the office of the Director-General of Railways with the Government of India, is at present under consideration.

A SCHEME was drawn up some time ago by the District Fund Officers to construct a steam tram line from Bellary 30 miles to the North to the banks of the Toongabudra river and 30 miles to the South to the town of Raidroog.

A SURPLUS dividend of £1 8*s.* 6*d.* per cent. in addition to the guaranteed interest of 2½ per cent. is announced by the Directors of the Bombay, Baroda, and Central Indian Railway Company for the half-year ended 30th June last.

THERE are at present only two technical schools in Lower Burma, namely, the Engineering School at Insein and the Industrial School at Akyab. Both these schools did good work during the past official year, more especially the latter.

AMONG the passengers by the *Pekin* was Mr. Barrington Browne, a mineralogist, engaged by the Secretary of State for India to inspect and report on the ruby mines. Mr. Browne, we understand, starts immediately for Rangoon.

THE Cawnpore-Kalpi section of the Indian Midland Railway, which has been hitherto worked by the East Indian, will be handed over to the Agent of the Midland on the 1st January, from which day the line will be open for general traffic.

THE hearing of the case of P. B. Johnson *vs.* the Secretary of State for India, in which the plaintiff claims Rs. 57,000 in respect of the Simla Post Office and Public Works Secretariat, has been closed. Judgment will be given early in January.

DR. BURGESS, the Director-General of the Archæological Survey of India, is in Calcutta. The Archæological Department is about to lose shortly one of its most distinguished officers, Colonel J. B. Keith, who is about to retire, owing to bad health.

THE question of the water-supply of Jutogh has of late been engaging the attention of the authorities, the present arrangement of bringing it up from some 500 feet below the lowest point of the station being considered quite behind the times.

THE recent reorganization of the Stores Department on the East Indian Railway, by which the whole control was centred in the Controller, is found to simplify the work and prevent undue accumulations, though the cost in establishment is about the same as it was before.

AN accident occurred at the Laxapana Bridge a fortnight since. The staging, over which a girder was being dragged, gave way, and all who were on it were precipitated 25 feet in the river below; one is dead, two are not expected to live, and three others are seriously hurt.

EXPERIMENTAL Invalid Carriages have been constructed on both the G. I. P. and B. B. & C. I. Railways for the use of sick and wounded soldiers. A Committee to test and report on them has been appointed, and will on Monday visit Victoria Terminus and Colaba Station, where the carriages will be ready for inspection.

THE Bombay Town Council, at their usual meeting on Wednesday the 7th instant, proceeded with the further consideration of the Municipal Budget for the year 1888-89; when the estimates of the expenditure under the heads of the "Public Works Department" and "the Maintenance of Public Gardens" were passed, as they stood in the Budget, with one slight alteration.

LIEUTENANT-COLONEL J. M. MCNEILE, on return from furlough, is expected to resume charge of the Bengal Irrigation, Secretariat and Chief Engineer's works, relieving Lieutenant-Colonel Harrison, R. E. Should the Government deem it advisable to retain the services of Colonel Harrison, there will be certain changes and transfers in the Bengal Works in consequence.

LORD REAY will visit Rajkote about the end of this month. His Excellency will proceed to Gondal. At Gondal his Excellency will perform the ceremony of turning the first sod of a new railway line from Porebunder to Gondal. Lord Reay will afterwards go on to Porebunder *viâ* Jerpur, to inspect the harbour. From Porebunder His Excellency will return to Bombay by sea.

PETERHOFF, Simla—or, as it has been more recently known, Viceregal Lodge—has, it is understood, been let for the next season. The new palace, Mt. Dufferin—or whatever it is to be called—is rapidly approaching completion. The wood-work and fittings are perfect examples of carpenters' work, and show what can be done even in India with plenty of supervision, and 8½ lakhs to spend on a house.

WE hear that an extension of the Nizam's Guaranteed State Railway to Dornakal, a distance of 53 miles from Warangal, and the Mineral Branch 16 miles from Dornakal Junction, is expected to be opened for all descriptions of traffic from the 1st January 1888, should Government pass the line. The Railway also hope to open for goods traffic only to Kummamet, 14 miles from Dornakal, at the same time.

WE hear that the quantity of coal extracted from the mines at Singareni and brought over the Nizam's Guaranteed State Railway during the month of November was 672 tons 11cwt. 3 qrs. Out of this amount about 140 tons of coal have been sent for experiment to various firms in Bombay. Mr. Roberts, the Chief Storekeeper of the Railway, proceeded to Bombay on Saturday last to make all arrangements to introduce the coal into the market at Bombay.

THE existing establishment employed in investigating the Madras Tanks' Restoration Scheme at a cost of Rs. 71,000 per annum, being found insufficient to enable them to expend the sanctioned grant of 6½ lakhs, Government have, on the recommendation of the Chief Engineer for Irrigation, sanctioned the increase of the present establishment to take effect from the 1st of the current month. The cost of the establishment as now constituted is Rs. 1,20,050.

IT has been finally decided to hand over the W. V. C. S. Railway to the G. I. P. Railway for working from the 1st January next. Mr. Davidson, the late Manager, has gone on two years' leave, after which he retires. Mr. Chirnside, C.E., now officiating Deputy Manager of the line and Warrora Colliery, takes another appointment so soon as the line is made over. Mr. Maugham, M.E., of the Nerbudda Coal and Iron Company, takes charge of the Colliery at Warrora.

ACCORDING to the Secunderabad paper, the amount payable by His Highness' Government as guaranteed interest on the railway for the half year ending this month is nearly £70,000. This will amount to about nine and a half lakhs of Government rupees, towards which the net earnings of the line for the half year which ended in June and the balance of the Berar surplus, amounting to about six lakhs of Government rupees, are available. The balance will, it is presumed, be met from the funds in the Public Treasury.

THE Bombay Government have after all definitively determined that the new building behind the Secretariat premises is not to be occupied by the Government Central Press, for the purpose of which it was designed and built. The building, as originally designed, was estimated to cost Rs. 4,18,598; but with an additional storey, with fireproof floors, it will cost about two lakhs more. It is stated that the Presidency Pay Office, the Pension Pay Office, and one or two other Government Offices will, according to present intentions, occupy the new building. It is probable that the Central Press will be removed to the portion of the King's Barracks, in the Fort, at present occupied by the Commissary-General's Offices, which are to be transferred to Poona.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

NEW TYPES OF CHEAP ROOFS.

SIR,—I am very sorry to find Mr. Bligh not fair in his replies. He evades the question at issue, replies at random, and repeats what he has mentioned before. I may say that he has betrayed weakness in using the old and inaccurate formula *a.d* for finding the modulus of rupture.

Thanks for publishing my letters.

DORABJEE B. RABODINA.

BOMBAY; *December* 6, 1887.

THE VISHWAMITRI SUSPENSION BRIDGE.

SIR,—With reference to the design for the Vishwamitri Suspension Bridge in your issue of 3rd December, it would be interesting to know why the designer adopted the antiquated type of flat links, instead of wire cables.

To judge from the sketch, the bridge will be a pretty lively one, for the chains are in a vertical plane, and there is no indication of wind bracing in the floor, nor even a good longitudinal stringer. F. E. R.

A PRIZE INDEED!

SIR,—The advertisement launched forth by the Umritsur Municipality is both instructive and amusing. At first I thought it a hoax and a stupid one, of the Simple Simon-type, but I am now convinced that it is intended to be clever. The Municipality ask for complete "working drawings, specification, and estimate," for a Hospital to cost Rs. 75,000 and offer a prize of Rs. 500. That is to say, they ask for Rs. 2,000 worth of work, and offer for it the magnificent sum of Rs. 500 in the form of a PRIZE! Such unbounded liberality should meet with a hearty response throughout India. Would you mind notifying that the undersigned will be happy to receive any number of dress suits of clothes valued at 8 guineas each, and he will give upwards of 2 guineas for the suit which fits him the best, and like the Umritsar Municipality he will not bind himself to return the rejected suits as they may be useful to him hereafter. Intending tailors will be furnished with full measurements on application. Now please don't all speak at once.

R. F. CHISHOLM.

BOMBAY; *December* 1887,

MORTIMER SYSTEM OF PUNKAHS.

SIR,—As no one has come forward with the information asked for about the Mortimer system, I am induced to say what little I know of same. It is a M.-W. plan patent for all I know. I only saw it noticed in the note-book and adapted my punkahs to it. Lest any should be deterred thinking they cannot afford the fine work done in the M.-W., I proceed to give an example: I had one large room 37′×24′, which had four large frame punkahs 20′×2½′ pulled by one man, and in spite of the most careful connections between the four frames, the coolie never could make the lot move. To adapt them to Mortimer system cheaply I hoisted them up, just rehung them again in the ordinary way, but with the top bar of the old frame 10 feet from the ground. I then cut off the frame just under the top bar, and connected the four bars as they hung by nailing on light bamboos laid horizontally above them in direction of pull. I tightened all up with two diagonal cords and there was the stiff Mortimer horizontal frame. A pulling rope attached, a hole in the wall 10 feet high, and a wooden pulley outside, completed the pulling arrangements. I then cut up the lower bars of the old punkah frames into short lengths and furnished each with a fringe of stiff gunny cloth covered with gara, as I found that simpler than the weighted edge and apparently as effective, and I hung these 12 punkahs where required, *i.e.*, three on each cross bar of the frame. The whole change only cost a few rupees, and the result is most satisfactory. It is easy work for the coolie and a good air for the sitters under each punkah. All parties are quite satisfied. In this case the beams from which the punkahs are hung are 24 feet above floor, and the wood of the frame is 3″ × 1½″. I made the frame 10 feet above ground instead of Mr. Mortimer's 8 feet, because I wanted to have my pull hole clear above the door, and also perhaps the punkahs are not wanted so low as they are not over beds as in the Barracks.

M. B.

P.S.—Men are so wanting in independence and such as that they may think all the screws and eyelets are necessary, which is quite a delusion, and indeed I always think that these things squeak and prefer the plain fixed rope. I make a point of hanging a stiff fixed hook in the beam above and ditto in punkah below. The rope bends just below the top hook or moves on it and there is no noise.

Literary Notices.

1. FIRST STEPS IN GEOMETRY.
2. EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

By Richard A. Proctor. London: Longmans Green and Co. 1887.

THE author of these two little Books is the best known living instance of the versatility of genius. He appears to be equally at home in all subjects ranging from this world of ours to the orbs round us, and few have done more to familiarise the exact sciences or to make their rough ways easy. We find him at times discussing the peculiarities of American slang while investigating the properties of the cycloid, or dealing with the infringements of the laws and etiquette of the whist-table while indulging in the poetry of astronomy. His latest productions shew neither intellect nor energy impaired by this constant, though variable, strain. The "First Steps in Geometry" form a valuable sequel to Books I. and II. of Euclid, being made up of Hints and Notes on the Elements intermixed with much of what is known as "Modern Geometry." The "Easy Lessons in the Differential Calculus" follow Ritchie's attempt some 40 or 50 years back to simplify a useful branch of mathematical science, but the plan or treatment is different. We write with the elementary works of Ritchie, Tate, Knox, and Millar before us, and are in a position to say that Mr. Proctor has removed much that is mysterious and metaphysical from the symbolic language of the higher analysis in his introductory volume to that great subject. His style is simple and familiar, and his plan of indicating from the outset the utility of the processes of Differentiation and Integration, though not original, is one calculated to awaken the interest of the student as the only effective way of bringing the "confidence of rational conviction" to remove the beginner's "doubts of imperfect faith in complex, abstract analytical processes.

New Books and Reprints.

ART AND ARCHITECTURE.

BEALE (S. Sophia) The Amateur's Guide to Architecture. With numerous Illustrations. Post 8vo. pp. 190. Virtue ... 3/6

FIELD (G.) and Davidson (E. A.) Grammar of Colouring as Applied to Decorative Painting and the Arts. 4th ed. 12mo, pp. 240. Crosby Lockwood 3/6

GEDDES (Patrick) Every Man his own Art Critic at the Manchester Exhibition, 1887. Cr. 8vo, pp 32. Heywood ... .. 6d.

TAYLOR (J. S.) A Descriptive Handbook of Modern Water-Colours Illustrated with Actual Washes of the Pigments on Whatman's Drawing Paper. With an Introductory Essay on the Recent Water Colour Controversy. 12mo, sd, pp. 74. Winsor and Newton .. 1/

TUCKERMAN (A. L.) A Short History of Architecture. With Illustrations by the Author. 12mo, pp. viii—168. New York .. 7/6

ASTRONOMY AND METEOROLOGY.

ABERCROMBY (R.) Weather: A Popular Exposition of the Nature of Weather Changes from Day to Day. (International Scientific Series.) Post 8vo pp. 486. Paul, Trench and Co ... 5/

CLARK (Latimer) Transit Tables for 1885. Giving the Greenwich Meantime of the Transit of the Sun, and of Certain Stars, for Every Day in the Year, with an Ephemeris of the Sun, Moon and Planets, Computed from the Nautical Almanac for Popular Use. Cr. 8vo, bds., pp. 71, Spons 2/6

FINDLAY (Alex. George) A Text-Book of Ocean Meteorology, Compiled from the Sailing Directories for the Oceans of the World. Edit. by W. R. Martin. 1 vol. Roy. 8vo. Laurie 12/

LOCKYER (J. N.) The Movements, of the Earth. Outlines of physiography. Post 8vo, sd., pp. 130. Macmillan 1/6

PARKES (S. H.) Unfinished Worlds: A Study in Astronomy. With Illustrative Diagrams. Post 8vo, pp. 230. Hodder and Stoughton 5/

PROCTOR (Richard A. Other Suns than Ours: A series of Essays on Suns, Old Young and Dead. With other Science Gleanings, Two Essays on Whist and Correspondance with Sir John Herschell. Post 8vo, pp. 428. W. H. Allen 7/

CHEMISTRY AND PHYSICS.

AVELING (Rev. F. Wilkins) An Elemetary Treaties on Light and Heat. Illust. with Diagrams. Cr. 8vo, pp. 158. Relfe Bros ... 3/6

DITTMAR (W.) Exercises in Quantitative Chemical Analysis, with a Short Treatise on Gas Analysis. Roy. 8vo. pp. 306. Williams and Norgate 10/6

GREVILLE (H. L.) Students Handbook of Chemistry. With Tables and Chemical Calculations. 2nd ed. 12mo, pp. 484. Livingstone (Edinburgh). Simpkin 6/

HARRIS (V. D.) and Power (D' Arcy) Manual for the Physiological Laboratory. 4th ed. With Illusts. Post 8vo, pp. 266. Baillière ... 5/6

MUIR (M. M. Pattison) and Salter (Charles) Elementary Chemistry Companion Volume to Pattison Muir and Carnegie's Practical Chemistry. Post 8vo, pp. 370. Cambridge Warehouse 4/6

———AND CARNEGIE (Douglas) Practical Chemistry: A Course of Laboratory Work, A Companion Volume to Pittison Muir and Slaters "Elementary Chemistry" Post 8vo. pp. 226. Cambridege Warehouse 3/

Muter (J.) A Short Manual of Analytical Chemistry, 3rd ed. Illust. Roy 8vo pp. 210. W. Baxter 6/6

NAEGELI (Carl) and Schwendener (Prof. S.) The Microscope, in Theory and Practice With numerous Illusts. 8vo. pp. 392. Sonnenschein 21/

PATCHETT (I.) Qualitative Chemical Analysis, Inorganic and Organic for Schools and Science Classes. Post 8vo, pp. 104. Bean (Leeds). Simpkin 2/

PEPPER (J. H.) Cyclopœdic Science Simplified New ed. Roy. 8vo, pp 710 Warne... ... ... 7/6

TIDY (C.M.) Handbook of Modern Chemistry, Inorganic and Organic, for the use of Students. 2nd ed, revised and enlarged 8vo. pp. 890 Smith and Elder 18/

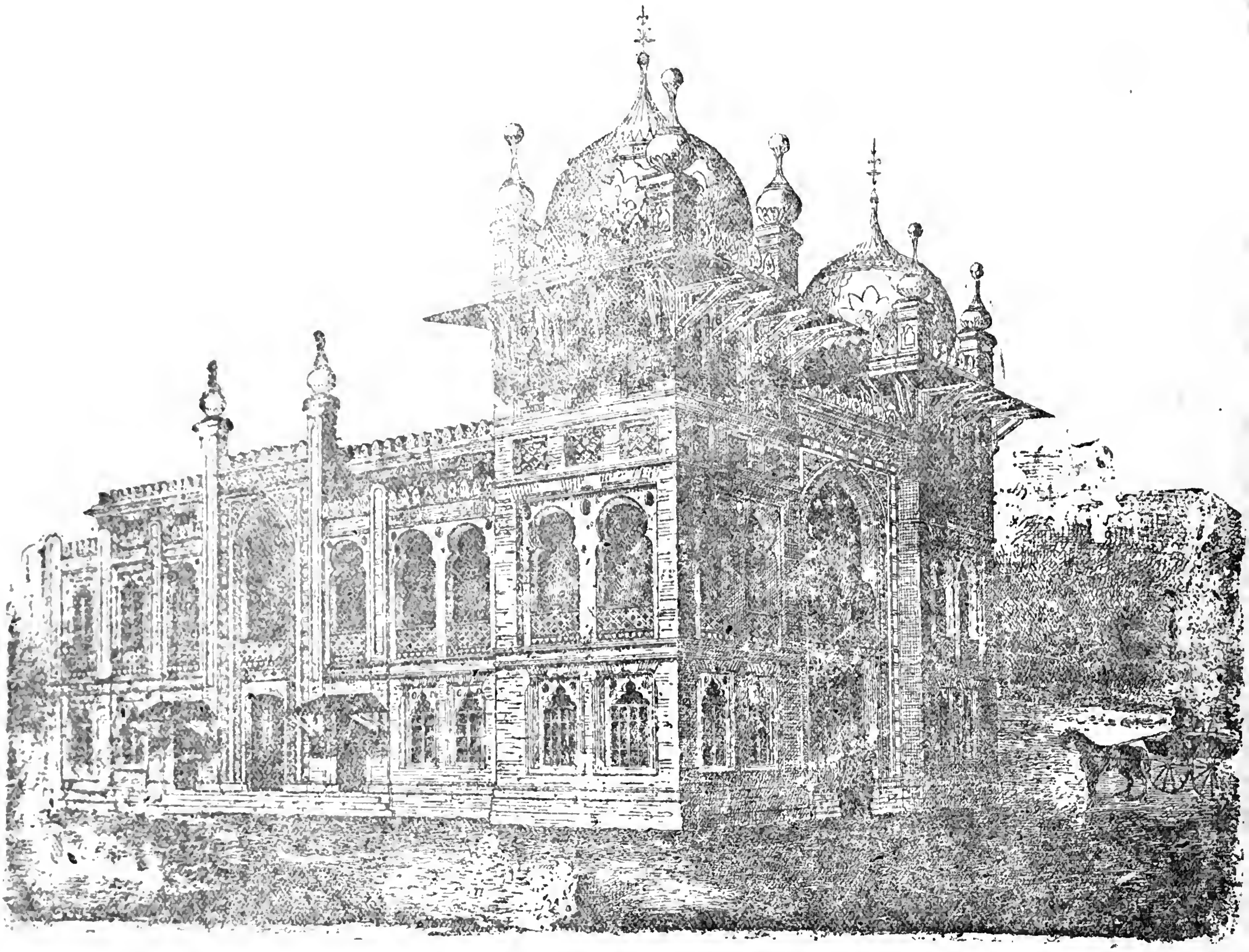
MATHEMATICS.

BASU (K. P.) Student's Mathematical Companion; containing Problems in Arithmetic, Algebra, Geometry and Mensuration, with Solutions, Explanatory Notes, and Occasional Hints, as well as Collections of Miscellaneous Problems for Solution for Students of the Entrance and Preparatory Classes of the Indian Universities. Post 8vo, pp. 444. Paul, Trench and Co 6/

CROWTHER (W. E.) Elementary Text-Book of Projectional Solid Geometry; or, The Descriptive Drawing of Solid Objects and their Component Parts, according to the Method of Orthographic Projection. To which is added a Section on Plane and Arithmetical Geometry and the Construction of Scales Cr. 8vo. pp- 109. Heywood 1/

ROBERTS (R. A.) A Treatise on Integral Calculus. Part 1, containing an Elementary Account of Elliptic Integrals and Applications to Plane Curves, with numerous Examples. Post 8vo. pp. 368. Hodges (Dublin). Longmans 10/6

General Articles.



LAHORE TOWN HALL.

THE GANGES BRIDGE AT BENARES.

In our issue of the 16th April last, we gave a full description of the Bridge over the Ganges at Benares then under construction by the Oude and Rohilkund Railway Company, and from that description we take the following particulars:—

This Bridge forms a most important link between the railways in Oude and the North-Western Provinces and the East Indian Railway. It brings Lucknow in direct Railway communication with Calcutta by a route 52 miles shorter than that *viâ* Cawnpore. Places north of Lucknow participate in this advantage, and places lying between Lucknow and Benares also derive even greater benefit.

The junction with the East Indian Railway at Mogul Serai will give the nearest route to the Punjab *viâ* the O. and R. Railway Company's new Northern Extension joining in with the North-Western Railway at Saharunpore.

The Bridge consists of 16 spans, *viz.*, 7 of 356 feet and 9 of 114 feet, measuring from centre to centre of piers. The larger spans extend from the north bank over the river, and the smaller spans are flood openings in case of overflow of the river on the south bank. The total length of the bridge from end to end of girders is 3,523 feet.

The piers of the larger spans are founded on elliptical wells 65 feet by 28 feet.

The piers of the smaller spans are each founded on two circular wells 12 feet 6 inches in diameter pitched 25 feet centre to centre, and varying in depth from 63 to 152 feet below ground level.

Both abutments are founded without well foundations —that at the south end having long wing walls giving access to the bridge by a flight of steps on each side. On these abutments block houses will be constructed for the military defence of the bridge.

The weight of the material used in one of the deep piers is about 16,000 tons. This enormous weight has with the exception of the iron caisson and stone cap, been carried into place on coolies' heads along a narrow floating staging leading to each pier.

The girders are lattice built and are entirely of steel, the total weight of steel used in the 16 spans being 6,405 tons.

The girders were supplied by the Patent Shaft and Axle-tree Co., Wednesbury.

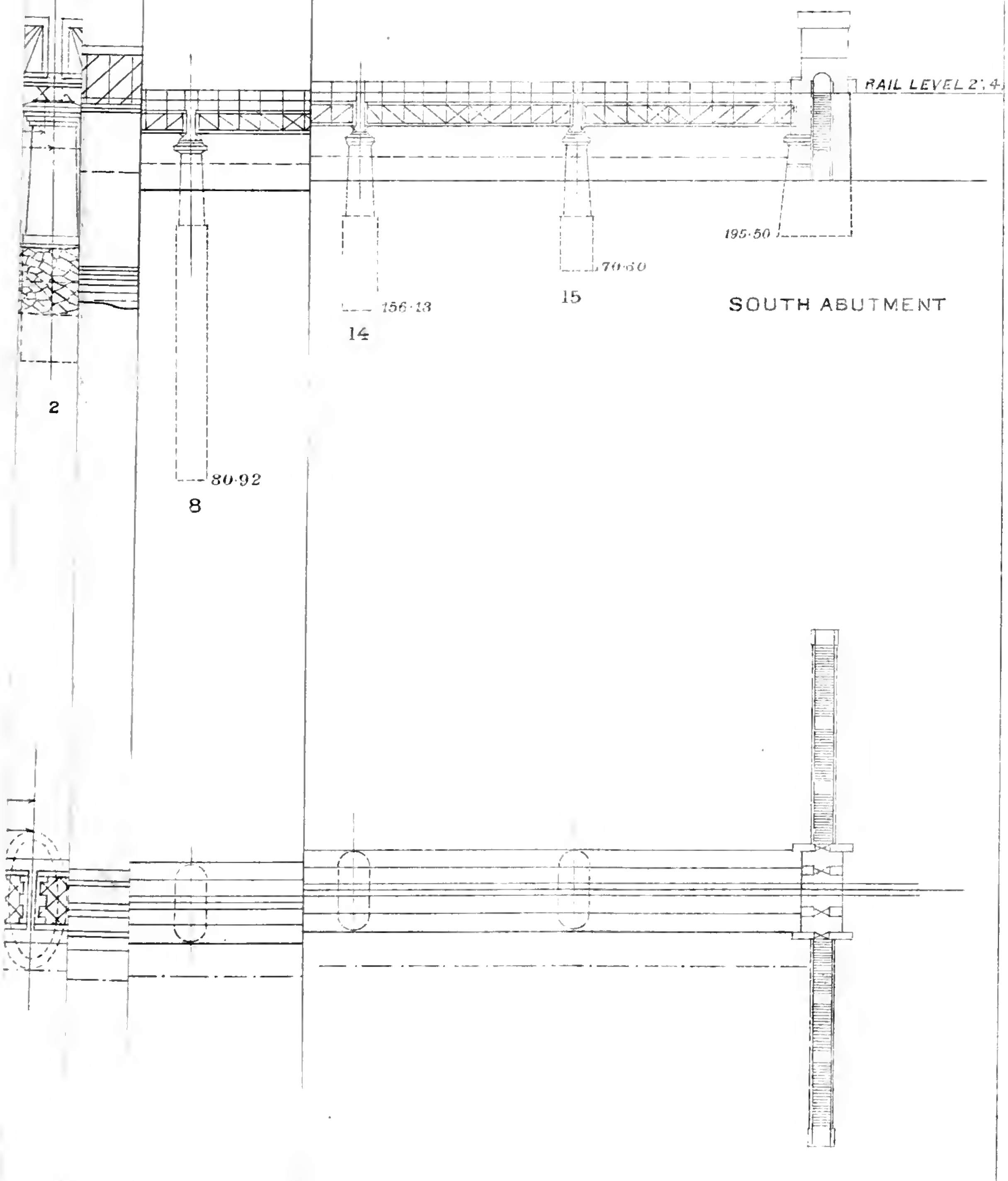
The main spans are the longest yet constructed in India, without the use of the cantilever form of girders, and the foundations of some of the main piers are the deepest in the world, being in some cases 140 feet below low water level.

The girders of the main spans are 35 feet in depth, 25 feet apart centre to centre. The traffic is carried be-

AN

H

TH



The "STAR" Press, 10, Lall Bazar, Calcutta

tween the girders of the main spans and on the top of the girders of the smaller spans, the road and rail being at the same level, with footways on either side on cantilevers outside the main girders.

The girders of the smaller spans were utilised for erecting the main girders. Their length being one-third that of the main girders, it required three of the smaller girders to carry one of the larger, and therefore by erecting two temporary piers one of the main openings was spanned by three smaller girders.

Work was carried on by day and night except during the very cold weather. The Gulcher system of electric lighting was in use and worked most satisfactorily. It may be confidently stated, that without the assistance of electric light the Bridge could not have been built, simply because it would be impossible without continuous night work during the busy time to get through such work as must be completed to render the structure safe from flood during each season.

The first brick of this Bridge was laid on 19th January 1882 and it was ready for traffic in October 1887.

THE PAST OF PORTO-NOVO IRON WORKS.

By A. Pierre de Closets C.E.

III.

THE difficulty in getting charcoal was a cause of the following failures of the Company:

The Directors were of opinion that it was better not to make wrought iron in Porto-Novo, but to concentrate all their manufacturing powers at Beypore, so as to be able to manufacture rails for the projected Madras Railway, the terminus of which was to be at Beypore.

Consequently they ordered to send the whole of the machinery at work in the forge at Porto-Novo to Beypore, and keep only in the former place a single blast furnace at work for pigs for English market.

From this time no profits were obtained on Porto-Novo, losses only, as well as at Beypore, were the result.

Such was the state of things when another idea struck the Directors. It was that to economise the charcoal in the blast furnace, the best method was to employ hot air blast. It appears that experiments on the Continent had proved an economy in the consumption of charcoal and it was thought that Porto-Novo and Beypore were to find some benefit by this new process.

For this purpose a new general manager was sent from England and changes were made in the operations; all the old system was discontinued, hot air stoves were constructed and the blast furnaces were provided with hot blast.

But this was an unfortunate step. The cast iron was of course more grey, but the principal character of the pigs produced, that is, their perfect quality for being converted into iron and annealed castings, was lost, and the demand for this pig ceased.

As regards the economy in charcoal resulting from the new mode of smelting, it proved to be trifling; in fact, the only advantage resulting was that the castings were more grey and could be run more easily. However, the resistance to a breaking strain was less.

It was also resolved at the time that to augment the produce in pigs other blast furnaces were to be erected in the vicinity of extensive jungles and forests; therefore, one was built at Trinamallee, and another on the bank of the Cauvery above Bawany at a place called Palamputty. There also hot blast was tried, and the air was heated by the blast pipe passing through stoves where wood was charred. These two furnaces were at work for some time. That at Palamputty was sending the pigs down the river in basket boats, but great deal of these pigs were lost in the stream, from rocks cutting the boats.

At Trinamallee, notwithstanding the clever management of a very able gentleman, Government interfered as to the rate at which the jungles were cleared. The pigs made at Trinamallee were of excellent quality for castings.

It was at that time that Bessemer invented his process of converting cast iron into wrought iron, or steel. (It is well to say here that the process of blowing a strong jet of air was used at Porto-Novo into gas furnaces upon the iron, thus aiding the conversion.) The Company's Directors thought then, that as the ores which were being smelted were particularly adapted to the production of steel, owing to the quantity of manganese in chemical combination, the best plan to follow was to introduce Bessemer process at Beypore for the manufacture of steel.

Beypore being a terminus of the Madras Railway, then in way of construction, was well located for the fabrication of steel for springs and rails. Mr. Wm. Maylor, who succeeded to the general managership of the Company, was asked to go back to England so as to study the Bessemer process in all its conditions, and to procure the apparatus and machinery necessary to start the manufacture of steel at Beypore.

Mr. Maylor, after some sojourn in England and Sweden, returned to Beypore, and started the new fabrication in a very fair way. He manufactured a large quantity of spring steel for the Madras Railway, and much of steel bars for the native market. However, the steel was not to be compared with the "Wootz" manufactured in the former days of the Company by Mr. Heath.

But the sale of steel in India was limited, and the manufacture slackened. In the meantime, the Company was experiencing some difficulties in raising the balance due on its shares. For this or other causes the works in the several establishments were suspended, and as the stoppage extended for more than six months Government, acting upon a clause of the agreement with the East Indian Iron Company, cancelled their exclusive privilege, so as to leave to the public to start, if any inducement was offered, an industry which is certainly the basis of many others.

This occasioned a very large loss to the Company, the several establishments, which had cost so much capital, were sold piece-meal, and public opinion concluded that it was impossible to make iron with profit in India.

But this is an opinion which I consider erroneous. Certainly if iron made here has to compete with the common and cheap iron from England, there will be little chance of success, but it must be borne in mind that with the ores found in India an iron of superior quality could be manufactured, and sold with profit at a rate lower than the Swedish iron (made in England) imported into India.

The fact is, that it is not necessary to employ European means to produce iron in India. Here the iron ores are so pure that it requires little skill to produce good iron, whilst in Europe, where generally the ores contain particles of several kinds injurious to the purity of iron, it is necessary to smelt them first before converting; and this, of course, requires a large capital and processes, which could be avoided here.

The ores could be treated directly, as in some part of Sweden, at a small expense of charcoal and machinery.

I can add that I have tried the process in this country and produced an iron exactly similar in quality and malleability to that of Swedish brand; the process was applied upon a large scale, and turned out blooms of from 2 to 5 cwts. These blooms hammered in merchant bars were estimated in the bazars at £15 per ton, the cost of manufacture being from £7 to £8.

Now with the management of forests by departmental agency and the facility of procuring an abundance of iron ores and charcoal, the time will come, perhaps, when the manufacture of a superior kind of iron or steel will be undertaken; but it is to be borne in mind that if the iron is made for the purpose of competing with the common kind of iron imported from England into India, it would be not safe to try such manufacture, but if it is to be sold as equalling the Swedish iron, there will be a fair prospect.

METAL *VERSUS* TIMBER SLEEPERS.

7. I WILL now consider the effects of each class of road on the rails, and on the rolling-stock used.

It will, I think, be admitted even by the advocates of a "metal road," that it has less elasticity in it, than has a "timber road." The value of this elasticity found in a "timber road" is in my opinion immense, but for want of figures it is impossible to give it a monetary value.

It is, to Engineers, a well-known fact that the sleepers, whether wooden or metal, fore and aft the rail joints in a line, require more lifting and packing maintenance, than do the intermediary ones. This is due to the "thump" the joint receives from a travelling wheel. This thump is again due to the wide expansion spaces it is found necessary to leave between rail ends, owing to the extremes of temperature a rail undergoes in Northern India. The result of this "thump" on the rail ends, if the joint sleepers are allowed to run and remain down, is pretty equal after a time, no matter what sleeper is in use; but taking for granted that joint sleepers receive decent maintenance, the ill effects of the "thump" on the rail ends of a "timber road," are not $\frac{1}{10}$th of what they are on a "metal road." In a few years of service the rail ends of a "metal road" get battered out, owing to the rigid nature of the road and the last foot or two of their length gets a permanent downward set. On a "timber road" the "thump" is not so severe, and the ill result of it, a mere nothing—by reason of what I may call the rolling elasticity the whole road has.

As soon as the rail ends get battered out on the head, or get a permanent downward set, or both—What is the result? A rough road—no matter how well maintained, and consequent constant damage to the rolling-stock—the value of which damage it is impossible to settle without considerable experience, and data, not yet collected in India. The "metal road" advocate will say that if the road is well maintained the ill result alluded to will not occur. I contend, however, that joint sleepers will run down, and that in practice it is impossible to keep them constantly at true level; the more perfect the maintenance, the less the damage, and that is all that can be said, but the damage occurring on a "metal road" will always be ten times what it would be on a "timber road."

8. To now consider the effects of accidents on each description of road, and on the rolling-stock in use at time of accident.

It is impossible to estimate what the damage would be to permanent pay and stock in an imagined accident; but from an experience of many, of varying degrees of seriousness, I am satisfied that the actual damage has always been much less in the accident on the "timber road" than in a similar accident on a "metal road." I will example a very common class of accident which I have dealt with on each class of road.

To deal first with a "metal road."

Site of accident, a crossing in a yard.

Speed, 10 miles an hour.

An engine hauling a train is derailed.

The destruction of way materials at once commences; every sleeper the engine touches is smashed to atoms, every tie is cut or buckled, the gauge is thrown out, and every vehicle passing derailment point falls in, the result—if not telescoping—then heavy damage to under frames, buffers, draw-hooks, bolts, etc.

Let a "timber road" be dealt with.

The engine drops on to the wooden sleepers, which if properly boxed, probably suffer nothing beyond a marking; the gauge is seldom disturbed sufficiently to cause the following vehicles' derailment. The damage to stock is *nil*, and very little, if any, to way.

Repairs to damaged "timber road" are given in $\frac{3}{4}$th the time a "metal road" demands, and at $\frac{1}{2}$ the cost for labor.

As to the value of old sleepers. Condemned wooden ones can be utilized in various ways; for instance, roofing outhouses, palisade fencing, office shelves, window sashes, temporary huts, and in many other valuable ways on an open line. Those not utilized find a ready sale at from 2 to 8 annas each, and taking the price realized as 4 annas each, we see the worn out deodar sleeper is worth $\frac{1}{9}$th of its initial cost. A condemned metal sleeper is almost valueless. There is little or no demand for scrap in this country and it cannot be used in any way on work.

10. That it is to the interests of the Government to keep its money in this country cannot be contradicted. The people of this country, both Europeans and natives, are entitled to benefit directly, as well as indirectly, by the making of Railways. The Indian Government has laid down an order, that when articles of local (*i.e.*, country) produce compare favorably, in description and cost with articles of European manufacture, they are to receive preference by officers purchasing on behalf of Government. In the matter of sleepers the Government should go further and give the Indian deodar sleeper the preference of the metal one, even if it were proved to be more expensive. The liberal use of timber sleepers being assured, capitalists would invest capital in growing timber and producing sleepers. Large areas of land in the hills, now barren, would be planted, and the country opened up, and employment would be found for a large number of Europeans and natives who can now find none.

Proved, however, as it easily can be, that the timber sleeper is cheaper than the metal one, both in initial cost, and throughout its life, it is imperative on the Indian Government to encourage its production in every possible way, and to secure for its own use every decent sleeper offered.

11. *Resumé.*

I have shewn that in initial cost the timber sleeper is cheaper by Rs. 2-1-2 than the metal one.

As I have already taken 1 sleeper as representing 3 feet forward of way,—I will keep to the same figures,—so we find there are 1,760 sleepers per mile.

1,760 × Rs. 2-1-2 = Rs. 3,648-5-4 = the saving in initial cost per mile of line. I have shewn that Rs. 53-8-0 per mile, per annum, is saved on a timber road on account of maintenance.

These savings, calculated at 4 % in 20 years (when it is admitted the timber road has to be relaid), represent Rs. 9,586-9-9, to which must be added Rs. 440 on account of 1,760 old sleepers at 4 annas each, making in all a sum of Rs. 10,026 in round numbers.

To relay a mile of road will cost—

1,760 sleepers @ Rs. 3-2-0	= Rs. 5,500-0-0
Labor in laying and carriage, etc.	= Rs. 800-0-0
Tools, fittings, etc.	= Rs. 100-0-0
Total cost per mile	= Rs. 6,400-0-0

So that after having relaid the mile, ready for another 20 years of work, there is still a saving of Rs. 3,626. What amounts could be added to this, on account of the longer life bestowed on rolling stock and rails, and what on account of savings in accidents (all due to the timber road) it is impossible to say, but I do not think I am giving too much in favor of the timber sleeper, if I say that the cost of minor accidents (and these, be it remembered, are the ruling accidents in India, and are besides very numerous), is ten times as much on "metal roads" as on timber ones.

There is another point in favor of the wooden sleeper, to which I have not yet alluded; this is, rate of exchange between India and Europe. My pricing of metal sleepers is based on figures which existed 6 months ago, but are now larger by reason of a falling exchange, and with a prospect of a further fall the advantages of using timber sleepers locally produced is still more apparent.

BLITZ.

PRINCIPLES OF MECHANICS.

By A. Ewbank.

II.

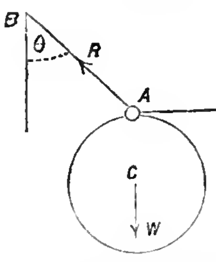
We have learned that two forces, each equal to the weight of one pound, acting on a body at right angles to each other, are equivalent to a force of x pounds where $x^2=2$. We might, to determine x approximately, proceed as follows: $x^2=2=\frac{50}{25}=\frac{49}{25}$ nearly. Therefore, $x=\frac{7}{5}$ nearly. Therefore, two forces, each of 5lbs. at the same angle—90°—produce 7lbs. nearly. This value 7 is, however, too small. Again $x^2=2=\frac{100}{50}=\frac{100}{49}$ nearly. Therefore, $x=\frac{10}{7}$ nearly. Thus two forces, each of 7lbs., produce 10lbs. nearly, and this value 10 is too great. Combining these results, we infer that two forces of 35 at 90° produce a force greater than 49 and less than 50. If, therefore, we say, that two forces of 35lbs. produce a resultant of 50lbs., our error is less than 1lb. Therefore, dividing by 5, we infer that we may put the resultant of 7 and 7 as being equal to 10, and our result is erroneous by less than $\frac{1}{5}$th of the weight of a pound. If we take 35 and 35 at 90° as equal to 49 nearly, we infer that 5 and 5 at 90° gives 7 nearly, and this calculation is incorrect by an amount less than $\frac{1}{7}$th of a pound. Each of the formulæ

5lbs. and 5lbs. at 90° produce 7lbs.
7lbs. and 7lbs. at 90° produce 10lbs.

is a good mathematical formula; for, though neither is quite exact, yet each is nearly exact, *and we know the limit of the error.*

Moreover, the study of mechanics is not intended merely for the library of the philosopher. The forces we reason about are such forces as we have to deal with in building bridges or driving steamships or working machinery generally. Now, it is very little use for us to know the intensity of a force correctly to a grain or a pennyweight. For, if we attempt to call into action the force whose magnitude we have so closely calculated, we shall find that friction and other unavoidable imperfections are introducing errors which are not, as is a grain, infinitesimal. We should, therefore, consider beforehand the degree of exactness which we may expect in our final results, and be content to keep that degree of exactness through all our calculations. Mechanical science, or mathematical science generally, is reasonable in this respect. It is what some people call "practical;" *i.e.*, it is meant for use, and is fit for use.

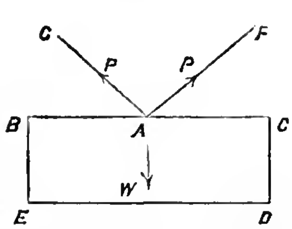
Fig. 2.



Let us now return to *fig.* 2, which is reproduced for the convenience of the reader. We now see that R, the tension of the suspending string B A, must equal the resultant of P and W. If P=W and W=7lbs. we see that R is nearly 10lbs. For here we have two equal forces P and W acting at right angles.

Thus the tension of the suspending string has been increased from 7lbs. to 10lbs. by reason of the disturbing action of the force P.

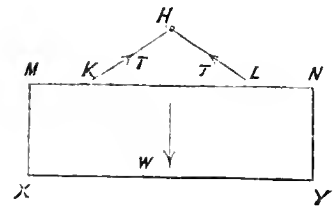
Fig. 7.



As another illustration of the knowledge we have now gained, let us, as in *fig.* 7, consider a map or picture, or other heavy body; hanging suspended by two strings. Here two strings A F, A G are attached to a ring A. The body weighs 12lbs. It is required to determine the tension of each string. It is supposed that F, G are two nails or pegs in a wall and that the strings A F, A G are inclined to the horizon at angles of 45° each. We may remember that two forces, each of 7lbs., give a resultant of nearly 10lbs. We may, therefore, say the ratio of P to W is that of 7 to 10. This gives $P=\frac{84}{10}=8\frac{2}{5}$lbs. This means that each string is as much strained as if it was, by itself, supporting $8\frac{2}{5}$lbs. Or, in other words, no string is fit for supporting the body, as in *fig.* 7, unless it can, without breaking, hold up a weight of $8\frac{2}{5}$lbs.

The mode of suspension adopted in *fig.* 7 is not usual.

Fig. 8.



The usual method is illustrated in *fig* 8. In this figure the strings H K, H L make each 45° with the horizontal line M N. Practically also we may say, M K=L N and K H=L H. Here we will consider what forces act on the nail or peg H which is fixed in the wall.

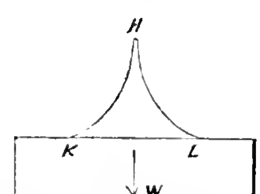
The nail or wooden peg is obviously pulled by the string H K in the direction H K and with a force of T lbs. The peg is also pulled by the string H L with a force T in the direction H L. The real force in the peg is the resultant of these two forces. But the peg must support the weight of the picture.

Let W, this weight, be equal to 12lbs. Then we shall have T to W as 7 to 10 as before. Thus the *figs.* 7 and 8 present the same question mechanically, although for artistic or other reasons we might always use the arrangement of *fig.* 8.

It is possible, however, that the reader may here interpose an objection. He may say that the weight pressure on the peg H should be the weight of the strings H K, H L as well as that of the map or picture. This objection is reasonable. Suppose, therefore, that each string weighs 5 pennyweights. We have supposed that there are two separate strings, each tied to the nail H. Then the total weight on the peg is 12lbs. *plus* 10 pennyweights (12lbs. 0oz. 10dwt.) But all that the peg immediately feels is a couple of forces each equal to T. Then we must say T is to 12lbs. 0oz. 10dwt. as 7 is to 10. Thus $T=8\frac{2}{5}$lbs.+7dwt. The reason why we initially neglected the weight of each string was, that we had only an approximate value for T in any case, and if the strings are light they cannot greatly increase the value of T.

If the strings are not light if—for example—we suspend a body of 12lbs., by two chains, each of which weighs 2lbs., then we must distinguish between the tension or pull downwards which the chain H K exerts on the peg H and the tension or pull upwards which this chain exerts on the body at K. In fact, the pull at H is now greater than the pull at K. But then also the *fig.* (8) is badly drawn (mechanically); for it treats the line H K as being a straight line, whereas a heavy chain will hang in a

Fig. 9.

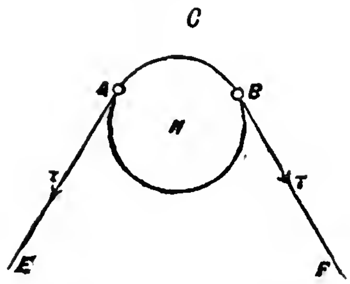


curve as is shewn in *fig.* 9. And then also the line of action of the upward pull at K on the body is different from the line of action of the downward pull at H on this peg. Thus our previous solution of $T=8\frac{3}{5}$lbs. was approximate, not only by our saying that two forces of 7lbs. give a resultant of 10lbs., but also by our neglecting other elements. And that answer which we got, *viz.*, $T=8\frac{3}{5}$lbs. + 7dwt. is itself not absolutely exact, unless we assume that the directions of the two chains at H in *fig.* 9 are at right angles. If so, they are not at right angles at K and L.

This discussion helps further to illustrate the reason for our being satisfied with the approximate formula "7 and 7 give 10." There is no use in having a formula more exact unless we take into account weights of strings, and the curves which these strings assume. Thus the mathematician is an intensely "practical" person, although the world in general is apt to assume otherwise.

The reader might also object that in hanging a picture we do not use two separate strings, but one string which simply lies over a nail or peg. This point also is worth considering, as it might perhaps be thought that the value of T would be different if we took only one string.

Fig. 10.



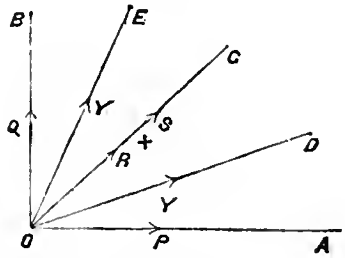
In *fig.* 10 we have the peg H shewn enlarged. If a string E C F passes round and leaves the peg at A and B then we see that E A is a tangent at A to the circle A C B. Similarly F B is a tangent. Now we supposed our string E A to be fastened at A and there to end. Similarly our other string F B was fastened at B and there ended. We will take two small rings A, B, to serve as places of attachment for the string. The strings being thus attached, we may take another length of string A C B and fasten it also at A and B. Thus we have one composite string E A C B F with a link at A and a link at B. Now, when this A C B portion has been fastened we might suppose the rings A and B to have become unfastened from the nail or peg H and to be simply loose. If the tension along A E equals the tension along B F neither ring will tend to slip round the peg nor to leave it. We may now imagine these rings to disappear altogether, being replaced by pieces of strings, so that we have one uniform continuous string E A C B F. The *mechanical* conditions are not altered and the body W is supported as before.

Conversely when one string E A C B F is passed round a body H and the ends E, F, are pulled with equal strength we have *two* forces acting on H. If we pull E and F with forces of 7lbs. we have about 10lbs. acting on H, provided the directions of A E, B F are perpendicular. If these strings make a smaller angle than 90,° the resultant will be more than 10lbs. If the strings E A, F K are exactly parallel the force on H becomes 14lbs. Instead of ourselves supplying two pulling forces of 7lbs., one at E and one at F, we might fasten F to some immoveable object and only pull at E. Then the resulting force on H may be more than 7lbs. and so we seem to have multiplied our strength. This frequently happens in machinery—as the reader probably knows already—and we shall have future occasions to recur to this curious feature of force being apparently created out of nothing.

But we will first consider how to calculate other resultants. Hitherto we have only learned how to estimate exactly, or approximately, a resultant when the original forces (called components) are at right angles. As generally the angle between two forces will not be a right angle our scientific knowlege is yet very scanty.

Having learned how to treat two equal forces at right angles, we can use our result to determine the case whose

Fig. 11.



two equal forces act at half a right angle. Let two forces, each 7lbs., act along O A and O B respectively, see *fig.* 11. Add also two more forces, each 7lbs., along the line O C. Here A O C and B O C are each half a right angle. Then we may approximately replace the forces along O A, O B by a force of 10lbs., along O C. Therefore, our final resultant is $10+7+7=24$lbs. along O C. But we may commence afresh, by coupling one force P along O A with one equal force R along O C. These give y lbs. along O D where y is at present unknown in magnitude and O D bisects A O C. Similarly Q and S gives y lbs. along O E. Also the angle D O E is half a right angle. Then the y force along O D coupled with y along O E must give a different force, say z, along O E. And z is to y as y to 7, or $7z=y^2$, or $z=\frac{y^2}{7}$. But we know z must $=24$; $\therefore$ $y^2=168$. Now $13^2=169$; $\therefore$ $y=13$ nearly. Thus two forces, each of 7lbs., acting at 45° produce 13lbs. approximately.

This result, though roughly true—or perhaps nearly true—is not quite satisfactory to the mathematician. He will say, "It is not sufficient to give an approximate answer. You must also define the limit of your error. You say y is less than 13. But is it also less than 12, or than $12\frac{1}{2}$, or $12\frac{3}{4}$? Unless you can speak confidently on these points your calculations are not sufficiently precise." We cannot deny the force of this criticism; so we must amend our procedure. We learned that while 7lbs. and 7lbs. at 90° produce a force less than 10lbs., we may also say that 5lbs. and 5lbs. produce a force greater than 7lbs. We may, therefore, apply *fig.* 11 to the case where P, Q, R and S are each 5lbs. Then the final resultant must be $R+S+7=17$ nearly. Let P and R give y along O D. Let Q and S give y nearly along O E, and let y and y give z along O C. Then $\frac{z}{y}=\frac{y}{5}$, or $z=\frac{y^2}{5}$. But $z=17$; $\therefore y^2=85$., and $y=9$ *plus* a small quantity. As the real force along O C is greater than 17, we have $y^2>85$. Thus y is certainly greater than 9. Now, if 5 and 5 at one angle—45°—give a resultant greater than 9, we have 35 and 35 at the same angle giving a resultant greater than 63. And if we refer back to the case where we took $P=Q=7$, the real force along O C is less than $2P+10$ or less than 24 $\therefore y^2<168$, or $y<13$ as before. Thus 7 and 7 give a resultant less than 13. $\therefore$ 35 and 35 give a resultant less than 65. We have now material wherewith to satisfy the mathematician's requirements. We know that the resultant of 35 and 35 is greater than 63 and less than 65. Therefore, 7 and 7 must give a resultant greater than $\frac{63}{5}$ or $12\frac{3}{5}$ and less than 13. Thus we may now say that 7lbs. and 7lbs. acting at 45° produce 13lbs., and we know that the error is less than $\frac{2}{5}$lbs.

These examples serve to illustrate how we may obtain approximate values for the resultant in certain cases; and may use these approximate values with a knowledge that the error in each final conclusion cannot exceed some known quantity.

(To be Continued).

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK.

XVIII.

Brickwork in Cement Mortar.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Masons No. ...	1½	Variable.	Do.	Do.
Do. „ ...	2½			
Coolies „ ...	3½			
Do. „ ...	1½			
Do. „ ...	3½			
Bhistie „ ...	1¼			
Sundries	...			
Materials.—	...			
Bricks, 1st-class, No. ...	1,350			
Portland Cement, lbs. ..	860			
Sand, c ft. ...	25			
Sundries	......			
Petty Establishment	......			

Note.—86lbs. dry cement (White Bros.) go to the cubic foot.

HYDERABAD—DECCAN.

(From a Correspondent.)

MADRAS is frequently called "The Benighted Presidency;" but if ever there was a "benighted" land it is Hyderabad Territory. Madras suffers greatly for want of a good, natural harbour, the artificial substitute being extremely unsatisfactory. The roughness of the sea on the Coromandel Coast paralyzes commercial activity and keeps the whole of the Madras Presidency in a state of comparative poverty. In Hyderabad matters are somewhat different. The Nizam's Territory, having no sea-coast, and being close to Bombay, needs no harbour of its own; it has great natural resources and does not suffer from over-population, like many other parts of India. It simply languishes for want of a more enlightened Government, and last, though not least, for want of skilful engineering agency to open out a country rich in minerals and naturally fertile.

The "Nizam's Guaranteed State Railway Company, Limited," has effected a junction with the Great Indian Peninsula line at Wadi, so that Hyderabad is in railway communication with Bombay, with Madras (*viâ* Raichore), with the East Indian Railway (*viâ* Jubbulpore), and with Central India, Rajputana and the Punjab. The "N. G. S. R." (as the Hyderabad Railway is called) is rather "slow," even for India; and delays, break-downs and collisions are somewhat frequent.

The Director-General of Railways recently paid Hyderabad a visit, and intended inspecting the construction of a line to the Singareni coalfields, but was prevented by ill-health from doing so. He returned to Calcutta at once, but the Consulting Engineer for Railways to the Government of India, accompanied by the Home Secretary (Nizam's Government) and the officials of the Nizam's State Railway, inspected the line and the coalfields. Another inspection by the Consulting Engineer for Guaranteed Railways, Madras, takes place on the 15th instant, after which final orders will be passed.

The Public Works Department of H. H. the Nizam's Government were, a few days ago, advertising for Assistant Engineers, Supervisors and Draughtsmen, but the salaries offered were so low, particularly for the Supervisors, that only pure natives could manage to live comfortably on them. Supervisors were offered from H. S. Rs. 50 to 150, equivalent to about Rs. 42 to 120 Government of India money. The maximum salary offered to Assistant Engineers was H. S. Rs. 400, equal to about 333 Indian Government rupees. They will, however, get about *half that* to commence with!

The amount payable by His Highness' Government as guaranteed interest on the Nizam's State Railway for the half-year ending 31st instant is nearly £70,000, which will amount to about nine and a half lakhs of rupees, towards which the nett earnings of the line for the half-year which ended in June and the balance of the Berar surplus are available.

W. P.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, December 3, 1887.

With reference to *Burma Gazette* Notifications, dated the 22nd November 1887, Mr. A. T. Dodsworth, Executive Engineer, 4th grade, sub. *pro tem.*, made over, and Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, received, charge of the Toungoo Division on the afternoon of the 25th idem.

Madras, December 6, 1887.

The following transfers are ordered:—

Mr. C. A. Smith, Executive Engineer, 4th grade, temporary rank, from the South Arcot Division, to the charge of the North Arcot Division, during the absence of Mr. C. J. Peters on privilege leave. To join at the public expense.

M.R. Ry. S. A. Subrahmanya Aiyar Avargal, Rai Sahib, B.A., B.C.E., Assistant Engineer, 1st grade, from the II. Circle, Nellore Division, to the V. Circle, South Arcot Division. To join at the public expense.

Punjab, December 8, 1887.

Mr. L. F. Robertson, Assistant Engineer, 2nd grade, attached to the Bannu Division, passed, on the 3rd October 1887, the Lower Standard Examination in Hindustani prescribed in the Public Works Department Code.

With reference to Government of India, Public Works Department Notification, dated 4th October 1887, Mr. F. W. K. Yeoman, Assistant Engineer, 2nd grade, is posted to the Umballa Provincial Division, which he joined on the forenoon of the 26th November 1887.

Irrigation Branch.

Major S. L. Jacob, R.E., Executive Engineer, 1st grade, from the office of Superintending Engineer, Bari Doab Circle, to the 5th Division, Sirhind Canal, which he joined on return from the 20 days' privilege leave granted to him in Irrigation Branch memo., dated 29th October 1887, on the forenoon of the 15th November 1887.

Major Jacob took over charge of the 5th Division, Sirhind Canal and the Canal Agency Office from Mr. E. S. Bellasis, Executive Engineer, on the afternoon of the 15th November 1887.

Assam, December 10, 1887.

Mr. W. McM. Sweet, Executive Engineer, 4th grade, temporary rank, and at present District Engineer, Sibsagar, who was appointed to officiate as Manager of the Jorhat State Railway in addition to his present duties in orders dated 29th November 1887, received over charge of the Managership of the above Railway from Mr. C. Sowerby, Deputy Examiner, on the forenoon of the 1st December 1887.

Mr. O. G. Smart, Executive Engineer, 3rd grade, sub. *pro tem.*, and Officiating Executive Engineer, Khasi and Jaintia Hills Division, who was appointed to officiate also as Manager of the open line, Cherra-Companyganj State Railway, in orders dated the 28th November 1887, received over charge of the Managership of the above railway on the forenoon of the 1st December 1887.

India, December 10, 1887.

Mr. B. H. Young, Assistant Engineer, 1st grade, Madras, is temporarily transferred to the Accounts Branch, in the temporary rank of Deputy Examiner, 2nd grade, and is posted to the Office of the Examiner of Public Works Accounts, Punjab.

Mr. W. B. Taylor, Executive Engineer, 1st grade, State Railways, is transferred from the Establishment under the Director-General of Railways to that under the Government of Bengal.

Director-General of Railways.

The undermentioned Assistant Engineers passed, on the 8th August 1887, the professional examination as prescribed in Public Works Department Code.

Mr. C. F. Sykes, Assistant Engineer, 2nd grade.
Mr. J. M. A. Despeissis, Assistant Engineer, 2nd grade.
Mr. J. Adam, Assistant Engineer, 2nd grade.
Mr. C. T. R. Scovell, Assistant Engineer, 2nd grade.
Mr. W. Nathan, Assistant Engineer, 2nd grade.
Lala Rala Ram, Assistant Engineer, 3rd grade.

N.-W. P. and Oudh, December 10, 1887.

Irrigation Branch.

With reference to Notification, dated 24th November 1887, transferring him to the 1st Circle, Irrigation Works, Mr. G. P. Horst, Assistant Engineer, 1st grade, is posted to the Anupshahr Division, Ganges Canal.

Bengal, December 14, 1887.

Establishment—Railway.

Mr. W. A. Lesmond, Executive Engineer, 2nd grade, Assam-Behar State Railway, is granted three months' privilege leave, with effect from the forenoon of the 1st November 1887.

Mr. B. Baxter, Executive Engineer, 3rd grade, Assam-Behar State Railway, is granted an extension of one day's privilege leave in continuation of privilege leave granted to him in Notification of the 29th August 1887.

Mr. A. Greenlees, Executive Engineer, 4th grade, temporary rank, returned, on the forenoon of the 10th December 1887, from the furlough granted to him in Notification dated 15th March 1887.

With reference to Government of India, Public Works Department Notification of the 9th December 1887, Mr. W. B. Taylor, Executive Engineer, 1st grade, is posted to the Rungpur-Dhubri Railway Surveys.

Establishment—General.

Mr. J. S. L. Long, Assistant Engineer, passed the examination in reading native letters and accounts on the 22nd October 1887.

Establishment—Irrigation.

Mr. R. E. Carter, Assistant Engineer, is transferred from the Cossye to the Northern Drainage and Embankment Division.

Rai Raj Kissen Banerjee Sahib, Executive Engineer, is transferred from the Mahanuddy to the Brahmini-Byturni Division.

Rai Krith Chunder Chowdry Sahib, Assistant Engineer, is transferred from the Northern Drainage and Embankment Division to the Office of the Superintending Engineer, South-Western Circle, which he joined on the forenoon of the 9th instant.

Mr. A. Monies, Executive Engineer, on return from leave, is appointed Executive Engineer of the Acqnapada-Jajepore Division, of which he assumed charge on the forenoon of the 2nd instant.

Indian Engineering Patent Register.

Specifications of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 7th December 1887.

120 of '87.—Adolphus Spitteler, Merchant, at present in the employ of the Scindia Paper Mills Company, Limited, at Gwalior.—*For certain methods, processes and appliances for manufacturing and producing from "Reh" or from "Rassi" an alkaline product named "Spitteler's Indian Soda Ash," which can be used as an efficient substitute for the soda ash of commerce.*

145 of '87.—John Jeffery of No. 98, Toorak Road, South Yarra, in the Colony of Victoria, Engineer.—*For raising and lowering the temperature of the air in confined spaces and for ventilating dwelling houses and other enclosed spaces.*

213 of '87.—Arthur Rollason of 53, Queen Victoria Street, London, in the county of Middlesex, England, Engineer.—*For improvements in gas or vapour engines.*

222 of '87.—Thomas Terrell, of No. 1, New Court Temple, in the county of Middlesex, England, Barrister-at-Law.—*For improvements in stoppering-bottles for aerated and other liquids.*

TO CONTRACTORS.

Contractors experienced in Ghat Work in Hilly Country are INVITED TO TENDER for OPENING and COMPLETING thirty miles of METALLED ROAD between Potinghi and Koraput on the Eastern Ghats, Vizagapatam District, in not more than four working seasons.

2. The work consists of approximately—

4,000,000 cubic feet of Earthwork in widening and forming and 18 feet roadway with Side Ditches and Catch Drains.

1,000,000 cubic feet broken Granite Metal with Gravel in proportion.

63 Culverts of Stone Masonry from 2 to 3 feet span.

13 Masonry Bridges from one span of 12 feet to 3 spans of 15 feet.

The Masonry and Erection of the following Iron Girder Bridges (Iron Work being supplied by Government), *viz.* :—

2 Iron Girder Bridges, each 44 feet span.
1 Do. Bridge, 7 feet span.
1 Do. do., 3 spans, each 70 feet.

3. This line of Road lies on an unwooded plateau 3,000 feet above the Sea and is reached from the port of Bimlipatam by 90 miles of Metalled Road *viâ* the Potinghi Ghat.

4. The best working season from about the middle of November to the middle of June, after which the South-West and North-East Monsoons impede building operations.

5. The plateau is for part of the year unhealthy for any but selected labour accustomed to wet and cold. It is in character somewhat similar to the country above the Malabar and Canara Ghats.

6. Some unskilled labour is procurable on the plateau itself, and a large amount can be drawn from below, but skilled workmen except Bricklayers are not obtainable in the District.

7. Schedules of approximate quantities and other information can be obtained from the EXECUTIVE ENGINEER, Vizagapatam Division, Madras Public Works Department, on application.

8. Sealed Tenders accompanied by a Deposit of Rs. 200 will be received by the EXECUTIVE ENGINEER up to the 11th February 1888, when they will be opened by him in the presence of such Tenderers as may choose to be present at the Executive Engineer's Office, Waltair, at noon.

9. The acceptance or rejection of Tenders will rest with the Chief Engineer, Public Works Department, who will not be bound to accept the lowest or any Tender.

10. The Deposits will of course be returned to unsuccessful Tenderers, but in the event of any Tender being accepted the Deposit Money which accompanied it will be kept, and with 10 per cent. deductions from all part payments, will form the security for due fulfilment of the Contract.

Notices.

The Office of Publication of Indian Engineering *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

Cheques and Postal Orders should be made payable to the Chartered Mercantile Bank of India, London, and China, Calcutta.

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free ; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong Shanghai*, and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney*, and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.
An allowance is made for continuous insertions.

THE friends of INDIAN ENGINEERING will confer a favor by letting us know, when they cannot find what they require advertised in its columns, and by mentioning the name of the Journal when corresponding with its advertisers.

CONTENTS.

ANSWERS TO CORRESPONDENTS.

Several of our News Letters and other Communications are held over for want of space.

INDIAN ENGINEERING.

SATURDAY, DECEMBER 24, 1887.

THE RECENT PROPOSALS OF THE GOVERNMENT OF INDIA REGARDING PROMOTIONS IN THE HIGHER GRADES OF THE P. W. D.

II.

THE proposals of the Government of India regarding promotion in the Public Works Department, to which we drew attention in our last issue, have been received with a general expression of dislike except by the immediate *entourage* of the Simla circle. We are quite willing to allow that the Government of India have been actuated by a desire to uphold the best interests of the Public Works Department in all recent appointments and promotions in the higher administrative posts, but we fancy that Government itself would admit that the results have not been generally popular. Rightly or wrongly nearly every such appointment made within the last two years has been met with a general growl of discontent, accompanied with a shrug of the shoulders and the remark: "Ah, another Government of India job!" If these new proposals are carried out and all promotions in the higher grades are to be made by the Government of India by SELECTION, this feeling will only be intensified. Every Class B man will have a grievance, and will air it loudly, and we feel sure that although the heads of the Government of India may really do their best to select the best and fittest men for the higher appointments in the service, their efforts will be misconstrued and their motives criticised by those officers who may consider that they have been hardly dealt with.

In addition to these reasons we cannot help feeling that the present step is distinctly a retrograde one. For years the cry has been for decentralisation and the extension of the powers of Local Governments, but now it is deliberately proposed to place every atom of real power in the hands of the Government of India. Although the Local Governments have the sham right to nominate men for promotion in the higher grades, they have to do so in the order of the list of names as prepared by the Government of India. This means that men will be transferred from one province to another possibly from one end of India to the other. The inevitable result will be confusion. The officer who has been so fortunate as to get promoted will have to take up his new duties in a part of India of which he may be profoundly ignorant, in so far as the language, customs, and methods of carrying out work are concerned. And we really cannot imagine a more hopeless position for any man than to be called on to take up, for the first time in his life, a high administrative post while being entirely ignorant of that part of the country to which he may be sent with a staff of aggrieved and discontented officers. The senior officers subordinate to him will be very naturally disgusted, that one of their own number, with whom they had worked side by side throughout their whole service, has not been selected. In addition to this the new scheme has the fatal defect of being nothing more or less than a system of selection by means of a huge promotion roll. No more unfair method could be chosen. The chances of a man throughout his career may be marred by the prejudices or natural temperament of his superior officers. The Government of India will know nothing about his qualifications, and probably may care less; but on the other hand, the recommendation for promotion of an impulsive man would of necessity be far more enthusiastic than that of a more cautious one, who expected a high standard of ability, and the former would naturally carry far more weight with the Government of India, for the simple reason that an absence of personal acquaintance with the abilities and merits of the respective officers would probably lead them to select the one who had been most highly recommended.

Another consideration forces itself to the front in connection with the question of promotion in the Public Works Department. Many of its officers never have a real chance of distinguishing themselves; they often are tied down to monotonous and uninteresting work, such as repairing buildings and roads. The lucky few who are put in charge of more important undertakings come into prominence, and if they succeed are promptly put down as what may be called "good men." They will form the A Class proposed by the Government. Their less lucky brethren may go on whitewashing kucherries and patching roads to the end of their service, unless some lucky chance should bring them to the fore. If this evil exists under the present system, and it assuredly does to a certain extent, we venture to predict that it will be intensified to a degree under the new system proposed by the Government of India. At present in a province, say Bengal for example, the Chief Engineer is personally acquainted with three-fourths of the officers serving under him, and, if he is a judge of men, can always arrive at a correct opinion as to the officers who should be selected for the higher appointments. The head of the Local Government who finally makes the promotion has also an extensive personal knowledge of the men who form the services subordinate to him. In cases where any doubt might arise it is possible for him to see at any time a full and complete record of any officer's services, together with all the remarks recorded by the gentlemen under whom he has served throughout his career. With this information, coupled with the opinion of the head of the Department, a Lieutenant-Governor can generally succeed in making such a selection as will give satisfaction to the great majority of the members of the Department, and as a rule, his choice is a successful one. On the other hand, rightly or wrongly, promotions by the Government of India are looked upon with distrust, and do not inspire confidence. We are willing to admit that this may be due to want of touch with the members of the Public Works Department, but there can be no doubt of the fact that the general feeling is one of dismay at the proposals recently put forward. They look very well on paper, but most of the officers concerned are impressed with the idea that the present arrangement is more satisfactory and less likely to cause jealousy and heart-burning. *Timeunt Danaos et dona ferentes!* No doubt the Government of India would try its very best to act fairly by all men in the service, but it could never succeed in doing so, and we think that the Government would be well advised to give up the idea of introducing the system now proposed.

MR. COLQUHOUN'S RAILWAY PROJECT.

The Bombay Gazette cavils at Mr. Colquhoun's railway project for connecting Burma and China—somewhat splenetically, it seems to us. In two late issues of this Journal we gave reasons for the faith that is in us with regard to this project, and it would be work of supererogation to repeat them here. We take leave to think that the many influential Chambers of Commerce throughout the world commercial which have expressed themselves in favour of Mr. Colquhoun's scheme, are—*ex-officio*—more competent judges of its merits and demerits than one individual journalist possibly can be, however encyclopædic his self-sufficiencies of opinion.

The Committee men of the Chambers of Commerce are giving an opinion as to a matter which, more or less nearly, concerns the commercial interests they have served a long apprenticeship to; and it is but fair presumption to suppose that they know more about trade needs and aptitudes than an untrained, inexperienced outsider possibly can. In such a matter, we for our part, would rather back business experience and faculties than doctrinaire preachments. *Ergo*, when our contemporary, basking in an armchair, evolves out of the depths of his own consciousness that such a line as Mr. Colquhoun advocates would tap nothing but stone and desert, we prefer (in the absence of survey maps) the opinion of an explorer who has spied out the land in question with his own eyes, and who has ears to hear, as well as sense to discriminate between the real and the rubbishy.

The *Gazette*, by the way, laughs at the notion of a railway competing successfully with a river flowing to the sea, for traffic. Has it never heard of the East Indian Railway and its dividends, and the transference to other waters of the magnificent fleet of steamers and flats that used to ply on the Ganges, and do a roaring trade, in the days before the East Indian Railway was?

The "disorganized condition of Siam" is put forward as another objection to the proposed line.

But, now-a-days, high authorities, Military as well as Civil, are agreed that a railway is the most efficacious pacificator and the very best remedy for disorganized conditions of society that a newly conquered country could be blessed with. It is mainly on that high political ground that the Government of India justifies the expenditure it is about to incur on railways in Burma, in spite of financial pressure; and it is ground that commends itself to the approval of statesmen of all shades of political opinion. In short, a disorganized condition of society in a newly conquered country is an argument for, instead of against, railway construction within its borders, as Russia has practically shewn in Central Asia, and France in some of her late acquisitions of Colonial territory.

Our contemporary writes :—"The assertion that Lord Dufferin and the Government of India effected the annexation in the belief that Upper Burma, would give access to the Chinese markets is wholly wide of the fact." Of course it is. Lord Dufferin and his colleagues had other things to think about; matters pertaining to the *haute ecole* of politics, with which Chinese markets could have no more to do than Billingsgate market-women. They were forced into annexation by Theebaw's disregard of treaty obligations, long continued contumacies, and outrages on the British flag.

We need not enquire too closely here upon whom lies responsibility for shifting the real *casus belli* from the real horse to a dummy of quite another colour and make. But, obviously, since political necessities and humanitarian considerations have forced annexation on the Government of India, it behoves that Government to make the best it can of existing circumstances, in its own interests, as well as in those of the erewhile much oppressed subjects of that disgrace to humanity—King Theebaw. Statesmen and sensible men are agreed that no economic agency at present known or knowable to men can tend more to the consolidation and prosperity of the new dominion than lines of railway, which will not only in the future stimulate trade, and develop the natural resources and prosperity of the country through which their course is laid, but can also, in the present, give employment to the unemployed and discontented, and keep them out of mischief and disaffection to the new rule. In what we may call its Public Works policy of administration in Upper Burma, the Government of India is but following an example set to it in Lower Burma years ago, under similar conditions of "disorganization," and attended, in due season, with the happiest, most satisfactory results. *Apropos* of material prosperity, the *Bombay Gazette* quite ignores the well established truism that the opening out of communications through a country rich enough to support its inhabitants in comfort creates trade, promotes agriculture, makes it worth while for people to prosecute industries theretofore neglected because of lack of facilities for transport and barter.

As English journalists we regret to be obliged to agree with one objection taken to Mr. Colquhoun's proposed railway. To wit, the indirect, yet very pertinent objection that the English commercial world, while fully recognizing its advantages, and urging its construction, shirks helping to pay any of the cost, and would fain throw the whole burden of expenditure on an already much straitened and embarrassed Indian Exchequer. The Bombay paper writes pertinently on this subject. Resolutions, it says, are passed with the most delightful unanimity and in the most undoubting faith, declaring that the railway would advance "the interests of British commerce," and that therefore the Government of India should "give substantial recognition to Messrs. Colquhoun and Holt Hallett for their valuable services" in "studying and reporting on the new markets of Indo-China and China and the best means of opening them by railway communication," —the best means of course being that India should pay for the railway communication. It never entered into the heads of any one of them that, as the railway would promote the interest of British commerce, the British Government might reasonably be asked to move the House of Commons to give a guarantee. The President of the Manchester Chamber of Commerce boldly declared that the question of making the Railway from Burma to Western China was so important to the interest of English commerce, "that it might very well come before the Royal Commission on Trade Depression, who should *insist*, as far as they could, that our trade with Burma and Western China should receive at all events the attention of the Indian Government." Nothing more simple, the Royal Commission should "insist" on the Government of India making the railway at the cost of India, so as to mitigate the effects of depression of trade in Manchester!

The proverbial, much-to-be-commended cautiousness of the British character must, however, be taken into account in estimating the chances of Mr. Colquhoun's railway scheme. Lombard Street and the Royal Exchange like to chew the cud over any project submitted for approval, much as Downing Street and the Carlton Club like to "think it over" when some new political idea threatens to cast a shadow on the Parliamentary game of talkee-talkee. Even the *Bombay Gazette* is less determined in opposition at the end of the article we have taken for text than at its beginning, and remarks that with an Imperial guarantee, if it ever come, there will be less reason than there is at present for viewing with dissatisfaction and alarm the growing tendency to saddle the Indian Exchequer with heavy liabilities at the bidding of irresponsible advisers who do not risk a five-pound note of their own, but gamble freely with other people's money.

THE PROGRESS OF NAVAL CONSTRUCTION AND ENGINEERING.

THE inaugural address of the President of the North-East Coast Institution of Engineers and Shipbuilders to the members at the annual meeting on Wednesday, the 19th October, on the question of the amount of work to be done to old steamships to make them efficient, is replete with all that is interesting and instructive.

Mr. Doxford has collected statistical returns of the work done in re-engining steamers since the beginning of 1886, and shews that 78 steamers have either been re-engined or had old engines altered to triples on the East Coast, the Clyde, the Mersey, and at Aberdeen, representing a tonnage of 167,306 tons gross. He estimates that 3 per cent. in number of the estimated total and $5\frac{1}{2}$ per cent. in tonnage require the change which is confined to the larger class of vessels. It would appear that practically all the alterations are being made to *triples* owing to the fact that no gain is obtained by using four cylinders—quadruples—with present pressures of steam. Mr. Doxford further shews that the greater part of the work was done on the North-East Coast; and gives statistical statements of the number of engines built or in course of building and alteration during the past and the present year. The gain which these conversions and constructions ensure to the ship-owner is doubtless immense, and his later investigations and generalizations go to confirm, rather than contradict, the opinion expressed by him last year. He then institutes comparison batween the tonnages of 1886 and 1887 and shews that there has been considerable decline in the gross tonnage of the world in the last year, which if due to excess of tonnage in previous years will soon right itself. To the pessimists who are discouraged by the expansion of constructive competition in foreign countries, he shews by tabulation that there is no fear on that score, as the addition of new vessels or tonnage built in France, Germany, Italy, Norway, and Sweden in 1886-87 formed only ⅙th of the total tonnage built in the United Kingdom. From the figures adduced it would appear that Germany and France are the only countries which produced any appreciable quantity of iron or steel tonnage, and Mr. Doxford finds that no country in the world excepting the United Kingdom, is at present able to supply a market outside of itself, and that therefore, with the exception of certain countries, the *whole world is dependent* upon the shipbuilding yards of the Old Country. The fact, therefore, in a great measure, contradicts the utterance of the President of the Institute of Naval Architects on the occasion of his address on 30th March this year. He declared that "formerly, England used to build ships for all the world and now all the world is building ships for itself." This, though not correct, judged by the light at present thrown upon the subject by Mr. Doxford, may too soon become true from the competition of Germany. It is, however, pointed out that with decreasing tonnage, and the possibility of an abnormal demand from America, the outlook for the immediate future seems not at all discouraging to shipbuilders and engineers. But the high prices which ruled five years ago in consequence of large demands must not be expected to recur again, as the world is proportionately better supplied with tonnage than it had ever been before. Such being the state of things, the question is appropriately asked, "Is the British shipbuilding keeping abreast of the improvements of the age?" It is shewn that a large proportion of the vessels built in the United Kingdom is now of steel —and advantage is taken of the application of steel produced by the basic and acid processes now largely resorted to all over the manufacturing world. Whether in the application of steel for the construction of marine boilers, or the adoption of forced draught or increased piston speed and insurance of high pressures, Mr. Doxford has, by a skilful array of facts and figures, conclusively shewn that the shipbuilders and engineers of Great Britain are within the van of improvements applicable to naval construction and engineering, which are not only adopted by them, but they have extended the sphere of their use.

On the whole, he takes a very hopeful view of the present and future positions of these industries; and this, be it noted, has been more than justified by subsequent events and experiments.

Notes and Comments.

PANJAB GUP.—The following officers in the Panjab P. W. D. (Executive Engineer, 1st grade) came under the 50 years' rule lately issued by the Government of India: Messrs. Harrington and Bailey, and Colonels Palmer and Garstin.

THE L. C. E. DEGREE, BOMBAY.—There is a proposal about to be brought before the Senate to the effect that the Previous Examination be made a necessary qualification for the L. C. E. degree. It is also proposed that a candidate be required to pass three examinations, *i.e.*, the first, the second, and the final, for the degree of L. C. E. There is a consensus of opinion that this change is uncalled for.

ROYAL ENGINEER NEWS.—The senior Colonel of the Royal Engineers, C. E. Cumberland, C.B., was passed over for the rank of Major-General, and J. B. Edwards, C.B., Commandant of the School of Military Engineering at Chatham, promoted over his head. This is tho first time such a thing has happened in the history of the Corps.

A DISPUTE.—Mr. Furnivall, the Engineer-in Chief of the Nizam's State Railway, has been appointed joint arbitrator with Colonel Smith to investigate the claims preferred by Messrs. Derry and Co., Contractors, against the State for work executed in connection with the Bellary-Kistna State Railway, and regarding which there is some dispute at present as to payment.

INDIAN RAILWAY CONTRACTS AND TENDERS.—The Bengal-Nagpur Railway are calling for wagon and carriage fittings and fixings. The Great Indian Peninsula Railway are advertising for steelwork and ironwork for bridges. The Indian Midland Railway want composite carriages and tranship vans. The Indian State Railways invite tenders for the supply of locomotives per the Director-General of Stores, India Office.

THE PARABLE OF INDIAN ART.—"The arts of India,' writes Sir George Birdwood, "will never be properly understood until there are brought to their study, not only the sensibility which can appreciate them at first sight, but a familiar acquaintance with the character and subjects of the religious poetry, national legends, and mythological scriptures that have always been their inspiration, and of which they are the perfected imagery."

CALCUTTA STEAM NAVIGATION COMPANY.—It having been resolved to increase the capital of this Company from Rs. 7,00,000 to Rs. 8,40,000 by the issue of 1,400 new shares of Rs. 100 each, the shares to be offered rateably to the shareholders at par, in proportion to the number of shares held by them: the Managing Agents have now offered, the said shares to the Proprietors accordingly, who must signify their acceptance of the same on or before 27th December 1887.

THE SONE IRRIGATION COMMISSION.—One of our Correspondents says:—The Shahabad Canal Inquiry seems to have been appointed with a view to eliciting only alleged briberies and corruptions within the four corners of the department. But, since such a Commission is to the fore, could it not be utilized somewhat in helping to determine what is, and what is not, the actual causative of the efflorescences of *réh* frequently complained about by owners of canal watered lands.

RAILWAY COMMUNICATION IN THE WEST DECCAN.—Two important events as regards railway communication in the Bombay Presidency have just taken place, one being the completion of the South Deccan Railway over the Braganza Ghat to the Portuguese Frontier at Goa, and the other the establishment of through-communication by the West Deccan line from Poona to Belgaum. The original scheme of the Southern Mahratta Railway has now been carried out, but there still remains an extension of the line between Harihar and Mysore.

CALCUTTA BOTANIC GARDENS.—*On dit* that Dr. George King of the Calcutta Botanic Gardens will retire shortly on pension. Could not a *practical* man be appointed as his successor? Rumour gives the post to Dr. Watt. He is compiling a dictionary on Indian Economic Products; a worthy enough work with which his hands ought to be full for the next two or three years. What is the advantage of sticking square men into round holes; and what possible profit can accrue to the State from diverting energies well employed at present into new pastures?

ECONOMIC BOTANY.—Perhaps the most interesting forest product submitted to the notice of the Chemical Examiner in Burma last year, was the wood of *Artocarpus integrifolia*, which yields a fast yellow dye much in favor with Buddhist lovers of yellow as a color. This dye may, with pains, be extracted by boiling the wood with water, but more efficiently by boiling it in alcohol. The world of nature in short, is very like the world of humanity. You can get more out of it through the medium of whiskey than ever so many gallons of cold water would enable you to.

MARINE ENGINEERING IN WESTERN INDIA.—The steam-ship *Neera* of the Bombay Steam Navigation Company's fleet has been altered in a noticeable way. Formerly, she was fitted with engines, that worked up to 350 indicated horse-power. By the addition of a third cylinder they now shew 700, producing 150 revolutions as against 70, and giving an increased speed of two knots an hour. And they do all this for "something between two and three tons of coal per diem." We commend the moral to missionaries at a loss for effectual means of conversion.

FIBRE-CLEANING MACHINES.—For several years past the subject of inventing a machine for decorticating raw Pineapple, Agave, and Moong, and other fibres has greatly exercised the public mind, and the problem remains yet unsolved. About three years ago some machines in full work were exhibited in Calcutta, but, we believe, owing to want of proper management, they did not give general satisfaction. Messrs. Ewing & Co. have come forward to exhibit Death's fibre machines for those desirous of becoming acquainted with, or interested in, fibre-cleaning processes.

A MADRAS RAILWAY PROJECT.—The Directors of the Madras Railway Company have informed the Agent and Manager that Messrs. Punchard McTaggart Lowther and Co. of London, are forming a Syndicate to carry out a scheme for the construction of a loop line from the Madras Railway through the Kolar Goldfields, or from Kamasamudram to Kolar Road station, and they have requested him to give all assistance in his power to the promoters. General Sir Andrew Clarke, G.C.M.G., late Public Works Member of the Goverment of India, is a member of the Syndicate.

SEEBPORE ENGINEERING COLLEGE RESULTS.—Messrs. Shavaksha and Hpo Thine have now both been appointed permanent Assistant Engineers to the Public Works Department from Seebpore College, after undergoing the usual year's practical training. Mr. Sorabji Shavaksha has been gazetted to the Darjeeling Division, Bengal, and Mr. Hpo Thine left for Burma some time ago. It seems to us that the boasted superiority of the Bengali has been rather belied by the fact that the only two vacancies of Assistant Engineerships should have been gained by a Parsi and a Burmese respectively. Young Bengal will have to look to his laurels.

WRONG INFERENCE AND DOUBTFUL CONCLUSIONS.—*Apropos* of a late Railway bridge collapse in the States, a New York Engineering paper says, :—"There is to be no mistake about the new 'tin bridge;' work on which we are informed has begun. Instead of having one of the greatest skews on record the new bridge is to have none, and instead of being a wretched iron one it is to be a solid stone one." But, surely, because one iron bridge was badly designed and inefficiently put up it does not follow that all iron bridges are "wretched" and unsafe. Or that stone bridges are inherently, *ex-officio*, so to speak, superior to iron ones.

INDIAN MANUFACTURES.—Messrs. Burn and Co. of Howrah, Calcutta, have made a new departure in regard to meeting the requirements of *the* Resolution of the Government of India so as to supply from the local market articles now unnecessarily obtained through the Secretary of State. They correctly assume that the Government is desirous of encouraging local manufacture, even although the raw material should be obtained from Europe, and where the workmanship is invariably Indian, and in some cases also the raw material used, they have advisedly adopted the course of stamping their Bills to that effect, *viz.*, that all goods are "guaranteed of Indian manufacture or construction."

THE BENGAL P. W. D. SECRETARYSHIP.—A correspondent writes:—"It is understood—the *Indian Daily News* is almost sure—that the Chief Engineership of Bengal will be vacant in February next, by the promotion of Colonel C. M. Browne, R.E., to Major-General, which will entail his retirement from the service. The question as to who will succeed Colonel Browne as Chief-Engineer is creating some speculation. But I am disposed to think that the nomination on this occasion will be made more in accord with the principles of equity than by the dubious procedure usually adopted for the disposal of such offices in the P. W. D." Our own views on this subject will be found under the same heading in a succeeding Paragraph.

THE BENGAL COAL COMPANY.—The usual half-yearly accounts, shewing the working of this Company for the half-year ended 31st October 1887, is a very satisfactory one. There is a balance at Credit of Profit and Loss Account of Rs. 2,09,709-12-10. After providing for Rs. 13,600 for Directors' remuneration, Auditor's fees, and commission to General Superintendent and General Manager, a sum of Rs. 2,56,109-12-10 will remain at Credit of Profit and Loss Account. The Directors propose that a dividend of Rs. 60 per share, or 12 per cent., payable on and after the 19th December 1887, be declared, which will absorb Rs. 1,44,000, and that the balance, Rs. 1,12,109-12-10, be carried forward to next half-year's account.

THE KHYBER ROAD.—A Calcutta paper says:—"It is surely time that steps were taken to improve the condition of the Khyber road. Communication by the so-called road which now exists in the pass is by no means easy and convenient, as His Excellency the Viceroy perceived during his recent journey to Lundi Kotal. In truth, this road is a mere cross-country surface track ; it is encumbered with rocks and rubble, pitted with great holes and ruts. Without drains, it is a morass after rain ; and in dry weather is covered almost knee-deep with the most overpowering and penetrating dust. Such a state of things should be rectified, and, as it would be a small matter to put the road in a good condition, at least as far as the Afghan frontier, the repairs should be undertaken and carried out without further delay."

OPENING OF THE DUFFERIN BRIDGE.—On the 16th December the Viceroy opened the Benares Railway Bridge, which is named after His Excellency. The ceremony took place at the bridge head on the Benares side of the river, in the presence of a numerous gathering. The proceedings commenced with the reading by Colonel J. H. Jenkins, Agent of the Oudh and Rohilkhund Railway, of a paper giving details regarding the construction of the Bridge. The Viceroy then, in a brief speech, expressed his thanks at the compliment paid to him by the Directors of the Company in naming the bridge after him. A survey of the structure had filled him with wonder, and he believed that there was really nothing which the Engineers of the age, if they were only supplied with enough money, could not accomplish. He had much pleasure in declaring the bridge open.

A MODEL IRRIGATION SYSTEM.—As a contrast to the Bengal and Behar Irrigation system, a Bombay paper brings to notice a system of irrigation which has given entire satisfaction to every one in the Jeypore State, the results of which are due to the judicious policy which the State has followed in the matter of irrigation under the guidance of Colonel Jacob, its Executive Engineer. The total expenditure exceeds twenty lakhs. The total return, however—a little over two lakhs—was nearly ten per cent. One explanation of the success of the Jeypore policy is to be found in a circumstance necessarily absent from irrigation administration in British territory, namely, the fact that the State looks for a return to its expenditure not in the water-rates, which are invariably low, but in the increased produce of the soil irrigated, of which it takes a fixed share.

RANEEGUNGE COAL ASSOCIATION, LIMITED.—The following is the Managing Agents' Report of the working of this Company for the half-year ended 30th September 1887, together with an abstract of the working for that period :—We beg to submit to you the usual Statement of the Working Account of your Collieries for the half-year ending the 30th September 1887, showing a credit balance of Rs. 4,561-4-0, a result, excluding in both cases the balances brought forward, better than the corresponding period of the previous year by Rs. 12,725-3-9. The output during the six months has been 49,240 tons against 59,570 tons for the same period of 1886, and the sales reach 59,644 tons of all classes of Coal against 49,487 tons the previous year. The decrease in the stock consists chiefly of small Coal at the Kurhurballee, upon which the screening, picking, and leading expenses have been heavy.

THE BENGAL P. W. D. SECRETARYSHIP.—Colonel McNeile, R.E., will probably arrive early next year and will take up the duties of Secretary to the Government of Bengal in the Public Works Department. Colonel C. M. Browne, R.E., retires shortly from the service on promotion to the rank of Major-General. His departure will be much regretted, as during his short tenure of office in Bengal he has succeeded in making himself generally popular. It is expected that Colonel Harrison, R.E., will return to the North-West Provinces, and that Colonel McNeile will resume charge of the Irrigation Branch, in which case a selection will have to be made for the General and Railway Branch. Colonel Luard's name has been generally mentioned in connection with the appointment, but it is difficult to see what he would gain by accepting it. His present post is equally well paid, and the work is probably more congenial to him.

WOODEN PAVEMENTS.—A Bombay paper thinks it is wonderful how behindhand that city is in many things, even when it is the most advanced city in India, and flatters itself that it is a good way ahead of its neighbours. It says :—What Bombay wants, in its principal thoroughfares at least, is a wood pavement, such as we see in London, Paris and the big American cities. Chicago has been making great advances in this line lately, having now as much as two hundred miles of wood pavement. There is no reason why the experiment should not be attempted in Bombay, unless it is barred by want of energy which is the bane of all Indian cities. Not only would the roads be infinitely improved, and made more pleasant by this process, but it would render Bombay a quieter and, consequently, pleasanter place to live and work in. Our readers will find much valuable information on this subject in the last volume of the Transactions of the Irish Institute of Civil Engineers, and in the Journal of the Association of American Engineering Societies for November 1886.

THE P. & O. *R. M. S.* "BRITANNIA."—The Superintendent of the P. and O. S. N. Co., Calcutta, has favored us with an illustrated account of the latest addition to the Company's fleet—the *Britannia*, which was launched from the yard of Messrs. Caird Brothers, at Greenock, on the 18th August 1887, in the presence of a large assembly. This Steam-Ship is designed to maintain an ocean speed of some 16 knots an hour, and during her trials with full steam pressure she attained a speed of 17 knots or 19½ miles, while she ran 16 knots all the way from Greenock to London. The *Britannia* is a four masted full rigged ship of 6,600 tons gross measurement, having a length between perpendiculars of 465 feet 9 inches (nearly 500 feet over all), with breadth of 52 feet, and a depth of 37 feet, while her engines develop a power of 7,000 horses. The design of the general details combines all the elements of comfort and safety for ocean travel. The arrangements for passenger accommodation point to a new era in ship-building in which utility is not obtained at the sacrifice of elegance.

THE DIRECTOR-GENERAL OF RAILWAYS.—*The Indian Daily News* is not quite correct in its paragraph regarding Colonel Conway-Gordon. We are glad to be able to state on good authority that Colonel Conway-Gordon's illness is by no means so serious as it was at first thought to be. It was generally believed that the disease under which Colonel Conway-Gordon was suffering was inflammation of the optic nerve, but subsequent examination has proved that the complaint is of a far less serious nature. After some few more days' residence in a darkened room, it is hoped that the Colonel will be able to resume work on or about the 10th of January next. As regards the proposal to make Colonel Wallace the Director-General of Railways, we believe we are right in saying that it was never seriously contemplated by the Government of India. If at any time it were necessary to replace Colonel Conway-Gordon, (and we trust this may not be the case for years to come,) Mr. F. L. O'Callaghan is undoubtedly the man for the post. There is no comparison between his claims as a professional man for the appointment and those of Colonel Wallace and furthermore he has been about two years longer in the Department.

Toungoo-Mandalay Railway Extension Plant and Material.—Up to the present time 125 miles of permanent way have arrived in the country, out of the 220 odd required; and there is a balance yet to arrive of nearly 12,000 tons of rails and fastenings. Of this quantity about 8,000 tons are due by four outside steamers, chartered by Government for this purpose, the *Regal, Renfrew, Sirocco, and Inchmaree.* The S.S. *Olive Branch,* brought a large quantity of fencing, 3 feet cylinders, 2,500 casks of Portland cement, rail fastenings and girders of all sorts. The different bridges might be got on with rapidly, if the permanent way would allow the transport of these girders, a sufficient quantity of which is now in the country. Of the rolling stock a quantity previously used by the open line has been forwarded to Mandalay, and the following new stock is now in use at the Toungoo end: 25 O and F class locomotives and 130 low-sided waggons, 70 ballast waggons and 6 break vans, whilst the Mandalay end boasts of 5 locomotives, 5 break vans, 60 ballast trucks and a few third-class carriages. A barge is now in the river loaded with about 20 more trucks and a quantity of girders for 10 and 20 feet spans. The *Irrawaddy* will bring 10 more locomotives and tenders. Of the 125 miles of permanent way, 65 miles has been delivered at the Toungoo end, and the remainder of the permanent way and rolling stock will be delivered in various quantities from time to time until March 1889.

The Straits Survey Department in 1886.—In Singapore, the departmental work was confined to current survey for revenue and engineering purposes, so that nothing has been done in the direction of trigonometrical measurement. In Penang and the Province, the trigonometrical survey has been gone on with so satisfactorily that its completion was expected about the middle of this year. In June last, the observations had almost been finished, and preparations were in progress for measuring the base line. The revenue survey only took in Balik Pulau, at an outlay exceeding $36,000. In Malacca, the trigonometrical survey has advanced sufficiently to admit of final observations. The trigonometrical stations have been utilised for revenue survey purposes. During the year engineering surveys took in 16 miles of country. Now that Colonel Barron has investigated survey affairs in the colony, and has drawn up a report on them, it is to be hoped that matters will change for the better in this respect. An officer of his experience and standing cannot fail to suggest improvements and changes in survey procedure which will tend materially to facilitate surveying operations. The publication of his report will no doubt throw light on many disputed points, and enable some idea to be formed as to the most advantageous reach and scope to be given to the revenue and cadastral surveys, the latter at present bidding fair to prove a source of enormous expense.

Iron Bridges in Malabar.—The Iritti and Merumpoya bridges with iron superstructures and Whipple-Murphy pony trusses on masonry abutment and piers made good progress during the past official year. Up to the end of the previous year the whole of the masonry and two-thirds of the earthwork were completed, notwithstanding the great difficulty in securing and keeping labor owing to the unhealthy localities in which the bridges are situated. At the end of 1885-86, there remained to be completed the iron superstructures, the platforms and scaffoldings with ⅓rd of the earthwork. All work on these bridges was stopped at the end of March 1886 for want of the iron superstructures. During the year 1886-87 the works were resumed in February immediately after delivery of the first two spans of the iron superstructure. By the end of the year the following works had been completed at the Iritti bridge:—(1) The iron trusses of two spans were fitted up and ready for lifting into permanent position. (2) All scaffolding was well in hand and nearly completed. And with regard to Merumpoya bridge, the iron work was not received till the end of April and the work was not consequently commenced in the year under report. It will not be out of place, to state here that before the rains set in on the 3rd of June this year the whole of the iron superstructure of the Iritti bridge had been erected and the centre span, the most difficult one of the Merumpoya bridge, had also been fitted up and lifted on the piers. Both of these important bridges on a heavily trafficked ghaut road will therefore be completed and opened for the season commencing at the close of the rains of the present monsoon. The Engineering staff has done wonders under great difficulties and with ordinary coolie labor in a very unhealthy locality and in a very short space of time.

New High Court Buildings, Madras.—The Government are disposed to fix on the fishing village, to the South of the Presidency College, definitely as the site for the High Court; to instruct the Government Architect to commence plans at once, in view to the prosecution of the work with the utmost vigour, so that the buildings may be ready for occupation by 1st January 1891; to advertise present premises with the adjoining Marine yard for sale. It will probably be at once conceded that this site is by far the best; that is if it is once determined to move away from Black Town and the noise and bustle of the North Beach. The site possesses every advantage that can be desired. Facing the Marina, it is open to the sea breezes, and standing apart from all other buildings, except the Presidency College, it affords ample scope for the erection of a handsome structure, such as the High Court ought to be in continuation of, and sufficiently in keeping with, the line of buildings which, with the Marina, have made Chepak a strikingly beautiful quarter. Further, it is already at the disposal of Government, and instead of incurring a large initial expenditure in the acquisition of a site, it will be possible to sell the present High Court for a sum which will go a considerable way towards paying for the erection of the buildings. There are no offices available for legal practitioners, but behind the Court house and along the canal there will be ample room where a line of offices may be constructed by Government, or which may be made over to private enterprise for that purpose, as may hereafter be determined. Before, however, coming to a final decision on a matter of so much importance to the public generally, His Excellency the Governor in Council is anxious to ascertain how far the conclusions at which he has arrived are accepted by those sections of the public most interested.

Current News.

SIR THEODORE HOPE laid down the Public Works portfolio last Thursday.

LORD REAY has promised to support the Godhra-Rutlam Railway scheme, the importance of which he fully recognises.

MR. GUILFORD L. MOLESWORTH, Consulting Engineer for State Railways, has returned to Calcutta from his Madras tour.

THE number of Burmans employed on the Mandalay Railway is now about 17,000, against between 7,000 and 8,000 foreign laborers.

IT having been decided that the Fort at Cannanore shall be maintained as a defensible point, a sum of Rs. 3,064 has been allotted for the necessary work being put in hand at once.

A PROPOSAL to make Marmagao the capital of Portuguese India is under consideration. The opening of the Marmagao Railway has been postponed to the end of January or the beginning of February.

IT is expected that the Toungoo-Mandalay Railway will be open to public traffic as far as Pyinmana on the 1st of April next. Pyinmana is to be one of the stations on the line, and is 59 miles from Toungoo.

MR. HENSLOWE, Personal Assistant to the Engineer-in-Chief Tounghoo-Mandalay extension, who joined the Railway just a year ago, leaves Burma as soon as he can be relieved by an Executive Engineer from India.

THE Indian Press is troubling itself about the Mu River Railway; considering that the Mu is at present a geographical expression only, it occurs to us that some Engineers are letting their zeal out-run their discretion.

THE Kungundi Gold Mines in North Arcot District may soon invite attention. There are already six blocks of 100 acres each surveyed and demarcated in the village of Peddaparthigoonta, seven miles from Kuppum Railway Station.

INSTRUCTIONS have been issued that all buildings in estates in the Ganjam District shall be transferred to the custody of the P. W. D., who will also, for the future, attend to all tanks and irrigation unless irrigating 50 acres and above.

IT has been ruled that Royal Engineer officers serving in India' howsoever employed, who do not elect for continuous service in the country, come under the rules applicable to regimental officers of the British Army with respect to furlough and leave.

THE Board of the Madras Railway have consented that all Engineers shall, on their first joining, be termed Assistant Engineers for two years, after which they shall be termed Resident Engineers, as soon as they are in independent charge.

THE Survey of India has recently lost two good and able assistants, after long and valuable service in the Department, whose going will be much missed—Mr. C. W. Coard, Superintendent of Engravers, and Mr. James Mackenzie, the head photographer.

THE Forest Department in the Central Provinces has been authorised to spend up to a sum of Rs. 60,000 during the current official year in connection with the operations undertaken for supplying sleepers to the Bengal-Nagpur Railway. The greater portion of the sum will be recovered this year.

THE Allahabad *Morning Post* has "the best authority" for stating that work on the Railway between Sialkot and Jummoo will be commenced in a couple of months. The sleepers for the line will be provided by the Cashmere Government. All the machinery, &c., has been ordered out from England.

THE Madras Railway authorities, in view to securing their property at Royapuram from any damage from erosion of the foreshore to the north of the Harbour, have requested the Harbour authorities to arrange for the collection of materials for the construction of protective groynes, should such a step become necessary or desirable.

THE *Rangoon Times* says that with the Channel properly buoyed, and a staff of Government river pilots, there would seem to be no good reason why ocean-going steamers of moderate dimensions should not be able to ply safely on the Irrawaddy, at any rate, during the rainy season, just as they do to Hankow on the Yangseekiang, where only river steamers ran some few years ago.

THE revenue results of the two great railways in the Bombay Presidency during 1886 contrasted favorably with the figures for the previous year. On the B. B. & C. I. the net result shewed an improvement of about 6 per cent. in earnings, and was equal to 8·6 on the guaranteed capital. On the G. I. P. Railway, the year's operations resulted in a net increase of earnings by over 28 lakhs of rupees or 7·7 per cent.

THE Mint Master of Calcutta suggests that the silver mint may be abolished here, but the engines and plant and engineer should remain in case of emergency. The copper mint may be permitted to continue, as it turns out a large quantity of copper coins, which supply not only the Bengal Presidency, but the Native States, Burma, and even colonial and foreign settlements. The copper mint should be maintained at a limited cost.

A CORRESPONDENT, writing from Quetta, states that the works for carrying the Sind-Pishin railway through the Khojak are begun. In May last a detachment of Bombay Native infantry had proceeded to Chaman, to protect the survey party which were seeking for the best route for this extension. This survey being completed, and the sanction of the Secretary of State accorded for the construction, the work has been promptly taken in hand. Owing to difficulty of tunnelling the Khojak, it will not be finished for some two years and a half to come.

MR. MYLNE of Beheea, in a note submitted to the Sone Irrigation Commission, deals with the question of illicit irrigation and the unauthorised use of canal water. He states that it is apparent from the rules that canal officers shirk all responsibility in the matter of preventing "waste" and "unauthorised" irrigation. The latter is openly permitted, and hence confusion and wrong assessment result when the rains come. Extra attention is demanded from the patrol and other canal subordinates who are supposed to maintain "the primary register of irrigation" and "to prove beyond possibility of dispute when every field received canal water."

MR. W. C. FURNIVALL, the Agent of a Company in England with a capital of £1,000,000, and who is carrying on mining operations in the dominions of His Highness the Nizam, having applied to the Madras Government for permission to prospect for minerals over one whole taluk in that Presidency, prior to conducting actual mining operations, and determining by actual experiment that they do actually exist in sufficient quantities to pay for mining operations, Government have informed Mr. Furnivall "that if he wishes to prospect in the sense of making merely a preliminary survey of the ground and superficial search for indication of minerals in view to future operations no special permission is necessary, but that in that case he will, of course, have no *exclusive* right to such prospecting."

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

INDIAN MICA—WANTED.

SIR,—Can you give me any information concerning the mining of mica in India, or put me in communication with some one who can give me the information?

I should like to know where it is mined, and in what quantity, and if there is any chance to secure good property there.

Also, I should be glad to have any information concerning the method of mining veins in which the mica occurs, cost of labor, &c.

A large quantity of mica comes to America from London under the name of Calcutta mica, and I take it for granted that much of this is mined in India, though some of it may come from Ceylon and other ports and be shipped *vid* Calcutta.

I shall be greatly obliged to you, if you can give me this information or put me in a way to obtain it.

BELLOW'S FALLS, VERMONT, U. S. A.,
November 11, 1887. CHAS. D. BOWERS.

[Doubtless some of our readers will be able to supply the required information. We consider it necessary, however, to state that an acquaintance of ours actually prospected America to find a market for Indian Mica, but failed.—ED., *I.E.*]

MORVI RAILWAY.

SIR,—With reference to the paragraph headed "Provincial Steam Tramways in Western India" on page 313, in your issue of 12th November 1887, I have to ask on what statement or publication of Mr. Molesworth's do you base the information contained in the paragraph under reference, as in the first place there is no such tramway as described between Wadhwan and Rajkot—in fact, there is no tramway at all there, and as regards the concluding statements, if intended to allude to the "Morvi Railway," they are entirely incorrect. I am anxious to know how the mistake arose so that I may take necessary action to set right the injury that might occur to the Morvi Railway from the publication referred to. The delay in the reference to you is explained by my having been away in England, and only having returned by last mail.

Trusting you will let me have an early reply.

MORVI RAILWAY; M. H. WHITE, C.E.,
December 11, 1887. *Manager and Executive Engineer.*

[As the publication of the statement in question was not confined to this Journal alone, we can scarcely see why it should be singled out so late in the day for the required explanation. However, we gladly give publicity to this contradiction, and are as anxious as any one to know how the mistake, if any, arose. But it is necessary to point out that a leading Bombay paper, no later than last week, in discussing the subject of "Railway Extension in Kathiawar" says: "Mr. Molesworth's recent report on the line—*i.e.*, 'the Morvi State Railway, a two feet six line, running at present from Wadhwan to Morvi, by Wikaneer'—was not flattering to its constructors, and it may be that profitable lessons as to the inadvisability of being too sparing in first cost may be derived from experience of the line."—ED., *I.E.*]

"FREE TRADE OR FAIR TRADE."

SIR,—A Calcutta paper suggests that the time has come for the British trader to open out trade in Afghanistan in cotton, silk and woollen piece-goods, soap, candles, sugar, musical boxes, and a lot of articles of Western world manufacture, suitable to Afghan markets.

Doubtless there are bazars in the Ameer's territory to which the piece-goods, and soap, and so forth might be sent if Afghan jealousy and suspicion of everything English could be overcome, if the Ameer did not say in Persian, or Pushtoo, *Timeo Danaos et dona ferentes.* Supposing however that the piece-goods and the soap got safely through the Ameer's Custom House, or let us get more on the safe side, and suppose that one half got through, who would pay for the piece-goods, who would use the soap? Did your contemporary never read about the one-sided methods of doing business that used to find favor with the Barons of feudal Europe when they took a fancy for any merchandise on sale in their neighbourhood; about the days of

" That good old rule, that simple plan
That he shall take who has the power,
And he shall keep who can. "

And did your contemporary ever hear the theory broached that the Afghans are descendants of the lost Israelite tribes, and the statement made, that no Gentile has ever since the world began got any profit out of " trade " with a Jew? I am willing to admit that free trade is a very pretty argument—in the abstract. Only, latter day traders have a weakness for wanting some profit on their trading ventures.

COMMON-SENSE.

PUNKAHS.

SIR,—I have only just noticed the correspondence in your paper on the subject of punkahs.

Will you allow me, through the medium of your columns, to call on " M. B." to remit me the sum of Rs. 4,000 as royalty for the unauthorised use of my system of hanging punkahs at the rate of Rs. 1,000 each for four punkahs set up by him as per his letter to the issue of 17th instant.

" M. B." calmly remarks that the system may be patented, but apparently takes no steps to satisfy himself on this point. If " M. B." question my authority, I would suggest his paying a visit to the Home Office and looking up the specification of a patent dated 11th January 1877. And unless he communicates at once with me, pay the ordinary royalty, which is something very trifling, and acknowledge in your paper his mistake in calling an invention which is mine, by a name other than mine, I shall take steps to enforce my demand.

To what extent Mr. Mortimer has participated in the coupling of his name with the invention under notice, I do not know. I imagine he has done no more than passively acquiesce in it, for the system is fully described in my little work on Punkahs published in 1880, and now procurable at Newman and Co.'s, and no protest has ever been raised against my claim of proprietorship. Further, when a year or so after the patenting of the invention I saw Mr. Mortimer on the occasion of his trying, with my patented system of *hanging punkahs*, a machine for *pulling them*, he made no attempt to claim in favor of himself originality for the system. I presume that the accident of his trying, at the same time, the two inventions, both of which were then comparatively new, led to his name being associated with that one of the two which has survived, is now in common use, and may therefore be considered a practical success.

G. E. HOTEL, H. BULL.
CALCUTTA; *December* 21, 1887.

[We have been promised a description of " Mortimer's System of Punkahs ", which will, we trust, set this and other disputed points at rest.—ED., *I. E.*]

INDIAN COAL MINES AND COAL MINING.

SIR,—I should like to ask you, what has happened to " again call" the "serious attention of the Government" to the present system of coal mining in India? I am sure the letter of " M. E." in your paper of the 3rd instant, has a very disagreeable smell of sulphuretted hydrogen, after damp, or something of this kind, but I see no account of any explosion or some other calamity recently occurring.

If nothing particularly has happened, then I conclude that Mr. T. H. Ward's recent pamphlet has so far infatuated " M. E." to condemn every Coal Viewer in India, as well as himself, who by the wording of his letter and his covert signature distinctly leads me to think him a mining engineer.

Now, Sir, it looks well for an officer crying out to a Government to give him means of discipline and methods of working, when it engaged him solely on account of his experience and for those duties. This idea of begging to be crippled applies to all the colliery managers, as they by "M. E.'s" system would be interviewed and their suggestions ascertained by three of a commission.

The first and second of this important body would know nothing of mining, and the third would necessarily do all the questioning and work, and upon this frail structure of a one mind, would the future of coal mining in India depend. Now, Sir, I am quite pleased that you gave us the benefit of your mind in the editorial note on the foot of page 364 and with you I think the Government acted wisely and " let well alone."

Let me tell " M. E." that it is not legislation, Coal Mines Acts, commissions, etc., that has led up to the healthy state of discipline and preservation of life in the English coal mines, but that it is intelligence combined with practice aided by science called into requisition by competition in trade, greater out-put needing extra precautions, and the better culture of mining officials and workmen generally.

We had better say that boiler explosions have been reduced by Parliamentary laws and also that this intelligent body reduced the loss of life at sea and that it also lessened the accidents in iron works? No, the increased safety of these respective callings have been brought about by individual energy, changes in time, and the chances offered by scientific research, as in the case of coal mining.

The Coal Mines Acts of England are nothing in themselves, but a record of the working of coal mines, ascertained from some actual development in the country and pirated by labour candidates from their brethren of the miners' unions and cried up as an invention for political purposes. The miner's vote is bid for, and Coal Mines Acts are the outcome and not the necessity.

Think you not, Sir, that all the owners and viewers associations throughout England do no good by their paper readings and " transactions," and that before any legislation was attempted, that these men of sense did not introduce rules and regulations at every colliery for the safety of the workmen and the mine? It was after this arduous training and the increased intelligence of the workmen that brought about better results.

Were the English miners still as ignorant as " the 30,000 poor ignorant miners of Bengal," the " Coal Mines Act" of recent production would not have been what it is. To spring an Act devised for intelligent miners upon the poor fellows of Bengal and other Indian coalfields would be madness itself.

To my humble thinking " M. E." ought to begin where his fathers at home started and do his duty by first introducing a few simple rules at his colliery, and see that they are efficiently observed and the result given to his brethren by a society formed for such discussions. After he had educated his men, the meaning of bratticing and doors, when he has taught them to inform of any one of themselves breaking a rule, and also the importance of quickly acquainting the proper official of any derangement in the ventilation, then I for one would think that certain application of the " Mines Regulation Act" might be applied to his colliery were he then in the same mind as he now is.

At the end of " M. E.'s" letter on the six points of record, he even goes beyond what the great Radicals have asked at home. For No. 1 and No. 2 is an interference on the method of working, and on this point it has always been thought well to leave the matter to the better judgment of the official knowing the seam and the quality of produce required by the markets.

In conclusion, I should like to ask " M. E." what benefit the Mines Acts are to England, why we in India deserve it, and why he should give into the hands of an unrepresentative Government a Radical measure?

F. W. FORSYTH.

Literary Notices.

THE ASSOCIATION OF ENGINEERING SOCIETIES.

THE Journal for October 1887 contains an exhaustive account of the " Change of Gauge of Southern Railroads"—a recent work of great magnitude performed with the least possible delay and discomfort to the public. The paper is replete with technical details, shewing much thought and mechanical ability, which can alone explain how the work was done so economically, and so quietly that the public hardly realized it was in progress. It must be noted that the " Change " affected not only the track, but the rolling stock of fourteen different roads, and was of an extent and character never before undertaken in any country.

New Books and Reprints.

ENGINEERING AND MECHANICS.

ARCHER (C. F.) Studies in Machine Design. Series 1, Elementary Examples; Series 2, Advanced Examples. Oblong. Griffith and Farran ... ... ea ; 6d

BALL (M. Powis) A Handbook for Steam Users: Being Rules for Engine Drivers and Boiler Attendants: with Notes on Steam Engine and Boiler Management, and Steam Boiler Explosions. Post 8vo. pp. 102. Longmans 2/6

BURNS (Wm.) Illuminating and Heating Gas: A Manual of the Manufacture of Gas from Tar Oil and other Liquid Hidrocarbons, and Extracting Oil from Sewage Sludge. Post 8vo, pp 68. Spons 5/

CRYER (Thos.) and JORDAN (Henry G.) Machine Construction and Mechanical Drawing, including Spur and Bevil Gearing, for the use of Students in Science and Technical Schools. 4to. Heywood ... 2/6

HOVGUARD (G. W.) Submarine Boats. Post 8vo, pp. 102. Spons 5/

KUNHARDT (C. P.) Steam Yachts and Launches: Their Machinery and Management. A Review of the Steam-Engine as Applied to Yachts; Laws Governing Yachts in American Waters, &c. 12mo, pp. 240. New York 15/

General Articles.

THE DUFFERIN BRIDGE, OUDE AND ROHILKUND RAILWAY, BENARES.

PAST AND PRESENT.

THE following passage explains our Illustration:—The Oude and Rohilkund Railway Bridge over the Ganges at Benares is a beautiful structure, its long, slim, graceful lines giving an added charm to the famous river view—an effect admirably interpreted in an adaptation of James Prinsep's well-known drawing, into which the two southern spans of the bridge are introduced —a drawing most aptly chosen as a frontispiece to the official "Description" of this latest engineering triumph in India.

COLONEL DOWDEN'S REPORT.

IN a Despatch from the Secretary of State, dated 3rd July 1879, the construction of a railway bridge across the Ganges at Benares was sanctioned as an integral part of the Oude and Rohilkund Railway Company's system; and alternative plans and estimates for a railway bridge and for a combined road and railway bridge were called for.

The site was selected by Mr. Hederstedt, the Chief Engineer of the Railway, and approved by Colonel E. Davidson, R.E., the Officiating Consulting Engineer to the Government of India, in July 1879.

The problem to be solved was the best means of crossing a river, 3,000 feet wide, with a bed, to an unknown depth, of pure sand, over which the level of water during the cold weather months was about 37 feet, rising during floods to 92 feet, with a velocity of about 20 feet per second.

The essential points to be decided in this problem were:—

(a).—The height of road-way above extreme floods;
(b).—The best combination for the utilization of the bridge, for both rail and cart traffic;
(c).—The description of pier;
(d).—The depth of foundations;
(e).—The distance between piers.

On the suggestion of the Government of the North-Western Provinces and Oudh, in order to give ample room for the free passage of boats, the height to be allowed between the highest recorded flood-level and the underside of the bridge, was fixed at 25 feet.

The height of the bridge being so great, the depth of the girders so considerable, and the right bank of the river so low, it was found to be too costly to arrange for separate platforms for cart and rail traffic. It was therefore decided that, instead of following the Allahabad-Jumna bridge type of separate cart-way, a modification of the Cawnpore-Ganges bridge type would be more suitable; and it was arranged that the girders should be made sufficiently strong to support footpaths, 5 or 6 feet in clear width, on cantilevers: and also to allow the space between the girders, to be laid with ballast, in order to enable the road at rail level to be used as a common cart-way.

These additions were estimated to increase the expenses by about 3½ lakhs of rupees, whereas a design for a road-way above the rails, would increase the estimate by 20 lakhs.

As regards the description of pier, three designs were carefully considered, *viz.*:—

(1).—Two iron cylindrical columns similar to those designed by Sir John Hawkshaw, and actually built at the Nerbudda Bridge at Broach, and for the Bombay, Baroda and Central India Railway.

(2).—Two brick wells of 30 feet diameter, surmounted by a superstructure of parallel sides and round ends.

(3).—A solid foundation block of brickwork encased in an iron shell, and furnished with three compartments, for the dredging of material, proposed by Mr. Hederstedt, the Chief Engineer of the O. & R. R.

After consultation with Mr., now Sir, Bradford Leslie, the Agent and Chief Engineer of the East Indian Railway Company, and in deference to the opinion of other officers who had had great experience in the sinking of foundations, it was held that the solid block of brickwork offered the best prospect of stability, under the especial conditions of the bridge, and that it would be less difficult to sink those blocks, than columns of iron, or brick wells. This style of design has since been successfully used for the E. I. R. Bridge at Hugli. It was considered that, in a river bed where, virtually, the only material met in borings, sunk 200 feet below low water, was sand, the point to which foundations should go down, would be determined, principally, by a consideration of the extreme limits of scour. Sand was held to be a good base on which to found a bridge pier, provided it was not subject to disturbance. It was decided that 120 feet below low water level, *i.e.*, 82 feet below the bed of the river, should be taken as the minimum safe depth at which to lay the foundations; but that this depth should be increased, if, in the course of operations, it should appear, that the bed was likely to scour to a greater depth than 70 feet below low water level. To this end soundings were ordered to be taken during extreme floods, with as much care as possible, to ascertain the limits of scour, and any movements in the river bed.

With a view to reduce expense and to avoid delay in erection, it was considered that all the large spans should be of uniform dimensions. The great difficulty attending the construction of the bridge was thought to lie in its piers, and that it was therefore most important to erect as few as possible, consistent with economy. Pending detailed calculation, spans of 416 feet, *from centre to centre of piers*, were accepted as a minimum length for the girders; and the bridge would consequently be composed of seven of these, with the railway carried between the girders, and the platform so arranged as to be adapted for rail and road traffic, with independent footways at each side. The cost of the bridge, and 5·28 miles of approaches thereto, was roughly estimated by Mr. Hederstedt at Rs. 42,52,824; and this sum was accepted, on the 20th March 1880, as the sanctioned cost of the work.

Abstract Estimate of the Ganges Bridge and its Approaches.

Item.	Description of Work.	Quantity.	Rate.	Amount.	Total.
	Seven spans of 416 feet centre to centre of piers, Railway and Grand Trunk Road on one level, piers on solid block wells			Rs.	Rs.
1	North Abutment ...	...	...	68,087	68,087
2	South Abutment ...	...	...	2,40,598	2,40,598
3	Piers	No. 6	Each 2,10,712	12,64,272	12,64,272
4	Superstructure, Girders, &c.	Spans 7	,, 2,64,217	18,49,519	18,49,519
5	River protection work :				
	North Abutment ...	...	...	55,020	
	South Abutment ...	...	...	65,625	
	Piers	No. 6	Each 6,710	40,260	1,60,905
6	Diversion of Grand Trunk Road over the Bridge :				
	North Approaches ..	--	...	11,548	
	South Approaches ..	...	...	24,295	35,843
7	Railway approaches to the Bridge :				
	O. & R. Railway or North side ...	Miles 3·22	Mile 1,20,000	3,86,400	
	E. I. Railway or South side ...	,, 2·06	,, 1,20,000	2,47,200	6,33,600
	Total Rupees...	...	...	...	42,52,824

(To be Continued.)

PAST AND PRESENT
Adapted from a drawing
by the late James Prinsep. B.C.S F.R.S.

The "STAR" Press, 19, Lall Bazar, Calcutta.

MINING ENTERPRISE IN CHINA.

By John Harris, M.E.

The Tamchow Silver Mine.

This mine is in the Huanshan district of the Quangtung Province, South China, about 60 miles from the British Colony of Hong-Kong, 40 miles from Canton, and about 12 miles due West from the Bogue Forts commanding the entrance to the Canton river.

The silver lodes are said to have been discovered by the Chinese, about 100 years ago, by quarrying operations which laid bare the side of a hill for about 1,500 feet in length by 100 feet in height, the ground surface level being 130 feet above tidal level. These operations exposed and laid bare several vertical veins in the red sandstone rock which were before hidden by the surface covering. Topographically and geologically the mine is situated at the extreme northern end of a low-lying hill of red sandstone, about four miles long by three quarters of a mile wide, the extreme summit of which reaches a height of 400 feet above the surrounding country, which embraces a large area of rice fields and water-ways comprising part of the delta of the Si-Kiang river. The country rock consists of sandstone of a deep burnt red color, mixed with a conglomeration of pebbles, cubes of diabase, quartz, chlorite and a kind of jasper. Traversing therock through the entire range of the hill are several lodes of baryta, some of which are standing up like walls or dykes several feet above the country rock which has been weathered away; in no case have these lodes shewn any indications of minerals on the surface, the veins found as exposed by quarrying, existing independent of the baryta dykes or lodes. The veins have a general bearing N. W., and S. E., varying considerably in their size and contents, from a few inches to a foot in thickness, the mineral being found in strings of baryta traversing the solid rock without any well defined walls or casing. One of these veins has lately been traced on the surface in a direct line for fully 2,000 feet; the Chinese on exposing this vein in their quarrying operations for building stone were fully alive to the value of the ore and are said to have smelted it by the old process of hand bellows, consisting of wood cylinders and plungers, blowing on a small bed of lime fixed in an earthen vessel, with a bath of lead, the ore being added gradually until the lead was fully charged, and then cupelled direct. The ore as found near the surface in a matrix of baryta, consists of zinc blende, galena, tetrahedrite antimonial silver, argentite, copper pyrites, bromide of silver, and ruby silver, sometimes assaying as high as 42 per cent of silver: the poorest of the ores are those containing copper pyrites, zinc blende and galena, which the Chinese always rejected as being too rebellious for their simple mode of treatment.

Occasionally small pockets of native silver have been met with. At one point in the vein, already spoken of as having been traced 2,000 feet on the surface, extensive old workings exist, which are now filled in, having been proved by present operations to have been carried down to a depth of at least 200 feet, by 100 feet long by 40 feet wide, in an open cut divided into seven claims varying from 12 ft. by 12 ft. to 20 ft. by 20 ft., and between each claim 6 feet of barrier of solid rock was left as a dividing boundary wall, so as to prevent disputes between the respective claimants. The width of 40 feet is explained by the old miners as being necessary owing to the number of thin cross veins, and occasional small pockets of native silver intersecting the main lodes at right angles; these were followed as far as practicable on either side or until they pinched out. The lodes followed and worked on were three, the thickest being 10 inches and the other two averaging only two or three inches each. For about 6 months every year the workings were flooded from the rains, and in the dry season,—that is from October till March inclusive,—the water was lifted out by Chinese chain pumps in vertical lifts worked by man power. All mining was done by hammers and chisels, no gunpowder or other explosive being used. These deep old workings were eventually stopped on account of the expense becoming too great in keeping the mine free of water, the influx constantly increasing the deeper the mine was worked. Some four or five other workings were afterwards opened on promising looking places of several lodes, and attained a depth of from 30 to 50 feet. These were worked till quite recently, in fact until the present owner took over the property for the purpose of developing it on more modern principles.

(To be Continued.)

PRINCIPLES OF MECHANICS.

By A. Ewbank.

III.

We have from the ancients a wise saying "brevity is the soul of wit." The more progress we make in the study of literature, the more our taste is cultivated to recognise and appreciate "good form" in the expression of ideas, the more shall we understand the excellence of brevity. If we write an essay on any subject—be it religious, social, literary, scientific, or political—and that essay is to the just critic irreproachable in form; it will have been modelled on that old and deep saying "brevity is the soul of wit." There will no where be one word redundant; no one word can be spared without weakening the presentation of some fact or the embodiment of some belief.

But suppose that this essay whose literary form is perfect were read as a lecture or were delivered as a speech. Let the audience be composed of men who have had no previous special training on the subject of the discourse, but who possess minds of average capacity and are wishful for information on the subject. Then this essay as a spoken word will be a comparative failure.

No lecturer will gain reputation *as a lecturer* from delivering a multitude of such discourses. He may indeed gain reputation as a thinker—his discourses being presently printed and studied in print by his disciples. But as a lecturer, who instructs as he speaks, he has not won his spurs.

Still less could he, as a would-be orator, be judged to have achieved success.

His exposition is too condensed, it is not sufficiently exposed. The man who has a genius for oratory, and who sets himself by thinking and by practice to perfect this natural gift, must place before his eyes an ideal very different from that which we have delineated as the proper ideal for the writer. The capable orator is never far ahead of his audience. They anticipate what he is going to say, his art leads them so to anticipate. They feel their own thoughts at times outrunning his conclusions and they wait excitedly for his definite words to measure out their overflowing conceptions. These listeners are to the speaker like a cheering crowd that accompanies a popular hero. Some of his admirers march with him —steadily keeping abreast; others may hasten on in advance and then halt for him to come up. When the orator reaches some great conclusion, the crowd have already taken possession. There applause is less the delighted apprehension of a new truth than the vociferous welcome to an old fact.

This orator indeed has reflected to some purpose on the principles of social mechanics. He knows how to drive a new idea or a new plan of action into the mind of the masses.

Now between these two ideals—that of the writer who writes for posterity and that of the orator who speaks to the question of the day—we have an intermediate ideal—that of the populariser of the results of scientific research. Since he does not speak but writes he needs less redundancy of illustration, less cautious preparation of the minds of his readers, than is necessary for the speaker who should leave no doubts behind him, who must carry his audience with him at the pace his speech prescribes.

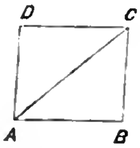
The reader of a book can pause over a sentence, he can, so to say, call a halt till the difficulty is fully surmounted. Meanwhile his teacher and guide, the writer of the book, is standing waiting—standing silent and patient —till his disciple is ready again for the march onwards.

As in the first of these papers on mechanics experienced mechanicians were "warned" not to read, it is tolerably certain—human nature being what it is—that experienced mechanicians have carefully read every word. And possibly some of them may be ready to criticise the writer for spending too much time and space over the very elements of the subject. But the fact is that an expert in any science usually forgets the slowness of apprehension which marked his first attempts to grasp its priciples. He forgets his former ignorance and helplessness as he forgets the days of his infancy.

In the first article we arrived at the conclusion that two forces, each of 1lb. acting at right angles produce a resultant $\sqrt{2}$lbs. Now this quantity $\sqrt{2}$ is apt to puzzle a beginner. We do not usually hear that a packet for the post weighs $\sqrt{2}$oz.—or that a man requires $\sqrt{2}$lbs. of food or that a steamer takes $\sqrt{2}$ days to work through the Suez Canal. Hence, when a student finds that he is not only required to apprehend a force with the same numerical accuracy as he might define the length of a wall, but is, moreover, told that this force must be thought of as being $\sqrt{2}$lbs.; he is likely to fear that we are leading him into an unreal world. He thinks his teacher may be using a logic which though unassailable is transcendental; and that the conclusions he may thereby reach are little adapted to this commonplace work-a-day world. Or, to use a foolish but common enough saying, the new science may be true in theory, but it is not true in practice. To prevent the student acquiring this distrust of the reality—this distrust of the "practical" use—of our science of mechanics; we hastened to shew that though $\sqrt{2}$ does indeed present itself at an early stage of our inquiries we can still get approximate mechanical results in the more familiar guise of such quantities as 7lbs. or 10lbs.

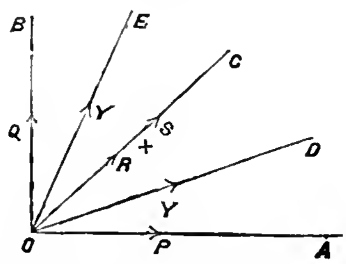
When we add for the student's information that if forces of 7 and 7 give 10 this number 10 is not quite accurate and that we cannot tell him the exact quantity; the student instead of being discouraged by our apparent inability to be rigidly exact, is rather encouraged thereby. For a "touch of nature makes the whole world kin." Imperfection is a note (as Cardinal Newman would say) of all things human. The mere idea that mechanics are or may be also imperfect predisposes the student to believe that they also are real, that they are or may be useful. By their imperfection they cease to him to be inhuman, or what is as bad, superhuman. It may however be observed that it is no special characteristic of the most sublime mechanics to introduce such quantities as $\sqrt{2}$ or $\sqrt{50}$. Let us measure with care,

Fig 12



see *fig* 12, a line A B one foot long. On this line draw with care a square A B C D. Then let us try and find by measurement the exact length of the diagonal A C. We have A B=12 inches, and it is highly probable that the student who measures A C with his yard measure will conclude it to be 17 inches exactly. Its real length is less than 17 by a certain very small quantity. The real length is greater than 16·970 inches and is less than 16·971 inches. If A C be called 17 inches the error is less than ·03 or $\frac{3}{100}$lbs. of an inch. The real value of A C is $\sqrt{288}$ or $12\sqrt{2}$, and $17^2=289$. And yet it is clear that the length of A C must have some definite value whether we can assign it or whether we cannot. If, however, we are not dismayed by these "surd" or "irrational" quantities, as even the mathematician describes them, we may endeavour to get a close idea of the real resultant of two equal forces at an

Fig 11



angle of 45°. In *fig* 11 (which is re-produced) we may suppose P, Q, R, and S to be each 1lb. Then P and Q give exactly $\sqrt{2}$ along O C and we have P and R giving y along O D and Q and S giving y along O E. Finally y and y give some force along O C. Now if at 45° 1 and 1 give y then at 45° must y and y give y^2. This final resultant y^2 must$=R+S+\sqrt{2}=2+\sqrt{2}$; therefore $y=\sqrt{2+\sqrt{2}}$. This is an exact formula; but it does not convey any clear idea to the mind of the beginner. Instead of giving him the answer outright it simply instructs him how he may find, or try to find, the answer. First, it says, find if you can the value of $\sqrt{2}$. Well this, by guess-work, or other means, we may find to be greater than 1·4142 and less than 1·4143. Therefore, getting again into approximation, we put $\sqrt{2}=1{\cdot}4142$. Then $2+\sqrt{2}=3{\cdot}4142$, and then again by guess-work or a method in Arithmetic, or by using logarithms, we find that y is greater than 1·84 and less than 1·85. This is the resultant of two forces, each equal to 1lb. and acting at 45°. Therefore if the component forces are 10 and 10 the resultant lies between 18·4, and 18·5 or if the components are 100lbs. and 100lbs. the resultant may be put at 184lbs. with an error of less than 1lb. A closer approximation *i.e.*, a pair of closer limits could if desired be obtained. Thus we always come back to approximation when we need to *realise* our results.

(To be continued.)

INUNDATION CANALS.

Down-stream Protection for a Flood Regulator.

The canal over which this Regulator has been built has been perennial for 9 years out of 11. From June to September the ordinary discharge is from 900 to 1,000 cubic feet per second, the depth of which being 8 to 9 feet, and the average fall about 1 in 5,000.

The bed here has never been graded, because it is scoured out below spring level, and never wants silt clearance, so it was difficult to know at what level to put the crest wall. It was better to be on the safe side and put it too low. *Figs.* 1 and 2 give an idea of the Regulator as it was designed and *figs.* 3 and 4 as it was actually built. The means for unwatering bridge pits were very slender. There were three lift pumps of the simplest form, a couple of Persian wheels worked by hand and some trays for spooning up the water as it were.

The spring level never went below R. L. 59·06 the whole winter, so it was found impossible to lay the flooring and crest wall at the designed level. It was also not possible to arch the well blocks of the foundations, and those carrying piers and wing walls had to be corbelled in at a higher level.

The design provided four lines of crates filled with brick blocks and *bedded* on two layers of fascines for the protection of the Regulator from any scour hole that might form on the down-stream side. It was difficult to lay the flooring though the flooring was divided into three compartments by cross well blocks and each compartment separately worked at night and day till completed. As the area for crate protection was much larger, and the depth to which it would be necessary to go to lay the fascines was much greater, the crate protection had to be abandoned.

In place of the crate-work of *figs.* 1 and 2, the so-called pile wells and intermediate pitching of brick blocks of *figs.* 3 and 4 were used. The pile wells were made cheaply; so the fracture of one or more would have been of no consequence and could have been easily remedied.

Down-Stream Protection as executed.

Fig. 3.

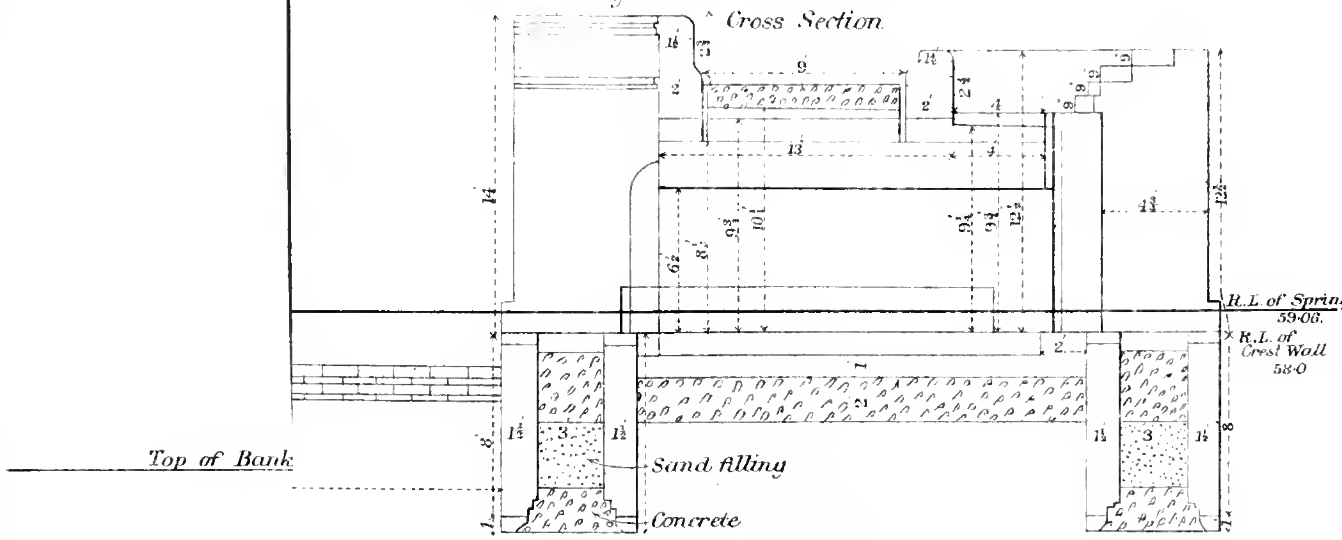
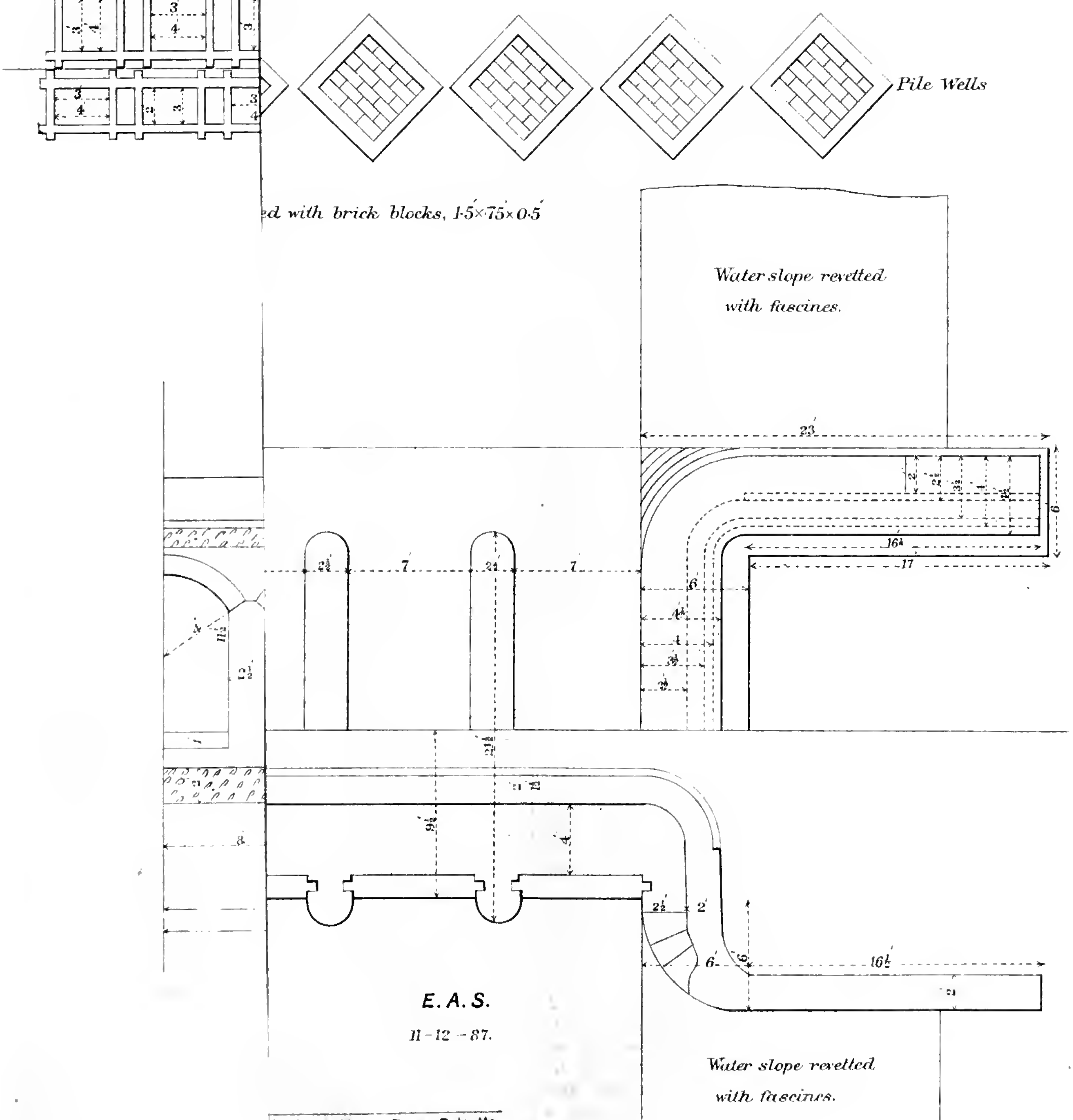


Fig. 4.



E. A. S.

11-12-87.

R" Press. (P ... Bazar Calcutta.

They had rough curbs of poplar wood and the sides were only one brick or 9″ thick set in lime mortar. To prevent bulging in rough frames of wood, one course in thickness was put in at every 2·0 feet in height. They were put through the running sand without the slightest trouble at a nominal cost. The pile wells were packed with blocks. The space between them and the Regulator was cleared as deep as possible and covered with blocks laid flat. The effect of placing the pile wells diamond fashion is to comb the stream, whereby the scour hole is lessened in depth and thrown further down stream. Apart from the exceptionable circumstances of the case, the pile wells will be found cheaper than crates.

E. A. S.

KOREISHI ; *December* 11, 1887.

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XIX.

Honey-comb Brickwork in Lime Mortar.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—		Variable.	Do.	Do.
Bricklayers No. ...	$1\frac{1}{4}$			
Do. " ...	$2\frac{1}{2}$			
Coolies " ...	3			
Do. " ...	1			
Do. " ...	3			
Bhistie " ...	1			
Grinding Mortar, c. ft.	15			
Sundries	...			
Materials.—				
Bricks No. ...	870			
Lime in powder, c. ft....	7·2			
Sand, dry " ...	7·2			
Surkhi " " ...	7·2			
Scaffolding	......			
Sundries	......			
Petty Establishment	......			

Note.—The above detail will cover cost of either rectangular ½ brick spacing, or lozenge shape honey-comb.

VICTORIA.

(*Expressly for* INDIAN ENGINEERING).

IN this colony there is no difficulty whatsoever in obtaining a subject to write on as the works going on are legion, but in the selection rather lies the rub, especially as everything is carried on at so much a higher pressure than in the East.

The Railway contracts let to-day for the extension of the Western line beyond Teiang are highly important, giving as they do the privileges of railway communication with the metropolis to the only two of the Western outposts that are not already personally acquainted with the snorting of the iron horse. Geelong has had railway communication for many years, and so has Portland for the last 10 years, while the completion of to-day's contracts will give similar favors to Warrnambool and Belfast, leaving only 90 miles of coast line unprovided with a railway. These lines have been divided into 3 sections, all of which are to be completed at the same time, *viz.*, 1st February 1889. None of the country passed through is difficult and consequently the earthworks are comparatively light, the heaviest being on the 1st section from Teiang to Warrnambool, a distance of 30 miles 3 chains, where half a million cubic yards of earth have to be shifted. The ruling gradient is that prevalent on our Victorian lines, *viz.*, 1 in 50, while the sharpest curve has a radius of 20 chains. The deepest cutting is 40 feet and the highest bank 29 feet. The principal bridge is over the Hopkins river at Allansford near Warrnambool, it having 19 openings of 20 feet each, while further back up the line we have a bridge near Panmure over the Even Creek of 35 openings of 15 feet each, and another over the Cudgee Creek with 27 openings of similar span to the last. Altogether there are 26 bridges and 120 culverts. This line passes through some very fine country, a considerable portion of which is, however, in large holdings ; but the construction of the line will increase the tendency already evident of subdividing Western grazing properties into agricultural lots. Garooc, Panmure, Cudgee Creek and Warrnambool are the places marked for stations, but as traffic increases no doubt others will be provided.

The second section, although short, is very important, passing as it does through the celebrated Farnham survey and connecting Warrnambool with Keroit. This line is 9 miles 11 chains long, and will necessitate the removal of 135,000 cubic yards of earth. The principal cutting is 19 feet deep at Albert Street, Warrnambool, and the highest bank 15 feet high. The Merri river is crossed at Dunnington by a bridge of 44 openings of 15 feet each, there being only three other bridges and 48 culverts. There will be a station at Dunnington and at Keroit where the northern line from Rushurt will come in.

The final section of this important line, which will join Melbourne and Port Fairy with bands of steel, is 11 miles 4 chains from Keroit to Belfast, the earthworks being very light, only about 150,000 cubic yards. There will be a curve on this line at the Keroit junction with a radius of 15 chains, the sharpest otherwise being 40 chains as is also the sharpest on the 2nd section. The deepest cutting is 13 feet and the largest bridge has 7 openings of 17 feet spans over the Moyne river outside Belfast. There being a number of small water-courses on this line, 21 other bridges will be required. Besides the terminal station two intermediate stations will be provided. Bloomfield Brothers' tender of £110,000 was accepted for the principal section, *viz.*, Teiang to Warrnambool, being at the rate of about £3,662-1-7$\frac{3}{4}$ per mile.

The Victoria Pier, S. Kilda, a sketch of which I enclose, is among the comforts provided for those who resort to the seaside for health or pleasure. The company who purpose constructing, maintaining and managing this recreation pier has secured a site from Government on the foreshore on a lease for 21 years. It will be projected from the Military Road at its junction with Lower Esplanade nearly opposite Robe Street, whence it will rise by an easy gradient to an elevation of 20 feet above high water mark. It will be about 1,500 feet long and 30 wide, and will terminate with a head containing 1,700 superficial feet area. The frame-work of the pier will be iron, the deck will be floored with *kauri* or pitch pine. Upon the head of the pier there will be a handsome pavilion capable of seating 1,000 persons, a band-stand, concert platform, and refreshment rooms, with ornamental kiosks at intervals along the promenade. A jetty or landing stage will be also attached to the pier head for the convenience of ferry steamers plying between Sandridge, Williamstown and Brighton.

The following notes may be interesting : 10,000 to 15,000 persons attended fireworks in Melbourne for several weeks consecutively. Average attendance at football matches estimated at 30,000.

20,000 persons visited Williamstown to inspect the *Nelson* and *Orizaba*.

∴ Attendace anticipated—

8	Public holidays	... at 5,000 each	...	40,000
52	Sundays	... " 2,000 "	...	104,000
52	Saturdays	... " 1,800 "	...	78,000
253	Other days	... " 500 "	...	126,000
365		Total	...	348,000

Income.	£	*Expenditure.*	£
348,000 at 6*d*.	8,700	£ 25,000 Debs. at 5 p.c.	1,250
Reserved seats	1,000	Bench	2,800
Rents	1,000	Gas	800
Advertising	500	Rent and Taxes	100
		Insurance	200
	11,200	Maintenece and cleaning	1,000
		Toll takers	300
		Directors and Managers	500
		Office rent and expenses	150
		Advertisements	200
		Sinking fund	500
			7,800
		Balance of profit	3,400
			11,200

∴ Profit = 13½ per cent. full on share capital of £25,000.

It is proposed to erect a new building for the Houses of Parliament in Sydney. The site is to be in the Domain facing Macquarie Street between Governer Bourke's statue and the present buildings and the preliminaries are hoped to be so far advanced by the time the centennial festivities occur that the foundation stone may be laid on that occasion.

Victorian Mines.—The Secretary of the Mines Department reports that during 1886 45 miners lost their lives through causes attributable to want of ordinary care and foresight. The Ballarat district has the largest number, *viz.*, 18, Sandhurst 13, Castlemaine 6, Maryborough 3, Gippsland 2, Beachworth 1, and Ararat 1. Average number within the last 18 years has been 58·23 per annum. The mean number employed last year was 23,361, so that there was one death per 576. The report contains descriptions of the various new apparatus used for gold saving, and improved methods of treating auriferous ores—the Newberry Vautin, the Hungarian, and the Designolle processes. The results of experiments of Mr. R. D. Oswald of Maldon prove the advantage of burning the quartz before crushing, the same kind of quartz yielding 3cwt. 14grs. per ton more gold when burnt, or about 14*s*. 6*d*. per ton. The extra cost of calcining was 6*s*. per ton, leaving a profit of 8*s*. 6*d*. per ton, besides the wear and tear of the crushing plant is considerably less and the stone is reduced in quantity. New rules are published for examining boilers and constructing them, with reports on the various methods used to save incrustation. An hydraulic test of 80lbs. per square foot is to be the least recognised. The report also furnishes the latest information as to gas producers and recuperative chambers which are being extensively used in England to economise the consumption of fuel. The best results obtained for economy of fuel are those attained by the St. Mungo Company at Eaglewick, which has at work one condensing engine driving 30 stampers, Hawley percussion tables, tailing and water pump, two high pressure combined winding engines, one engine to drive a dynamo giving 34 lights, 16 below and 13 above. The company crushes 430 tons of quartz per week, passing it through gratings having 144 holes to the square inch. This quartz, together with mullock of 45 to 50 tons is hoisted from depths varying from 400 to 950 feet. They also bail 200 tanks of water per week, each tank holding 230 gallons. They have 3 boilers working at a pressure of 50lbs. per square inch and the total consumption of firewood (box) is 53 tons per week. The Government are recommended to institute a system of licensing the stock brokers so as to prevent buying and selling on spec, that is, the broker agrees to purchase or sell on a price to be fixed now, a certain number of shares in a Mining Company, delivery of shares to be made at a future date, say three months hence. This opens the door to fraud and is often the cause of the Bulling and Bearing that takes place, whereby stocks are suddenly and abnormally enhanced or depressed in value. Some stock exchanges have already issued rules to prevent this, but as these are not binding on non-menbers, nothing but an Act of Parliament will suffice.

FRANK W. THOMSON.

BOMBAY.

(From our own Correspondent.)

WHEN, not long since, about 15 tons of dynamite exploded near Quetta, a good deal of nonsense was written by the *Pioneer* relative to nitro-glycerine compounds in general and dynamite in particular. Your contemporary said that if another similar explosion occurred in India, it would be incumbent on Government to take steps to stop altogether imports of dynamite and similar explosives, in the interests of public safety. But as a matter of fact, pure nitro-glycerine compounds are harmless and none but pure compounds are allowed to pass the Customs in India, the Chemical Analysers to Government testing them with the greatest care. The explosion near Quetta was caused by carelessness and neglect and was in no sense due to the imputed deadly properties of dynamite. A fire had been smouldering in the vicinity of the place where the compound was stored, the wind blowing in the direction of the magazine and there can be little doubt that a spark caused the mischief.

About that time it was reported that a quantity of dynamite was in a very bad condition close to Kach, where the explosion above-mentioned occurred, and fears were entertained that another explosion would take place. It was said that the dynamite was exuding, and grave apprehensions were expressed of impending disaster. Nobody would go near to, or handle the stuff, and the officials were on the horns of a dilemma. Major Carré-Carter, R.E., was ordered to hold himself in readiness to proceed to Quetta to examine and report on the condition in which it actually was. Fortunately Mr. John Harris, of the firm of Messrs. Nobel's Explosives Co., returned quite recently from Japan to Bombay and placed his experience at the disposal of Government. He proceeded to Quetta with Major Carré-Carter and carefully inspected the dynamite with the result that the scare was proved to have no grounds for existence whatever. The dynamite (656 boxes) is in as good a condition as when it was imported, and a load has been removed from the minds of the officials. Major Carré-Carter and Mr. Harris are now on their way back, rejoicing.

The Bombay Municipal Corporation have sanctioned the appropriation of Rs. 1,23,733 from the surplus revenue of last year to provide for the cost of the full metalling of various roads, at the rate of eight annas per square yard. These repairs are much needed in Bombay, the thoroughfares of the City being generally in a condition very far from satisfactory. Indeed, the sum mentioned is considered as far short of requirements in this connection, and many roads, not included in the list for repairs, are in greater need of them, than those roads which are so included.

Should the Select Committee of the Legislative Council now at work upon the revised draft of the Bombay Municipal Bill introduce the clause, which it is said they intend embodying therein, to the effect that the height of any new building shall not exceed one-and-a-half times the width of the street on which it is built, a considerable flutter in the dove-cots of local City-fathers may be expected. The question at issue like all questions has two aspects. Admittedly there is a ridiculous disproportion between many streets in the native town and the houses on either side of them. But, if, when these houses are rebuilt, their height is restricted to the proportion mentioned, where can the vast population find other accommodation. Again, land every year is materially increasing in value, so that the question is fraught with serious issues. The average width of some streets in Bombay is less than 20 feet, the height of the opposite houses being for the most part quite 50 feet. This will give an idea of the sweeping nature of the measure now in contemplation.

A very interesting book on Cotton Spinning by Mr. R. Marsden, has lately been published. According to Mr. Marsden, the best evidence yet obtained points to India as the birth-place of the manufacture, and he ascribes to this country the honor of having first invented mechanical appliances to aid in the manufacture of the fibre. He estimates the number of spindles (excluding doubling spindles) in Europe, the United States and India, at the present time as being 80,000,000. This total is made up as follows :—

Great Britain	... 42,000,000,
Continent	... 22,000,000,
United States	... 12,750,000,
India	... 1,750,000,
Other countries	... 1,500,000,
Total	... 80,000,000

For a very long time the cotton industry in this country languished, while it took a large developement in Europe and America, chiefly due to the improved machinery employed in the two last-named countries. But the peculiar conservatism of India is gradually dying away and without doubt the time is not far distant when a modification of the above figures, much more to the advantage of this country, will take place. The new mills which are now constructed, employ the best machinery obtainable and there are many people who confidently anticipate the time when Indian mills will not only be able to supply all the requirements of the native populations, but will also be able to obtain a footing for their manufactures on the home and American markets, as they have already done in the far east. The cottons of India are comercially known as Surats, and are generally, says Mr. Marsden, characterized by the names of the localities in which they are produced, the best known being the Dharwar, Broach, Oomrawuttee, Dhollera and Hinganghat. There is an appendix to the book under reference, on Steam Boilers and Engines, which contains much that is instructive. Regarding oil consumption the writer says :—"It has been found that one pint of oil will suffice for each indicated horse-power as many as 5,000 hours in favorable cases, the best results being obtained from beam engines ; 2,000 to 3,000 hours being a fair average duration of a pint per horse-power, the expenditure of tallow per horse-power at the same time being at the rate of a pound in about a third to a fifth of the same time." He further says, with reference to Mechanical Stokers : "The question of stoking by machinery is an open one. I know of many successful stokers, and also of many the very reverse, and would not like to express any general opinion on the matter. So much depends on environment in this matter that nothing but an inspection of the whole surroundings of a boiler to which it is proposed to apply stokers will suffice to arrive at a proper conclusion."

The monsoon is still several months distant, but some of your readers may not think it premature to be informed that an excellent asphalte or mortar waterproofing for damp walls or other surfaces can be made of coal tar as the basis; clay, asphalte, rosin, litharge and sand being added. It is applied cold and is extremely tenacious and weather-resisting. The area to be covered is first dried and cleaned, then primed with hot roofing varnish—chiefly tar. The mortar is afterwards laid on with trowels, leaving a coat $\frac{3}{8}$ inches thick. A large area is then coated with varnish and sprinkled over with rough sand. To frost or rain this mostar is impervious. The cost is 5 annas per square foot and for large quantities 4 annas. In the case of stone walls the following ingredients, melted and mixed together and applied hot to the surface of stone, will prevent all damp from entering, and vegetable substance from growing on it, *viz.*: $1\frac{1}{2}$lb. rosin, 1lb. Russian tallow, 1 quart linseed-oil. This simple remedy has been proved upon a piece of very porous stone, made into the form of a basin, two coats of this liquid on being applied caused it to hold water as well as any earthenware vessel.

The mornings and evenings in Bombay are becoming cool and pleasant. I was up in Khandalla a few days since, and found the weather there delicious. News of local interest is very scarce at present.

XENOPHON.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, December 10, 1887.

Upper Burma.

With reference to *Burma Gazette* Notification, dated the 17th August 1887, for the words "on the afternoon of the 16th instant" *read* "on the afternoon of the 20th instant from Calcutta."

With reference to the above Notification Mr. H. J. Richard, Superintendent of Works, Upper Burma, reported his return to Calcutta from privilege leave on the forenoon of the 17th November 1887.

Madras, December 13, 1887.

The following promotions are made :—

Mr. C. M. Smith, Executive Engineer, sub. *pro tem.*, 3rd grade, to be Executive Engineer, 3rd grade, permanent rank, with effect from 4th October.

Rai Bahadur S. Subharayachariyar Avargal, B.C.E, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 4th October.

Mr. A. B. Todd, Executive Engineer, sub. *pro tem.*, 4th grade, to be Executive Engineer, 4th grade, permanent rank, with effect from 4th October.

Mr. C. J. Usher, Executive Engineer, temporary rank, 4th grade, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 4th October.

Mr. G. E. Manson, Executive Engineer, temporary rank, 4th grade, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 4th October.

Mr. G. B. Lambert, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 24th November.

Mr. B. H. Young, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 6th November.

The following transfers are ordered at the public expense :—

Lieutenant-Colonel J. Pennycuick, R.E., Superintending Engineer, 2nd class, from charge of the VI. Circle to charge of the Periyar Project Works.

Mr. J. W. Rundall, Superintending Engineer, 1st class, from the II. Circle to charge of the VI. Circle. To join on relief by Mr. J. Hannan.

Hyderabad, December 15, 1887.

Furlough to Europe on medical certificate for six months, with effect from the 3rd September 1887, is granted to Mr. M. J Scobie, Executive Engineer, 3rd grade, sub. *pro tem.*, attached to the South Berar Division.

Punjab, December 15, 1887.

Mr. B. C. Bensley, Executive Engineer, 4th grade, temporary rank, is transferred from the Peshawar to the Dera Ismail Khan Provincial Division.

Captain H. E. S. Abbott, R.E., Executive Engineer, is, on return from furlough, posted to the Peshawar Provincial Division.

Mr. C. Roberts, Assistant Engineer, 2nd grade, attached to the Kohat Provincial Division, passed, on the 8th November 1887, the colloquial examination in Hindustani prescribed in Public Works Department Code.

Bombay, December 15, 1887.

The following officers have passed a colloquial examination in Kanarese, according to the standard laid down in the Public Works Code :—

Rao Bahadur P. P. Chadanani, L.C.E, Executive Engineer, 4th grade.

Mr. F. L. Spratt, Assistant Engineer, 1st grade.

In consequence of the return to duty of Mr. S. Rebsch, Mr. G. O. W. Dunn will revert to Executive Engineer 4th grade, with effect from 12th October 1887.

Mr. S. Rebsch will resume the rank of Executive Engineer, 3rd grade, sub. *pro tem.*, which he held when he proceeded on leave, with effect from the above date.

N.-W. P. and Oudh, December 17, 1887.

Irrigation Branch.

Mr. G. T. Barlow, Assistant Engineer, 2nd grade, is transferred from the Bulandshahr to the Northern Division, Ganges Canal.

Central Provinces, December 17, 1887.

Privilege leave for one month and twenty-eight days is granted to Mr. W. Donkin, Assistant Mining Engineer, Warora Colliery, with effect from the 14th November 1887.

With reference to Government of India, Public Works Department, Notification dated the 28th October 1887, Mr. H. W. Clift, Excutive Engineer, reported his arrival at Bombay on the forenoon of the 5th instant, and at Nagpur on the forenoon of the 7th iostant, and is attached to the Chief Engineer's office on special duty in connection with a Reconnoissance Survey.

With reference to Notification, dated the 13th August last, Mr G. M. Harriott, Excutive Engineer, was relieved of his duties in the Hoshangabad Division on the afternoon of the 13th August 1887.

The unexpired portion of privilege leave (5th to 15th November 1887) granted to Colonel D. Ward, R.E., Chief Engineer and Secretary to Chief Commissioner, Public Works Department, Central Provinces, in Central Provinces Notification of 17th September 1887, is hereby cancelled.

India, December 17, 1887.

The services of Mr. W. H. Parker, Superintending Engineer, 1st class, State Railways, are placed temporarily at the disposal of the Government of the Punjab.

This cancels Public Works Department Notification of 31st October 1887.

The services of Captain R. C. Maxwell, R.E., Executive Engineer, 3rd grade, sub. *pro tem.*, State Railways, are replaced at the disposal of the Military Department, with effect from the 17th October 1887.

Colonel R. G. Smyth, R.E., Superintending Engineer, 1st class, is granted two years' special leave under the terms of Public Works Department No. dated 3rd October 1887, in continuation of the furlough already granted him.

The following officers are temporarily transferred to Burma Provincial Establishment :—

Mr. C C. S. Clark and Mr. J. W. L. Toozs, Assistant Enginee rs 1st grade, Nort-Western Provinces and Oudh.

Mr. P. W. Gilliland, Assistant Engineer, 2nd grade, Central Provinces.

The dates of permanent promotion to Executive Engineer, 3rd grade, of the under-mentioned officers are as noted opposite each, and not as published in Public Works Notification, dated 2nd November 1887 :—

Mr. W. R. Gilbert,—12th June 1887.

Mr. F. Sharp,—22nd June 1887.

Mr. C. C. B. Knapp,—8th September 1887.

In continuation of Public Works Department Notification dated 25th August, 1887, Mr. J. C. Mills, Assistant Engineer, 1st grade, State Railways, is temporarily promoted to Executive Engineer, 4th grade, with effect from the 9th May 1887.

Director-General of Railways.

Mr. H. L. Butcher, Assistant Engineer, 1st grade, is, on return from furlough, posted to the North-Western Railway.

Mr. T. W. Grant, Executive Engineer, 2nd grade, sub. *pro tem.*, is, on return from furlough, posted to the Toungoo-Mandalay Extension of the Burma State Railway.

Bengal, December 21, 1887.

Establishment—General.

The Lieutenant-Governor is pleased to make the following promotions in the Engineer Establishment with effect from the 30th November 1887 :—

Mr. K. H. Stephen, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*

Mr. H. H. Green, Assistant Engineer, 1st grade, sub. *pro tem.* to be Assistant Engineer, 1st grade, permanent rank.

Establishment—Irrigation.

Rai Rajkissen Banerjee Sahib, Executive Engineer, is transferred from the Brahmini-Byturni to the Mahanuddy Division.

Mr. J. T. Boase, Executive Engineer, Acquapada-Jajepore Division, is granted three months' privilege leave from such date as he may avail himself of it.

Indian Engineering Patent Register.

Specifications of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 14th December 1887.

70 of '87.—Howard Pratt Garland of San Rafael in the County of Main, and State of California, one of the United States of America, Engineer.—*For improvements relating to means for forming slivers of jute and other fibres.*

166 of '87.—William Bull of Southborough, Tunbridge Wells, England.—*For improvements in the manufacture of tubular roofing tiles.*

212 of '87.—Andrew Engle, of Baxter, Iowa, one of the United States of America.—*For a furnace for, and process of, burning wet and offensive substances.*

PATENTS, TRADE MARKS, DESIGNS.

INDIAN ENGINEERING now offers to Inventors generally the advantages of its Patent Department.

Patents procured and Designs and Trade Marks registered in all parts of the world.

The sale or working of inventions negotiated.

Correspondents or representatives in all countries.

Advertisements.

Notices.

The Office of Publication of Indian Engineering *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

General correspondence, and all communications bearing upon literary matters, should, as heretofore, be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

It is particularly requested that all letters on business concerning subscriptions and advertisements be addressed to the "Managing Agents," MESSRS. BALMER, LAWRIE & Co., 103, *Clive Street, Calcutta; and all remittances be made payable to them.*

Terms of Subscription :

	Yearly.	Half-yearly.	Quarterly.
Including Postage in India	... Rs. 12	... Rs. 7	... Rs. 4

Specimen copy—Free; Single copy—One Rupee.

Foreign Subscriptions should be converted at current exchange and postage added.

FOREIGN AGENTS FOR INDIAN ENGINEERING.

LONDON.—STREET & Co., 30, *Cornhill, E.C.*
NEW YORK.—THE SCIENTIFIC PUBLISHING Co., 27, *Park Place.*
ROME.—LOESCHER & Co.
STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*
CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*
JAVA.—G. KOLFF & Co., *Batavia.*
AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

Scale of Charges for Advertisements.

One Page.	Half Page.	Quarter Page.	Eighth Page.	Sixteenth Page.
Rs. 50 ...	Rs. 30 ...	Rs. 18 ...	Rs. 10 ...	Rs. 6.

Double these rates for outside front.

An allowance is made for continuous insertions.

THE friends of INDIAN ENGINEERING will confer a favor by letting us know when they cannot find what they require advertised in its columns, and by mentioning the name of the Journal when corresponding with its advertisers.

CONTENTS.

ANSWERS TO CORRESPONDENTS.

E. HARVEY, LT.-COL., R.E.—Thanks—in our next.

Obituary.

MAHONY.—At Royapooram, on the 20th December, Robert Mahony, Superintendent, Railway Works, Royapooram, aged 44 years.

HARDAKER.—At Bangalore, on the 9th December, George Oates Hardaker, of (Random) Leeds, Yorkshire, and for many years a resident of Mysore, Mechanic to H. H. the Maharaja of Mysore, aged 51 years.

INDIAN ENGINEERING.

SATURDAY, DECEMBER 31, 1887.

OURSELVES.

AT the close of the first year of our existence we take the opportunity of informing our readers, that the expansion of business affairs has necessitated new arrangements in connection therewith, and we have accordingly entrusted this branch of the Journal to Messrs. Balmer Lawrie & Co., of Calcutta, who will act as our Managing Agents, in regard to advertisements and subscriptions only, from the 1st January 1888.

While the foregoing paragraph speaks for itself,—not only for the present, but suggestive for the future,—we may appropriately say something regarding our career during the past twelve months with particular reference to Professional Journalism in India.

More than a quarter of a century back the Calcutta *Engineers' Journal and Railway and Public Works Chronicle* made the announcement that when a journal of its class had secured 300 *boná fide* subscribers, its success was assured. As a matter of fact, the circulation of that journal did go a little beyond that figure; but as this was due to the very liberal subscription of Government, a comparison for our purposes is futile.

So likewise the *Bombay Builder*, a contemporary of the above, never went beyond 370, but the latter journal was also, and we may say, almost solely, supported by Government.

To the credit of Government be it recorded, that in both these cases they saw and acknowledged the want, and readily came forward with help, notwithstanding the fact that no less than three engineering serials were for some period under publication at the same time in the country.

It has been our policy to endeavour to dispense with such help. We think, with others, that every journal purporting to give a free and impartial opinion on all subjects treated of, should be above any such contingency for its existence. We trusted that the Profession in India would agree with us in this, and, agreeing would do also what is requisite. Our position in the matter was further strengthened by the fact that our appearance was only in response to a call from the Profession for a representative in the public press; and we have not been disappointed, for our expectations are more than realized. Many have come forward not only by subscribing, but with contributions. The result has been so far successful that our List already contains more than 900 names, while our circulation exceeds 1,000 copies; and as regards contributions "want of space" is a regret we have often to express.

Within our own experience, the Roorkee *Professional Papers*—an *Official* publication issued under the authority of the Secretary of State for India in Council—alone approached to anything like these results, and that was when they were first started in 1863-64. But as years went on, the number of subscribers and sales gradually fell till, at the close of the publication, in 1886, there were only 122 private, and 282 public subscribers, or a total circulation of 404.

It should, however, be borne in mind that the rate of subscription for the Calcutta *Engineers' Journal*, the *Bombay Builder*, and the Roorkee *Profesional Papers* was high, which made them perhaps looked upon more in the light of a luxury than a want. The first two were published *monthly*, the annual subscription of one being Rs. 24, and of the other Rs. 30. The third was a *quarterly*, and its subscription was at first Rs. 16, and afterwards Rs. 10 a year. In all cases, however, the financial result was either *nil* or *negative*.

We appear *weekly* with a punctuality of which we may be justly proud, and our rate of subscription is only Rs. 12 per annum inclusive of postage. This low figure has enabled us to secure at least one of our objects—a large circle of readers.

But as we desire to enlarge the Journal and improve its illustrations, we must appeal to our friends to still further extend the circulation, and for assistance otherwise.

Those among our readers who have never specially examined the subject can have no idea of the great difficulty and expense attendant on the publishing of a journal of this description. Subscriptions alone will not suffice to maintain an organ dealing with matters which other journals not so professing cannot enter into. The scope of this Journal makes it aspire to become the only thoroughly useful and trustworthy means of communication between the Profession and those who supply its wants. It should prove useful alike to users of machinery, engineering and building plant, or materials, and to the engineering trades generally, including manufacturers or importers in this country.

An object has therefore been to obtain for its columns special recognition as the best medium for ENGINEERING ADVERTISEMENTS in *India*. We use the word "India" advisedly since our circulation is not confined to any particular locality or province, but is pretty equally distributed all over the country. To those disposed to cavil at our rates for advertisements, we would point out that a comparison can scarcely be made between an Illustrated Professional Journal and a general newspaper, as the relative cost of production in the former case is very much higher, while the extent of patronage is less or limited; nevertheless, the rates fixed by us will be found, after due consideration, both moderate and accommodating.

The Editor's task is accomplished. His trouble and anxiety has been rewarded in the establishment of a Journal which is now acknowledged as the representative of the Engineering Services of the country.

In expressing his obligations to the Profession at large for the encouragement and valuable aid given him in the undertaking, he should explain that the substantial return which usually reimburses those who labor for the Fourth Estate has not been his. But he does not complain. A fond hope has been realized, for which he begs to acknowledge once more the help he has received from every branch of the Profession.

The Journal is now able to dispense with his immediate attention, and, after the tax on his undivided time by the heavy grind, single-handed, of the last fifteen months, he wants a respite—if he can get it. He would, therefore, be glad to make over his work to other and, it is hoped, abler and better hands. His interests are identified with the Journal, and he will always be watchful to prevent aught that may negate its special aim or derogate from its established character. Under any circumstances, it will continue to do as it has done—maintain its policy—and prove in every way worthy of the support of its constituents.

THE SO-CALLED PUBLIC WASTE DEPARTMENT.

THE Viceroy, in his amusing speech at the opening of the Dufferin Bridge, touched a responsive chord in the hearts, or at least the pockets, of Income Tax-payers, when he said that Engineers seemed to consider the supply of funds unlimited.

It is also a widespread public opinion that P. W. D. stands for Public Waste Department, and in the face of such transactions as the Sind-Pishin scandal it would be hard to deny that there is much ground for this belief.

But we would recommend to His Excelleny, or rather to the new Minister for Public Works, a careful investigation into the extent to which the much maligned Engineer is the cause of this extravagance.

Taking the latest and most colossal waste of public money, the Sind-Pishin scandal, it would appear, that as an investigation has been held, and none of the officers concerned have been even reprimanded, the Government are of opinion that the Engineers are not to blame, and everybody acquainted with the history of this unhappy line will agree. A great deal of mud has been thrown, and things have been written and said, that were not justified, about the causes of this extravagance, but even if it were admitted that General Browne was the most extravagant man in the P. W. D. and his staff entirely ignorant of work, still the percentage that would have been saved by the most economical Chief and experienced staff, would have been almost imperceptible, in the financial crisis caused by the action of Government, or, to be more precise, the Home Government, to whom this waste is directly due.

The Indus Valley was avowedly constructed as a political line, yet beyond collecting 20 miles of permanent way at Ruk, nothing was done towards one of the most important parts of it till 1879, when it was discovered that a line must be made at once, to what particular place was not known; but it was hoped that a suitable terminus would turn up. Hence the first named, Sukkur-Dadur Railway, so called because it did not start from Sukkur nor go to Dadur.

Just at that time, 1877-79, rails were very cheap, and it would not have been a bad investment to have got out the permanent way for any possible length of line, ready to lay when required. Instead of this, old rails were raked up from the four corners of India and railed up to make this line, until their carriage came to more than they were worth when new, and of course the effect of this sudden rush, combined with the demands of the Military Department, was to double the rates of every thing.

Then the enterprise got to be called the Kandahar State Railway, and its progress in that direction and subsequent abandonment will be fresh in the minds of our readers. Thus the time was wasted from 1880 to 1885, when after a preliminary struggle as the Hurnai Road, the old sore broke out again and the line was to be pushed through at any cost. Had the work been carried on steadily from 1879, and no pressure put upon the constructors, we believe it would have been finished by the same men for half the cost, for it must be remembered that not only were rates increased by the imperative necessity of getting the work done at any cost, but these demands were always synchronous with those of the Military Department, in itself no light strain upon a thinly populated country, and one where all except purely agricultural labor is not to be found.

Nor were these extravagances of administration confined to this line; the upper section of the Punjab Northern which could easily have been completed years before, can shew some pretty little extravagances, which however are not so generally known.

In a quieter way, the Government contrived to waste a good deal of money over the Indus Valley. Here we have a line, begun in 1869, and allowed to drivel along till it was opened in 1878 with a rush, for Military traffic, and to this day the bridge over the Indus at Sukkur has not been completed, whereas to ordinary minds it should have been the first work to undertake, as a railway with a bit left out of the middle is not of much use in a military crisis.

The enormous time taken over this line was not due to any natural obstacles, but to the imbecility of the financial arrangements, which allotted funds enough to occupy the Engineers about half the year, and forced them to waste money very often to "utilise the grant" by March 31st as they would get no money next year. Truly April 1st is an appropriate date to work from. We know of instances where green bricks perished and fuel rotted, because money could not be given to bring the two together in the kilns, and when it is remembered that this has been done in many places, and sorely against the will of the Engineers, it would seem that they are not the only people who are responsible for the waste of public funds.

Is it necessary to explain to such an intelligent and exalted body as Government, that if you do your work steadily with regard to the natural seasons, and can command it by pushing, when labor is cheap, and hanging back when it is dear, you can do it far cheaper and better, than by any reference to April Fool's day, by which the money must be spent, that has been given a month or two before, and for want of which during the previous six months, the work was stopped and the men scattered.

It is the business of the Financial Department to settle these affairs. We merely point out the facts, and venture to say that any Engineer in Government employ would be very glad to have the money that he has been *compelled* to waste in Government work, and which he would not have so wasted had he been a free agent.

How often do Engineers in sending up a project, ask that timely sanction may be given in order that they may collect material and have the whip hand of the labor, yet sanction is withheld from financial or other considerations, until orders are sent down to do the work in something less than no time.

Judging from the numerous advertisements that appear, it looks as if Government intended to make a "corner" in work for Military Defences. As tax-payers we earnestly hope that they will sanction all they intend to do, and tell their Engineers to spend as much as they conveniently can and no more. They need not be afraid the work will not progress, and the financial result will be satisfactory.

The Viceroy's words were spoken in jest, but they form an appropriate text for the consideration of a very serious subject.

THE TIRHOOT STATE RAILWAY.

INDIAN Railways have taught untutored Indian peoples very many knowable things, very many useful facts. The modern schoolboy knows them by heart; and we are not going to recapitulate them. But it is worth while noticing here, *àpropos* of the last issued Progress and Administration Report on Railways in Bengal that the responsible managers of the Tirhoot State Railway did not find out for a long while after inception of the line they had governance of that cheap rates for carriage of goods and passengers induce local traffic and travel. It happened therefore that when they did reduce their rates, in accordance with true principles of railway economy and the spirit of the times, they found that they had counted without their host, and were "somewhat impeded at first by the insufficiency of passenger stock." However, traffic rates for goods were decreased; and have resulted in improvement both in the quantity and quality of the goods carried. As to passenger traffic we are told that a steady increase has been developing in the passenger traffic of the Tirhoot State Railway since a third-class passenger rate of $1\frac{3}{4}$ pies per mile was introduced. Wisdom, in short, is fulfilled of this child. The writer of the Report we have taken for text thinks that this aforesaid passenger traffic has increased in "an extraordinarily rapid manner." That is to say specifically that 1,761 thousands of third-class passengers were carried during the year under review in the Tirhoot State Railway's carriages. as against 655 thousands in 1883. Not a bad result for a very backward bit of Gomarh-land. Of course, other causes over and above the lowering of rates have helped towards this result, though the writer of the Report does not seem to be aware of it. Neither need we be perhaps, whilst prospects are rosy, and rainfall abundant, and pilgrimages frequent.

With regard to the future it was expected when the writer of the State paper we received the other day, put pen to paper that the opening of the new Gunduck Bridge would have the "important effect" of producing an interchange of traffic between the districts served by the Tirhoot State Railway, and those served by the Bengal and North-Western Railway. Probably it has. One and one joined together usually do have the "important effect" of making four, we have heard.

The Tirhoot State Railway was severely tried by floods during last year's rains, but stood the test in a way that reflects great credit on the engineering staff responsible for its construction. Only one culvert failed to respond effectually to the severe extra call made on the line's power of resistance. It remains to be seen how the new Tiljoga bridge, four 60 feet spans, will stand the impact of a mountain stream coming down upon it some fine day with a sudden, violent rush.

We are told that considerable capital expenditure was incurred upon the open line, principally in the direction of additional station accommodation, and conveniences for handling traffic. The fencing of the line made steady progress. The old broad gauge branch line across the Ganges from Barh to the river was dismantled.

During the year under review the Tirhoot State Railway only increased its length by 20 miles. The Report does not explicitly say so, but we judge from coincident evidence that this shortcoming was due to want of funds. The Report does say, with reference to the extension of the line from Baptchi to Pertabganj, the terminus of the system on the Kosi river, that "for this section it is expected that funds may soon become available." This arrangement, or rather want of arrangement, in dribbling out money for admittedly needful, useful, and more than half-finished public works is wasteful as well as stupid; bad economy from every point of view a sensible man can take of it—penny wise and pound foolish as the old saw pithily characterizes such procedure. It is surely better to borrow in an open market at a low rate of interest than it is to let your property remain unprofitable and rot, for lack of such aid to its legitimate development.

The Tirhoot section of the Assam-Behar State Railway, 13 miles in length, running from Junjharpur to Gogardiha, was rounded off during the year under review by the opening of the Gunduck Bridge, which had been a little over two years under construction. It consists of eight steel girders of 250 feet span apiece. The line on the west side of the bridge runs over a viaduct half a mile in length and joins the Bengal and North-Western Railway at Sonepur Station.

Here is an oracular delivery from the Report:—"When completed, the whole of the Assam-Behar section of the Assam-Behar State Railway will form an integral part of the Northern Bengal State Railway system, with which its capital will be amalgamated. Whether the traffic of the western end will tend towards the East Indian Railway, or *viâ* the Northern Bengal line to the Eastern Bengal State Railway is a question which experience only can solve." Is such a question worth putting at this time? Time and tide may safely enough be left to work out their destiny on the lines appointed for them. It would be argument much more to the purpose they ought to subserve if these platitudinarian writers of reports would set their talents and energies to work on devisement of worthy and governmentally acceptable means of providing funds for Railway construction and extension.

Notes and Comments.

WANTED.—*Indian Engineering*, Nos. 2 & 3, Vol. I., Vest and Co., Booksellers, Mount Road, Madras.—*Madras Mail.*

A CHANGE—FOR THE BETTER, WE HOPE.—We hear that Mr. J. F. E. Spring is about to leave the Bengal Secretariat shortly, in order to rejoin the Railway Branch under the Government of India.

LAHORE TOWN HALL.—We are indebted to Rai Bahadur Kunhya Lal, M.I.C.E., for a neat and correct photograph of the "Town Hall" which is being erected at Lahore. It gives a correcter idea of the building and a more pleasing effect than our photo-etchings.

A LIGHT RAILWAY FROM MYAVERAM TO TRANQUEBAR.—The Madras Government are prepared to support a proposal for a metre-gauge line of the light feeder class to be constructed without a guarantee and have intimated the same to Mons. de Closets in negating his 2′ 6″ gauge scheme.

THE SOUTH INDIAN RAILWAY.—The Directors of this Company have given notice of their intention to make application in Parliament in the next Session for an Act for the purpose of extending and enlarging the powers of the Company and the objects for which the Company was incorporated.

THE AFGHAN BOUNDARY DEMARCATION.—The Boundary Commission had settled the new line up to the Murghad on the 8th instant, and the last pillar on this section was expected to be erected by the 18th. The party then marched towards the Oxus to mark the strip of territory east of Dukchi.

THE MADRAS HARBOUR.—The expenditure on the Madras Harbour Works during the official year 1886-87 (including debits to suspense heads of accounts) was Rs. 9,22,157, of which "works" cost Rs. 7,85,717; establishment Rs. 65,774, and tools and plant Rs. 70,666. The grant for the year was Rs. 10,19,100.

BENGAL-NAGPUR RAILWAY.—The Eastern terminal junction has been so far settled that preparations are now in progress for putting the work of this line in hand at once between Asansol and the Damuda, so as to facilitate the transport of materials and plant for the bridge about to be commenced across the river mentioned.

THE "P AND O." DIVIDEND.—The Directors of the Peninsular and Oriental Steam Navigation Company announce that they will recommend a dividend of 2½ per cent. for the half-year ended 30th September with a bonus of 1 per cent making, with the interim dividend of 2½ per cent. paid in June, a total payment of 6 per cent. for the year.

ACKNOWLEDGMENT.—We have been favoured with an advance proof of Selection from the Records of the Government of India concerning the Zhara Karez Irrigation Scheme, Beluchistan. This Official paper contains Mr. R. G. Kennedy's Reports and Estimates, Notes by Colonel Home, R. E., and the Views of the Government of India, on the Proposals.

THE BENGAL P. W. D. JOINT SECRETARYSHIP.—Colonel McNeile, R.E., Joint Secretary to the Government of Bengal in the P. W. D., has, we hear, been offered a year's special leave, in extension of his furlough, which is about to expire. If the offer is accepted it will make a considerable change in Bengal, as Colonel Harrison, R.E., will then stay on as Joint Secretary, possibly for good.

A WATER-SUPPLY FOR ALLAHABAD.—The City Fathers have at last decided upon a water-supply for Allahabad, and we hope that, having made up their minds so far, they will push on the scheme as speedily as possible. We believe that Mr. Kimber, Engineer to the Calcutta Municipality, will, with the sanction of that body, be asked to prepare the scheme.

THE BOMBAY EXTENSION COMMITTEE'S REPORT.—The Committee appointed by Government has at length presented its report on the expansion of Bombay. The report is very voluminous, and we are unable to say more at present than that the Committee make some important recommendations of a nature so portentous, that a generation or two would not suffice to give them effect.

THE RANGOON CATHEDRAL.—The new Cathedral does not seem to progress so fast as one would expect, but we suppose the contractors are somewhat hampered in their work, by having to import all the dressed stones for the pillars and arches from Madras. It is about time now that a clerk of works should be appointed to look after the Cathedral, as the most intricate portions of ecclesiastical work begin with the construction of the roof.

RAILWAY ADMINISTRATION.—The *Gazette of India* contains a resolution on Railway rates and fares in India. It is considerably over four years ago since the Government of India promised to issue general rules for the regulation of rates and fares on the Indian Railways, and the promise has now been fulfilled. For the present we are content to note our satisfaction that the subject has at last been dealt with in a manner befitting its importance.

THE MORVI RAILWAY.—For the satisfaction of the Executive Engineer, and Manager of this line, and for the information of our readers, we state with reference to the letter that appeared in our last issue on this subject, that the information given on our paragraph of the 12th November last, though derived from other sources, was based on a Note by the Consulting Engineer to the Government of India for State Railways, dated 4th August 1887, "on the defects of the permanent way materials and rolling-stock of the Morvi Railway."

INDIAN PORTLAND CEMENT.—We have always held that Portland Cement Manufacture in India never had a fair trial—at least so far as Bengal is concerned. We have also expressed the view that the existing conditions for producing the article economically and satisfactorily at Raneegunge are as favourable as could be desired. We are, therefore, pleased to learn that the Raneegunge works will soon be revived and in active operation under the guiding influence of Messrs. Burn and Co., to whom the country will be indebted for another industrial undertaking.

THE FRONTIER RAILWAY EXTENSION.—There were three schemes submitted to Government for extending the Kandahar Railway beyond the Khojak range. These were, by a detour of about eighty miles, a ghât railway, and by tunnelling most of the way. The last scheme was approved, and the work has been commenced. It will take nearly three years to complete. By sanctioning the extension of the Pishin Railway over the Khojak Pass, Lord Dufferin, says the *St James's Gazette,* has put the copestone on his frontier defence policy.

THE BENGAL IRON WORKS.—The swindling case at Burrakur has ended in a *fiasco.* Both the accused have been acquitted by the jury, but the Judge, Mr. Rampini, C.S., has refused to accept the verdict and has referred the case to the High Court. The Accountant was let off on the ground that Ritter von Schwarz appeared to have been careless, though what that had to do with the man's guilt it is difficult to conceive. The Cashier was acquitted on the ground that after all he ought not to be punished, as he had confessed to the crime. Moral, whenever you want to be let off by a native jury, always confess to the accusation, when you are found out!

DISTRICT BOARD ENGINEERS IN SOUTHERN INDIA.—The best paid Local Fund Engineer on the Madras side is apparently in North Arcot, where the Engineer is paid Rs. 700 a month. Besides this, he receives Rs. 100 a month from the Kangundi minor estate for services rendered by him to the zemindar. But the President is requested by Government to quote the authority under which the allowance of Rs. 100 per mensem is received by the Local Fund Engineer for his services in the Kangundi Zemindari—attention being drawn in this connection to Rule 8, Chapter IV. of the Account and Audit rules published in G. O., dated 29th June 1887, No. 1231 L.

ROORKEE AND LUCKNOW LA MARTINIERE.—An analysis of the results of the last examination for the entrance into the Engineer class at Roorkee shews that the Lucknow Martinière has passed no less than seven of the successful candidates. For admission to the Roorkee Upper Subordinate Department the Martinière sent up twelve candidates, of whom seven passed. In connection with these results, the Principal of La Martinière says, "I may mention that I have recently visited the Roorkee College and have had the pleasure of seeing no less than fifteen of our old Martinière boys hard at work under the care of Colonel Brandreth and his distinguished staff."

"INDIAN ENGINEERING."—The *Madras Times* says:—"The attention of the Government of India having been attracted by the articles in INDIAN ENGINEERING of the 30th July and 13th August 1887, on the Artesian Borings in the Sunderbands, in which a suggestion is made for their extension generally in India, the Madras Government, we hear, have been requested to invite the attention of the Presidents of District Boards, and Chairmen of Municipal Councils to those articles. It is to be hoped that the Committees of some of our larger Municipal and District Bodies will take up the hint and undertake the boring of artesian wells on the lines laid down in the articles."

A RAILWAY PROJECT.—The Chief Commissioner of the Central Provinces has called attention to a project of considerable importance. This is a scheme of feeder railways to the Bengal-Nagpur line, which will soon be running through the southern half of the province, and whose benefits, great as they will be, cannot be fully realised without subsidiary communications. In the existing state of communications much of the produce of the country will be practically almost as much shut off from a market as it was before, and it is in view of this that the Chief Commissioner has adopted the idea of the Agent of the Bengal-Nagpur that a Company of native capitalists might undertake the construction of branch lines.

ARTESIAN WELL EXPERIMENT.—Mons. A. De Closets has, for some months past, been engaged in experimental artesian boring at Karani, in the Kortalayar Valley, near Madras, and has now reached 300 feet. After reaching the depth of 200 feet Government ordered that the boring should be continued down to 300 feet. But as the prevailing opinion that the thickness of the alluvium filling up the tertiary basin of the Kortalayar could not be more than 200 or 250 feet, was belied, and as the Geological Survey think that the boring should reach the gneiss, the Government in passing orders on the subject, consider it desirable to continue the boring to a depth of 420 feet, unless gneiss is reached or water tapped at a less depth.

THE VICEROY ON THE PROFESSION.—The *Pioneer*, referring to the importance of the Viceroy's presence at the opening ceremonial of the Dufferin Bridge at Benares, adds:—"By attending such an occasion with all the circumstance of an Imperial function, the Viceroy not only impresses the natives with a new sense of the dignity of industry and commerce, and the intimate connection between English rule and India's material progress, but pays some sort of tribute at least to the merits and services of men who have always as arduous and often as deadly work as the soldier, whose services are no less important to the welfare of the country, and who yet have never the prospect of a ribbon or a medal to crown their labors."

THE BENGAL IRRIGATION INQUIRY.—The Sone Commission is leading to startling results. The native member of the Commission, Rai Joy Prokash Bahadur, the Dewan of the Doomraon Raja's Estate, has solemnly recommended that all the Sub-divisional Officers should be compelled to marry at once, or in case of the refusal of present incumbents, only married men should be allowed to hold charge in future. This startling proposal is made on the ground that the Dewan is convinced that married men would be more sympathetic with the poor ryot! The experience of the writer of this, (who, however, ever admits to the charge of old bachelorhood,) leads him to believe that the married state is rather liable to make men more morose than otherwise.

THE NEW W. I. P RAILWAY. The West of India Portuguese section of the Ghat from Collem to the frontier, a distance of 13 miles, was, on the 17th instant, officially inspected by a Commission appointed for the purpose by the Governor-General of Portuguese India. The Commissioners expressed themselves highly satisfied with the state of the line and the manner in which the natural difficulties of the Ghat had been overcome. The Governor-General's decree authorizing the opening of the same for public traffic, is expected in a few days. Through traffic between Marmagoa harbour with Castle Rock and Belgaum, Dharwar and the rest of the Southern Mahratta Railway system will commence as soon as that section of the Ghat is ready to receive it.

RANGOON GUP.—We learn, from one of our correspondents, that the workshop expenses of the Burma State Railway have been greatly reduced since its Foreman, Mr. Wernigg, returned from leave; and that under the present Loco. Superintendent, Mr. Dudgeon, who is a very practical and efficient officer, further reductions may be expected. Progress on the second section of the Mandalay extension of the Burma Railway is stopped for want of rails, which will not arrive till the middle of January, due to the bad arrangements made by the India Office. 59 miles of rails have been laid from Toungoo and 27½ miles from Mandalay to Kyoukse. Private T. Northridge, Overseer, 1st grade, lent from the Central Provinces for employment on the Mandalay Railway, died on the 9th December.

NEW DEPARTURES.—The appointment of Mr. Barrington Brown, as a geological expert, to examine and report on the Burma Ruby Mines is another blow struck at the prestige of the Indian Geological Survey by the Secretary of State. The appointment of Mr. Bosworth Smith as Mineralogist to the Madras Government a couple of years ago was something worse. The former is only a temporary measure, whereas the latter was a permanency. The time has gone by for the Indian Geological Survey to be looked upon as the centre of all knowledge pertaining to matters Geological, Metallurgical, and Minerological in the country, and while we gladly acknowledge our own obligations to the Survey, and to some of its members individually, we cannot, in the interests of Science and Progress, but welcome the change.

UMARIA COLLIERY.—There is a rumour that the Bengal Nagpur Railway Company will take over the Katni-Umaria section of the extension at once instead of waiting till the line reaches the grain districts of the Central Provinces. An immediate transfer would doubtless be advantageous to the Company, but it is questionable whether in the interests of the colliery undertaking, in its present condition, the Government would consent to it. Indeed, certain administrative changes in the prospective point to an inclination on the part of the present proprietors to remain in possession as long as they can. It is a patent fact that the coal from these mines is used largely all over Central India. The Great Indian Peninsula Railway have been using it with success for some time past for their mail trains. The Bilaspur-Etawah Railway have used it ever since the line opened.

THE BANGALORE WATER-SUPPLY QUESTION.—A local paper says that Lieutenant-General J. F. Fischer, R.E., late of the P. W. D., Madras, has, it is told, submitted a scheme to the Government of Madras in the competition for the prize offered for the best scheme to supply the troops in Bangalore with water. General Fischer is one of the best authorities on irrigation matters in India, and if any man can solve the difficulty of providing Bangalore with an efficient water-supply at a minimum of cost, it should be him. His experience is very wide, and any scheme of his should command serious attention. The scheme he has now submitted embraces a catchment area in the Nundidroog Water-shed exceeding that of General Sankey's project by ten square miles, and will include a reservoir at Ooparhully, constructed on a different plan to General Sankey's.

QUALIFICATIONS FOR SANITARY INSPECTORS.—The Sanitary Commissioner of Madras thinks that an examination for Sanitary Inspectors and Overseers should be instituted, and would recommend that Government be pleased to rule that Municipalities and District Boards entertain only men as Sanitary Inspectors and Overseers who have successfully passed this examination. The argument is that in England, owing to the great and increasing importance of the duties devolving upon local Surveyors and Inspectors of nuisances, the Council of the Sanitary Institute of Great Britain was led to establish voluntary examination, to appoint a Board of Examiners, and to grant certificates of competency to local Surveyors and Inspectors of nuisances. But it would appear that the cases of India and England are not analogous, and in view of the low pay which local and Municipal bodies at present give their Sanitary Inspectors, the Government are not prepared to prescribe any compulsory test.

RAILWAYS IN KASHMIR.—The *Morning Post* is confronted with the *Statesman's* query as to whether the services of a "Royal Engineer" can be required for the construction of the "short line" of railway which is about to be commenced between Sialkot and Jammu. It says:—A distinction seems to be drawn between the services of a "retired officer" of acknowledged, tried ability, and those of perchance some Civil Engineer of less note. In explanation of this choice it will appear strange to some persons at least, that the Kashmir Government are to be disallowed the liberty in selecting their own special Engineer Officer. The country has been already committed to public works of considerable magnitude, including the Murree-Baramala cart-road, waterworks for Jammu, and the railway from Sialkot to the capital, to say nothing of the contemplated railway into Kashmir; hence it is hardly to be wondered at, that the Maharaja and his Council should desire to secure the services of a retired Engineer Officer, of whose qualifications they had already had proof.

THE KIDDERPORE DOCKS.—The Kidderpore Docks appear to have made steady progress during the quarter ending on the 30th September, in spite of the intervention of the rainy season, a solid advance was made with the tidal basin section, the construction of the east and west walls, and the diversion of the Garden Reach Road and the Dock Tramway. The excavation of the open cutting for the 60 feet lock was pushed on vigorously, and everything was arranged for a start being made with the construction of the timber trenches as soon as the required level was reached. In No. 1 Dock the walls were founded for a length of 257 feet and considerable progress was made with the superstructure. All the land required for the works has not as yet been handed over, but this has so far caused no inconvenience. On a daily average 4,141 persons were employed during the quarter, and among these only eight deaths are reported. The total outlay up to the end of September was Rs. 63,82,617, but of this sum Rs. 21,72,719 went for the acquisition of land.

PROGRESS AT BARODA.—The great Ajwa water-works, situated at a distance of twelve miles from the city, have been sanctioned, and are in rapid progress. The cost of the work is estimated at 30 lakhs of rupees. The Lakhmidas Palace, designed by the late Major Mant, and constructed under the supervision of Messrs. Chisolm and Reynolds, stands unrivalled in its elegance and beauty. The Countess of Dufferin Hospital for Women and Children, the Chimnabai Market and Tower, the Baroda College and the Makarpura Palace for the second queen, are among the achievements of the Public Works Department. It is believed that, with its carvings in teak and ebony, its inlaid furniture, supplied by the East India Art Manufacturing Company, its glazed tiles in Indian patterns, and its painted walls, it constitutes a feat in the domains of architecture and decorative art. With Colonel Berkley's hearty co-operation and the facilities which he has afforded for opening up the country by means of railways, the Messana-Vadnagar line and the Anand-Petlad line have been completed; the route of the proposed Bahadarpur-Udepur frontier line has been surveyed; and the route of the Khandeish frontier line is now being surveyed.

CALCUTTA WATER-SUPPLY.—A Bombay contemporary says:—"The Calcutta water-supply, which of late has attracted so much attention, has at last come to a head." With reference to this pronouncement, a ditcher writes us:—Why can't it come to a head on third storeys? Is a respectable soap abiding man, a broker earning his Rs. 700 a month, let us say, never to get a bath because he has the misfortune not to live on a ground floor flat? Has the god Aquarius cut Calcutta out of his regard on account of Municipal shortcomings. *Absit omen!!* Mr. Robert Turnbull, the retiring Secretary, had a valuable knack of throwing oil and soft soap on vexed waters. We lament his loss to society, even as we should that of any other artistic Virtuoso. But, in the fond notion that his successor may vouchsafe to us sufficient water to bathe in, there is a germ of comfort to atone for the migration of the dear departed. There are ditchers who have not been behind the scenes, and who lay all the blame of deficient water-supply on a much abused Public Works Department. As to that matter we can only say, that the Jewish scape-goat is an antique survival which can put forward no legitimate claim to respect in modern times.

THE SHAHABAD ENQUIRY—AGAIN.—The Sone Commission have been asked to swallow very extraordinary statements in the way of native evidence. Many say that the canal water is the curse of the Shahabad District, and has reduced the outturn of the crops considerably. As, however, it is well known that the country has been saved from severe scarcity, if not from famine, not less than three times within the last ten years, and further that the average outturn per acre in normal years has considerably increased, this evidence can be taken *cum grano*. We remember some years ago talking to a sturdy old Shahabad ryot, (needless to say not a Brahman or a Rajput,) and when he was asked what he thought of the canal, he said: "Sahib, it is the finest thing on the face of the earth. We used to think ourselves very lucky to get a twelve or fourteen-anna crop, and a sixteen-anna crop was something to be remembered for a long time; but now we get twenty-anna crops every year." In connection with this subject it is, we are informed, a mistake to suppose that the area of *reh* land is increasing owing to irrigation. There always have been isolated patches of *reh* both in Gaya and Shahabad, but there is no proof that this class of land is becoming greater in extent.

SIMLA'S LAST GRIEVANCE.—Simla perenially suffers from want of some necessity of life or another. One year it is want of water-supply, another year want of sunshine, another want of a sufficient supply of tame cats. This year the grievance has been the scarcity and high cost of firewood, due mainly, it is said, to retaliations combined with business aptitudes on the part of Hill Chiefs, conservation of whose forests has been insisted on by the Punjab Government, and who resent this interference with their immemorial prejudice in favor of spendthrift waste, and being unable in their state of vassalage to demand satisfaction from Sirkar Bahadoor are "taking it out" of the Simla public and putting money into their pockets withal by a practical monopoly of the trade in fuel. They refuse to allow the Simla wood-cutters to enter their forests, and have taken care at the same time to have a large supply of firewood on hand, and available at famine prices. This is Simla's last grievance; and in a Himalayan climate it is no inconsiderable one. The remedy proposed is a cart-road to Sunni on the banks of the Sutlej, where the river could, it is believed, be inexpensively bridged; and then a sufficient and cheap fuel supply would be straightway available.

Current News.

Good service pension is granted Major-General Æneas Perkins, c.b., Royal Engineer.

The Lieutenant-Governor of the Punjab goes on a small tour to enable His Honor to see the Chenab Canal system.

The Madras Municipality has accepted the tender of the Indian Tramway Syndicate in London for the construction of lines there.

An archæological department has been established at Mysore for a period of three years certain under Mr. Lewis Rice, Education Secretary.

Mr. Smythe, of Messrs. Glover & Co., and formerly Store-keeper of the Port Trust, has been appointed Assistant Secretary to the Trust.

Colonel Conway-Gordon is so much better that it is expected he will be able to rejoin his appointment on the expiry of his leave about the middle of January.

Mr. Fleury, of Calcutta, recently visited Katmandu for the purpose of furnishing the local Government with plans and estimates for a water-supply, and has just returned.

Up to the present time nothing has been done to close the Jancooly Breach of the Damuda. And there is nothing to shew when the matter is likely to be settled one way or the other.

The Government of India has decided that, on all Imperial State Railways, articles intended for the Glasgow Exhibition shall be carried at the lowest rates quoted in the goods tariff.

The head-quarters of the Consulting Engineer to the Government of India for Railways, Central Division, will, from the 1st of January 1888, be located at Jubbulpore instead of at Agra.

The Government of India has declined to assent to the proposal of the Eastern Bengal Railway to construct a branch line to the Petroleum Depôt at Budge-Budge. The Calcutta Port Trust has asked that the matter may be reconsidered.

Ahmedabad is supplying itself with water-works at Dudheshwar, on the banks of the Sabarmati. The pumping apparatus will supply eighty gallons of water per minute, and is supposed to be capable of supplying the whole of the city.

A Bengali paper says it is proposed to open a branch line up to a place called Dulo in the Tarkessur line. A temporary line will for the present be opened for trial. If the number of passengers prove large, then it will be permanently established.

Sir Theodore Hope shortly leaves Calcutta for the Upper Provinces and starts from Bombay for the continent of Europe on the 13th proximo. He resigns on the 5th of January, after 35 years' service, during which he has covered more ground than almost any official in India.

There seems every probability, we are glad to hear, that an exploration of the country between Chittagong and Burma will be undertaken during the present cold season. The advisability of this step was shewn pretty conclusively, as we believe, in our remarks of a few weeks ago.

At the instance of the Forest Department, the Railway Companies in the Madras Presidency are making trials with indigenous Coimbatore teak supplied recently in small quantities, in view to doing away largely, if not entirely, with the exotic Burman article. The teak is being supplied at Rs. 2 per cubic foot.

The Pachpadra Railway scheme dies hard. Whatever its defects, the scheme has not been altogether fairly dealt with by the Public Works Department of the Government of India. A correspondent, who has himself gone over a good deal of the road, denies point-blank the official statement of the physical difficulties said to exist.

The progress made with the Toungoo-Mandalay line is, we understand, of so satisfactory a character, that we may confidently look for the line to be opened as far as Yemethen next July. Considering the work has had to be carried on throughout a period of disturbance, it speaks well for all concerned that so much has been done towards the completion of the new line.

The Irrawaddy Flotilla Company, Limited, have turned out of the Dalla Dockyard during the past year, 10 steamers, 13 flats, 2 gunboats for Government, besides numerous smaller craft. In addition to the two steamers which are to be sailed out from the Clyde, this enterprising Company intend also building at Dalla 6 more steamers and 16 flats for the Mandalay trade; all of which are expected to be at work before the end of 1888.

The Government of Bombay have appointed Dr. Pollen, Collector of Hyderabad, to conduct a special inquiry into zemindari rights in Upper Sind. Those who always look for motives behind the action of authority, will no doubt aver that Dr. Pollen has been appointed to look after zemindari rights in Upper Sind, because he had been looking too well into the merits of the railway scheme which the P. W. D. has tried in vain to crush.

With the view of determining how far articles manufactured in India, or of Indian origin, and substituted for stores hitherto imported through the Secretary of State, are produced by Government establishments, and how far they are the results of private enterprise, the Governor-General in Council has directed that a separate return be rendered annually by each Government factory, through the regular channel, the Government of India, in the Finance and Commerce Department, showing the value of its issues to all Government departments during the year for which the statement is prepared.

Work on the new hut cantonment at the West Ridge, Rawal Pindi, has now been commenced. The ground will be rented this year and purchased next year. The first huts to be built will be the combined canteens and coffee-shops. These will be very fine huts, some 200 feet long and 40 feet broad. After that the theatres and sergeants' messes will be commenced. Over a lakh has been sanctioned, and it will require much energy to spend this before the end of the financial year. They are, however, lucky in Pindi in their administrative and executive officers of the Royal Engineers, and it will not be their fault if great progress is not made.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

METAL *VERSUS* TIMBER SLEEPERS.

Sir,—I had much pleasure in reading the article on "Metal *versus* Timber Sleepers" which was published in your issue of the 10th instant signed by "Blitz." The facts stated in the article are very clear, and will greatly facilitate those who are connected with a "metal road."

My warm thanks are due to "Blitz" for the accurate information. I shall also be thankful if he will kindly enlighten me as to what is the average of imprest he would allow for a "metal road" of 60 miles per annum where 8 trains roll over daily.

Permanent Way.

HER MAJESTY'S MINT, CALCUTTA.

Sir,—As I have made no suggestion which can in the very smallest degree be interpreted as a recommendation that the silver mint here should be abolished, I shall feel obliged if you will contradict the report published at the foot of page 412 of your issue of the 24th instant.

A similar report, which appeared in a daily paper, has already been contradicted.

R. Riddell, *Lieut.-Col., R.E.,*
December 27, 1887. *Master of the Mint.*

ABOUT SELF-ACTING PUNKAHS.

Sir,—It is a fact that many experiments have been made by several people through India to work a punkah several hours by a motor of some sort without any fair success. It is true that steam power has been employed in several places where a great many punkahs had to be worked together; for instance, at Madras all the punkahs of the General Hospital are worked by a steam engine. This arrangement was done by Mr. Orr, the senior partner of the firm of P. Orr & Sons at Madras, and has proved to be a great success. This is all fine where economy is not looked for; but to work only one punkah at the time a steam engine is out of question, except if a very small engine was used; for instance, a Shipman kerosine oil steam engine, but they are sold very dear, and besides it requires to be looked after. I have worked a 7' punkah in Pondicherry for a native with sand, and this experiment was a success, the only inconvenience was in lifting the sand up into a box placed six feet over the ground. However, that punkah worked six hours with 1 cubic metre of dry river sand. A motor which can work 10 to 12 hours without being looked after, and which would cost cheap, say about fifty or sixty rupees, would be just the thing wanted by everybody. I have during the past two years made many experiments and found a very simple machine to work a punkah or several together, either at Calcutta or Bombay, and have no doubt that it would be a great boon to the public during hot weather.

Chandernagore; *December* 23, 1887. L. C.

THE P. & O. *VERSUS* THE WHITE STAR LINE.

Sir,—English folk are inveterate grumblers on sea and ashore. It is for the most part a harmless amusement; and probably the P. and O. Company, surely the best abused, as well as the most free from accidents and discomforts of all oceanic steamboat companies, is no more affected by exhibitions of temper in its corporate capacity than it is in its aptitudes dividendial,—if I may be allowed to coin a word for the occasion. Last May, the *Pioneer* was jubilant over a White Star Line of steamships, destined to run between India and England, in competition with the P. and O. Company. Mr. Ismay, of the firm of Ismay, Imrie and Co. of Liverpool, managing owners of the White Star Line, arrived in Bombay lately, *incognito*, as a globe-trotter. He was, however, interviewed by an enterprising Bombay newspaper reporter, who charged him with intention to run a line of steamers between London and Bombay, warranted to steam as rapidly as Atlantic liners do. Mr. Ismay laughed, and replied:—"It would be interesting to try it; but it would not pay very well, even if the whole route were easily navigable. In Liverpool we get cheap coal, and in New York the same; but we could not on this route. But, apart from this, it is absurd to talk of steaming at the same rate as we do across the Atlantic." In reply to further questioning Mr. Ismay admitted that it was impossible for any line to compete as a passenger line with the P. and O. Company in the East, as long as they received their subsidy. It has to be taken into account that the passenger traffic between England and India is a season traffic, which will not bear comparison with the constant traffic going on between England and America. That goes on, on pretty much the same average rates, all the year round. Moreover, Mr. Ismay doubted whether his White Star Line steamers could possibly be utilized for the Eastern trade, *vià* the Suez Canal. He feared their bigness as an insuperable objection. They run to 9,000 tons against the P. and O.'s 7,000. They measure in length 565 feet—say 100 feet longer than the *Victoria*. They steam on a mean draught of 28 feet water. Mr. Ismay considered it questionable whether they could make the passage of the Suez Canal. He declined, the *Bombay Gazette* says, to express any opinion as to whether the P. and O. boats were inferior in build, equipment or internal management to the Transatlantic liners, but from what he said it appears that they afford accommodation for about double the number of passengers; that fitted as they are with triple expansion engines and twin screw propellers, they steam at the rate of nineteen to twenty knots an hour as against P. and O.'s twelve or thirteen, or their maximum of sixteen to sixteen and a half. For ten years in succession the White Star Line steamers, it will be remembered, outstripped all others in the race across the Atlantic; in fact, made more rapid passages than any other steamers in the world, and their new vessels will doubtless even enhance the line's reputation.

FREE COMPETITION.

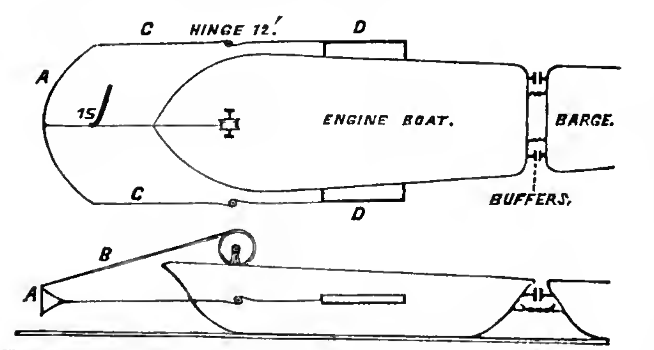
THE PUNJAB RIVERS.

SIR,—Referring to your various items on the above, I would observe that the use of the boat-bridges in the Punjab is such an old established affair that very little can be said on the subject, and certainly nothing new.

With regard to the feasibility of water transport on the Punjab rivers I have recently (about a month ago) read an article in the *Civil and Military Gazette*, suggesting the use of a train of flat-bottomed barges pushed by an engine on a specially made boat, similar to those said to be used on the Mississippi. The several boats forming the train being coupled (and I suppose with intermediate buffers.) The head boat being guided by a jointed connecting bar worked from the engine-boat.

In my own opinion, something of this kind would pay for carriage of grain from towns on the river banks, but I would rather have the engine-boat leading and drawing the others instead of pushing them.

The engine-boat to be provided at the bows with a shield or feeler, which should extend out in front some 15 feet; and on running on any sandbank press back against strong springs at the side of the boat, and hinge for drawing up when run aground.



The action of the rods when forced back to immediately shut off steam, when forced back more than 4 feet, say—

A shield with draw rope B and windlass for raising it out of sand; C hinged rod with play of about 12 feet; D springs at side of boat.

INDUS.

A HARD CASE.

SIR,—I shall deem it a great favor by your making known, through your Journal, the great piece of injustice that has been done to me by the Chief Engineer and Agent of the S. M. Railway.

In October 1886, I applied to the Chief Engineer, S. M. Railway, for an appointment. In my application I *distinctly* stated I was employed on the O. and R. Railway in charge *permanently* of the open line "Maintenance," and only for the sake of health, and having lost my child, wanted to leave. Shortly after I received a telegram from the Chief Engineer, S. M. Railway, offering me an appointment, and asking me when I could join. I replied to the telegram, and soon after joined my new appointment, sacrificing both interest and money, in thus hurriedly breaking up my household.

On my arrival I was sent to the West Deccan section, where I did such good work, that after one month my pay was increased from Rs. 250 to Rs. 300.

Shortly afterwards I was informed that I was only got up for the "linking," and as that was done I would be paid up and dismissed. It was then I was brought to find that my post was temporary.

I protested against the treatment, and on this representation I was transferred to the Mysore extension, and no sooner had I arrived there, I was handed a letter from the Chief Engineer reducing my salary from Rs. 300 to Rs. 250, but without assigning any reasons for it.

I submitted to the reduction, and hardly have I been three months here, when notice has been served on me that my services are no longer required.

The excuse now brought forward is that an attachment from the Court was brought against my salary, hence the notice. On receipt of the notice, I at once wrote to the Chief Engineer, informing him that I was not involved, but that I was possessed of landed property and cash and would pay up the amount of the decree at once and, moreover, if required I could give cash or landed security for my faithful service to the Company; that I was not made aware by the Court, nor by the decree-holder that a decree was passed against me. I further paid the sum off to the Court to remove the attachment by telegram.

I brought to the notice of the Chief Engineer and Agent that I was not aware any such rule as that referred to being in force in the Company's service, and the Company should have made me acquainted with the rules in force when I was engaged, and that if the rule be in force it only applied to such individuals as were involved, and to cancel my notice. To which I received a reply in the following words:—

"Mr. Salt is informed in reply to his letter of the 30th November 1887, that his services are no longer required"—*and asking the Executive Engineer if he required another Inspector in my place.*

I may here add that since my arrival here at the last inspection the Executive Engineer, to use his own words, was "very much pleased" with the progress I made in my sub-division.

R. W. SALT,
Inspector in Charge, Bunsandra Sub-Division.

Literary Notices.

BABIES.

MISS EDITH BOARDMAN, a distinguished young lady student of the Medical School at Hyderabad—Deccan, has favored us with her translation into Urdu of Dr. Harvey's well-known book, which was issued in Calcutta under the auspices of the Public Health Society. The subject may appear out of place for notice in this Journal, but, (using Miss Boardman's words,) "at a time when an attempt is being made to direct the attention of the Indian public to the question of sanitation and preventible mortality," it is within our province to welcome any publication intended to further such commendable aims.

ASIATIC SOCIETY OF BENGAL.

PART II, No. II of the Journal for 1887 contains essays on (1) the effects produced by Small Quantities of Bismuth on the suctility of Silver, by Surgeon-Major J. Scully, Assay Master, Calcutta; (2) Monge's Differential Equation to all Conics, by Asutosh Mukhopadhyay, M.A., F.R.A.S., F.R.S.E.; and (3) the Mean Temperature of the Deep Waters of the Bay of Bengal, by Commander Carpenter, R.N., D.S.O., F.R. Met. Soc., F.Z.S.

The following is a summary of Dr. Scully's paper:—1. The Indian assay process for silver bullion is, incidentally, a delicate qualitative test for the presence of bismuth in such bullion. 2. The assay process can be readily modified so as to give accurate results in the presence of such proportions of bismuth as are likely to be encountered in practice. 3. Fine silver when alloyed with only 1 per mille of bismuth has its ductility sensibly impaired thereby; and 1 per cent. of bismuth is sufficient to render fine silver, or alloys of it with copper down to 906 fine, extremely brittle. 4. Fine silver alloyed with small quantities of bismuth, and silver-copper alloys down to 980 fine when containing small proportions of bismuth, have the remarkable property of being more ductile when rapidly cooled in water after casting than if allowed to cool very slowly, thus resembling bronze in this respect. 5. Coinage bars such as are used in the Calcutta Mint, and with the procedure there adopted for rolling, are quite unfit for coinage owing to brittleness, if they contain only 3 per mille of bismuth; while if the latter metal forms less than 0·5 per mille of the whole mass the ductility of the bars is not much affected.

Mr. Mukhopadhyay shows that the geometrical interpretation of the Mongian equation sought for in vain by Boole, has yet to be discovered. It is refreshing to find a young Bengali discussing this question in its various aspects, and dealing with the methods employed in connection therewith by some of the best-known living English mathematicians.

Commander Carpenter's contribution is derived from the Natural History Notes of H. M.'s Indian Marine Survey Steamer *Investigator.*

General Articles.

RANGOON HIGH SCHOOL AND COLLEGE.

This building is a composite one, the lower floor walls being of brickwork, the upper entirely of teakwood work. Both floors, lower and upper, are of teak 1″ planks on joists. The roof is of teak shingles. The lower floor plan is divided along the centre by a long corridor, and on both sides of it are placed the class and lecture rooms. On the right and left flank are broad spacious staircases leading up to the upper rooms, which are used entirely as dormitories for boys and residences for the junior masters.

The building is the design of Mr. H. M. Mathews, C.I.E., M.I.C.E., now retired. It occupies a fine site at the junction of Pagoda and Commissioner's Roads. It was constructed in 1874 and cost about Rs. 1,45,000 made up thus:—

Main building	... Rs.	74,000
Lecture Hall	... „	13,000
Outbuildings, etc.	... „	13,000
Clock-tower	... „	3,000
Cost of land, etc.	... „	42,000

THE DUFFERIN BRIDGE,
OUDE AND ROHILKUND RAILWAY, BENARES.

COLONEL DOWDEN'S REPORT.
II.

(*Continued from page 414.*)

It was ruled by the Government of India, that the Oude and Rohilkund Railway Company should be allowed to levy tolls, on passenger and local cart traffic over the bridge; such tolls to be within the maximum scale fixed for floating bridges in the North-Western Provinces.

The Government of India approved, in their 131 R. C. of 14th April 1880, of the deputation of Mr. Hederstedt, the Chief Engineer, to England, to confer with Mr. W. F. Batho, the Company's Consulting Engineer, regarding the details of the designs of the bridge. He left India on the 1st May for the purpose. Tenders were invited for 300 lakhs of bricks, 4th May 1880, and a contract for them was given to Messrs. Ford and MacDonald.

In discussing the designs of the foundations, it was intimated in P. W. D., No. 349 of 18th June 1880, that the Government of India had recommended to the Secretary of State, that Mr. B. Leslie should be appointed as the Consulting referee in India, on all points on which a difference of opinion might arise, connected with the construction and erection in India of the bridge; and that Mr. Hederstedt's designs, which, in principle, had been approved by Mr. Leslie, would, if referred to him, be considered in detail.

On the 3rd June 1880, the Secretary of State approved of the proposal to admit a cart road at rail level into the design of the bridge. The O. and R. Railway accepted the expense, and in compensation, were allowed the tolls to be levied. On the question of closing the existing boat bridge no decision was given.

The E. I. R. Board consented to Mr. Leslie's opinion being taken on any special points that might be referred to him from time to time, but deprecated his employment in any responsible connection with the work. The O. and R. R. Board readily adopted the suggestion that any matter of difficulty that might arise in India, while the bridge was under construction, should be referred to Mr. Leslie, who at the time was considering a project for bridging the E. I. R. at Hugli near Calcutta, (completed in February 1887.) He had bridged the Gorai River on the Eastern Bengal, and again had subsequently constructed a floating bridge over the Hugli at Calcutta, between that City and Howrah, the terminus of the East Indian Railway.

On the 9th September 1880, the Secretary of State reported the result of Mr. Hederstedt's conference with Mr. Batho, and the conclusion of the O. and R. R. Board, that the pier foundations to be adopted should be elliptical caissons, 65 feet by 28 feet at base. The Marquis of Hartington being of opinion that, before sanction for such a large bridge could be given, the approval of it by some eminent Engineer who had made this class of work a special study, should be obtained, the design was referred to Mr. W. H. Barlow, then the President of the Institution of Civil Engineers.

Mr. Barlow approved of the general design on 10th August 1880. He considered that single caissons were preferable to groups of wells. He recommended the increase, from 3′ to 6′ of the thickness of the cross walls of the caissons and also an increase of 400′ of water-way, on the right bank, to pass the high floods.

Several proposals for placing the girders in position were considered, one was to float them, if the water was sufficiently deep, and to erect them on scaffolding where the river bed was dry—another was to build all the girders in position, on their piers, and on staging at a level a little above low water; and then to raise them by hydraulic lifts simultaneously with the building up of the piers themselves to their full height. A serious difficulty attending this arrangement was the large amount of work required to be done in a single season, to escape the annual high floods, the obstruction to navigation in the river during progress, and risk of destruction of the whole work from delay, from accident, or other causes, at any one point in the entire length of it.

A third scheme was to carry up all piers to highest flood level, and to erect the land spans on a temporary embankment of clean sand; and the four river spans, on the Benares bank of the river, and then float them on pontoons into position at a height of 60 feet. The proposal was not approved by Mr. Barlow, who estimated the difficulty of carrying it out to be very great. He recommended a system of staging, or temporary supports, by which floatation and hydraulic lifting might be avoided, and noticed that the completion of the bridge would be regarded with much interest by the Engineering profession, because it would be the first application of steel, for structural purposes, on so large a scale.

Part of the land for the approach line on the Benares side of the river, was made over to the Company, on the 28th May 1880; and earthwork commenced on it, on 12th June 1880.

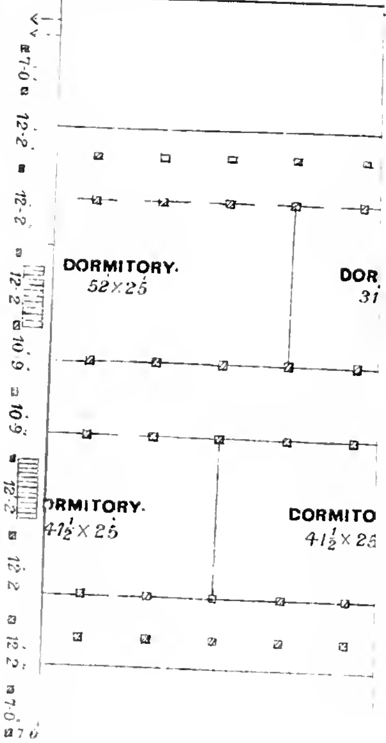
The line strikes across the Rajghat plateau, where there was formerly a fortified post to command the crossing of the Grand Trunk road, and the City of Benares. The post was abandoned in 1865. It presents the appearance of having been an important position in ancient times.

The land all along the Benares side, or left bank approach, was very valuable, and was thickly covered with sacred tanks, groves, temples, tombs, and mosques; so considerable pains were necessary in taking it up, so as to avoid vast expense or injury to property. The cost of compensation paid for it by Government, amounted to Rs. 1,16,818.

On the 3rd March 1881, the Marquis of Hartington intimated to the Government of India, that he had sanctioned the adoption of spans of 356 feet instead of the 416 feet previously arranged. The reduction of span was advocated by Mr. Batho and Mr. Barlow after Mr. Hederstedt had returned to India. Also, these gentlemen proposed to substitute a viaduct on the right bank of the river, for the embankment originally contemplated. It was thought that a saving of £50,000 could be effected by the reduction in the size of large spans. The weight of the girders would be reduced by 200 tons. The question of still smaller spans was considered with the following results:—

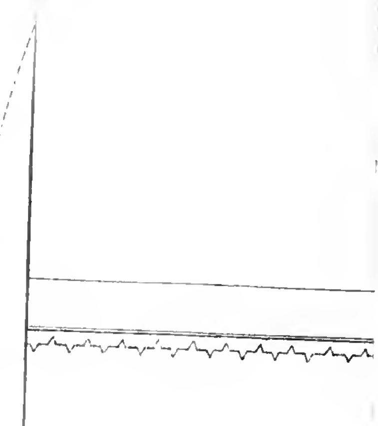
No. of Spans.	*Spans in feet.*	*Total waterway in feet.*	*Cost.*
7	356	3,482	£ 440,379
9	110		
8	306	3,493	„ 449,861
11	95		
9	256	3,504	„ 460,036
10	120		

(*To be continued.*)

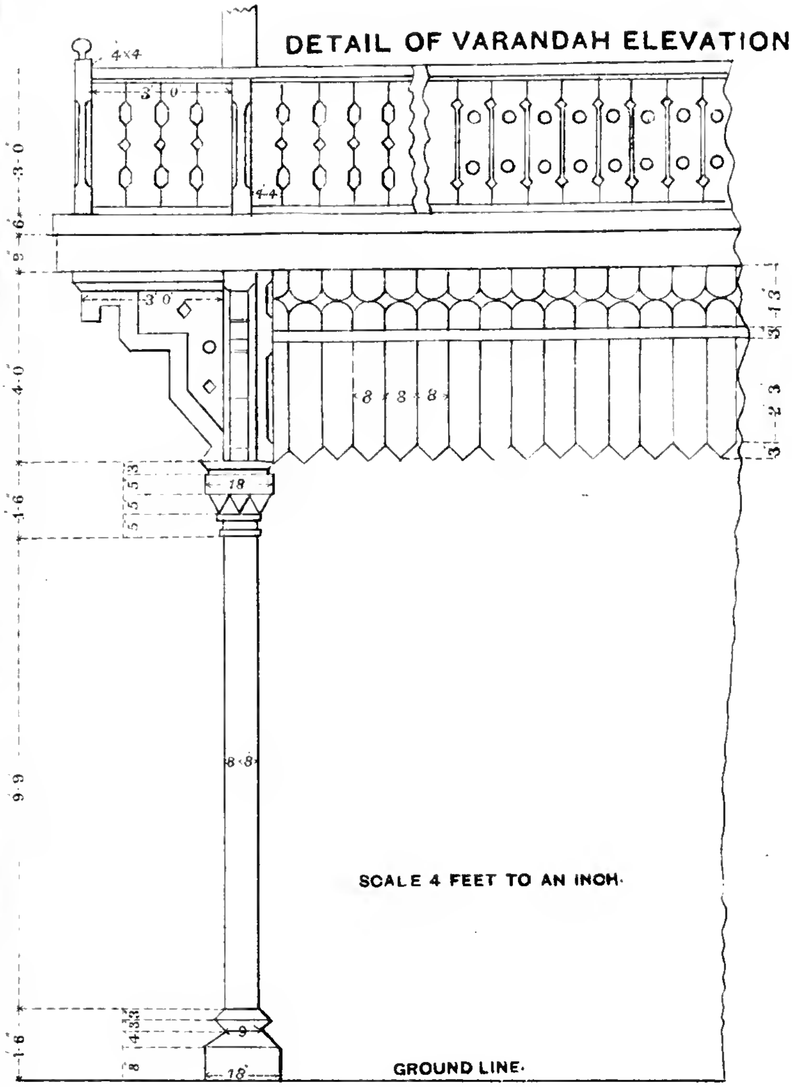


HIG
R

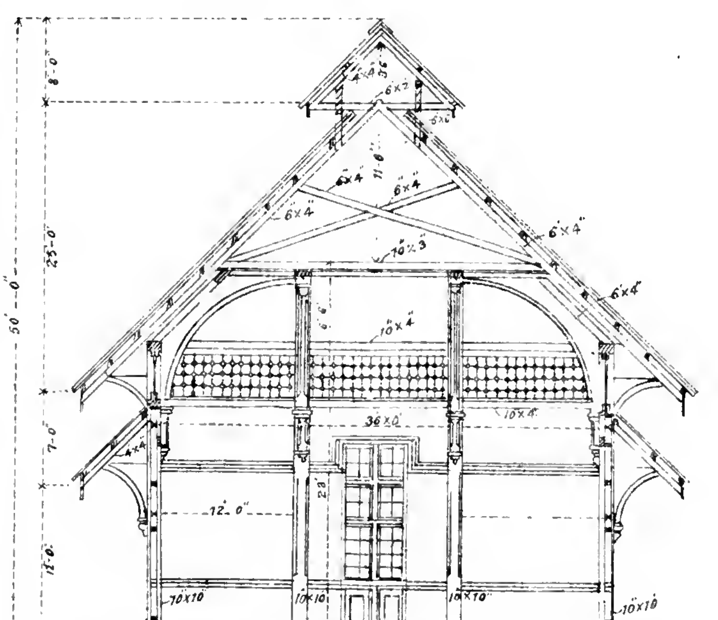
Of composite c
of brick u



DETAIL OF VARANDAH ELEVATION.



TRANSVERSE SECTION ON A. B.



The "STAR" Press, 19, Lall Bazar, Calcutta

MINING ENTERPRISE IN CHINA.

By John Harris, m.e.

II.

The Tamchow Silver Mine.

Mr. Ho Amei, one of the principal and most enterprising Chinese residents in Hong-Kong, and who has spent several years of his life in the gold mining districts of the Australian colonies and New Zealand, felt assured from his general knowledge of mining, that mining enterprize in China could be made a success if he could obtain the sanction and moral support of the Chinese Imperial Government together with that of the Mandarin and local authorities. For a period of over 10 years he laboured in vain, but eventually, in 1884, he obtained permission to engage the assistance of a foreign Mining Engineer and staff of miners to open up mines in China, according to the most approved western methods. As soon as this authority was granted Mr. Ho Amei engaged the services of Mr. Thos. E. Candler, F.G.S., of Newcastle-on-Tyne, who arrived in China in the month of May 1884—just in the midst of the Franco-Tongkin-Chinese complications—when foreigners were in great disfavour with the Chinese people generally. Mr. Candler after examining the Tamchow property, got out two English miners, who with an Engineer were obliged to remain in Canton for more than two months before operations could be commenced, owing to the hostile feelings felt towards foreigners by the Chinese created by the Franco-Tongkin difficulty. In September 1884 operations were begun by sinking 4 shafts on the most promising parts of the property in the vicinity, and to command the lodes to the deep of the old workings. No. 1 shaft, which is the present main shaft of the mine, was set out on the extreme western end of the old workings in a position to command favourably in depth a lode above 4 feet thick exposed by quarrying on the surface, which, although poor where exposed, gave promise if continuous in depth of proving valuable when under the influence of rocks more congenial for containing minerals. Judging from the position of the primary rocks in the surrounding country, Mr. Candler estimated that the transition from sandstone would take place at a depth of not less than 300 feet, and on these grounds he advised the Chinese owners to sink this shaft to at least this depth before crosscutting into the above named lode. The trend or bearing of this lode is nearly due East and West, dipping to the South at an angle of 69°. The shaft was sunk to the south of the lode and it was expected to cut the lode from the shaft at the 300 feet level, by a crosscut to the North 100 feet long. After much trouble with the Chinese workmen (who were all strangers to this class of work and to the control of foreigners) and the difficulty of contending with the water percolating into the pit from the old workings, the 300 feet depth was attained by November 1885. The crosscut was then commenced and the lode cut at a distance of 89 feet, proving eighteen inches thick, containing rich silver ore consisting of argentite, fine grained galena, copper pyrites and zinc blende. The lode has proved continuous and has been opened up on for more than 100 fathoms, proving variable both in size and contents, but containing mineral more or less throughout, a winze sunk on it proving very rich. The No. 1 shaft was continued to a depth of 380 feet, the country rock both in the shaft and winze gradually and almost imperceptibly changing until at the 380 feet level it has quite a granitoid appearance, the lode continuing in the transition rock uninterrupted; in fact it is larger and more defined, having a clay casing which it had not in the sandstone rock above. From the 380 feet level the lode has been opened on its course by level 250 feet, and three winzes are being sunk still further to the deep all carrying mineral. Crosscuts at the 380 feet level have been driven North and South of the shaft 450 feet and 400 feet, respectively, intersecting several small veins and leaders containing small quantities of rich ore. These with three exceptions have been stopped and all work concentrated on the main lode. Altogether more than 4,000 feet of shaft, headings, winzes, levels and rises have been driven and a large quantity of ground opened ready for stoping, and more than 1,000 tons of ore extracted which is now ready for treatment.

The main shaft is bratticed from top to bottom, and has a ladder-way throughout; a strong head gear 50 feet high fitted with two ten-feet pulleys connected with a Robey winding engine working double skips with iron guide-ropes to the 350 feet level. The quantity of water averages 3,500 gallons per hour. The pumping plant consists of a Warner's steam-pump fixed at the 300 feet level with 2½ inch steam pipes. The pump is double acting with 6 inch ram, the steam condensing direct into the suction pipes. So far no water of any consequence has been found below the 300 feet level. It may further be noted that the top of this shaft is only 30 feet above tidal level. The ore is washed, picked and cobbed principally by women, the richest of the ores being packed away in tubs and stored under proper protection. A small parcel of selected ore weighing 360 lbs. was sent to London and realised £84 sterling. It assayed over 4,000oz. of silver to the ton according to the following analysis:—

Lead ...	...	... 7·54	
Copper	...	... 16·08	
Zinc ...	...	... 3·50	
Iron ...	...	... 4·69	
Sulphur	...	... 14·32	
Alumina	...	... 5·20	
Barium	...	... 3·62	
Lime ...	...	... 4·85	
Magnesia	...	... ·70	oz. dwt. gr.
Silver ...	...	... 13·00	= 4246-13-8
Gold ...	...	... ...	
Arsenic	...	... traces	
Antimony	...	... ...	
Silica ...	...	... 26·50	
		100·00	

No. 3 shaft is 800 feet S. E. of No. 1 on rising ground 60 feet above the sill-level of No. 1 shaft. It is down 180 feet, having been sunk without other winding apparatus than a hand windlass and capstan. The lode which gave such good returns to the old miners was intersected by a short crosscut of 20 feet in length and proved to be very rich for a short distance. It has been opened out E and W a total distance of 900 feet, the ground to the West towards the old workings proving the most profitable. A communication is expected to be made shortly in the West end with workings in No. 1 shaft. This will complete the ventilation of the mine, which has hitherto been accomplished by a Root's Blower at the No. 3 shaft and by a small fan at No. 1. A crosscut to the North has been driven a distance of 600 feet to prove the massive lodes of baryta shewing up so boldly on the surface of the adjacent hill. Three of these have been intersected, the one in the extreme end of the crosscut having the character of a continuous lode dipping to the South, and is according to survey identical with the main lode in No. 1 shaft. Several other lodes have been opened on, which at this depth are poor, but judging from analogy of the same lode in No. 1 shaft it should improve to the deep. This shaft (No. 3) has lately been sunk a further distance of 90 feet but at date is flooded. About 3,500 feet of heading has been driven in No. 3 and 4,000 feet in No. 1, making altogether a distance of 7,500 feet, in exploiting the mine.

The ore is to be transported from No. 3 shaft to No. 1 by an overhead wire rope tramway and from thence by an ordinary tramway (both now under construction) to the canal close by, from whence it will be taken by boat a distance of 40 miles to the Island of Tai-Y-Shan (10 miles from Hong-Kong) to the smelting works now being laid down.

(To be continued.)

BHAGALPUR WATER-WORKS.

The inception of the scheme dates from November 1882, in which month His Honor the Lieutenant-Governor of Bengal performed the ceremony of turning the first sod of the works. From that time till December 1884, the Municipal Commissioners were arranging to get the plans and estimates prepared. Its financial history is somewhat as follows:—

Raja Surendra Narain of Barwan, Bhagulpur, came forward with a munificent donation of one lakh of rupees. The other local zemindars and raisees also contributed their share. The subscription thus raised was supplemented by a Government grant of Rs. 50,000. The amount available was rupees 2,31,000, and the project which was made out in accordance with the notes from the Chief Engineer, amounted to over 3 lakhs. As this was considerably in excess of the available contribution, the project was modified, providing *kutcha* settling tanks, &c., and reducing the estimate as near as possible to the amount available.

Bhagalpur is situated on the right bank of the Ganges. The population mostly derive their supply of water from wells, but the well-to-do inhabitants get all their water from the Ganges.

For a portion of the year—between December and July—a branch of the river close to Bhagalpur silts up above and below the town, and the water, owing to there being no current, gets polluted. It was, therefore, decided to get the water from Barari situated below the town over two miles, and north-east from the Kutcherries. A project for a water-supply was submitted by the Municipality, but Government could not accord sanction, owing to its being incomplete in details. It was subsequently decided by Government to take up the work as a Provincial Public Works. The Executive Engineer was called on to submit a project; this was done and was modified by the Chief Engineer to suit the finances of the Municipality.

The population of the town of Bhagalpur is 66,000; out of this number the main town contains about 25,000, although water for the whole town is provided. Only piping will be laid to supply the main town. The supply is limited to 5 gallons per head; this for 66,000 people would be 330,000 gallons. Engine and boilers have been procured from James Watt and Co., London, capable of giving a supply of 40,000 gallons per hour, or 480,000 gallons per day.

No record of gauge reading has previously been kept a Bhagalpur, but careful daily readings have been made a Monghyr and Sahebgunge and recorded since 1872. The lowest level sinc the above date at Monghyr is 96·142 above mean sea level, the difference in the readings of low water level at Monghyr and Bhagulpur is a little in excess of 16 feet, thus the low water level is taken at 80 feet above mean sea level, and by a similar comparison the high water is taken at 113·25.

The project consists of the following head-works:—

1. Inlet weir and channel
2. Settling tanks
3. Filter beds
4. Clear water well
5. Service reservoir
6. Engine and boiler-house
7. Special pipes for head-work
8. Cast-iron piping
9. Valves and hydrants
10. Engineer's house

The following are the principal levels of the project:—

Low water level ...	... 80·00
High do. do. ...	... 113·00
Level of pumps ...	... 96·00
Engine bed ...	... 143·00
Bottom of settling tanks	... 142·00
Top of water of do. ...	... 151·00
Bottom of filters ...	... 137·75
Top of water do. ...	... 144·50
Bottom of clear water well	... 121·50
Top of do. ...	... 141·50
Bottom of service reservoir	... 173·34
Top water in do. ...	... 191·00
Ground at end of 12″ main	... 121·52

A ground plan shewing the relative positions of the above works is annexed.

(To be continued.)

EXTRACTS FROM AN ENGINEER'S NOTE-BOOK. XX.

Lime plaster ¾″ to 1″ thick on rough stone face work, with rendering.

Items per 100 c. ft. (1)	No. or quantity. (2)	Rate. (3)	Amount. (4)	Total. (5)
Labor.—				
Masons No. ...	1	Variable.	Do.	Do.
Do. " ...	1			
Coolies " ...	½			
Do. " ...	1			
Do. " ...	3			
Bhistie " ...	1			
Grinding Mortar, c. ft.	11			
Sundries	...			
Materials.—				
Lime dry, c. ft. ...	5·28			
Sand " " ...	5·28			
Surkhi " " ...	5·28			
Sundries & Scaffolding	......			
Petty Establishment	......			

Note.—For ½″ plaster on brickwork with rendering of surface included, the detail of labor is about the same. The mortar used is 9 c. ft., and the dry ingredients required to make this quantity 4·32 c. ft. of each, lime, sand, and surkhi.

X.

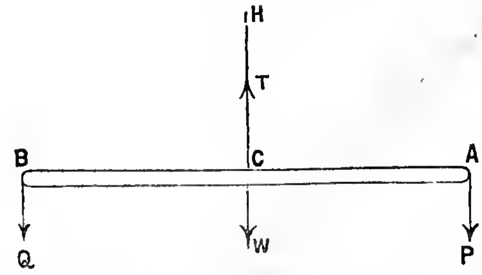
PRINCIPLES OF MECHANICS.

By A. Ewbank.

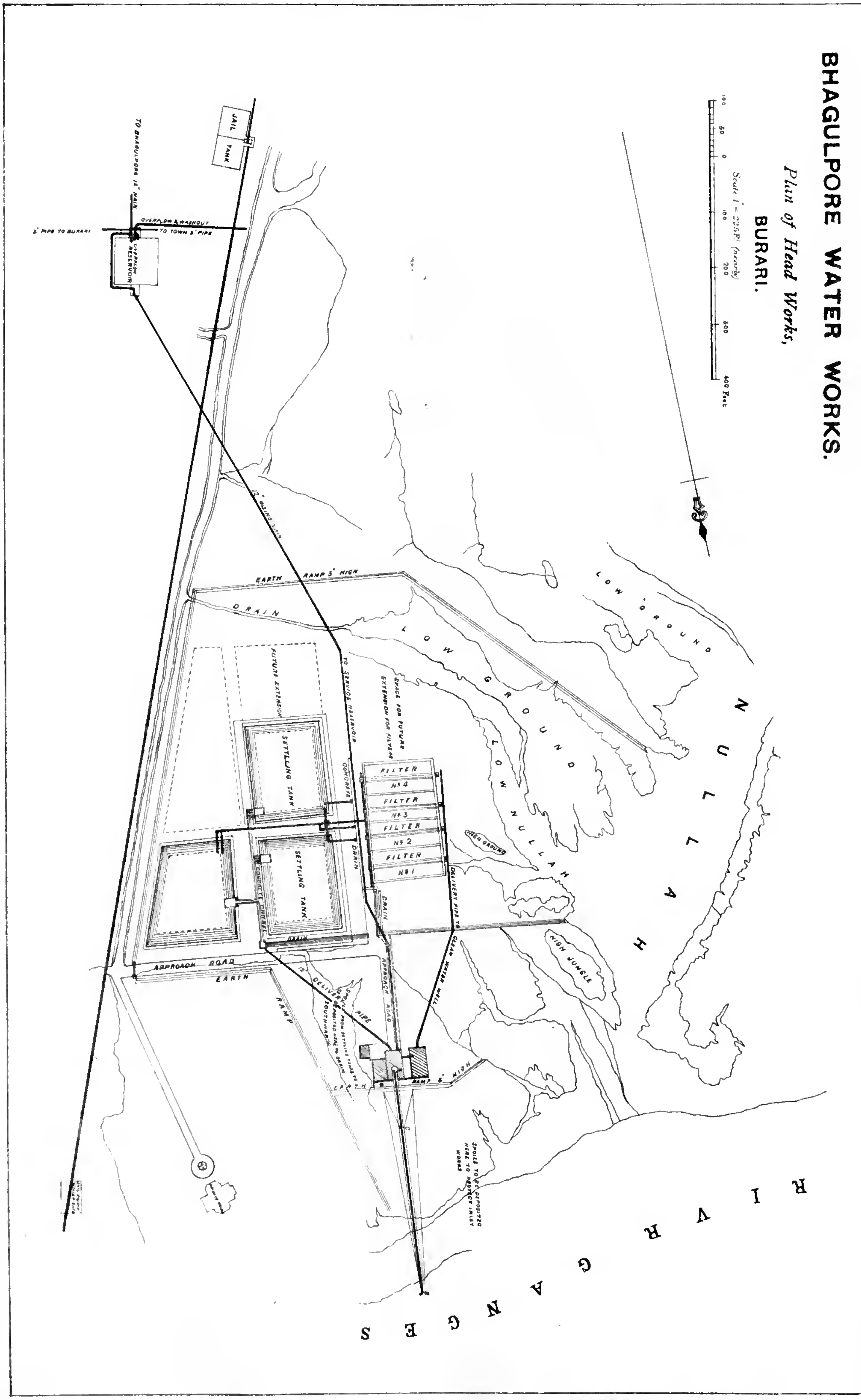
IV.

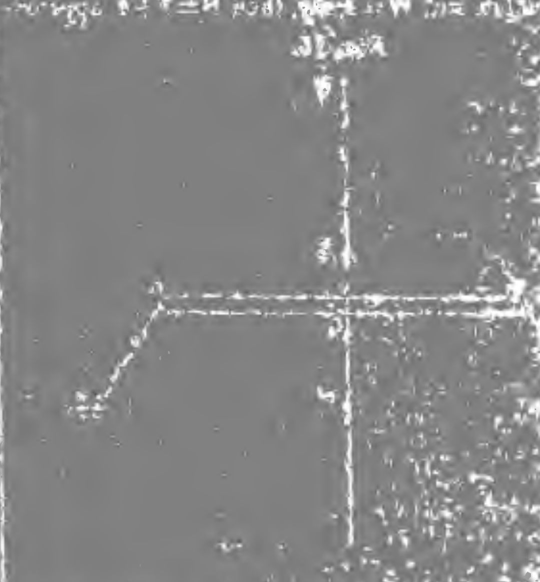
In the few examples hitherto discussed, in which two components produce a resultant or in which they require a third counter-acting force (equal to that resultant in magnitude) to keep the body at rest, we have tacitly assumed that the two components act at one and the same point of the body. But many cases exist where the component forces act at different points of the body. And though sometimes by a mathematical or mechanical fiction we may reduce the problem to a case of the components acting at the same point, yet we may without this fiction treat in many instances the cases which arise.

Fig. 13.



Thus in *fig.* 13 we have such a crude balance as we may see in the bazaar in the hand of a man or woman, who has a small stock of goods for sale. A B is supposed to be a rod or bar, say of wood of uniform thickness. Round the middle is fastened or passed a band of small but appreciable thickness. The tension T of this band is the necessary upward force which acts on the bar A B. The downward forces are the weight W of the bar and certain equal forces P, Q at the ends A, B. The reader will readily admit that in this simple case we must have T = P + Q + W.


BHAGULPORE WATER WORKS.
Plan of Head Works,
BURARI.
JAIL TANK
TO BHAGULPORE 12" MAIN
OVERFLOW & WASHOUT
TO TOWN 3" PIPE
3" PIPE TO BURARI
SERVICE RESERVOIR
12" RISING MAIN
EARTH RAMP 3' HIGH
DRAIN
LOW GROUND
LOW GROUND
LOW NULLAH
NULLAH
FUTURE EXTENSION
TO SERVICE RESERVOIR
SPACE FOR FUTURE EXTENSION FOR FILTERS
SETTLING TANK
SETTLING TANK
CONCRETE
FILTER No 4
FILTER No 3
FILTER No 2
FILTER No 1
HIGH GROUND
DELIVERY PIPE TO CLEAR WATER WELL
HIGH JUNGLE
APPROACH ROAD
EARTH
APPROACH ROAD
12" DELIVERY PIPE
RAMP
EARTH RAMP 6' HIGH
SPOILE TO BE DEPOSITED HERE TO PROTECT INLET WORKS
RIVER GANGES



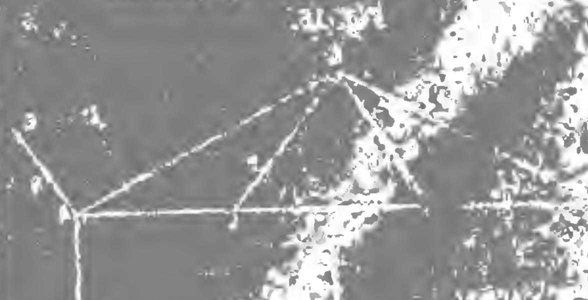
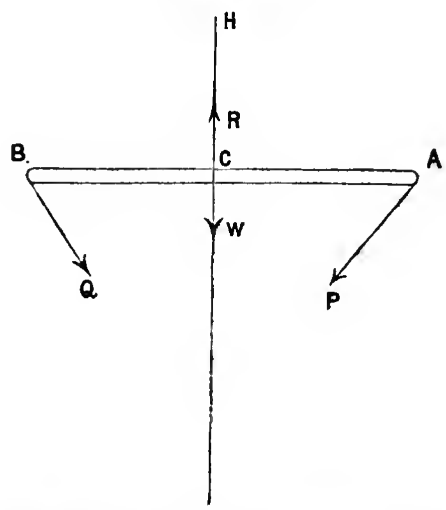


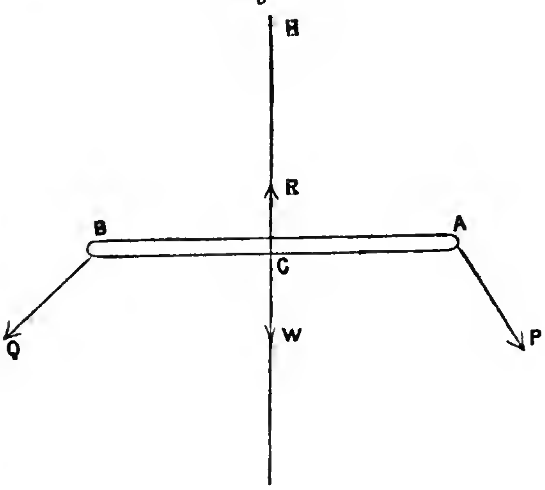
Fig. 14.



In *fig.* 14 the forces P, Q are no longer vertical. The bar remains horizontal and the lines of action of P, Q are equally inclined to the bar.

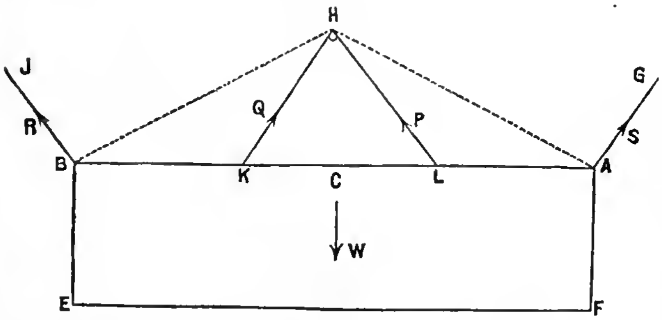
Or we may say that these lines of action meet each other where each meets the line H C produced. If P and Q are unaltered in magnitude and the bar is the same in weight, the tension R in the band C H is no longer the same. If P = Q = 5 and their lines of action are perpendicular, and W = 4 say, then R = 7 + 4 approximately.

Fig. 15.



In *fig.* 15 the forces P, Q slope outwards, but if they still make a right angle with each other and are unchanged in magnitude the necessary value of R is the same as before. These results will probably seem simple enough to the reader. They are merely introduced as preliminaries to the following question.

Fig. 16.



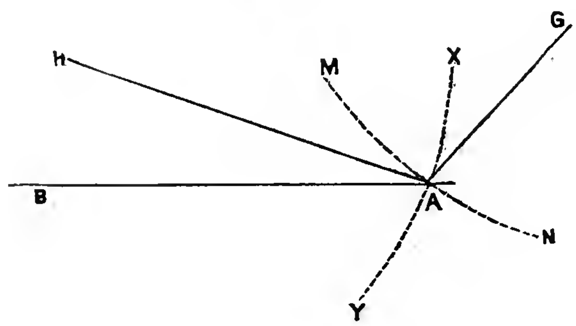
B F—*fig.* 16—is a map, picture or other heavy body. It is supported by a string K H L which passes over a peg H fixed in a wall. As this arrangement would allow the body to sway from side to side, it is further controlled by a string B J fastened to a peg J and a string A G fastened to a peg G. The dimensions of the figure are such that K H C = L H C = 45° and the strings A G, B J make each an angle of 22½° with the vertical, or 45° with each other. It is required to calculate the tensions of the strings K H L, A G and B J, when the body weighs 81oz. The problem thus stated is however insoluble. We will now add, *i.e.*, suppose, that the strings have equal tensions. The problem is then determinate. In fastening such a body we might accidentally put the principal strain on the central string and leave the other or outside strings little to do in the way of supporting the weight.

They would however still have another function presently to be considered. Now as the tensions P, Q are equal and act at right angles, then for every 5oz. in each we have a resultant of 7oz. approximately. And as R, S act at 45°, for every 5oz. in each we get a resultant of 9·2oz. approximately. For we know that at 45° 1oz. and 1oz. give 1·84oz nearly. Thus if each string has a tension of 5oz. the body should weigh 7 + 9·2 = 16·2oz. On dividing the actual weight 81oz. by 16·2 we get 5 as quotient. Thus our tensions of 5 each must be multiplied five-fold or each tension is really 25oz.

Practically, if we suspend a body as in *fig.* 16, we shall seldom succeed in putting the same strain on all the strings. We may say, therefore, that we have only discovered a sort of average strain. Unless a cord can of itself sustain 25oz., we should consider it unfit for use in such an arrangement when W = 81oz.

If the body is a rack for hanging things on, we may wish to correct the tendency of such a body to swing and to alter its position whenever we add or remove some one article. Now we see that the string K H L would, if

Fig. 17.



alone, allow the body to swing about H. In *fig.* 17 we also see that A will thus be made to describe an arc of a circle X Y whose centre is at H.

But if A commences to move towards Y, the string G A, fixed at G, must lengthen. The only movement which the inelastic string G A would not oppose, would be for A to move along a different arc, *viz.*, M N, whose centre is at G. Thus the string G A prevents the end A from dipping. Similarly, the string J B prevents B from dipping, and therefore prevents A from rising. The best direction for A G to have in connection with its present steadying function is such that G A H = 90°. Similarly, J B H should be 90°.

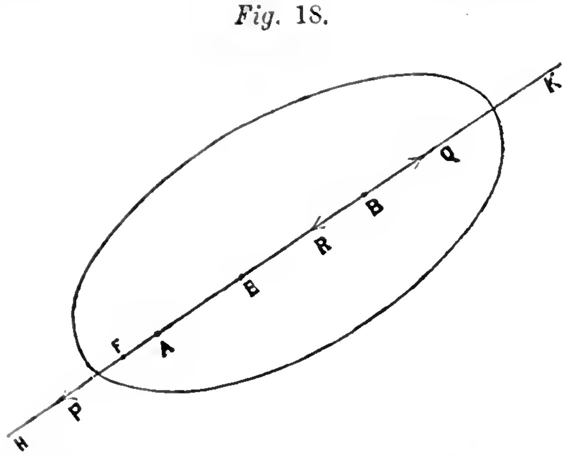
These conditions are not incompatible with the supposition that P and Q are at 90° and R, S at 45°. But G A H and J B H should be made right angles, while the other angles may be chosen more arbitrarily. For they only affect the tensions of the string, and the strings may be taken strong enough to make the particular tensions they may have to sustain a matter of indifference.

This example is introduced as a simple illustration of mechanical and geometrical conditions being in intimate relation with each other. The common way to steady the rack is to nail it to the wall or drive in nails close to it. But the arrangement of *fig.* 16 is equally effectiv mechanically.

If the points G H J be taken in a horizontal line, the rack can by hand be moved *out* from the wall without disarranging the strings, this movement being sometimes desirable for cleaning or other objects.

We may now consider what we have above referred to as

Fig. 18.

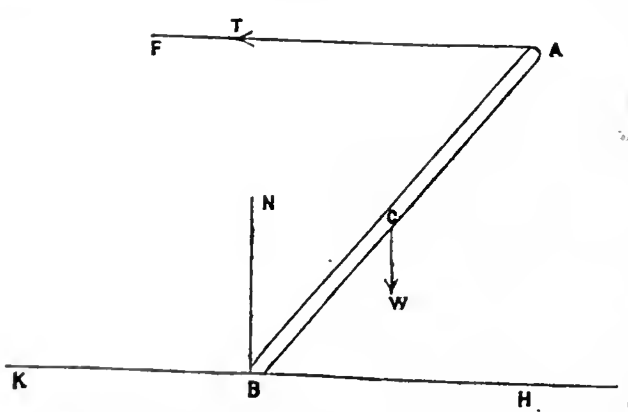


a mathematical fiction. H A B K *fig.* 18 is a straight line drawn through two points A, B of a body. At A and towards H acts a force P. At B and towards K acts an equal force Q. Then it is clear that the body as a whole cannot move in any one direction. Now remove the force P and in its stead let a force R act at B and towards H. Let R, in magnitude equal P. Then Q and R will neutralise each other. As Q neutralises separately either P or R we infer that R and P are mechanically equivalent to each other. We mean that if P forms one of a system of forces acting on the body, we may remove P and introduce R, which acts at a different point. Then if P and the other forces of its system produces equilibrium, so will R and those other forces of the P system.

The use of this method, this transference, as it is called, of the point of application A to another point B will be illustrated by the use we shall now make of it. The point of application A must not be transferred to any point such as C (in *fig.* 18). C is not in the line of action of the force of P and only points in the line of action may be taken. A force R acting at C and parallel to K H would not with Q preserve equilibrium. On the contrary, the body under the action of R and Q would commence to turn round or rotate. But R may act at E or at F instead of at B.

Let us now consider the following question. Take a stick, umbrella, ruler, or any other similar shaped body and let it rest on an ordinary horizontal floor H K by

Fig. 19.



one extremity B. See *fig.* 19. To the other end A have a string tied and hold the body in a sloping position by the string A F which is always to be kept horizontal. The student will find by practice that the angle A B H may have a variety of values consistent with equilibrium. But if he attempts to make the angle A B H very small, the end B will slip towards K and the body will fall.

If for some particular value, say 60°, of A B H the body A B is at rest, we will first inquire what forces act on A B and in what directions they act. If we consider A B to be a rod of uniform thickness and material, we will —subject to further inquiry—assume that its weight is a force W acting vertically downwards through C, the centre of A B. Also there is T, the tension of the string pulling horizontally and to the left. There must be some third force acting on the body and this must be applied at B.

The first question which we now ask is—In what direction will this third force act? The student should himself consider this question by (1) supposing that the third force, which we will call R, acts within the angle A B H, (2) within the angle A B N, where B N is vertical, (3) within the angle N B K, (4) in some direction sloping downwards from B. Let him copy *fig.* 19 and introduce successively these four cases into the figure and think which one of them is the right one.

(To be continued.)

NOTES FROM MADRAS.

(From our own Correspondent.)

I READ with much satisfaction a note of yours in your issue of the 10th instant on Government competition. You are quite right, it is high time that Government retired from competition with private manufacturing firms. Everything they do costs more than it could be done for by private Agency, leaving out the salaries of their officials, and as to quality we have just had an instance in point. The iron columns cast at the local D. P. W. Workshops for the extension of the Civil Engineering College buildings, have been condemned, and stone pillars are to be substituted for them. As for the Government brickfields, which Messrs. Groves and Co. propose to lease, I would advise those gentlemen to mind what they are about, for nothing is more risky in this country than brick-making. I am reminded here of the disastrous result which attended the attempt of the Bombay Municipality to make bricks for themselves. The only people who can make money by brick-making in this country are natives. They manage it by cheating the coolies, and using house-sweepings for fuel. A respectable European firm would find itself at a disadvantage, for house-sweepings would never burn bricks for it, nor would the coolies allow themselves to be cheated by it.

I see the Chief Engineership of the Madras Railway is to be made a five years' appointment. This is as it should be, and the rule should be extended to the Agents and heads of other departments on all State and Guaranteed Railways. The way some of these officials stick on in their places, blocking all promotion, is simply indecent. If they do not know when they have had a fair share of the loaves and fishes of the service, the time should be indicated to them. The most amusing part of the thing is that when they have hung on, drawing their fat salaries, for years after they should have been superannuated, they expect some special recognition in the way of personal allowance or a handsome bonus for their long services—as if they had remained much against their will and interests, to oblige their employers.

Talking about echoing, I see the plan adopted by the D. P. W. to destroy the echoes in the apse of St. Andrew's kirk here, has not been successful. I mean the piercing a hole through the crown of the dome. I do not know on what principle of acoustics it was expected it would have the effect desired. I recollect reading some time ago of a cure for this complaint having been discoverd by accident in France. It was a precisely similar case. The dome needing repairs a scaffolding was put up, and it was observed, that whila it was up there were no echoes. The inference of course was that the posts of the scaffolding cut up the echoes and so destroyed them: and what was subsequently done was to hang wires from the ceiling to within about ten feet of the floor. The plan was perfectly successful; and the wires did not look unsightly, for they were so thin that they could not be seen.

Our Harbour Trust Board were in a state of jubilation not long ago, for they got a telegram from home saying, that. the Nor' East entrance to the harbour had been approved of This is what they have all along been recommending, and there is no doubt they are right. But between having it approved of, and getting it they will find a vast difference I am afraid. It appears to me that the work has progressed too far on the original plan, to allow of such an alteration being made; for although very little of the original sea walls (I mean those parallel to the shore) can be seen now, it must be remembered that they are all there, and the greater part of them would have to be removed before the proposed alteration could be made. Lifting thirty-ton blocks is no joke—especially in a sea that is seldom quiet. Of course it could be done; but whether it is worth while doing it is the question.

I see the Amritsar Municipality invite competitive designs for a hospital building to cost Rs. 70,000 and they offer Rs. 500 as a *prize!* A wonderful prize truly. Why, an architect's ordinary fee for designing such a building would be Rs 1,750. I wonder what people will consider it worth their while to compete for such a prize. If any architects go in for it the prospects of the profession must be at rather a low ebb in this country at present. In this case the Government should get all their designs made by competition. They would have the pick of several at about a quarter the ordinary cost of one.

I was glad to hear of the success of our architect, Mr. W. N. Pogson, in the competition for designs for the Lahore Town Hall. Mr. Pogson is proving himself a worthy successor to Mr. Chisholm. When that artist left us we were in despair for the architectural future of the place; but you see there is as good fish in the sea as ever was caught—for I am sure that opportunity is all Mr. Pogson wants. What I like in his work is that he does not draw a centre line across his paper and then make one half of his elevation the exact counter-part of the other. That sort of design may look very evenly balanced, but I do not think it is æsthetic. Give me a little irregularity. It depresses me to contemplate a perfectly symmetrical object. The Burmese idols of that "Light of Asia"—Buddha—always move me to tears—can anything be more symmetrical. That is why nothing will induce me to go to Burma—that and those villainous dacoits. In this aversion to perfect regularity I am glad to have on my side no less an authority than that great little man, the late Mr. Alexander Pope. You no doubt recollect those lines of his, where he vents his spleen against Dutch gardens:—

"Grove nods at grove; each alley has its brother;
And half the fountain just reflects the other."

Mind you there was once a nation, who certainly cannot be accused of want of taste, who were very symmetrical in their architecture. Need I say—the Greeks? But then, I do not like Greek architecture. Observe my consistency. Even in moral conduct I think a little irregularity is more amiable and lovable than perfect symmetry. Who does not prefer a man who will take an extra pint or two of whisky to oblige a friend, to the party who will rigidly stick to a regular allowance. I once fell in love with a girl with a squint. But I am afraid I am getting out of strictly engineering subjects now, so shall pull up. I would strike out some of the above (perhaps you will do it for me) only I have an idea that these revelations of my tastes and private life will endear me to your readers, so I hope you will let it all stand.

Wishing you a merry Christmas—and a bright New Year to INDIAN ENGINEERING.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, December 17, 1887.

Upper Burma.

Mr. W. W. Robertson, Honorary Assistant Engineer, Minbu Division, is granted six months' leave on medical certificate, with effect from the 20th June 1887.

With reference to *Burma Gazette* Notification, dated the 24th October 1887, Mr. P. B. Roberts, Executive Engineer, 2nd grade, made over, and Bhagat Singh, Sirdar Bahadur, Executive Engineer, 3rd grade, sub. *pro tem.*, received, charge of the Taungdwingyi Division on the afternoon of the 30th November 1887.

Lower Burma.

Mr. E. M. Sage, Executive Engineer, 4th grade, sub. *pro tem.*, was granted an extension of 12 days to the 20 months' furlough already granted him.

With reference to *Burma Gazette* Notification, dated the 12th December 1887, Mr. E. M. Sage, Executive Engineer, 4th grade, sub. *pro tem.*, reported his return from furlough on the forenoon of the 12th December 1887, and is posted to the Toungoo Division.

Mr. H. W. James, Assistant Engineer, 1st grade, Meiktila Division, Upper Burma, has passed the Lower Standard Examination in the Burmese language.

Mr. H. Luckstedt, Executive Engineer, 3rd grade, on transfer to the Burma State Railway, reported his arrival at Rangoon on the forenoon of the 12th December 1887.

The services of Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, Toungoo Division, are placed at the disposal of the Superintending Engineer, Public Works Department, Upper Burma.

Burma State Railway.

Mr. R. L. Campbell, Executive Engineer, 4th grade, sub. *pro tem.*, is granted three months' privilege leave, with effect from the forenoon of the 26th November 1887.

Mr. H. Groves, Executive Engineer, 2nd grade, was relieved of his duties on this railway on the afternoon of the 2nd December 1887.

Mr. W. Giles, Assistant Engineer, 1st grade, is transferred from the 2nd to the 6th Division, Toungoo-Mandalay Extension, with effect from the forenoon of the 25th November 1887.

With reference to Director-General of Railways Notification, dated the 2nd December 1887, Mr. D. F. Hogarth, Executive Engineer, 1st grade, reported his arrival at Rangoon on the forenoon of the 12th idem, from which date he is also attached to the Engineer-in-Chief's office, Toungoo-Mandalay Railway.

Mr. F. W. Roberts, Assistant Engineer, 2nd grade, reported his return from the three months' privilege leave granted to him in this office Notification dated the 21st September 1887, on the forenoon of the 1st instant.

Mr. A. R. Lilley, Executive Engineer, made over, and Mr. H. Luckstedt, Executive Engineer, received, charge of the office of the Executive Engineer, Irrawaddy District, on the forenoon of this date.

Madras, December 20, 1887.

The following promotion is made:—Mr. A. T. Mackenzie, Assistant Engineer, 1st grade, officiated as Executive Engineer, Coimbatore Division, from the 12th October to 23rd November 1887.

Bombay, December 22, 1887.

His Excellency the Right Honorable the Governor in Council is pleased to make the following *permanent* promotion in the Engineering Establishment with effect from 13th November 1887, *vice* Colonel Seton, R.E., deceased:—Mr. H. M. Thompson, B.A., M. Inst. C.E., to be Executive Engineer, 1st grade.

Punjab, December 22, 1887.

Mr. F. E. Rose, Executive Engineer, 1st grade, attached to the Dera Ismail Khan Provincial Division, is allowed, under section 50 of the Civil Leave Code, furlough for two years, with effect from the 27th November 1887, or such subsequent date as he may avail himself of the same.

Irrigation Branch.

With reference to Government of India, Public Works Department Notification, dated 22nd November 1887, Mr. G. S. Morley, Executive Engineer, 4th grade, whose services have been temporarily placed at the disposal of the Agent to the Governor-General, Biluchistan, left the 5th Division, Sirhind Canal, for Quetta on the afternoon of the 21st November 1887.

India, December 24, 1887.

Chandu Lall, Apprentice Engineer, North-Western Provinces and Oudh, is promoted to Assistant Engineer, 3rd grade, with effect from the 24th November 1887.

Mr. A. E. Behrmann, Executive Engineer, 3rd grade, sub. *pro tem.*, Bengal, is permitted to retire from the service, with effect from the afternoon of 31st July 1887.

Mr. H. H. Green, Assistant Engineer, 1st grade, is retransferred from Biluchistan to Bengal.

The Government of India in the Public Works Department has no further need for the services of Mr. J. Leonard, Assistant Engineer, 2nd grade, Burma.

Director-General of Railways.

Mr. F. J. Pope, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India leave for ten months in extension of the furlough granted to him in Director-General's Notification, dated 21st February 1887.

Mr. W. J. Weightman, Assistant Engineer, 1st grade, passed, on the 9th November 1887, the Departmental Standard Examination in Hindustani, as prescribed in Public Works Department Code.

Mr. W. Monies, Assistant Engineer, 1st grade, is, on return from furlough, posted to the North-Western Railway.

N.-W. P. and Oudh, December 24, 1887.

Irrigation Branch.

His Honor the Lieutenant-Governor, North-Western Provinces and Chief Commissioner of Oudh, is pleased to order the following reversions with effect from the date specified:—

Mr. A. M. Fagan, Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, from 2nd December 1887, consequent on the return from furlough of Mr. T. C. Evans, Executive Engineer.

Rai Preonath Ghose Sahib, Executive Engineer, 4th grade, temporary rank, to Assistant Engineer, 1st grade, from 2nd December 1887. Consequent on the return from furlough of Mr. W. Ward-Smith, Executive Engineer.

Mr. C. H. Hutton, Assistant Engineer, 1st grade, is transferred from Nadrai Aqueduct Division to the Mainpuri Division, Lower Ganges Canal.

Buildings and Roads Branch.

Captain E. Blunt, R.E., 2nd Assistant Principal, is appointed to officiate as 1st Assistant Principal, and Captain R. V. Phillpotts, R.E., temporarily transferred from the Military Works Branch, as 2nd Assistant Principal of the Thomason Civil Engineering College, Roorkee, with effect from the afternoon of the 22nd October 1887, *vice* Captain Harrison, R.E., granted furlough to Europe for one year and four months.

Bengal. December 27, 1887.

Establishment.

With reference to the Government of India's Notification of the 22nd December 1887, Mr. H. H. Green, Assistant Engineer, is posted to the Darjeeling Division.

Mr. C. A. Mills, Executive Engineer, Second Calcutta Division, is granted privilege leave for three months, with effect from 7th January 1888.

Mr. W. B. Gwyther is appointed to officiate as Executive Engineer of the Second Calcutta Division, during the absence, on privilege leeave, of Mr. C. A. Mills, or until further orders.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed, under the provisions of Act XV. of 1859, in the Office of the Secretary to the Government of India in the Home Department :—

The 20th December 1887.

90 of '87.—Robert Samnel Thornton, Civil Engineer of Etawah.—*For "Thornton's bale dividing and shearing apparatus."*

215 of '87.—Philip Diehl of Elizabeth, State of New Jersey, United States of America, Mechanical Engineer.—*For improvements in sewing machines.*

216 of '87.—Philip Diehl of Elizabeth, State of New Jersey, United States of America, Mechanical Engineer.—*For improvements in sewing machines.*

Advertisements.