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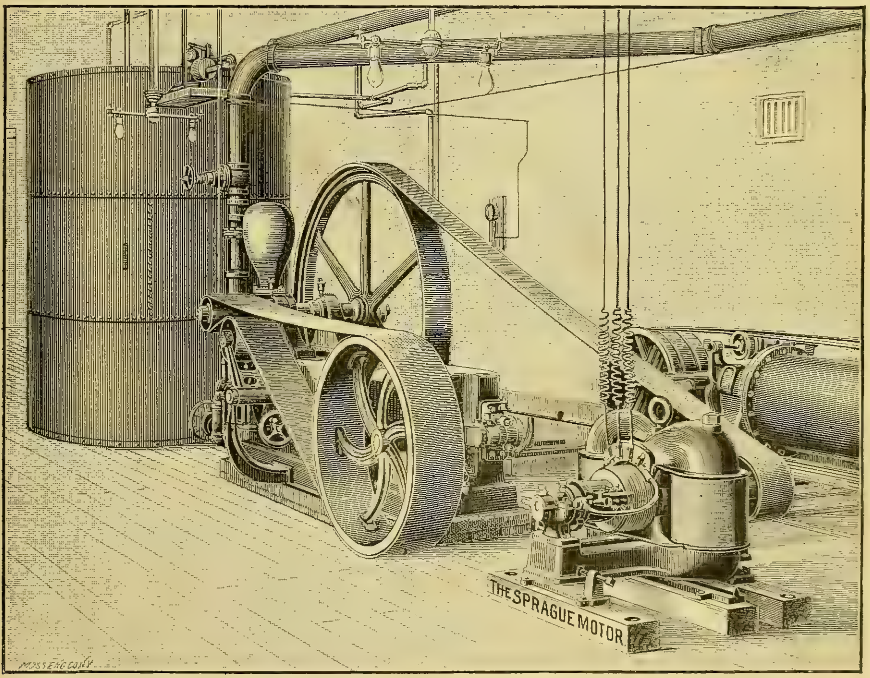
MODEL ELECTRIC ELEVATOR INSTALLATION.

WE present in this issue a view of a recent model hydraulic elevator installation made at the building of the United Security, Trust, and Safe Deposit Company of Philadelphia by the Otis Elevator Company of Yonkers, N.Y., and Chadbourne, Hazleton, & Co. of Philadelphia, agents in Pennsylvania for the Sprague Electric Railway and Motor Company.

One of the first things which strikes an observer is the minimum of space required for every part of the installation. The pump was manufactured by the Otis Elevator Company specially for this plant, and the arrangement for reduction of speed between the armature-shaft and the pump is made in the compact manner shown in the illustration. The motor operates the pump against a pressure in the tank, there being no overflow; and when the maximum pressure is reached, the motor runs empty, automatically cutting down the amount of electric current taken from the line, so that only sufficient current is used to supply enough energy to keep the motor in revolution.

Before the installation of the electric motor at this place, a gas-engine was used to supply the necessary power; but gas never proved satisfactory in this capacity, and the Sprague motor was substituted.

This motor is now giving perfect satisfaction, and the plant is one of the finest elevator plants in Philadelphia. Our view is made from a photograph, and shows all the details of the installation.



A NEW ELECTRIC ELEVATOR.

THE WORLD'S MEAT CONSUMPTION, PRODUCTION, AND TRADE.

THE average consumption of meat in the world, says a recent number of the *Journal of the Society of Arts*, London, has increased; but, on the other hand, the world's commerce in meat has declined. Germany's imports of meat declined from $94,450,000 in 1878, to $73,700,000 in 1887, while the exports declined from $88,300,000 to $33,900,000. In France, between 1879 and 1887, imports diminished from $82,300,000 to $53,910,000, while exports increased from $35,950,000 to $52,600,000. In England, where exports of meat are insignificant, the imports decreased from $240,000,000 in 1880, to $215,000,000 in 1887. On the other hand, the British colonies exported largely: for example, from Canada the exports increased from $4,430,000 in 1879, to $30,000,000 in 1887.

Australia exported also large amounts. In Austria-Hungary, imports diminished from $10,950,000 in 1879, to $8,000,000 in 1887, while exports increased from $20,750,000 to $33,900,000. In the United States, imports increased from $7,100,000 in 1879, to $16,650,000 in 1887, while exports decreased from $128,800,000 to $112,600,000. Importations into Belgium decreased from $16,400,000 in 1879, to $10,400,000 in 1887; in Italy, from $21,200,000 to $14,000,000; in Russia, from $18,330,000 to $10,400,000. By adding the above figures, it is found that the entire imports of meat into the countries specified have diminished from $490,970,000 to $403,120,000, while the entire exports decreased from $278,180,000 to $244,700,000. In 1875, Germany possessed 24,400,000 neat-cattle (four small cattle, such as sheep, hogs, and goats, being reckoned as one); in 1883, only 23,500,000. Between 1881 and 1887 there was in France an increase from 19,700,000 to 20,750,000; in Great Britain, from 17,800,000 to 18,600,000; while in Austria-Hungary the figures remained the same. The increase in population in these countries during this time was as follows: in Germany, 3,500,000; France, 480,000; Great Britain, about 3,000,000; and Austria-Hungary, 2,000,000. The ratio in France on account of the small increase of population is most favorable. This country, therefore, could increase its exports, says the United States commercial agent. In Germany the ratio is very bad, the number of neat-cattle having diminished 900,000 head, and the population having increased 3,500,000. It is most remarkable in the case of the United States, where imports increased 130 per cent, and exports diminished 12½ per cent, although the number of neat-cattle increased from 56,600,000 head in 1880, to 71,200,000 in 1888, and the population increased only from 50,500,000 to 62,000,000.

STANLEY'S EXPLORATIONS.[1]

I REMEMBER, while standing on the edge of the plateau which overlooks the southern end of Lake Albert, in December, 1887, that looking across the lake to the Unyoro plateau, and running my eye along its unbroken outline from north to south, I was much struck by the gradual but steady uplift of the land to a point near the lake's end, where a wide cleft separated the plateau from the disjointed mass and higher elevations culminating around Mount Ajif. Southward beyond Ajif we could see nothing but dark impenetrable clouds, ominous of a storm; yet underneath these night-black clouds lurked a most interesting mystery, — that of the long-lost and wandering Mountains of the Moon. Little did we imagine it, but the results of our journey from the Albert Nyanza to Unyampaka, where I turned away from the newly discovered lake in 1876, establish beyond a doubt that the snowy mountain which bears the native name of Ruwenzori or Ruwenjura is identical with what the ancients called "Mountains of the Moon."

Note what Scheaddeddim, an Arab geographer of the fifteenth century, writes: "From the Mountains of the Moon the Egyptian Nile takes its rise. It cuts horizontally the equator in its course north. Many rivers come from this mountain and unite in a great lake. From this lake comes the Nile, the most beautiful and greatest of the rivers of all the earth."

If, adopting the quaint style and brevity of the Arab writer, we would write of this matter now, we would say, "From Ruwenzori, the Snow Mountain, the western branch of the Upper Nile takes its rise. Many rivers come from this mountain, and, uniting in the Semliki River, empty into a great lake, named by its discoverer the Albert Nyanza. From this lake, which also receives the eastern branch of the Upper Nile, issues the true Nile, one of the most famous of the rivers of all the earth."

But this is a matter of slight moment compared to the positive knowledge that in the least-suspected part of Africa there has shot up into view and fact a lofty range of mountains, the central portion of which is covered with perpetual snow, which supplies a lake to the south of the equator, and pours, besides, scores of sweet-water streams to the large tributary feeding the Albert Nyanza from the south.

You will remember that Samuel Baker, in 1864, reported the Albert Nyanza to stretch "illimitably" in a south-westerly direction from Vacovia; and that Gessi Pacha, who first circumnavigated that lake, and Mason Bey, who in 1877 made a more careful investigation of it, never even hinted at the existence of a snowy mountain in that neighborhood; nor did the two last travellers pay any attention to the Semliki River. I might even add that Emin Pacha, for years resident on or near Lake Albert, or Capt. Cassati, who for some months resided in Unyoro, never heard of any such remarkable object as a snowy mountain being in that region: therefore we may well call it an unsuspected part of Africa. Surely it was none of our purpose to discover it. It simply thrust itself direct in our homeward route, and, as it insisted on our following its base-line, we viewed it from all sides but the north-east. Only then could we depart from its neighborhood.

Surrounded as I am by the hourly wants of an expedition like this, I cannot command the time to write such a letter on this subject as I would wish. I must even content myself with allowing a few facts to fall into line for your leisurely consideration.

If you will draw a straight line from the debouchure of the Nile from Lake Albert, 230 geographical miles in a direction nearly south-west, magnetic, you will have measured the length of a broad line of subsidence, which is from 20 to 50 miles wide, that exists between 3° north latitude and 1° south latitude in the centre of the African continent. On the left of this great trough, looking northward of course, there is a continuous line of upland, rising from 1,000 to 3,000 feet above it. Its eastern face drops abruptly into the trough: the western side slopes gently to the Ituri and Lomva basins. To the right there is another line of upland. The most northerly section, 90 miles, rising from 1,000 to 3,000 along the trough, is the Unyoro plateau, whose western face almost precipitously falls into the trough, and whose eastern face slopes almost imperceptibly towards the Kafur. The central section, also 90 miles long, consists of Ruwenzori range, from 4,000 to 15,000 above the average level of the trough. The remaining section of upland, and the most southerly, is from 2,000 to 3,500 feet higher than the trough, and consists of the plateaus of Uhaiyana, Unyampaka, and Ankori.

The most northerly section of the line of subsidence, 90 miles in length, is occupied by the Albert Nyanza; the central section, also 90 miles, by the Semliki River valley; the southernmost portion, 50 miles long, by the plains and New Nyanza, which we have all agreed to name the Albert Edward Nyanza, in honor of the first British prince who has shown a decided interest in African geography.

You will observe, then, that the Semliki valley extends along the base of Ruwenzori range; that the northern and southern extremities or flanks of Ruwenzori have each a lake abreast of it; that the Semliki River runs from the upper to the lower lake in a zigzag course.

If you were to make a plan *in relievo* of what has been described above, the first thing that would strike you would be, that what had been taken out of that abyss or trough had been heaped up in the enormous range; and if along its slope you were to channel out sixty-two streams emptying into this trough, and let the sides of the trough slope here and there sharply towards the centre, you would be impressed with the fact that Ruwenzori was slowly being washed into the place whence it came. However, all these are matters for geologists.

For months all Europeans on this expedition, before setting out on their journey towards Zanzibar from the Albert Lake, were exercised in their minds how Sir Samuel Baker, standing on a hill near Vacovia, five or six miles from the extremity of the Nyanza, could attach "illimitability" to such a short reach of water; but after rounding the Balegga Mountains, which form a group to the south of Kavalli, we suddenly came in view of the beginning of the Semliki valley, — a sight which caused officers to ask one another, "Have you seen the Nyanza?" and the female portion of the Egyptian following to break out into rapturous "Lu-lu-lus." Yet we were only four miles away from the valley, which was nearly white with its ripe grass, and which indeed resembled strongly the disturbed waters of a shallow lake.

This part of the Semliki valley, which extends from the lake south-westerly, is very level: for 30 miles it only attains to an alti-

[1] Letter from Mr. Henry M. Stanley to the Royal Geographical Society of London and to the Royal Scottish Geographical Society, written from Camp at Kizinga Uzinya, Aug. 17, 1889.

tude of 50 feet above the lake. All this part can only recently have been formed; say, the last few hundred years. In one of its crooked bends nearer the south-eastern range, we stumbled suddenly upon the Semliki River, with an impetuous volume, from 80 to 100 yards wide, and an average depth of 9 feet. Its continually crumbling banks of sandy loam rose about 6 feet above it. One glance at it revealed it to be a river weighted with fine sediment. When we experimented, we found a drinking-glass full of water contained nearly a teaspoonful of sediment. We need not wonder, then, that for miles the south end of Lake Albert is so shallow that it will scarcely float a row-boat.

Beyond the grassy portion of the valley, a few acacias begin to stud it, which, as we proceed south-westerly, become detached groves, then a continuous thin forest, until it reaches the dense and rank tropical forest, with tall trees joined together by giant creepers, and nourishing in its shade thick undergrowths. Every thing now begins to be sloppy wet; leaves and branches glisten with dew; weeping mosses cover stem, branch, and twig. The ground is soaked with moisture: a constant mist rises from the fermenting bosom of the forest. In the morning it covers the valley from end to end, and during the early hours, stratum after stratum rises, and, attracted by the greater drought along the slant of Ruwenzori slopes, drifts upwards until the summits of the highest mountains are reached, when it is gradually intensified until the white mist has become a storm-cloud, and discharges its burden of moisture amid bursts of thunder and copious showers.

The valley sensibly rises faster in the forest region than in the grassy part. Knolls and little rounded hills crop out, and the ground is much more uneven. Violent streams have ploughed deep ravines round about them, and have left long narrow ridges, scarcely a stride across at the summit, between two ravines a couple of hundred feet deep. At about 75 miles from the Albert Nyanza the valley has attained about 900 feet of altitude above it, and at this junction the forest region abruptly ends. The south-west angle of Ruwenzori is about east of this, and with the change of scene a change of climate occurs. We have left eternal verdure, and the ceaseless distillation of mist and humid vapors into rain, behind, and we now look upon grass ripe for the annual fire and general droughtiness. From this place the valley becomes like a level grassy plain until the Albert Edward Nyanza is reached.

The southernmost stretch of the Ruwenzori range projects like a promontory between two broad extents of the ancient bed of the Albert Edward. To avoid the long *détour*, we cross this hilly promontory in a south-easterly direction from the Semliki valley, and enter eastern Usongora, and are in a land as different from that at the north-western base of Ruwenzori as early summer is from midwinter. As we continue easterly, we leave Ruwenzori on our left now, and the strangely configured Albert Edward Nyanza on our right. The broad plains which extend between were once covered by this lake. Indeed, for miles along its border there are breadths of far-reaching tongues of swamp penetrating inland. Streams of considerable volume pour through these plains toward the Nyanza from Ruwenzori, without benefiting the land in the least. Except for its covering of grass, — at this season withered and dried, — it might well be called a desert; yet in former times, not very remote, the plains were thickly peopled. The zeribas of milk-weed, and dark circles of *Euphorbia*, wherein the shepherds herded their cattle by night, prove that, as well as the hundreds of cattle-dung mounds we come across. The raids of the Waganda and the Warasura have depopulated the land of the Wasongora, the former occupants, and have left only a miserable remnant, who subsist by doing work for the Warasura, their present masters.

From Usongora we enter Toro, the Albert Edward Nyanza being still on our right, and our course being now north-easterly, as though our purpose was to march to Lake Albert again. After about 20 miles' march, we turn east, leave the plains of the Albert Edward, and ascend to the uplands of Uhaiyana, which having gained, our course is south until we have passed Unyampaka, which I first saw in 1876.

South of Unyampaka stretches Ankori, a large country, and thickly peopled. The plains have an altitude of over 5,000 feet above the sea, but the mountains rise to as high as 6,400 feet. As Ankori extends to the Alexandra Nile, we have the well-known land of Karagwé south of this river.

Since leaving the Albert Nyanza, between Kavalli and the Semliki River, we traversed the lands of the Wavira and Babegga. On crossing the Semliki, we entered the territory of the Awamba. When we gained the grassy terrace at the base of the Ruwenzori range, we travelled on the border-line between the Wakonju, who inhabit the lower slopes of Ruwenzori, and the Awamba, who inhabit the forest region of the Semliki valley. The Wakonju are the only people who dwell upon the mountains. They build their villages as high as 8,000 feet above the sea. In time of war — for the Warasura have invaded their country also — they retreat up to the neighborhood of the snows. They say that once fifty men took refuge right in the snow region, but it was so bitterly cold that only thirty returned to their homes. Since that time they have a dread of the upper regions of their mountains.

As far as the south-west angle of Ruwenzori, the slopes of the front line of hills are extensively cultivated. The fields of sweet-potatoes, millet, eleusine, and plantations of bananas, describe all kinds of squares, and attract the attention; while between each separate settlement the wild banana thrives luxuriantly, growing at as high an altitude as the summits of the highest spurs, whereon the Wakonju have constructed their villages.

Though we were mutually hostile at first, and had several little skirmishes, we became at last acquainted with the Wakonju, and very firm, close friends. The common enemy were the Warasura; and the flight of the Warasura, upon hearing of our advance, revealed to the Wakonju that they ought to be friends with all those who were supposed to be hostile to their oppressors. Hence we received goats, bananas, and native beer in abundance. Our loads were carried, guides furnished us, and every intelligence of the movements of the Wanyoro brought us. In their ardor to engage the foe, a band of them accompanied us across Usongora and Toro to the frontier of Uhaiyana.

South-west of Awamba, beyond the forest region of the Semliki valley, begins Usongora. This country occupies the plains bordering the north-west and north of Lake Albert Edward. The people are a fine race, but in no way differing from the finer types of men seen in Karagwé and Ankori, and the Wahuma shepherds of Uganda. Their food consists of milk and meat, the latter eaten raw or slightly warmed.

The Toro natives are a mixture of the higher class of Negroes, somewhat like the Waganda. They have become so amalgamated with the lower Wanyoro that we can find nothing distinctive. The same may be said of the Wahaiyana. What the royal families of these tribes may be, we can only imagine from having seen the rightful prince of Usongora in Ankori, who was as perfect a specimen of a pure Galla as could be found in Shoa. But you need not conclude from this that only the royal families possess fine features. These Ethiopic types are thickly spread among the Wahuma of these Central African uplands. Wherever we find a land that enjoys periods of peace, we find the Wahuma at home, with their herds; and in looking at them one might fancy one's self transported from the midst of Abyssinia.

Ankori is a land which, because of its numbers and readiness to resistance, enjoys long terms of uninterrupted peace; and here the Wahuma are more numerous than elsewhere. The royal family are Wahuma: the chiefs, and all the wealthier and more important people, are pure Wahuma. Their only occupation, besides warring when necessary, is breeding and tending cattle. The agricultural class consists of slaves; at least, such is the term by which they are designated. The majority of the Wahuma can boast of features quite as regular, fine, and delicate as Europeans.

The countries to the south of the Albert Edward are still unexplored, and we have not heard much respecting them; but what we have heard differs much from that which you find illustrated by that irregular sheet of water called Muta Nzige, in the "Dark Continent" map.

Ruanda bears the name of Unyavingi to the people of Ukonju, Usongora, and Ankori, and is a large compact country lying between the Alexandra Nile and the Kongo watershed to the west, and reaching to within one day's long march of the Albert Edward. It also overlaps a portion of the south-west side of that lake. The

people are described as being very warlike, and that no country, not even Uganda, could equal it in numbers or strength. The late queen has been succeeded by her son, Kigeri, who now governs.

Since the commencement of our march homewards from our camp at Kavalli, we have undergone remarkable vicissitudes of climate. From the temperate and enjoyable climate of the region west of Lake Albert, we descended to the hot-house atmosphere of the Semliki valley, at nearly 3,000 feet lower level. Night and day were equally oppressively warm and close, and one or two of us suffered greatly in consequence. The movement from the Semliki valley to the plains north of Lake Albert brought us to a dry but a hot land. The ground was baked hard; the grass was scorched; the sun, but for the everlasting thick haze, would have been intolerable; in addition to which, the water — except that from the Ruwenzori streams — was atrocious, and charged with nitre and organic corruption. The ascent to the eastern plateau was marked by an increase of cold and many an evil consequence, — fevers, colds, catarrhs, dysenteries, and paralysis. Several times we ascended to over 6,000 feet above the sea, to be punished with agues, which prostrated black and white by scores. In the early mornings, at this altitude, hoar-frost was common. Blackberries were common along the path in North-West Ankori, 5,200 feet above the sea-level.

On entering Uzinya, south-west corner of Lake Victoria, the health of all began to improve, and fevers became less common.

I have jotted these few remarks down very hastily. Whether it is from lack of wholesome food or not, I confess to feeling it an immense labor to sit down and write upon any subject. I do not agree with Shakspeare when he says —

> "Fat paunches have lean pates; and dainty bits
> Make rich the ribs, but bankrupt quite the wits."

In our case, and I speak for all our officers as well as myself, "dainty bits" just now would brighten up our wits, for we suspect that our wits have strongly sympathized with the bodies' pains.

That you may know what the upper regions of Ruwenzori are like, I send you Lieut. Stairs's account of his ascent to a height of nearly 11,000 feet.

[Lieut. Stairs's account, written from Expedition Camp, June 8, 1889.]

I have the honor to present you with the following account of an attempt made by me to reach the snow-capped peaks of Ruanzori: —

Early on the morning of the 6th of June, accompanied by some forty Zanzibaris, we made a start from the expedition's camp at the foot-hills of the range, crossed the stream close to camp, and commenced the ascent of the mountain.

With me I had two aneroids, which together we had previously noted and compared with a standard aneroid remaining in camp under your immediate observation; also a Fahrenheit thermometer.

For the first 900 feet above camp the climbing was fairly good, and our progress was greatly aided by a native track which led up to some huts on the hills. These huts we found to be of the ordinary circular type so common on the plains, but with the difference that bamboo was largely used in their interior construction. Here we found the food of the natives to be maize, bananas, and colocasia roots. On moving away from these huts, we soon left behind us the long rank grass, and entered a patch of low scrubby bush, intermixed with bracken and thorns, making the journey more difficult.

At 8.30 A.M. we came upon some more huts of the same type, and found that the natives had decamped from them some days previously. Here the barometer read 23″.58 and 22″.85; the thermometer, 75° F. On all sides of us we could see *Dracænas*, and here and there an occasional tree-fern and Mwab palm; and tangled in all shapes, on either side of the track, were masses of long bracken. The natives now appeared at different hill-tops and points near by, and did their best to frighten us back down the mountain by shouting and blowing horns. We, however, kept on our way up the slope, and in a short time they disappeared, and give us very little further trouble.

Of the forest plains, stretching far away below us, we could see nothing, owing to the thick haze that then obscured every thing. We were thus prevented from seeing the hills to the west and north-west.

At 10.30 A.M., after some sharp climbing, we reached the last settlement of the natives, which consisted of beans and colocasias, but no bananas. Here the barometer read 22″.36; thermometer, 84° F. Beyond this settlement was a rough track leading up the spur to the forest. This we followed; but in many places, to get along at all, we had to crawl on our hands and knees, so steep were the slopes.

At 11 A.M. we reached this forest, and found it to be one of bamboos, at first open, and then getting denser as we ascended. We now noticed a complete and sudden change in the air from that we had just passed through. It became much cooler and more pure and refreshing, and all went along at a faster rate and with lighter hearts. Now that the Zanzibaris had come so far, they all appeared anxious to ascend as high as possible, and began to chaff each other as to who should bring down the biggest load of the "white stuff" on the top of the mountain.

At 12.40 P.M. we emerged from the bamboos, and sat down on a grassy spot to eat our lunch: barometers, 21″.10 and $27\frac{95}{120}$″; thermometer, 70° F. Ahead of us, and rising in one even slope, stood a peak, in altitude 1,200 feet higher than we were. This we now started to climb, and, after going up it a short distance, came upon the tree heaths. Some of these bushes must have been 20 feet high; and, as we had to cut our way foot by foot through them, our progress was necessarily slow, and very fatiguing to those ahead.

At 3.15 we halted among the heaths for a few moments to regain our breath. Here and there were patches of inferior bamboos, almost every stem having holes in it, made by some boring insect, and quite destroying its usefulness. Under foot was a thick spongy carpet of wet moss, and the heaths on all sides of us we noticed were covered with Old Man's Beard. We found great numbers of blue violets and lichens, and from this spot I brought away some specimens of plants for the Pacha to classify. A general feeling of cold dampness prevailed. In spite of our exertions in climbing, we all felt the cold mist very much. It is this continual mist clinging to the hill-tops that no doubt causes all the vegetation to be so heavily charged with moisture, and makes the ground under foot so wet and sloppy.

Shortly after 4 P.M. we halted among some high heaths for camp. Breaking down the largest bushes, we made rough shelters for ourselves, collected what firewood we could pick up, and in other ways made ready for the night. Firewood, however, was scarce, owing to the wood being so wet that it would not burn. In consequence of this, the lightly clad Zanzibaris felt the cold very much, though the altitude was only about 8,500 feet. On turning in, the thermometer registered 60° F. From camp I got a view of the peaks ahead, and it was now that I began to fear we should not be able to reach the snow. Ahead of us, lying directly in our path, were three enormous ravines. At the bottoms of at least two of these there was dense bush. Over these we should have to travel, and cut our way through the bush. It then would resolve itself into a question of time as to whether we could reach the summit or not. I determined to go on in the morning, and see exactly what difficulties lay before us, and, if these could be surmounted in a reasonable time, to go on as far as we possibly could.

On the morning of the 7th, selecting some of the best men, and sending the others down the mountain, we started off again upwards, the climbing being similar to that we experienced yesterday afternoon. The night had been bitterly cold, and some of the men complained of fever; but all were in good spirits, and quite ready to go on. About 10 A.M. we were stopped by the first of the ravines mentioned above. On looking at this, I saw that it would take a long time to cross, and there were ahead of it still two others. We now got our first glimpse of a snow-peak, distant about two and a half miles, and I judged it would take us still a day and a half to reach this the nearest snow. To attempt it, therefore, would only end disastrously, unprovided as we were with food, and some better clothing for at least two of the men.

I therefore decided to return, trusting all the time that at some future camp a better opportunity for making an ascent would present itself, and the summit be reached. Across this ravine was a bare, rocky peak, very clearly defined, and known to us as the south-west of the Twin Cones. The upper part of this was devoid of vegetation, the steep beds of rock only allowing a few grasses and heaths in one or two spots to exist.

The greatest altitude reached by us, after being worked out and all corrections applied, was 10,677 feet above the sea. The altitude of the snow-peak above this would probably be about 6,000 feet, making the mountain, say, 16,600 feet high. This, though, is not the highest peak in the Ruanzori cluster. With the aid of the field-glass, I could make out the form of the mountain-top perfectly. The extreme top of the peak is crowned with an irregular mass of jagged and precipitous rock, and has a distinct crater-like form. I could see, through a gap in the near side, a corresponding rim or edge on the farther, of the same formation and altitude. From this crown of rock, the big peak slopes to the eastward at a slope of about 25°, until shut out from view by an intervening peak; but to the west the slope is much steeper. Of the snow, the greater mass lay on that slope directly nearest us, covering the slope wherever its inclination was not too great. (The largest bed of snow would cover a space measuring about 600 by 300 feet, and of such depth that in only two spots did the black rock crop out above its surface. Smaller patches of snow extended well down into the ravine.) The height from the lowest snow to the summit of the peak would be about 1,200 feet or 1,000 feet. To the east-north-east our horizon was bounded by the spur, which, starting directly behind our main camp, and mounting abruptly, takes a curve in a horizontal plane, and centres on to the snow-peak. Again, that spur which lay south of us also radiated from the two highest peaks. This would seem to be the general form of the mountain; namely, that the large spurs radiate from the snow-peaks as a centre, and spread out to the plains below. This formation on the west side of the mountain would cause the streams to start from a centre, and flow on, gradually separating from each other, until they reach the plains below. There they turn to the west-north-west, or trace their courses along the bottom spurs of the range, and run into the Semliki River, and on to the Albert Nyanza. Of the second snow-peak which we had seen on former occasions, I could see nothing, owing to the Twin Cones intervening. This peak is merely the termination, I should think, of the snowy range, we saw when at Kavalli's, and has a greater elevation, if so, than the peak we endeavored to ascend. Many things go to show that the existence of these peaks is due to volcanic causes. The greatest proof that this is so lies in the numbers of conical peaks clustering round the central mass and on the western side. These minor cones have been formed by the central volcano getting blocked in its crater, owing to the pressure of its gases not being sufficient to throw out the rock and lava from its interior; and consequently the gases, seeking for weak spots, had burst through the earth's crust, and thus been the means of forming these minor cones that now exist. Of animal life on the mountain, we saw almost nothing. That game of some sort exists, is plain from the number of pitfalls we saw on the road-sides, and from the fact of our finding small nooses in the natives' huts, such as those used for taking ground game. We heard the cries of an ape in a ravine, and saw several dull grayish-brown birds like stonechats; but beyond these, nothing.

We have found blueberries and blackberries at an altitude of 10,000 feet and over, and I have been able to hand over to the Pacha some specimens for his collections, the generic names of which he has kindly given me, and which are attached below. That I could not manage to reach the snow, and bring back some as evidence of our work, I regret very much; but to have proceeded onwards to the mountain under the conditions in which we were situated, I felt would be worse than useless, and, though all of us were keen and ready to go on, I gave the order to return. I then read off the large aneroid, and found the hand stood at 19″-.900. I set the index-pin directly opposite to the hand, and we started down hill. At 3 P.M. on the 7th I reached you, it having taken four hours and a half of marching from the Twin Cones. The following are the generic names of the plants collected by me. Emin Pacha has kindly furnished them. 1. *Clematis*; 2. *Viola*; 3. *Hibiscus*; 4. *Impatiens*; 5. *Tephrosia*; 6. *Elycina*; 7. *Rubus*; 8. *Begonia*; 9. *Peucedanum*; 10. *Gnaphalium*; 11. *Helichrysum*; 12. *Senecio*; 13. *Sonchus*; 14. *Vaccinium*; 15. *Erica arborea*; 16. *Landolphia*; 17. *Heliotropium*; 18. *Lantana*; 19. *Moschosma*; 20. *Lissochilus*; 21. *Dracæna*; 22. *Luzula*; 23. *Carex*; 24. *Anthesteria*; 25. *Adiantum*; 26. *Pellæa*; 27. *Pteris aquilina*; 28. *Asplenium*; 29. *Aspidium*; 30. *Polypodium*; 31. *Lycopodium*; 32. *Selaginella*; 33. *Marchantia*; 34. *Parmelia*; 35. *Usnea*; 36. Tree fern; 37. One fern; 38. One *Polypodium*. The generic names of the last three are unknown.

PHONETICS.[1]

I CONGRATULATE the Modern Language Association on the establishment of a section which is as indispensable to language as the character of the Prince of Denmark is to the play of Hamlet. Language lives in sound; and the study of modern languages is the study of the spoken tongues.

I was honored by appointment to the presidency of this section, not in virtue of any linguistic attainments, but simply in recognition of my long and minute study of practical phonetics. At this the first meeting of our Phonetic Section, a few words on that subject will not, I trust, be unwelcome.

We constantly hear of the difficulty in pronouncing a foreign language, and especially of the difficulty of our own language to foreigners; but the reason of the difficulty has not been sufficiently recognized, namely, that learners have no initiatory phonetic training. They try to imitate speech in the mass; and they fail, because, after our earliest years, the faculty of imitation is no longer an instinct, as it is in childhood. The child unfailingly adjusts its organs of speech to the production of whatever sound it is accustomed to hear, and no difficulty is experienced in the process. The youth and the man cannot do so, however, because their organs are already set for the pronunciation of one class of sounds, and they cannot readily alter the adjustment to suit the production of other varieties; that is, they cannot form new sounds in the verbal combinations of speech, but (and this is the point I wish to bring out) they can, or they can be readily taught to, produce any sound by itself. This power is a prerequisite for the certain result of facility in combining the new sound with others as fluently as by a speaker "to the manner born;" for what is called combination is in reality merely rapid sequence.

I have known persons who had long been familiar with Welsh speakers, utterly unable to pronounce the sound of *ll* in a word, but they have been taught in a few seconds to give the element its true native effect, by itself, and, after brief exercise, to give it and an associated vowel the rapidity of sequence which is called combination. We all know speakers who cannot pronounce the English *w* in *we;* but we do not any of us know a single such speaker who cannot at once be made to pronounce the element by itself, and within a few minutes to give it and the succeeding vowel the necessary rapidity of sequence to convert *w-e* into *we*. On the same principle, the German *w*, which English imitators pronounce *v*, can be readily acquired as an elementary sound by any person, and then syllabically connected with vowels exactly as by native speakers.

The sound of *th* is another shibboleth to those who do not possess it in their vernacular. Habit and association have fixed the false method acquired in early undirected attempts, and the wretched mispronunciation is continued year after year. Yet this supposed difficult sound can be pronounced as an element almost at the first effort by any of these speakers, and its combination in syllables be afterwards mastered with certainty.

The only difficult part of English pronunciation is in the application of what is called "accent," which gives a definiteness and stress to some one out of any group of syllables, and a feebleness and indefiniteness to all the other syllables in the group. Accent (or syllabic light and shade) is the most marked characteristic of English utterance, and generally the last to be acquired by a foreigner; yet there is no real difficulty in mastering even this accen-

[1] Address by Dr. A. Melville Bell before the Modern Language Association, at the first session of the Phonetic Section.

tual habit, by simply practising syllables in unison with taps of the fingers. The broken English of foreigners who have been long resident in our midst is due entirely to phonetic neglect, and not to any inherent difficulty in the sounds of the language.

I can foresee that this statement will be called in question, because many teachers of languages have to be included among the speakers of broken English. Nevertheless, the fact remains, that such speakers labor under a disability which might have been prevented, and which may still be removed, by application of the principle that the separate formation of any element, in any given way, is feasible by any person, and that elementary combination is merely elementary sequence.

One result of this principle is to show the pre-eminent importance of the study of phonetic elements. Another result is to show the necessity of some means of indicating these elements independently of ordinary letters, because the latter have already, in all our minds, fixed associations with certain sounds. We require some symbols for pure phonetic qualities, — analogous to the Arabic ciphers for numbers, the algebraic signs, and the notation for music. We want characters which have an absolute value in the mouth — in all mouths — to enable us to teach and discuss the sounds of our respective languages, and to express our exact meaning in regard to them. We do not want to apply such signs instead of letters and in substitution for alphabetic writing, but we want to use them in interpretation of letters. The attempt to interpret letters by other letters is never free from ambiguity.

The symbols which make up what I call "Visible Speech" are precisely such as here described. They constitute a universal alphabet, because by means of them the sounds of any language are expressed with such directiveness that they can be reproduced from the writing by any expert in the system. But the main function of the symbols is fulfilled when they have taught the learner the phonetic value of ordinary letters. Our familiar *A B C*, the German alphabet, the Greek, the Arabic, and every other system of letters, may be preserved unchanged, while the symbols of "Visible Speech" are available as a key to them all.

In one of the early experiments with the system, the professor of Oriental languages in the University of Edinburgh dictated some peculiar East Indian words which were entirely new to me when I wrote them; and, when they were reproduced by the boys who were then the sole interpreters of the system, Professor Reid declared that he could not get his students to pronounce the same words with similar accuracy, after six months' instruction.

In this case the young readers heard the words for the first time when they themselves pronounced them. The explanation is, that the symbolic writing exhibited to their initiated eye the organic mechanism of the sounds, and they had only to follow this, and the original effect was necessarily reproduced without thought of sound on their part, or of any thing but the organic positions.

Some very interesting and crucial tests were applied by Mr. Alexander John Ellis, — the one man in England competent to apply such tests, as he was the author of the most exact analysis of speech-sounds, and the most complete phonetic alphabet that had then been published. I quote Mr. Ellis's own description of the experiments: —

"The mode of procedure was as follows: Mr. Bell sent his sons, who were to read the writing, out of the room, — it is interesting to know that the one who read all the words in this case had only had five weeks' instruction in the use of the alphabet, — and I dictated slowly and distinctly the words which I wished to be written. These consisted of a few words in Latin, pronounced first as at Eton, then as in Italy, and then according to some theoretical notions of how the Latins might have uttered them. Then came some English provincialisms and affected pronunciations; the words 'how odd' being given in several distinct ways. Suddenly German provincialisms were introduced; then discriminations of sounds often confused, in Polish, German, Dutch, and Swiss words; French and English words, and German and French words; some Arabic, some Cockney English, with an introduced Arabic guttural, some mispronounced Spanish, and a variety of shades of vowels and diphthongs. The result was perfectly satisfactory; that is, Mr. Bell wrote down my queer and purposely exaggerated pronunciations and mispronunciations, and delicate distinctions, in such a manner that his son, not having heard them, so uttered them as to surprise me by the extremely correct echo of my own voice. Accent, tone, drawl, brevity, indistinctness, were all reproduced with surprising accuracy. Being on the watch, I could, as it were, trace the alphabet in the lips of the reader. I think, then, that Mr. Bell is justified in the somewhat bold title which he has assumed for his mode of writing, — 'Visible Speech.'"

Mr. Ellis subsequently had the whole phonetic theory of the system, and the plan of symbolization, explained to him, when he had the magnanimity to write, —

"Mr. Melville Bell's scheme will, I believe and hope, thoroughly supersede one on which I have labored for many years, and expended much money."

I venture to say that the whole history of authorship does not exhibit a course of action more altruistic and honorable than that of Alexander John Ellis in his reception of "Visible Speech."

Mr. Ellis, of course, embodied the classifications of "Visible Speech" in his subsequent works. His system of "Glossotype" or "Glossic" was designed for the purpose of enabling all the new phonetic distinctions to be represented by Roman letters. This it accomplished by inversions and other arrangements of the letters, making up an alphabet, complete but arbitrary, and consequently difficult to use without constant reference to tables. "Glossotype" is a translation of "Visible Speech" into letters that are to be found in every printing-office. It, of course, entirely lacks the grand characteristic of "Visible Speech;" namely, self-interpreting letters, which exhibit in their forms a symbolic record of what the mouth must do in order to pronounce their sounds. "Glossotype" may be correctly described as "'Visible Speech' without its visibility."

My speaking to you here in Harvard reminds me that when I paid my first visit to America, in 1868, the then president of this university, Dr. Thomas Hill, was, I found, much interested in "Visible Speech," and in phonetics generally. I had the honor of meeting in Dr. Hill's drawing-room a gathering of professors and others, whom he had invited to receive some demonstrations of the system. To my surprise, Dr. Hill showed himself almost as well acquainted with my system as I was myself. I wrote on the blackboard for his interpretation, and he wrote for mine. Yet he had had no oral instruction in the method, but had studied it entirely from the written description.

I mention these facts simply to encourage those of you who may not have already entered on the study, to make practical investigation for yourselves. In this way you will, at all events, acquire a knowledge of the varieties of linguistic sound, and also see the organic formation of familiar elements, which you may possibly have been forming all your lives without knowing how you formed them; and the power of analyzing familiar sounds will ultimately become a guide to the formation of new and unfamiliar sounds.

We live in a busy world, and cannot afford to spend much time, even in the most interesting studies, unless they involve also our material interests. I may therefore point out, that a knowledge of the whole round of speech-actions can be acquired, under proper oral instruction, in a period so brief that the busiest student need not be deterred from undertaking the work. The study is in itself most interesting, and it is, besides, of important material benefit to those who master it. In primary schools, in schools for the deaf, and in all the fields of teaching, there is an increasing demand for skilled phoneticians; and to you, members of the Modern Language Association, this demand naturally looks for supply.

I am most desirous, before I leave the world, to see the subject of phonetics added to the curriculum in universities and normal schools. I may add, that, in furtherance of this object, I have presented, through the Bureau of Education, and with the kind co-operation of the commissioner of education, a copy of my recent work on "Vocal Physiology and Visible Speech," to every university and normal school in the United States. The same presentation has also been extended to the universities and normal schools in Great Britain and the British Colonies. The opening of this Phonetic Section of the Modern Language Association may be taken as an indication of the growing interest in the subject, and an omen of its future prominence among educational studies.

You will, of course, have many aspects of phonetics presented to

you in the contributions you will receive from year to year, — such as historical phonetics, or the order of past changes in pronunciation; national phonetics, or the tendencies of individual languages; formal phonetics, or the operation of definite laws; assimilative phonetics, or the influence of sound upon sound; and doubtless other varieties, — but all these should pre-imply a fundamental power in practical phonetics. Theorizing on sounds which you cannot illustrate is profitless.

Sounds have been described as long, short, acute, grave, flat, sharp; heavy, light, dull, obscure, hard, soft; harsh, smooth, open, shut, thick, thin; narrow, broad, fat, liquid, etc.; and organically as labial, lingual, palatal, guttural, nasal, dental, head sounds, throat sounds, chest sounds, even ventral sounds. The whole nomenclature has been indefinite and unscientific. Such names must be discarded for a terminology that shall express something which is uniformly intelligible to all who use it.

For example: certain mouth-actions are produced with, and certain others without, accompanying voice: these are clearly distinguished as "vocal" and "non-vocal." Certain actions are performed by the back of the tongue, others by the top of the tongue, others by the front of the tongue, others by the point of the tongue, others by the lips; and the resulting elements are unambiguously named "back," "top," "front," "point," "lip." Some sounds are formed with the tongue in close approximation to the roof of the mouth, others with the tongue removed from it as far as possible, and others in an intermediate position: these varieties are clearly distinguished as "high," "low," "mid." Some sounds are formed with constriction of the organic aperture, and others with comparative looseness and expansion; and these are distinguished by the term "wide" applied to the latter class. Some sounds issue through a channel over the centre of the organ concerned, others through apertures formed at the sides, and some with the mouth-passage entirely closed: the last are descriptively named "shut;" and the side-aperture sounds, "divided." Some sounds are formed with the co-operation of two parts of the mouth, and these are called "mixed;" and some are emitted wholly or partly through the nose. The former are called "nasal;" the latter, "nasalized." Such definite nomenclatures as these are easily learned, readily remembered, and unambiguously understood.

One practical application of phonetics will probably come occasionally under the consideration of this section; namely, the removal of anomalies and irregularities in spelling. This association may well become the national authority and umpire in questions of what is called "spelling-reform." The established writing of our words is only partially phonetic; and the first point to be determined is, Can it be made wholly so? The answer is both yes and no, — no, if the condition be made to admit no new letters, and to maintain the present aspect of words; yes, if new letters be allowed, and the aspect of words be free to change, without regard to present usage. Written words become pictorial to the eye, and any change of the literal picture destroys for a time the identity of the word. Thus words are both combinations of sounds and combinations of letters. The sound is the original, the real word: the letters form a conventional pictorial word. Are we to retain both in mutual independence, with all the inconvenience which the present arrangement entails, or are we to alter the conventional so as to represent the real? If we agree to disturb the old word-picture, let us make the new one perfectly accord with the word-sound; but that would be to give up historical spelling altogether. If we decide to retain historical spelling, we should then agree on some initiatory scheme, by which the difficulty of learning to read may be importantly lessened, for the benefit of children and of the nations which are acquiring the English tongue.

In an extended English alphabet recently published under the title of "World-English," a method is shown by which the writing of the language is rendered perfectly phonetic, while the aspect of words is changed in the least possible degree consistent with that result. The alphabet is designed only for initiatory use, and to facilitate the learning to read from common letters and common spelling. Some critics have failed to see this limitation of the scheme, and have looked on the proposition as a new attempt at spelling-reform; but, on the contrary, the reason for producing "World English" was to demonstrate, that, so far as learners of the language are concerned, present orthography may remain altogether untouched; and that the literature of England and America need not be rendered foreign to the eye by any change in spelling.

Why cannot our legislatures rise to the importance of regulating school and official practice in the representation of our speech? Private efforts have cleared the way, and shown, in a variety of modes, what may be done. Official action now would be comparatively easy.

In the mean time, might not this association with advantage formulate some conclusions on the subject? Suppose the following questions to be discussed, and the answers promulgated for general information: —

1. Should our spelling be altered for the sake of facilitating the work of learning to read?

2. Can that object be attained without such alteration?

3. Can our spelling be partially phoneticized, by dropping silent letters and otherwise, without destroying the identity of words to the eye?

4. Can a purely phonetic method, in place of ordinary spelling, be made acceptable to the educated public?

5. Should we not recognize two independent forms of our written words, — one in common spelling, for use in literature; the other in phonetic spelling, for use in primary schools, and wherever else may be desired?

Definite answers to these or such questions would tend to concentrate effort in the approved direction, and to suspend futile effort in other directions.

The varieties of sound heard in dialectic and district pronunciation prove that the necessities of intercourse do not depend on nice phonetic distinctions. In fact, one who is familiar with the words of a language can understand speech when only one unchanging vowel-sound is used; or writing, when a mere hyphen is substituted for all vowel-letters. One system of shorthand is based on this principle. The consonants are written small when no vowel-sound follows them; and in this way the relative size of these characters informs the eye where vowels do and do not occur; with the result, that, except in monosyllables, the writing is sufficiently free from ambiguity for practical stenography.

Extended intercourse is assimilating the pronunciation of districts which differed widely in their utterance before the days of steamboats and railways. The dialect of my native place is no longer what it was in my remembrance. The provinces of a nation, and the nations of the world, are rising gradually to one phonetic standard. But variety comes with refinement; shades of sound become associated with shades of meaning; and the ear itself becomes more appreciative of slight differences.

Early English pronunciation was very unlike what we hear now, chiefly because it lacked many shades of sound which we distinguish. The letter *r* had always its consonant sound, which is now heard only before a vowel. *A* was alway *ah; ai, ah-i; aw, ah-w*. *W* was always pronounced after a vowel, as *ew, eh-w; ow, oh-w*. *U*, as in *but* and *us*, was always pronounced *oo;* and our silent letters *gh* and *l*, as in *might* and *would*, were always sounded. I can fortunately illustrate the effect of the English of Shakspeare's time by repeating a short speech, the pronunciation of every word in which has been ingeniously recovered by Mr. Ellis. This is Portia's speech on mercy, from the "Merchant of Venice," as prouounced on the Shakspearian stage ["The quality of mercy," etc.]. My object in this brief address has been simply to incite you to give increased attention to practical phonetics. Mastery of the mouth will give an advantage in all the other departments, and also in the teaching of modern languages. Without entering further into detail, which would make this a lesson instead of an address, I shall conclude by hoping that the deliberations of this Phonetic Section may advance the study of the art and science of speech, enhance both professional and popular interest in the subject, and be a continuous credit to the Modern Language Association.

THE Russian Government has in contemplation a project for connecting, by a system of canals, the White Sea with Lake Onega and with the principal navigable rivers of Russia. The canals are to be of sufficient depth to admit vessels drawing ten feet of water.

HEALTH MATTERS.

The Difficulties of the Medical Profession.

"AN Old Doctor" deplores the visible decadence of the profession in a long letter of lamentation in *The Lancet*. Among other things, he says,—

"In these advertising days, in medicine, as in every thing else, people who know little or nothing of a subject, who presume ignorantly to address the public in the daily and weekly press, attract more notice than those who have devoted their lives to their particular work. It is a misfortune that in this country (i.e., England) a very large amount of medical practice (and that the most easy and profitable) is lost to the profession by the fact that almost all chemists prescribe largely. This is a great and crying evil. The practice is, instead of diminishing, largely increasing. This should be stopped. The chemist nearly always prescribes, but generally says, to cover himself, 'If worse, take patient to a medical man.' And so the medical man reaps all the hard work (often without being paid), and the chemist most of the profits. Then, again, hospitals, both special and general, take away largely from the proper, legal, and rightful profits of the profession. The public have a notion that they get advice and medicine of the highest character from the hospitals for nothing, but, if they pay for it to the general practitioner, they get a second-rate article. This is a bad system. Why not set up legal dispensaries for free legal advice, free places to get married in, free clothing establishments, free meat-stores, etc., all paid for by subscriptions or rates?

"The fact is, the medical profession is gradually and surely committing suicide, and its career on the downward path should be promptly arrested. If we were true to ourselves (which we are not, and never have been), the present increase in the profession would be insufficient to supply the needs of the public. But, if we go on working on the 'sweating system,' (for who sweats more, mentally and physically, than the hard-worked medical practitioner, night and day doing his best to preserve the health and life of the people?) often indeed without reward, then we shall be fools indeed. This idea, that medical services can be had for nothing, and so ought to be paid for at that price, is spreading. We are doing away with all professional reserve. We make every thing plain, and it is valued accordingly. The more a profession is lowered in the eyes of the public, the less respect it receives."

THE BACILLUS OF WARTS.—Dr. Kuhnemann has found, says *The Medical Record*, in sections of warts (*verruca vulgaris*) a bacillus which is always present in the prickle layer. It has distinctive qualities as regards its capacity for color, and is found both between and in the cells. Its form is that of exceedingly delicate, slender rods, the thickness bearing the proportion to the length of one to six. It is seldom found in the skin surrounding the warts, and is found most plentifully when the wart is recent.

MEMORY FOLLOWING CRANIAL INJURY.—The following case is reported by the patient, a distinguished member of the legal profession. The loss of memory has been permanent for certain subjects extending over a certain area of time preceding the accident. In all other respects, says *The Medical Analectic*, the mental faculties are of a very high order. "When twelve years and ten months old, I fell over a cliff at Howth, County Dublin. The cause of my accident was a kind of landslip, and I fell and rolled about thirty feet, when I caught a bush, which gave way with me, and I fell about thirty feet more on to rocks. I was picked up quite insensible. My jaw was broken in four places, but no other bones. I am told, however, that my appearance was like that of some one who had been beaten into a jelly from head to foot. I have no recollection of the accident beyond holding on to the bush or bramble which gave way with me. Nor do I remember being picked up, nor any thing which subsequently occurred, until about ten days after the accident, when I seemed to awake out of a long sleep, in great pain, and seeing Surgeon Butcher standing over me and setting my jaw, or doing something to it which caused me great pain. I was more or less incapable of doing any thing for seven or eight months, owing to the shock to my system. My father had died about seven months before the accident; and I am told that I used constantly to be with him, and that he was very fond of me, but I have not the smallest recollection of him, or what he was like, nor can I remember a single incident of my life before the accident; and, in fact, up to the time it occurred, every thing is a complete blank in my memory, both as regards individuals and events. I am told that I was practically insensible for about a week after the accident occurred."

INFLUENZA.—We are now passing through one of the periodic visitations of this annoying disease. For the last four centuries these attacks have come at varying intervals, those most pronounced being at intervals of forty or fifty years, although others have occurred at shorter intervals. These last, however, have been confined to smaller areas, where for some reason the conditions were favorable to the spread of the disease. A peculiarity of the great attacks has been their universality, spreading as they have from the equator to the poles. We are now inclined to connect some micro-organism with each disordered state of the human system. So it may be that this enemy of human comfort has his periods of activity, just as the seventeen-year locust has his. Influenza comes suddenly, and goes as quickly. The cause, whatever it may be, descends on a community with the result that the least robust, of whatever age, are afflicted most. The outbreak of epizootic among horses in 1870 has been connected by some with the influenza in man.

NOTES AND NEWS.

THE government of Chili has had a committee of engineers examining the water-works of the principal European cities, with a view to establishing similar works, on a large scale, in some of the Chilian cities.

—Professor R. H. Thurston has received the university decoration, "*Officier de l'Instruction Publique de France*."

—The canal to connect the North Sea, at the mouth of the Elbe, with the Gulf of Kiel on the Baltic, which was begun two or three years ago, is making fair progress. It will be 61 miles long, 85 feet broad at the bottom, and nearly 200 at the water-level, and of sufficient depth to take the largest German war-vessels. It will have only two locks, one at each end.

—The sixth annual meeting of the American Historical Association was begun in Washington, Dec. 28. Among those present were President Charles K. Adams of Cornell University; the Hon. John Jay of New York; John F. King, president of the New York Historical Society; Dr. Justin Winsor of Cambridge, Mass.; Mrs. Martha J. Lamb, editor of the *Magazine of American History*; Gen. James Grant Wilson of New York; Horatio King, Washington; Gen. George W. Cullom, William F. Poole, Chicago; Senator Hoar, President Gallaudet, of Washington; Judge Chamberlin of Boston; and Gen. Charles Darling of Utica, N.Y. Professor George L. Burr of Cornell University delivered an address on the literature of witchcraft. Ex-President Andrew D. White of Cornell followed in a paper entitled "A Catechism of Revolutionary Re-action." It calls attention to the fact, that, while there are so many histories of the French Revolution, there is as yet no history of the re-actions which have followed it. The next paper was on the "French Revolution in San Domingo," by Herbert Elmer Mills, instructor in history, Cornell University. Clarence Winthrop Bowen, Ph.D., read a paper entitled "A Newly Discovered Manuscript: Reminiscences of the American War of Independence, by Ludwig, Baron von Closen, Aide to Count de Rochambeau." This contained a description of the movements of the allied armies in the neighborhood of Manhattan Island in the summer of 1781, of the meeting of Washington and Rochambeau, and of the scenes following Cornwallis's surrender. The writer gives many interesting personal reminiscences of the Washington family and of early American society. The subject of President Charles K. Adams's inaugural address was "The Recent Advancement of Historical Studies in the Colleges and Universities of America and Europe." Mr. Talcott Williams of Philadelphia read an interesting paper on "Historical Survivals in Morocco." The full programme has already been published.

—A careful computation of the speed of a routing-machine cutter, made recently in Chicago by mechanical experts, showed it to be making 23,466 revolutions per minute. This was the regular

working speed, but the machine is sometimes speeded up to 28,000 revolutions per minute. The magnolia anti-friction metal, mentioned recently in these columns, is used for bearings, which permits this high speed to be maintained for ten hours a day without heating the journals.

— In a recent pamphlet on petroleum-fields, Mr. Charles Marvin states that the oil-fields of Canada cover upward of a hundred thousand square miles. There are also extensive oil-fields, comparatively undeveloped, in South Africa, New Zealand, South Australia, and Burmah. As the South African oil-fields underlie the diamond and gold mining districts, it would seem to be assured of a speedy development, fuel costing nearly a hundred dollars a ton there.

— Mr. Loubat, a member of the New York Historical Society, as we have already noted, has given to the Academie des Inscriptions et Belles-Lettres of Paris, a fund with an annual income of 1,000 francs for the giving of a prize of 3,000 francs every third year. This prize is to be given to the best printed work on history, geography, archæology, ethnography, linguistics, or numismatics of North America. The academy fixes 1776 as the latest date to which the works are to apply. The prize will be awarded in 1892, and any work will be open to the prize if published after July 1, 1889, whether in Latin, French, English, Spanish, or Italian.

— In the manufacture of one or two proprietary articles, Mr. James Gresham of Brooklyn has found it necessary, according to the *Oil, Paint, and Drug Reporter*, to use beeswax, from which he extracts the saccharine and gelatine matters, leaving a fine powder containing all of the other principles of beeswax. This latter substance has always been considered a waste product until lately, when experiments demonstrated its value for polishing fine surfaces, such as furniture, silver, glass, etc. The discovery is considered important, and will no doubt be turned to industrial account instead of the by-product being destroyed, as formerly.

— The Maryland Historical Society has published in a handsome volume the first instalment of the "Calvert Papers," recovered after years of fruitless search, and acquired by the society somewhat more than a year ago. These papers consist of about one thousand documents relating to the Calvert family and to the province of Maryland; and they extend chronologically from the reign of Elizabeth to about ten years before the American Revolution. A large number are of great historical importance and interest. This volume, besides a selection from these documents, gives an account of their recovery and presentation to the society, and a complete calendar, carefully prepared by Mr. J. W. M. Lee, of all the papers recovered. A handsome blazon, in colors, of the arms of Cecilius Calvert, as given in Gwillim, forms the frontispiece.

— At a largely attended meeting in Edinburgh on Tuesday, Dec. 3, it was resolved, we learn from *Nature*, that Mr. George Reid, R.S.A., should be commissioned to paint a portrait of Professor P. G. Tait, to be placed permanently in the rooms of the Royal Society of Edinburgh. A committee was appointed to carry out the resolution, including, among others, Mr. John Murray ("Challenger" expedition), convener; Mr. Gillies Smith, honorary treasurer; Lord President Inglis; Lord Kingsburgh; Lord Maclaren; Sir William Thomson; Sir Arthur Mitchell; Professor Robertson Smith; Professor Chiene; Dr. Alexander Buchan; Mr. Robert Cox; and Mr. William Peddie. It was proposed that an etched engraving of the portrait be prepared for distribution among the subscribers, the plate to be destroyed after the required number of copies have been thrown off. It was further resolved that all the fellows of the Royal Society of Edinburgh, the professor's old pupils, and others, be afforded an opportunity of taking part in this public recognition of Professor Tait's eminent services to science.

— Italy, France, and the United States of America were represented in the elections to foreign membership of the Royal Society of London on Thursday, Dec. 5, according to *Nature*. Professor Stanislao Cannizzaro of Rome was elected on the ground of his researches on molecular and atomic weights; Professor Chauveau of Paris, for his researches on the mechanism of the circulation, animal heat, nutrition, and the pathology of infectious diseases; and Professor Rowland of Baltimore, for his determination in absolute measure of the magnetic susceptibilities of iron, nickel, and cobalt, for his accurate measurements of fundamental physical constants, for the experimental proof of the electro-magnetic effect of electric convection, for the theory and construction of curved diffraction-gratings of very great dispersive power, and for the effectual aid which he has given to the progress of physics in America and other countries.

— French colonization and development companies are making encouraging progress in creating new oases in the Algerian part of the Desert of Sahara. One company have sunk nine artesian wells, reaching water-bearing strata at a depth of 230 feet, giving a steady flow of about five thousand gallons per minute. The water is brackish, and unfit for drinking, but it answers very well for irrigation. This company have about fifty thousand palm-trees under cultivation, the date-palm being the principal variety. Henna and madder are also cultivated profitably, and experiments are in progress with cotton, flax, tobacco, grape-vines, wheat, and barley. Rye-grass and lucern grow abundantly, the latter especially flourishing in the palm-tree plantations. This company began operations in 1882, and they now have upwards of nine hundred acres of productive land reclaimed from the desert, watered by twenty-five miles of irrigating canals. These are very interesting experiments, and it is to be hoped they will be commercially successful, if not extremely profitable.

— The committee on building fund of the Natural Science Association of Staten Island, appointed to consider the possibility of obtaining a fund for a meeting hall, museum, and library, state that they have succeeded, by informal personal solicitation, in obtaining a pledged subscription for that purpose of $100 from each of the following gentlemen: Capt. A. L. King, Eberhard Faber, L. F. Whitin, Dr. N. L. Britton, Aaron Vanderbilt, Henry R. Kunhardt, L. P. Gratacap, Arthur Hollick, and K. B. Newell. The following active members have agreed to become life members (by the payment of $50 each) in order to assist the fund: Dr. Frederick Hollick, Dr. William C. Walser, W. B. Kunhardt. From the above it will be seen that more than $1,000 is definitely pledged at the present time. It was thought best to secure some such amount, as a guaranty of earnestness and good faith, before making a general appeal to the public. The gratifying success has determined the committee to push on with the work, and to publish and distribute a general appeal to the public at an early date, probably during the first part of next month. The sum estimated as necessary to be raised is $7,000.

— A street-railway about a mile and a half in length, on an entirely new principle, is being constructed in Washington, D.C., by the Judson Pneumatic Railway Company of this city. In this system, power is to be transmitted by compressed air from a central station to a series of motors placed beneath the track at intervals of about fifteen hundred feet. In a conduit between the rails, similar in construction to a cable-railway conduit, revolves a smooth cylinder, or series of cylinders coupled together at the ends about six inches in diameter. These cylinders are to be kept in continuous rotation by the compressed-air motors. An adjustable blade or arm projecting from the bottom of the car, and passing through the narrow slot into the conduit, carries at its end a group of friction-wheels, which may be pressed down forcibly upon the upper quarter of the revolving cylinder. The plane of revolution of these friction-wheels may be changed by an ingenious device controlled by a lever, to be operated by the driver of the car. While the friction-wheels revolve in the same plane as the cylinder, the frame supporting them is at rest, but the moment the axes of the wheels are thrown out of line with that of the cylinder, by a movement of the lever, the frame is driven along the cylinder by the diagonal travel of the wheels, which is similar to that of the travelling ink-distributer on some of the old-fashioned printing-presses. The speed of the car is regulated by the angle of inclination of the friction-wheel axles, the cylinder revolving continuously in one direction at a uniform speed. The feasibility of this system, which at first glance would seem doubtful, has been demonstrated to the satisfaction of those interested by the successful working of a full-size model on a two-hundred-foot track in this city.

SCIENCE:

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author n request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

Vol. XV. NEW YORK, January 3, 1890. No. 361

CONTENTS:

AMERICAN GEOLOGICAL SOCIETY.

THE annual meeting of this society began Dec. 26, in the new building of the American Museum of Natural History in this city. The result of the election of officers was announced as follows: president, James D. Dana; vice-presidents, John S. Newberry and Alexander Winchell; secretary, John J. Stevenson; treasurer, Henry S. Williams; executive council, J. W. Powell, George W. Dawson, and Charles H. Hitchcock.

Fifteen new fellows of the society were announced as having been elected, and they are as follows: Frank Dawson Adams, lecturer at McGill College, Montreal; Albert Smith Bickmore, American Museum of Natural History; Aaron Hodgman Cole, Hamilton lecturer on natural history at Madison University; Thomas Sterry Hunt of New York City; R. D. Lacoe of Pittston, Penn.; Alfred Church Lane, Houghton, Mich., assistant on Geological Survey of Michigan; Alexander Richard Cecil Selwyn, Ottawa, Canada, director of the Geological and Natural History Survey of Canada; Bailey Willis, Washington, D.C., United States Geological Survey; J. E. Wolff, Cambridge, Mass., instructor of petrography at Harvard; Lorenzo G. Yates, Santa Barbara, Cal.; Victor C. Alderson, Englewood, Ill., teacher of geology; Henry M. Ami, Ottawa, Canada, Geological Survey of Canada; Ezra Brainerd, Middlebury, Vt., president of Middlebury College; Daniel Webster Landon, jun., Cincinnati, O., geologist of the Chesapeake and Ohio Railway; George Clinton Swallow, Helena, Mont., inspector of mines of Montana.

T. C. Chamberlin of Madison, Wis., read a paper upon "Some Additional Evidences bearing on the Interval between the Leading Glacial Epochs," and W. J. McGee of the United States Geological Survey replied briefly. Professor N. S. Shaler of Harvard spoke on "The Tertiary Deposits of Eastern Massachusetts." In his paper, Mr. Shaler endeavored to show that in that district there had been, since the miocene age, a large amount of true mountain-building action at Gay Head, on Martha's Vineyard. The evidence of this had been distinguishable for a long time; but about a year ago it was uncovered, so that it could be better seen than at any previous time, by a most violent rain-storm somewhat in the nature of a cloud-burst. In two hours' time, five and one-half inches of water had fallen, and the cliffs at Gay Head had been washed so much that opportunities for investigation were better than ever before. A remarkable instance of dislocations had been exposed, and the formation of the cliffs made plainly visible. The evidences of mountain-building were plain, and it was of a comparatively late period. The same thing could be seen on Block Island. Its limit to the north was sharply defined, for the greensands of Marshfield, Mass., had been examined by Mr. Shaler, and they were perfectly horizontal, and not disturbed. To the south and west investigations had not been pushed: so the extent of the mountain-building in that direction was unknown. Mr. Shaler said further that the evidences of glacial action were plain, and that it must have taken place after the upheaval or mountain-building age.

The second day's session was opened with an address by the present president, Professor James Hall, geologist of the State of New York. Professor Hall's address was a sketch of the earlier geologists, and was directed chiefly to the younger members of the society present. He paid tributes, among others, to Agassiz, Sir Charles Lyell, Professor Logan, the royal geologist of Canada, and William Smith, and closed with a reference to his colleague, Professor Dana.

Professor Edward Orton, State geologist of Ohio, considered the "Origin of the Rock-Pressure of Natural Gas in the Trenton Limestone of Ohio and Indiana." The gas is the product of ages, which has been accumulated in the porous limestone of Ohio and Indiana. It has been produced so slowly that when once exhausted it will take many thousands of years for it to again accumulate in sufficient quantities to be used, even if the elements necessary for its production were present, which he thought was not at all probable. The pressure which forces the gas out with such tremendous power that it sometimes reaches 1,000 pounds pressure per square inch is not due to the pressure of the gas itself, but to the hydrostatic pressure brought to bear by the column of salt water that enters the porous stratum of rock containing the gas, at the sea-level, and which by its weight tends to force the gas out. To the explanation and elucidation of this phenomenon, Professor Orton's paper was more especially devoted. The men who are engaged in the practical development of gas and oil fields, said he, made great account of rock-pressure. It is the first fact they inquire after in a new gas-field. They appreciate its importance, knowing that the distance of the markets they care to reach, and the size of the pipes they can employ, are entirely dependent upon this element. After discussing the theories of its origin, he expressed the opinion that the gas-supply could not be of very long duration. This fact he regarded as of the greater importance on account of the vast extent to which natural gas had become a factor in Western manufacture and development. He said that 400,000 people in north-western Ohio and central Indiana alone depended upon it for fuel and illumination, and that a large proportion of their manufactures depended upon it. The supplies were being wasted in a vandal fashion, and he thought that nine years at most would mark its duration in this region. Artificial gas he believed preferable.

The next paper was by Professor William B. Clark of Johns Hopkins University, his subject being "The Tertiary Deposits of the Cape Fear River Region."

Professor Andrew C. Lawson of Ottawa, Canada, next read a paper entitled "Note on the Pre-Palæozoic Surface of the Archæan Terranes of Canada." Professor William M. Davis of Cambridge, Mass., presented the fourth paper, on "The Structure and Origin

of Glacial Sand Plains." "Glacial Features of Parts of the Yukon and Mackenzie Basins" was the title of the paper submitted by Professor R. G. McConnell of Ottawa, Canada. Professor J. B. Tyrrell of Ottawa, Canada, read a paper on the "Post-Tertiary Deposits of Manitoba and the Adjoining Territories of Canada." Professor G. Frederick White of Oberlin College, Ohio, followed with a paper on "Terminal Moraine in Ontario;" Professor W. J. McGee of Washington, one on the "Southern Extension of the Appomattox Formation;" and Professor Charles D. Walcott of Washington defined the value of the term "Hudson River Group" in geologic nomenclature.

At the concluding sessions on Dec. 28 the number of speakers was so large that a general curtailment was necessary, and papers were withdrawn by the following members: Joseph P. Iddings and George H. Eldridge, Washington, D.C.; C. R. Van Hise, Madison, Wis.; Frank L. Nason, New Brunswick, N.J.; W. O. Crosby; Professor J. E. Wolff of Harvard University; Professor J. F. Kemp, Cornell University; F. J. H. Merrill, New York; H. M. Crump, Persifor Frazer, E. D. Cope, Philadelphia; and Peter McKellar, Ontario.

The paper which provoked the most discussion was read by Professor Alexander Winchell of Michigan University, Ann Arbor, the title of which was "Some Results of Archæan Studies." Those who took part in the discussion were Professor C. H. Hitchcock of Dartmouth, Professor Emerson of Amherst, Professor A. C. Lawson of Ottawa, Canada, and Professor C. R. Van Hise of Madison, Wis.

The first paper of the day was read by Professor H. S. Williams of Cornell, who set forth a new method of illustrating the relation of the history of different regions by graphic representation of the oscillation of sediments, and urged the study of fauna to bring out the relation of local fauna to their ancestors.

Professor G. H. Williams of Johns Hopkins University exhibited and described some specimens highly metamorphosed, but still containing fossils, collected in Norway. C. D. White of Washington claims to have found fossils showing rock on Martha's Vineyard to be middle cretaceous in place of middle tertiary, as supposed. J. S. Diller of Washington projected upon the screen photographs of dikes in California. In some cases the dikes were five feet wide and twenty feet high. Professor A. S. Richmond then projected some Alaskan views, and a diagram of the buildings that would be erected on the museum ground for the world's fair of 1892.

Professor C. H. Hitchcock of Dartmouth read an interesting paper on "Granitoid Oval Areas in the Laurentian," and Professor B. K. Emerson of Amherst spoke on "Porphyritic Granite." Professor A. C. Lawson of Ottawa read a paper on the "Archæan of Central Canada." Then followed papers by Professor Warren Upham, President James Hall, and F. J. H. Merrill.

The next meeting of the society will be in Indianapolis, Ind., August, 1890.

BOOK-REVIEWS.

Scientific Papers of Asa Gray. Selected by CHARLES SPRAGUE SARGENT. 3 vols. Boston and New York, Houghton, Mifflin, & Co. 8°. $3 per vol.

THE general public will, we are sure, be much surprised to learn that Professor Gray was so voluminous a writer as these volumes show him to be. Indeed, Mr. Sargent, in his introduction, states that his contributions to science were so numerous and varied as to astonish those of his associates who were most familiar with his intellectual activity, his various attainments, and that surprising industry which neither assured position, the weariness of advancing years, nor the hopelessness of the task he had imposed upon himself, ever diminished. His first scientific paper was published in 1834, and his last was written in 1887, but a few weeks before his death. During this half-century it may truly be said that his pen was never idle. In the selection of Professor Gray's writings for republication, Mr. Sargent omits those contributions which are devoted to descriptive botany, and many of which form the best textbooks in the English language; nor does he attempt to reproduce the philosophical essays which grew out of the discussion of the Darwinian theory. Reviews, biographical notices, and a few essays upon subjects of general interest to botanists, all of which have long been out of print, form the greater part of the volumes before us. It was doubtless a most difficut task to select from so much material that which was most desirable to publish. More than eleven hundred bibliographical notices and reviews, all of them from the hand of such a critic as Asa Gray, must indeed have been an *embarras de richesses*. Mr. Sargent's plan has been to present in his selection, as far as possible, a history of the growth of botanical science during a period which has been marked by the gradual change of ideas among naturalists upon the origin and fixity of the species which has broadened the field of all biological investigation, by the establishment and systematic arrangement of vast herbaria gathered from all parts of the world, by the introduction of improved and more philosophical methods of investigation in the laboratory, and by the growth of popular appreciation for the value of scientific training. The task which Mr. Sargent set out for himself was a most arduous one; but so well has he performed it, that the whole scientific world has been made his debtor. The future reputation of Asa Gray will be enhanced by the presentation of his writings; and the editor of them will always have the satisfaction of knowing that he has in no inconsiderable degree assisted in preserving the lustre of the name of Asa Gray.

AMONG THE PUBLISHERS.

ON Saturday, Feb. 1, 1890, the Illustrated American Publishing Company (New York) will issue the first number of a weekly news magazine, which, it is claimed, will "rival the most artistic periodicals of England, France, and Germany, and surpass those produced in this country." The illustrations will be the picturesque chronicling of contemporaneous history. A colored supplement will be the most conspicuous feature of every number. It will be a facsimile, in color, of the masterpiece of some celebrated painter, in the preparation of which the discoveries in the art of reproduction will be employed. *The Illustrated American* is designed for the home. It will be unsectarian, and free from political discussions and heavy debates. The serial novel and short stories will be illustrated, and other matter will be selected to afford amusement, entertainment, and valuable information.

— *St. Nicholas* for January is a second Christmas number. Walter Camp's foot-ball paper deals with the great games at the Polo Grounds, and is re-enforced by a study of "The Drop-Kick," contributed by Yale's famous expert, W. T. Bull, whose kicks won Yale a championship. A story of New-Mexican life, by Charles F. Lummis, gives the legend of the now inaccessible "Enchanted Mesa," upon which, tradition says, there is a deserted village just as it was left hundreds of years ago. A photograph of the mesa from nature is one of the illustrations.

— Messrs. Macmillan & Co. will shortly publish the first part of Professor Eimer's work on "Organic Evolution as the Result of the Inheritance of Acquired Characters according to the Laws of Organic Growth," translated by J. T. Cunningham, M.A., F.R.S.E., late fellow of University College, Oxford, England.

— After Mr. Gladstone, Pope Leo XIII. is the most vigorous man of his age of the day, says Edward W. Bok, in the January *Ladies' Home Journal.* The routine of his work would kill an ordinary man. There is no detail too small for him to pass over; and from daybreak until after midnight he devotes his time to the church and literature. Those who surround him know when he is particularly tired or worn out, for then he takes down a volume of Dante, and reads with the avidity of a school-girl enjoying her first novel. Of all the authors, Dante is the Pope's favorite, and it has been remarked that in physique he is not unlike the accepted idea of that great Italian. He reads Dante for pleasure; but, for keeping himself well informed on all that is happening out of the church as well as in it, he reads not only American books, but newspapers and magazines; and it may surprise American readers to know that he is well informed on all the topics of the day, political, religious, and social. He has taken a deep interest in the cause of labor in the United States, and reads every thing bearing on that

subject which comes to hand. Once a week a well-selected bundle of American newspapers is sent to the Vatican; and the Pope and those that surround him know not only what is going on in the United States, but they are familiar with the calibre and character of the men who make laws and enforce them. It is so in England also. In addition to his correspondence in the British Empire, he follows with eager interest the reports in the various newspapers, not only of the doings of Parliament, but of royalty as well, the progress of the church, and the cause of labor. Much the same plan is followed in Germany; in fact, from every corner of the world each week is sent to the Holy Father newspapers, books, and magazines containing important discussions. A great many of these are filed away for future reference. The books that interest Leo the most are those of a religious, political, and philosophical nature. He cares nothing for fiction, and rarely spends an hour in glancing at novels; but if he should like to read novels, or, in fact, books of any kind, he has only to walk into the magnificent library attached to the Vatican, for there is not a mail arriving in Rome that does not bring books of all sorts of types from all sorts of authors and publishers. A great many of these the Pope never sees, and many of them are sent to the cardinals who surround him for an opinion of their merits or demerits. But it may be said, taking it all in all, that the Pope has as wide a field to select from as, if not wider than, any man in Europe; and he resembles Mr. Gladstone in this, that he is quite willing to spend an hour or more with a magazine or book, if in the end he can find something that is worth remembering. He has a wonderful memory, and, although his eyes are dimmed and his hand trembles, he is still as vigorous mentally as he was when he was elected to succeed Pius IX.

— Part V. of the "New English Dictionary," edited by Dr. Murray, has just appeared from the Clarendon Press. It comprises the words from "cast" to "clivy," and contains, in all, 8,371 words, of which 5,966 are "main words." It comprises all the words beginning with *ch*, which, as the editor remarks, "contains more words than *j*, *k*, or *q*, and more than *x*, *y*, and *z* put together." Many of the words here dealt with have an interesting form-history, which is treated with the same fulness and accuracy that have characterized all previous work of the kind in this dictionary. The verb "cast" fills five pages, — the largest space required by any word yet reached; and the other strong verbs, of which the present instalment contains quite a number, are treated with similar fulness. The scientific terms comprise the important groups beginning with "cerebro-," "chalco-," "chiro-," "chloro-," together with many others. One of the most interesting features of this part of the dictionary is the large group of words relating to the Christian church, including "Christ" and its derivatives, "church," "catholic," "clergy," "cherub," and many more, all of which are treated with great fulness of detail and wealth of illustration. It is somewhat singular that the origin of "church" is still uncertain, the derivation from Greek, κυριακόν, meaning "of the Lord," which the editors adopt, being admittedly uncertain. The system of spelling and pronunciation adopted in the dictionary, though not always such as we should prefer, is in the main judicious, and remarkably free from hobbies. To criticise such a work as this would require almost as great a combination of talents and information as has been employed in its preparation, while to praise it is superfluous; and we will therefore commend it anew to our readers without further comment.

— The January *Magazine of American History* opens its twenty-third volume. A portrait of William Cullen Bryant forms the frontispiece, and a paper by the editor treats of his place in American history. "A Rare Picture of Early New York," painted on the panel of an old Dutch war-vessel, a view never before published, is a contribution from the collector Dr. Thomas Addis Emmet. "Uncle Tom's Cabin and Mrs. Stowe," an extract from the new work of Mrs. McCray, is entertaining, and is also illustrated; then from Hon. J. O. Dykman there is a sketch of "St. Anthony's Face" on the Hudson, with a picture of that piece of natural sculpture. Of interest for every thoughtful reader is the study, by Hon. Gerry W. Hazleton of Milwaukee, entitled "Federal and Anti-Federal;" next following, Hon. James W. Gerard shows, in the longest paper of the number, "The Impress of Nationalities upon the City of New York." A paper, "Ralph Izard, the South Carolina Statesman," comes from the pen of Dr. Manigault of Charleston, which, with "American Republics — Their Differences," by George W. Pavey, completes the group of contributions.

— The January issue of *The Quarterly Journal of Economics*, published for Harvard University, will contain articles by Professor Hart of Harvard, on American cities, discussing their rise, the causes of their growth, their population, the foreign element; by Professor Hadley of Yale, on the effects of the prohibition of pools by the Interstate Commerce Act; by Professor Giddings of Bryn Mawr, on the theory of interest, a solid contribution to economic theory; by E. Cummings, describing the exhibition on social subjects at the Paris Universal Exposition; and by A. de Foville of Paris, on the economic movement in France, the revival of the protectionist feeling, and the legislation on railroads. In addition, there will be varied notes and memoranda, and the usual bibliography of recent economic publications.

— E. & F. N. Spon have just issued a third edition of "Brown's Manual of Assaying Gold, Silver, Copper, and Lead Ores," by Walter Lee Brown, B.Sc., thoroughly revised and corrected. This manual is a 12mo of 488 pages, with 94 illustrations, colored plate, and flexible covers. It is devoted to the assaying of the ores of the four metals mentioned, but principally to those of gold and silver. Every step is clearly defined, from the crushing of the rough ore to the weighing of the final particle of gold obtained. The important features of this, as compared with the first edition, are, increase in matter and illustrations; the expansion of the crucible process to almost ninety pages; full charges in the scorification process; detailed notes on the colors of scorifiers (with a colored plate) and cupels, after work; the stating of all charges in assay tons, grams, and grains; and more complete articles on the assay of gold and silver bullion, and volumetric analysis of copper ores. The book is a practical treatise, free from technicality, and as such will be of value to every one interested in mining or assaying, whether an expert or an investigator.

— We have received from C. W. Bardeen of Syracuse, N.Y., a series of "Papers on School Issues of the Day," Nos. I.–VII. They were originally read at the meeting of the National Educational Association at Nashville, Tenn., last July, and contain much interesting matter. The largest of the pamphlets, and the one most likely to attract attention, is that on "Denominational Schools," being a discussion by Cardinal Gibbons and Bishop Keane of the Roman Catholic Church on the one side, and Edwin D. Mead and John Jay on the other. The ablest part of the discussion, in our opinion, is the essay by Mr. Mead, who has evidently given the subject a good deal of thought and study; but the Roman Catholic view of the subject was ably presented by Bishop Keane, and there are many points of interest in Mr. Jay's paper. All persons interested in the subject should read this pamphlet. The two next of the papers before us are by William T. Harris, on "The Educational Value of Manual Training," and on "Art Education the True Industrial Education." The former is the report of a committee appointed at a previous meeting of the Educational Association, of which Mr. Harris was chairman. It deals but little with the economic aspects of manual training, and treats of its educational or disciplinary value only, which it deems of a low order. The paper on "Art Education" is the work of Mr. Harris himself, and insists on the importance of artistic training of a high order, even for industrial purposes. The paper on "Methods of Instruction and Courses of Study in Normal Schools," by Thomas J. Gray, is largely technical, and therefore of less general interest than some of the others; but it was highly commended by those who listened to it. B. A. Hinsdale discussed the subject of "Pedagogical Chairs in Colleges and Universities," maintaining the importance of such chairs and their appropriateness in such institutions. The last of our pamphlets is by Charles Foster Smith, on "Honorary Degrees as conferred in American Colleges." The author shows that such degrees are now conferred without regard to merit or achievement, and rightly holds this to be a pernicious practice; but he has little that is new to suggest in the way of remedy. All these papers give evidence of the recent awakening of thought in this country on educational themes.

— "Beneath Two Flags," by Maud B. Booth, just published by Funk & Wagnalls, New York, is partly an explanation, and partly a vindication, of the Salvation Army. The author is the wife of Marshal Booth, who is the son of Gen. William Booth, founder and leader of the whole movement.

— *The Sidereal Messenger* is devoted wholly to astronomy, and is issued monthly except for July and August. It is announced that it will hereafter contain articles in each number from "some of the best American and English astronomers, with expensive illustrations when desirable or necessary." Most of these articles will be in popular language, and adapted to the wants of scholars in other lines of scientific research. The article in the December, 1889, number by Professor Asaph Hall, United States Naval Observatory, Washington, D.C., entitled "The Resisting Medium in Space," though necessarily somewhat mathematical in form, is an admirable presentation of the present state of knowledge on this important theme. The feature of "Current Celestial Phenomena" will be "kept full, timely, and interesting." The addition of "Astronomical Bibliography" will be "a feature that all scholars will prize." "The Astronomical News and Notes" will be in the future "more varied and general, aiming to give as complete a history of astronomical work and progress as can be secured from month to month." The attention of all interested in astronomical science is called to this publication as adapted to the wants of (1) those who are teachers or students of astronomy; (2) those in charge of astronomical observatories; (3) those in charge of reading-rooms, and of all public and private libraries. It is published by William W. Payne, Carleton College Observatory, Northfield, Minn.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Unconscious Bias in Walking.

THE question is again raised as to the cause of the deviations from a right line in walking with the eyes closed, or in the dark, in the letter to the editor with the caption "Is Man Left-Legged" (*Science*, xiv. p. 412). Several theories have been advanced to account for the frequently observed phenomena referred to, which may be briefly stated as follows: —

1. The legs are not of equal strength, and the strongest outwalks the other, making a curve to the opposite side.

2. The relative dexterity with which the legs are used; some persons being right-legged, and others left-legged, regardless of strength or length. It is probable, however, that there will be the greatest dexterity with the strongest limb; and, if so, this is only another form of the first theory.

3. The legs are not of equal length, and a person will take the longest step *with* the longest leg.

4. The legs are not of equal length, and a person will take the longest step *from* the longest leg.

In the last two theories, it will be observed, opposite conclusions are reached from the same assumed facts.

Several years ago I made a careful series of experiments with forty-nine young men to test the correctness of these theories. Their legs were accurately measured to determine the length, and a dynamometer was used to ascertain the relative strength. The curves representing their bias in walking when blindfolded were accurately traced and plotted on a diagram, so that they could be readily compared and studied.

The results of these experiments (published in *Nature*, July 30, 1885) were as follows: Of five cases in which there was no bias, in two the right leg was longest (in one of these the right leg was strongest, and in one the strength of the legs was not tested), — one presented the greatest difference in length of legs, and the other more than the average of those with right leg longest, — and in three the legs were of equal length (in one of these the right leg was strongest, and in two the left leg was strongest (*a*)). Four were right-handed: one used right and left with equal dexterity (*a*). In pointing at a distant object with both eyes open, in three the right eye was dominant, in one the left eye was dominant, and in one both eyes were apparently used to determine the range. Of fourteen cases in which the bias was to the right, in five the right leg was longest (in two the right leg was strongest, in two the left leg was strongest, and in one the strength of the legs was not tested), in four the left leg was longest (in three the right leg was strongest (*a*), and in one the left leg was strongest), and in five the legs were of equal length (in two the right leg was strongest (*a*), and in three the left leg was strongest). All were right-handed. In pointing at a distant object with both eyes open, in twelve the right eye was dominant, and in two the left eye was dominant, the latter in the groups marked (*a*). Of thirty cases in which the bias was to the left, in eight the right leg was longest (in five the right leg was strongest (*a*) (*b*), in two the left leg was strongest, and in one the legs were of equal strength), in ten the left leg was longest (in five the right leg was strongest (*b*), in four the left leg was strongest (*b*), and in one the legs were of equal strength), and in twelve the legs were of equal length (in five the right leg was strongest, in five the left leg was strongest (*b*), and in two the strength of the legs was not tested). One was left-handed (*a*), twenty-five were right-handed, four used right and left with nearly equal dexterity (*b*). In pointing with the finger at a distant object with both eyes open, in twenty-two the right eye was dominant, in six the left eye was dominant, and in two both eyes were apparently used to determine the range.

From the facts here presented, it is evident that the relative length or strength of the legs cannot be assigned as the cause of the observed bias in walking. The phenomena in question can, however, be readily explained by the application of well-established physiological principles.

When walking in a straight line, the muscles of locomotion are made to act in orderly correlation through impressions received by the senses and conveyed to the nervous centres, and thence transmitted to the muscles by the motor nerves.

When a person is blindfolded, or in the dark, or in a mist, the senses cannot serve as guides to direction, and the muscles of the two sides of the body may not act with the same energy, from differences in nutrition, or from lack of co-ordinating impulses from the nervous centres; that is to say, an exact equilibrium in the muscular activity of the two sides of the body can only be secured through the co-ordinating influence of the senses acting through the nervous system. When this directive agency is not available, a divergence from a direct course will, in most cases, follow from a lack of bilateral symmetry in the functional activity of the muscles.

MANLY MILES.

Lansing, Mich., Dec. 26.

The Influence of Baking-Powder Residues on Digestion.

THERE has always been more or less discussion over the question of what a pure baking-powder should consist, and which of the constituents of many kinds of baking-powders are most deleterious to the human system.

The manufacturers of different brands of powders obtain indorsements from eminent chemists that theirs is the only powder on the market which does not exert a harmful effect when taken every day in our food.

What one manufacturer calls an adulteration another claims is beneficial to the health, when taken in small quantities. This is especially true in the case of the animated discussion in the newspapers at the present time between the manufacturers of the various phosphate baking-powders and those who produce a powder made of bicarbonate of soda and cream-of-tartar.

The manufacturers of the latter brands advertise that theirs does not contain any calcium phosphate, and look upon this compound as an adulterant; while the firms interested in the sale of the former brands laud the use of phosphates in food, at the same time claiming that the bicarbonate of soda and cream-of-tartar form, after baking, a residue of Rochelle salts, the constant introduction of which daily into the stomach would prove very deleterious to the action of the gastric juice.

While these claims are made by the different manufacturers merely for the purpose of selling their own goods, and consequently the harmfulness of their rivals' products greatly overdrawn, yet in a measure the claims of both are true.

That all baking-powders have, to a greater or less degree, a retarding action on digestion by reason of the difficultly soluble salts left as residues after the process of baking, no one doubts; but now the question arises, "Which of the constituents used in the manufacture of baking-powders have the least injurious effects?"

In order to learn what were the most common adulterants of baking-powders, the writer made a tour of many grocery-stores in the city of New Haven, and was enabled to purchase thirteen different brands. In all cases it was found that the cheaper brands, and those offering inducements to the poorer classes by reason of their gifts of household articles, etc., with the purchase of their powders, were adulterated to by far the greatest extent.

The adulterations in some of these cases were not of a harmful character in themselves; e.g., starch was used in a very liberal quantity on account of its being so much cheaper than bicarbonate of soda and cream-of-tartar.

The only ill effect produced by the use of starch is, that, the strength of the powder being lessened so much by the absence of the proper amount of bicarbonate of soda, the housekeeper is forced to use a great quantity of the powder in order to cause the liberation of carbonic-acid gas necessary for the lightness of the bread or pastry. Thus the stomach gets a greater dose of impurities, which generally occur in a powder adulterated with starch, than it would from a powder not containing the latter ingredient.

Of the thirteen brands of powder examined, eight contained large quantities of alum; and two more, traces. Six contained calcium phosphate; two of which, however, were labelled "phosphate powders," but in the other cases it was used as an adulteration.

One of the phosphate powders contained a great quantity of alum, although it claimed to be free from it. All contained more or less starch, but the better brands use only a very small quantity of it, for the purpose, they claim, of keeping the powder from being decomposed by the moisture. *Terra alba*, or "white earth," was found as a common adulterant of the cheaper powders; and, while it is claimed that it is so insoluble that it passes through the body unchanged, yet, accepting that, the same thing may be said of it as has been said of the use of a large quantity of starch; viz., that a larger amount of the powder must be used to produce the required porosity in the bread, thus increasing the amount of residue.

It was the object of this investigation not only to find out the influence the residues of impure baking-powders have on digestion, but also to find out to what extent, if any, the residues of the purest made powders retard the digestive action of the gastric juice.

Regarding the use of alum as an adulterant, Dr. Mallét of the University of Virginia has just made a careful investigation, and finds that its use is very harmful, as it does not retain its form as a sulphate, but, on being subjected to the process of baking, assumes the highly insoluble form of aluminium hydroxide.

By quantitative work with this latter compound, and also by means of taking a large dose of it after a hearty meal and noting the result, he has found that digestion is impaired, and proves that this result is due to the fact that the aluminium unites with the acid of the gastric juice, thus depreciating the effectiveness of the latter secretion; also that part of the organic matter of the food is precipitated in an insoluble form by the presence of the aluminium compounds.

Accepting, then, this well-proved and universal belief that alum is deleterious to the human system, a series of experiments were begun to find out what other salts used in the preparation of baking-powders exert a harmful effect on the digestive process.

For these experiments, an artificial gastric juice was prepared by dissolving .05 of a gram of scale pepsin in a solution of .4 of one per cent hydrochloric acid.

In the first series, egg-albumen was taken as the material to be digested, after freeing it from globulin by precipitating the latter with a few drops of hydrochloric acid.

The first experiment was undertaken to determine what effect the purest made baking-powder has on digestion; the one which stood the best tests in the previous analysis being chosen, as it contained only the bicarbonate of soda and pure cream-of-tartar.

Three digestions were carried on at the same time and under the same conditions. The first was the control or normal digestion, in which 10 cubic centimetres of albumen, 40 of distilled water, and 50 of the artificial gastric juice, were used. In the second 1 gram of the baking-powder was heated with the 40 cubic centimetres of water for a short time at a temperature of 100° C., to give it the same conditions it would have in baking bread; then the starchy residue was filtered off, and the same amounts of gastric juice and albumen added as were used in the control. The third was treated in the same manner as the second, except that 2 grams of the baking-powder were used.

The three digestions were then carried on in a 40° C. water-bath, thus giving the digestion normal temperature.

After stirring well at different periods, the digestions were stopped, after five hours had elapsed, by raising their temperature above 70° C., and killing the ferment. All were neutralized with a dilute solution of sodium carbonate, filtered through a weighed filter, washed well with hot water, and, after drying in an oven, the precipitate was weighed.

If none of the albumen had been digested in any case, the precipitate should weigh 1 gram, for 10 cubic centimetres of egg-albumen yield (with slight variations) 1 gram. The following figures, however, representing the weight of the precipitates, show how far digestion had proceeded in each case: No. 1, or control, .3065; No. 2, 1 gram of powder, .6495; No. 3, 2 grams of powder, .7570: in other words, the amounts digested in grams would be, No. 1, .6935, or 100 per cent; No. 2, .3505, or 50½ per cent; No. 3, .2324, or 33½ per cent.

Regarding the normal amount digested as 100 per cent, the amounts digested in the other cases are thus deduced.

While the inhibitory action of this residue seems to be very great on studying these figures, it must be remembered that only a small amount of albumen was used in comparison with the amount of baking-powder; but these results only go to show that even the "purest" baking-powder retards digestion in a measure.

To avoid the trouble with the starchy sediment that occurs with the baking-powder, a second series of experiments was undertaken with different amounts of the pure Rochelle salts, which is the residue formed by the action of cream-of-tartar on bicarbonate of soda in baking. The same amount and strength of gastric juice were used in this series as in the first, and also the same amount of albumen. The following table shows the result obtained after digestion had proceeded seventeen hours:—

	Grams of Salt used.	Weight of Precipitate.	Grams digested.	Per Cent digested.
No. 1	0.0	.2263	.7737	100.0
No. 2	0.1	.2398	.7602	98.2
No 3	0.5	.3314	.6686	86.4
No. 4	1.5	.7347	.2653	34.2
No. 5	2.0	.7575	.2425	31.3

Three other series were carried through to verify the result obtained in this experiment, and the amount digested in any case was found to be fairly constant with the amount of salt used.

A series of digestions was then carried on with the use of ammonium alum to show what effect this salt has on digestion in its unchanged form of a sulphate, and it is interesting to note that its inhibitory action is not very much greater than the Rochelle salts.

The following table shows the result obtained after digestion had been carried on five hours:—

	Grams of Salt used.	Weight of Precipitate.	Grams digested.	Per Cent digested.
No. 1	0.0	.4021	.5979	100.0
No. 2	0.1	.5496	.4504	75.3
No. 3	0.8	.7079	.2921	48.8
No. 4	1.0	.7128	.2872	48.0

The next residue experimented with was the one which is left in the cooked food when a baking-powder adulterated with calcium phosphate and alum, or an ordinary phosphatic powder containing alum, is used; i.e., aluminium phosphate.

The results obtained in this series, when compared with those of the Rochelle salts, or even with the alum, show a greater inhibitory power than either, and go to show that the occurrence of alum and calcium phosphate in the same powder forms a residue which greatly retards digestion.

The results after digestion had been carried on fifteen hours were as follows:—

	Grams of Salt used.	Weight of Precipitate.	Grams digested.	Per Cent digested.
No. 1	0.0	.1651	.8349	100.0
No. 2	0.1	.2889	.7111	85.1
No. 3	1.0	.6323	3477	41.6

In order to obtain a correct comparison between the inhibitory effects of a baking-powder made from bicarbonate of soda and

cream-of-tartar, and one made by substituting calcium acid phosphate for the cream-of-tartar, two different amounts of Rochelle salts and calcium acid phosphate were used, and each subjected to the same conditions.

The difference in the retarding action of these residues is easily seen from the following table (digestion carried on five hours): —

	Grams of Salt used.	Weight of Precipitate.	Grams digested.	Per Cent digested.
No. 1	0.0	.3441	.6559	100.0
No. 2	0.5 (Rochelle)	.5678	.4322	65.9
No. 3	1.0 (Rochelle)	.7700	.2300	35.0
No. 4	0.5 ($CaH_4(PO_4)_2$)	.8220	.1780	27.1
No. 5	1.0 ($CaH_4(PO_4)_2$)	.8852	.1148	17.5

The superiority of cream-of-tartar over calcium acid phosphate as the acid principle of a baking-powder is shown very well in this last experiment; and, although it is claimed that the latter form of powder furnishes the necessary phosphates for building up the bone-tissue of the body, yet this benefit is rather overbalanced by the harm done by the retardation of the digestive process.

In some cases where it was desirable to compare the effects of two baking-powders directly, or in cases where insoluble salts were used, time digestions were resorted to, in order to avoid loss in neutralizing and filtering.

For these experiments 20 grams of coagulated albumen, and 200 cubic centimetres of artificial gastric juice, were employed.

The digestions were carried on in a 40° C. water-bath, stirred well, and observations made regarding the time of disappearance of the coagulated albumen in each digestion.

In the first series, three amounts of a phosphate baking-powder were used, and, as in previous experiments, a control free from powder.

	Grams of Powder.	Time (hours) to digest.
No. 1	0.0	22
No. 2	0.5	30
No. 3	1.0	42
No. 4.	1.5	50

Having obtained the datum in a previous experiment that a phospate powder adulterated with alum had great retarding action on digestion, a comparison was made between a pure phosphate powder and one known to contain alum; and, although the digestion was not carried on until all of the coagulated albumen had disappeared, yet it was carried far enough to enable the observer to make a good comparison. No. 1 contained no salt; No. 2, .5 of a gram of pure phosphate powder; No. 3, 1 gram; No. 4, 1.5 grams; No. 5, .5 of a gram of impure phosphate powder; No. 6, 1 gram; No. 7, 1.5 grams.

The albumen in No. 1 was first to disappear, followed closely by No. 2, then a little later by No. 5; and so on, in every case the one containing the pure phosphate powder digesting before the one containing a similar amount of impure powder.

Ammonium carbonate has been put down by some as inhibiting digestion, but others claim that on baking it volatilizes and goes off as ammonia gas, leaving a harmless residue; but, in fact, only a small portion of the whole is driven off in this way, for the ammonia forms a compound of ammonium tartrate immediately on heating, and this latter salt is not easily decomposed by heat.

To discover the relative inhibitory action of this residue on digestion, a series was made, using comparative amounts of aluminium phosphate, Rochelle salts, and ammonium tartrate. No. 1 contained no salt; No. 2, .5 of a gram of aluminium phosphate; No. 3, 1 gram; No. 4, .5 of a gram of Rochelle salts; No. 5, 1 gram; No. 6, .5 of a gram of ammonium tartrate; No. 7, 1 gram.

No. 1 was digested in about 45 hours, followed closely by No. 6, and the remaining ones digested in the following order: Nos. 4, 7, 5, 2, 3.

As far as could be seen from this series, there is very little difference in the inhibitory powers of the Rochelle salts and the ammonium tartrate; and the latter cannot be considered, therefore, to be more harmful than the residue of a pure baking-powder.

As a summary of the facts brought out by this investigation, we find (1) that the residues of all baking-powders, no matter how pure may be their constituents, have a harmful effect on digestion, due, in all probability, primarily to the fact that the salts are acted upon by the hydrochloric acid of the gastric juice with the formation of more soluble compounds, and, secondarily, that these salts may form organic compounds with albuminous bodies in the same manner as many of the metals do; (2) that calcium phosphate, on account of its great inhibitory action on digestion, must be regarded as a poor agent for the manufacture of a baking-powder, while ammonium tartrate may be looked upon with more favor; (3) that the presence of alum in a powder made with calcium phosphate greatly increases its retarding action; (4) that the least harmful baking-powder is one containing only the bicarbonate of soda and cream-of-tartar, and that the presence of any other chemical substance, however harmless it may be in itself, tends only to increase the complexity of the residue and impair the activity of the gastric juice. R. TAYLOR WHEELER.

Jersey City, N.J., Dec. 24.

Resemblance of People.

WHILE in Chicago during the Republican convention of the summer of 1888, it occurred to me to make an estimate of the number of people that must be taken, in order that there may be in general two persons who look enough alike for the resemblance to be noticed at first glance, taking account only of the features, and not of characteristics of voice, motion, etc., which of course help us very much to distinguish persons.

Posting myself upon a street-corner so as to face the moving crowds of people, and throwing myself into as passive a condition as possible, I gazed intently upon the passing faces. Out of 700 persons tried, 29 brought to mind some acquaintaince. I estimated the number of available acquaintances at 5,000 at least, for among the number suggested some could scarcely be called acquaintances. This would indicate, that, among 120,000 people, one will likely be found to resemble any one person enough to be noticed at a glance; or among $\sqrt{120{,}000}$, i.e., about 400 persons, two will probably be found to resemble enough to be noticed at a glance. Of course, the result depends upon one's memory of faces and the ease with which faces are distinguished, and undoubtedly upon many other things. W. S. FRANKLIN.

Lawrence, Kan., Dec. 23.

A Remarkable Bowlder of Nephrite or Jade.

THE writer lately obtained in southern Oregon a bowlder of jade, which is the largest erratic mass of the mineral yet found on this continent. It was found among the auriferous gravel of a stream near a small mining hamlet by a gold prospector. Its color is of a mottled deep leek green, interspersed with veins of light green and yellow. It is turtle-back in form, and weighs 47¼ pounds avoirdupois. To the eye it is semi-translucent, splintery, and fibrous in its structure; but that it is remarkably compact and homogeneous in character, is attested by a blow, when it produces a clear metallic ring like bell-metal. The specific gravity of three small chips taken from different parts of the bowlder is 2.949, 3.01, 3.04, the difference being probably due to the variance of magnetite in the pieces. The extremes correspond nearly with those given by Dr. Fischer (*Nephrit und Jadeit*, p. 54, Stuttgart, 1880) and by Clarke (*Proceedings of the United States National Museum*, p. 116, 1888). This occurrence of nephrite bowlders among the river-gravel of our Western coast streams, in connection with Mr. G. M. Dawson's (*Science*, xi. p. 186), tends to confirm the belief that it was found by the native races of that coast in sufficient quantities from which to manufacture their various implements of jade.

JAMES TERRY.

New York, Dec. 30.

INDUSTRIAL NOTES.

A New Electrical Testing-Set.

THE great progress made in the applications of the electric current to the service of man during the past few years has many times multiplied the demand for accurate instruments for electrical measurement. This demand has been readily supplied by the various makers of such instruments, who have kept pace with the development in the eleetrical field in all directions. One result of this increased demand has been a striving, on the part of the instrument-makers, to combine in one portable set all the various devices needed by the working electrician in making the tests called for at every stage of his work. The great economy in time, trouble, and expense of such a compact testing-set will readily be seen by all whose duty it may be to make electrical measurements.

A new testing-set of this kind has recently been brought out by the electrical supply house of E. S. Greeley & Co. of this city. It combines in one instrument a rheostat, bridge, galvanometer, double contact key, and a dry battery of five chloride-of-silver cells. The battery furnishes current enough to enable ordinary tests to be made up to a resistance of one megohm. The galvanometer-needle, which is of peculiar construction, is extremely sensitive, and will, it is claimed, under ordinary circumstances, retain its sensitiveness many years. The pointer, which is made of aluminum, is long enough to show a clear reading with the slightest movement of the needle.

The apparatus may be placed for use in any position, regardless of the points of the compass, owing to the peculiar construction of the galvanometer, which may be readily revolved to the left or right for zero without altering the connections. In the bridge there are three coils on each side, with a resistance of ten, a hundred, and a thousand ohms respectively. There are four rows of resistance coils in the rheostat, with ten coils in each row, giving a range of measurement extending from $\frac{1}{100}$ of an ohm to 1,111,000 ohms. These instruments are all carefully adjusted in the laboratory, out of reach of disturbing electrical influences.

The battery, though contained in the same case, is entirely distinct from the testing-set, so that any other battery may be substituted when more convenient for workshop or laboratory use. It is provided with flexible selecting cords, so that any number of cells, from one to the whole battery, may be readily connected

AN ELECTRICAL TESTING SET.

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Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes, etc., wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886.) for scientific books — those published in the *International Scientific Series* preferred.—James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.—D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write. — J. M. Keck, Chardon, Ohio.

"I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities." — P. C. Truman, Volga, Brookings Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida. — Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Dec. 28. — A. F. A. King, On the Flight of Young Birds; M. B. Waite, On the Method by which the Seeds are projected in Pilea pumila; C. Hart Merriam, A New Red-backed Mouse (Evotomys) from Colorado; Theodore Holm, Generic Characters of Gramineæ and Cyperaceæ, taken from the Structure of the Leaves.

Natural Science Association, Staten Island.

Dec. 12. — Charles W. Leng, The Carabidæ of Staten Island: The Lebiini and Allied Forms. The corresponding secretary read by title a paper by Mr. William T. Davis, upon the homestead graves of the island, which will be issued as a special number of the Proceedings. Mr. Jos. Thompson showed *Cecropia* cocoons which had been eaten by field-mice. Mr. Arthur Hollick showed specimens of wheat in which the grains had all sprouted while in the ear. The specimens were from stacks in a field on the Vanderbilt farm at New Dorp. The grain in all the stacks was in the same condition, due to the phenomenal wet season.

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Lippincott's Magazine	3.00	5.80
Littell's Living Age	8.00	10.80
London Quarterly	4.00	6.80
Macmillan's Magazine	3.00	5.80
Magazine of American History	5.00	7.80
Medical and Surgical Journal	5.00	7.80
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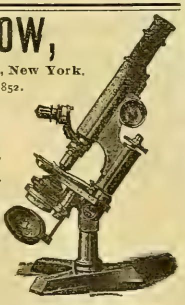

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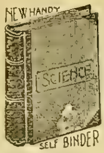

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STATISTICS OF LEPROSY IN THE UNITED STATES.—In view of the general impression that leprosy is spreading in this country, it is desirable, in the interest of the public health, to obtain accurate information on this point. The undersigned is engaged in collecting statistics of all cases of leprosy in the United States, and he would ask members of the profession to aid in this work by sending a report of any case or cases under their observation, or coming within their knowledge. Please give location, age, sex, and nationality of the patient, and the form of the disease,—tubercular or anæsthetic; also any facts bearing upon the question of contagion and heredity. Address Dr. Prince A. Morrow, 66 West 40th Street, New York.

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SCIENCE

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EIGHTH YEAR.
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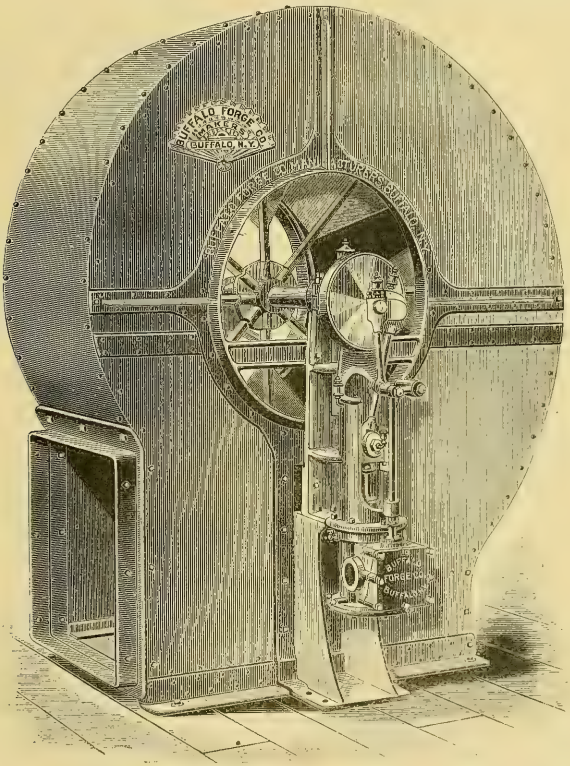
AN IMPROVED STEAM-DRIVEN FAN.

THE accompanying illustration shows a new design of fan driven direct by a vertical steam engine, making a compact and direct-acting piece of machinery. There is no question but that the direct attached engine affords far superior advantages in fan propulsion, there being no slipping or wearing of belts, the rate of speed being easily increased or diminished as occasion requires, perfect control of the fan as to starting and stopping instantly being secured. Where economy of space is an object this combination possesses great advantages, as but little more room than that taken up by the fan itself is required, which is less than that used with a pulley and belt. In some makes of fans with direct attached engines the engine has been attached so as to leave no space between it and the blower, but where perfectly noiseless action is imperative, some space should be left. And when the fan is required for continuous use, the latter is the more satisfactory plan.

The engine shown is for either high or low pressure steam, and runs with very little friction, as it has balanced valves. It is made in sizes ranging from two to fifty horse-power where high-pressure steam is used.

By reference to the engraving, it will be noted that while doing its work, the engine acts as a brace to the blower, the base of which is made of the best angle steel. The amount of bearing surface also deserves comment, being one of the engine's strong points, considering its compact build. In a one-hundred-inch fan the shaft is three inches and a quarter in diameter, and the bearings are fifteen inches and three-quarters long.

There can hardly be a doubt that the great variety of uses to which blowers may be readily adapted was never realized in the earlier periods of their manufacture; but when one reviews the substantial growth each year in this one branch of the manufacturing business alone, it is no marvel that neither pains nor expense are spared to produce patterns which in design, durability, and



STEAM-DRIVEN FAN.

construction are abreast of the times, and fully satisfy the rapidly increasing demand for them.

In order to be a complete success, a direct driven fan should possess high speed, ability to run continuously, and oft-times in the midst of considerable dust, without the engineer's attention at any regular time. These qualities seem to be fully secured in the fan shown, which is made by the Buffalo Forge Company of Buffalo, N.Y.

CLARK UNIVERSITY.[1]

WE are here to mark in a simple way, as befits its dignity, a rare event, which we hope and pray may prove not only the most important in the history of this favored city, but of forever growing significance for our state and nation, for culture and humanity.

Located, with great forethought, in a city whose culture ensures that enlighted public sentiment so needful in maintaining the highest possible academic standards; in a city whose wealth and good will, we trust, are as fair a promise as can anywhere be given or asked of that perpetual increase of revenue now required by the rapid progress of science; in a city central among the best colleges of the East, whose work we wish not only to supplement but to stimulate, whose higher interests we hope to serve, and whose good will and active co-operation we invite; governed by trustees of eminence in the nation as well as in the state, who ask no sectarian and no political questions of their appointees, whose influence without and whose counsels within are of inestimable and well appreciated value; consecrating ourselves to the toil of science at an hour so peculiarly critical and so opportune in the university development of the country, — I must believe that not only every intelligent inhabitant of Worcester, but every unbiased friend of higher education everywhere, will wish to add to our already unexpectedly large endowment of public and private good will at home and abroad, his and her hearty, ungrudging, and reiterated God-speed.

Just because, instead of the easy and wasteful task of repeating what is already well done about us, we strive to take the inevitable next step, and to be the first, if we can, upon the higher plane; because we must study not only to utilize all available experience wherever we can, but to be wisely bold in innovations wherever we must; because there will be indifference and misconception from friends who do not see all the importance of our work at first; because there are difficulties inherent in the very nature of that work itself as great as the work is needed, — we must go slowly and surely, establishing but few departments at first, and when they are made the best possible, adding new and most related ones as fast as we can find the men and money to support them. We must prolong the formative period of foundation, and must each and every one realize well that we are just entering upon years of unremitting toil, in which patience and hope will be tempered with trial. But our cause is itself an inspiration, for it is in the current of all good tendencies in higher education; and of the ultimate success of what is this day begun, there is not a shadow of doubt or of fear.

Our history begins more than twenty years ago, in the plans of a reticent and sagacious man, whose leave we cannot here await to speak of, who in affluence maintains the simple and regular mode of life inbred in the plain New England home of his boyhood, — plans that have steadily grown with his forture, and that have been followed and encouraged with an eager and growing interest, which extended to even minor items, by the devoted companion of his life. Besides a large fund already placed to our account, he has given his experience and unremitting daily care, worth to us large sums in economies, and resulting in well-appointed buildings, and a solidity of materials and a thoroughness of workmanship which I believe are without a parallel of their cost and kind in the country. Not only in the multifarious work of the university office, its methods of estimates, orders, book-keeping, of individual accountability for all books, apparatus, supplies, and furniture, but in the larger questions of university polity without and effective administration within; in the definition of duty for each officer, the strict subordination and the concentration of authority and responsibility sure to appeal to all who have the instinct of discipline, and which are exceptionally needful where the life of science is to be so free, and the policy so independent; in the express exemption, too, of all instructors who can sustain the ardor of research from excessive teaching and examination, in the appointment of assistants in a way to keep each member of the staff at his best work and to avoid the too common and wasteful practice in American universities of letting four-thousand-dollar men do four-hundred-dollar work, in the ample equipment of each department, that no force be lost on inferior tools, — in all these and many other respects, the ideal of our founder has been to make everywhere an independent application of the simplest and severest but also the largest principles of business economy.

As business absorbs more and more of the talent and energy of the world, its considerations more and more pervading if not subordinating, whether for better or worse, not only the arts, the school, the press, but all departments of church and state, making peace and war, cities or deserts, so science is slowly pervading and profoundly modifying literature, philosophy, education, religion, and every domain of culture. Both at their best have dangers, and are severe schools of integrity. The directness, simplicity, certainty, and absorption in work so characteristic of both, are setting new fashions in manners, and even in morals, and bringing man into closer contact with the world as it is. Both are binding the universe together into new unities and imposing a discipline ever severer for body and mind. When their work, purified of deceit and error, is finished, the period of history we now call modern will be rounded to completeness, culture will have abandoned much useless luggage, the chasm between instruction and education will be less disastrous, and all the highest and most sacred of human ideals will not be lost or dimmed, but will become nearer and more real.

When one who has graduated with highest honors from this rigorous school of business, after spending eight years of travel abroad studying the means by which knowledge and culture — the most precious riches of the race — are increased and transmitted, and finding no reason why our country, which so excels in business, should be content with the second best in science, devotes to its services not only his fortune at the end of his life, but also years yet full of exceptional and unabated energy, we see in such a fact not only the normal, complete, if you please, post-graduate ethical maturity of an individual business life, but also a type and promise of what wealth now seems likely to do for higher education in America. It is no marvel that our foundation has already been so often, so conspicuously, and so favorably noted in authoritative ways and places in an European land, where, if monarchy should yield to a republic, university culture could not penetrate its people as it now does. It is thus a more typical and vital product of the national life at its best than are foundations made by state or church in which to train their servants. In thus giving his fortune to a single highest end as sagaciously and actively as he has acquired it, may our founder find a new completeness of life in age, which Cicero did not know, and taste "all the joy that lies in a full self-sacrifice."

The very word "science," especially when used in its relation to business, is too often degraded by cheap graduates who are just fit to look after established industrial processes, but are useless if competition finds or needs new and better ones; who certify to analyses of commercial products that good chemists know are impossible; who, if international competition in manufactures were more free, would give place to better trained, perhaps German, experts still faster than they are doing; who in criminal, medical, and patent-law suits often have the address to carry judge and jury against far better chemists, but who have no conception of the higher quality and more rigorous methods of their own science; who make chemistry, physics, and geology mercenary, culinary, the servants instead of the masters of industrial progress and the very "life-springs of all the arts of peace or war." This evil, although so great and common that even the best men in other professions too rarely see the high ideal culture-power of real science, is yet only incidental and temporary.

A good illustration of the high and normal technological value of pure science is at hand in dyeing, one of the most scientific among

[1] Address delivered by President G. Stanley Hall at the opening of Clark University, Worcester, Mass., on Oct. 2, 1889.

the many and increasing chemical industries. England furnishes nearly all the raw, formerly valueless, material for coal-tar colors, out of which Germany made most of the seventeen and a half million dollars' worth manufactured in 1880. England bought back a large fraction of the colored goods, and Germany made the profits, because she could furnish the best training in pure chemistry. It is for this reason that she is driving other countries out of the field in other leading chemical industries. The great factories there employ from two or three to more than a score each of good, and often the best, university-trained chemists, at large salaries, and the best of these spend a good part of their time in original research in the factory laboratories. The prospect of these lucrative careers has had very much to do in filling the chemical laboratories of the universities with hundreds of students, and the German government (best that of Prussia) has met the demand by erecting and equipping new and sometimes magnificent laboratories at nearly all of her universities. New artificial processes of making organic products of commerce have freed thousands of acres of land where they were formerly grown, and have made new industries and often impaired old ones. Many professors of chemistry make large outside incomes. Nearly all are sanguine, some even declare, that before very long leading drugs, and even food, that will equal if not actually excel nature's products, will be made artificially. The leading professor in one of the largest chemical laboratories of Germany told me in substance that he no longer went after outside technical work, but now made it a virtue to wait for it to seek him; and it has been strongly urged that even the government should take steps to prevent the migration of German chemists to the universities of other countries, lest Germany lose her pre-eminence in chemical industries.

This remarkable contact of the marvellous new business-life and energy of Germany, particularly of North Germany (which in both suddenness and vigor equals any of the wonderful developments in this country), with staid and tranquil academic ways, has had some marked reverberations, and given new direction and impetus to other studies in some other departments where it is not directly felt. It has led to the erection and equipment by the government of great technological schools, and has shown to business men and employers that no course in the sciences which underlie technology can be too advanced, prolonged, or severe to be practical. Where ought the value and significance of such a training be better appreciated than here in the land of Fulton, Morse, Bell, and Edison?

There are, however, eminent chemists in Germany, and many more in surrounding European countries, who deplore what they call the irruption of the technical spirit into the universities. They fear the proximity of the factory and the patent office to the university laboratory has narrowed the field of view and made methods of research relatively less severe; they complain that in their teaching they must hasten over inorganic chemistry, neglecting all the other elements for the carbon compounds, and that there are almost no inorganic chemists in Germany; that in choosing between several substances inviting research, one of which promises great commercial value and the other none, strict scientific impartiality is lost; that in the eagerness for practical results, problems are attempted too complex for the present methods of experimenters, who are trying to "eat soup with a fork," as one sadly told me, and that thus, while published researches are more numerous they are less thorough, and have introduced many formulæ that neither prove nor agree, so that much work now accepted must be done over again and far more thoroughly; that even Liebig set a bad example in this respect, and that many new products, of which university chemists boast, are so inferior to those of nature as to be really adulteration.

What I have tried to illustrate mainly in the field of one science is more or less true under changed ways and degrees in the sphere of others. The sciences are also at the very heart of modern medical studies. Biology explores the laws of life, upon which not only these studies but human health, welfare, and modern conceptions of man and his place in nature, so fundamentally rest. The law of the specific energy of nerves, e.g., which Helmholtz says equals in importance the Newtonian law of gravity, and more than anything else made physiology the science which has had so large a share in raising the medical profession in Germany to a position in the intellectual world such as it never had before, doing for it in some degree what chemistry has done for dyeing; and even instruments like the ophthalmoscope, which almost created a department of medical practice, or the spectroscope, now indispensable in the Bessemer process, in sugar refining, in wine and color-dye tests, the detection of photographic sensibilators, in the custom-house, and in two important forms of medical diagnosis, — all these, to cut short a long list of both epoch-making laws and important instruments, are the direct products of whole-souled devotion to unremunerative scientific research.

It is hard for medical students to realize that they cannot understand hygiene, forensic medicine, pharmacology, and toxicology without a rigorous drill in chemistry; that they must know physics to understand the diagnostic and therapeutic use of electricity, ophthalmology, otology, the mechanism of the bones, muscles, circulation, etc.; that zoology is needed to teach sound philosophic thought, generic facts about the laws of life, health, reproduction, and disease. These, and sometimes also sciences like mineralogy, anthropology, and psychology, are required in Europe, with much more rigor than is common with us, of every medical student. Thus doctors, like technologists, cannot know too much pure science. An eminent medical practitioner in Europe compares young physicians who slight the basal sciences of their profession and pass on to the clinical, therapeutic, and practical parts, to young men who grow prematurely old and sterile. The phrase of Hippocrates, "God-like is the physician who is also a philosopher," is still more true and good in its larger, more modern, and looser translation, viz., exalted is the physician who knows not only the most approved methods of practice, but also the pure sciences which underlie and determine both the dignity and the value of his profession.

Medical instruction, on the one hand, must select as its foundation those sciences and those parts of the sciences most useful in meeting man's great enemy, disease. It needs far more anatomy than physics, and little mathematics, astronomy, or geology. Technical instruction, on the other hand, is and must be so organized as to reflect the state of industry. It properly lays more stress upon chemistry, with its many applications, than upon biology, which has far fewer; more upon electricity than upon molecular physics; and more upon organic than inorganic chemistry. The university, which is entirely distinct from and higher than any form of technical or professional instruction can be, should represent the state of science *per se*. It should be strong in those fields where science is highly developed, and should pay less attention to other departments of knowledge which have not reached the scientific stage. It should be financially and morally able to disregard practical application as well as numbers of students. It should be a laboratory of the highest possible human development in those lines where educational values are the criterion of what is taught or not taught, and the increase of knowledge and its diffusion among the few fit should be its ideal. As another puts it, "The more and better books, apparatus, collections, and teachers, and the fewer but more promising students, the better the work." In Europe, besides its duty to science, the university must not fail of its practical duty to furnish to the state good teachers, preachers, doctors, advocates, engineers, and technologists of various kinds. Here a university can, if it chooses, do still better, and devote itself exclusively to the pure sciences. These once understood, their applications are relatively easy and quickly learned. The university must thus stand above, subordinate, and fructify the practical spirit, or the latter will languish for want of science to apply.

The important facts that are both certain and exact, and the completely verified laws, or well ordered, welded cohesion of thought that approach such mental continuity as makes firm, compactly woven intellectual or cerebral tissue, are so precious in our distracted and unsettled age, that it is no marvel that impartial laymen in all walks of life are coming to regard modern science in its pure high form as not only the greatest achievement of the race thus far, but also as carrying in it the greatest though not yet well-developed culture power of the world, not only for knowledge but also for feeling and conduct. It is of this power that universities are the peculiar organs; to them is now committed the highest in-

terests of man; from them and from science now come the light and advancement of the world. They became and remained the asylums of free thought and conviction when Rome and all other privileged orders declined, and their germs were brought and piously and early planted on these shores by our fathers. The term is not only "the noblest in the vocabulary of science," but universities are the chief nurseries of talent, where is kept alive the holy fervor of investigation that in its passion for truth is fearless of consequences, and has never been more truly and loftily ideal than now, when its objects of study are often most crassly material. It is their quality more than any thing else that determines not only the status of the medical and all technological professions, but also whether the legal profession is formal, narrow, mercenary, and unlearned, as it seems now in danger of becoming in Germany; because even the German universities, despite their great pre-eminence in all other respects, are by general consent of the most competent Germans themselves relatively weak in those departments which underlie the practice of law, or broadly based on history and social or economic science, informed in administrative experience, and culminating in judicial talent and statesmanship. Universities largely determine whether a land is cursed by a factious, superstitious, half-cultured clergy, or blessed by ministers of divine truth, who understand and believe the doctrines they teach; who attract and enlarge the most learned, and penetrate the life of the poor and ignorant, quickening, comforting, and informing in a way worthy the Great Teacher himself, and making their profession as it should be—the noblest of human callings.

Compared with our material progress, we are not only making no progress, but are falling behind in higher education. It has been estimated that but five per cent of the practising physicians of this country have had a liberal education, and that sixty per cent of our medical schools require practically no preliminary training whatever for admission, while European laws require a university training for every doctor before he can practice. Again, we apply science with great skill, but create or advance it very little indeed. Should the supply of European science, which now so promptly finds its way here and fertilizes and stimulates to more or less hopeful reaction our best scholars, and upon which we live as upon charity, be cut off by some great war or otherwise, the unbalanced and short-sighted utilitarian tendencies now too prevalent here would tend toward the same stagnation and routine which similar tendencies, unchecked, long ago wrought out in China. We all most heartily believe in and respect technical and applied science and all grades of industrial education, but these are as much out of place in a truly academic university as money-changers were in the temple of the Most High.

But yet the fact that these and other evils and difficulties are now so widely seen and so deeply felt, that endowments for higher education seem now the order of the day, that the largest single endowment in this country has already so effectively begun so many reforms in scarcely more than a decade in Baltimore; that churchmen, statesmen, and business men now need only to see their own interests in a way a little larger and broader, as they are now tending to do, to co-operate more actively than they ever have done in strengthening our best foundations, — such considerations sustain the larger and more hopeful view that our country is already beginning to rise above the respectable and complacent mediocrity still its curse in every domain of culture, and will show that democracy can produce — as it must or decline — the very highest type of men as its leaders. The university problem seems to be fairly upon us. We now need men in our chairs whose minds have got into independent motion, who are authorities and not echoes, who have the high moral qualities of plain and simple living and self-sacrificing devotion to truth, and who show to this community and the country the spectacle of men absorbed in and living only for pure science and high scholarship, and are not mere place-holders or sterile routine pedagogues, and all needed material support is sure to come.

A word so characteristic here that it might stand upon our very seal, is "concentration." Of this, our founder, in declining to scatter his resources among the countless calls from individuals, institutions, and causes, from excellent to vicious, and refusing us as yet, in the one work he has set out to accomplish, no needed thing, sets an example. We have selected a small but closely related group of five departments, and shall at first focus all our means and care to make these five the best possible. Neither the historical origin nor the term "university" have any thing to do with completeness of the field of knowledge. The word originally designated simply a corporation with peculiar privileges, and peculiarly independent to do what it chose. We choose to assert the same privilege of election for ourselves that other institutions allow their students, and offer the latter in choosing their subjects a larger option between institutions. The continental habit of inter-university migration, also, on the part of students, if once adopted here, would no doubt stimulate institutions no less than it has stimulated competing departments in the same university. Our plan in this respect implies a specialization as imperatively needed for the advanced students as it would, we admit, be unfortunate for students still in the disciplinary collegiate stage. If our elementary schools are inferior to the best in Europe, and if our fitting schools are behind the French Lycee, the German gymnasium, and the great English schools, it is our universities that are comparatively by far the weakest part of our national system. The best of these best know that fifty or one hundred instructors cannot do the work of three hundred and fifty; that they cannot hope at present to rival European governments which erect single university buildings costing nearly four million dollars each, as at Berlin and Vienna, nor equal the clinical opportunities of large European cities with poorer populations and more concentrated hospital systems. Our strongest universities are far too feeble to do justice to all the departments, old and new, which they undertake. Our institutions are also too uniform; the small and weak ones try to copy every new departure of the stronger ones, as the latter copy the far stronger institutions in Europe. If the best of them would do work of real university grade, should they specialize among the fields of academic culture, doing well what they do, but not attempting to do every thing, the American system might yet come to represent the highest educational needs of the country. In contrast with the present ideal of horizontal expansion and the waste of unnecessary duplication, we believe our departure will be as useful as it is new.

Again, concentration is now the master word of education. In no country has the amount of individual information been so great, the range of intelligence so wide, the number of studies attempted by young men in colleges and universities so large for the time and labor given to each, the plea for liberal and general, as distinct from special and exclusive studies, been so strong. This is well, for general knowledge is the best soil for any kind of eminence or culture to spring from, and because power, though best applied on a small surface, is best developed over a large one, and not in brains educated, as it were, in spots. More than this, our utilitarian ideal of general knowledge is far more akin to that of Hippias, who would make his own clothes and shoes, cook his own food, etc., or to that of Diderot, who would learn all trades, than to the noble Greek ideal of the symmetrical all-sided development of all the powers of body and mind. The more general knowledge the better; but every thing must shoot together in the brain. In the figure of Ritcher, the sulphur, saltpetre, and charcoal must find each other, or the man makes no powder. The brain must be trained to bring all that is in it to a sharp focus without dispersive fringes. The natural instinct of every ambitious youth is to excel; to do, or make, or know something better than any one else, to be an authority; to surpass all others, if only in the most accuminated speciality. Learning thus what true mental freedom is, he is more docile in all other directions.

If it be extravagant to say that no minds are so feeble that they cannot excel, if they concentrate all their energies upon a point sufficiently small, nothing is more true than that the greatest powers fail if too much is attempted. This is not only a wise instinct that makes for economy, but, in the parliamentary committee-rooms, in corporation meetings, in the court room, in business, in science, in the sick-chamber, the modern world in nearly every department is now really governed by experts, — by men who have attained the mastery that comes by concentration. The young man who has had the invaluable training of abandoning himself to a long experimental research upon some very special but happily-

chosen point was typically illustrated in a man I knew. With the dignity and sense of finality of the American senior-year quick within him, his first teacher in Germany told him to study experimentally one of the score of muscles of a frog's leg. He feared loss and limitation in trying to focus all his energies upon so small and insignificant an object. The mild dissipation of too general culture, the love of freedom and frequent change, aided by a taste for breezy philosophic romancing, almost diverted him from the frog's leg. But as he progressed he found that he must know in a more minute and practical way than before — in a way that made previous knowledge seem unreal — certain definite points in electricity, chemistry, mechanics, physiology, etc., and bring them to bear in fruitful relation to each other. As the experiments proceeded through the winter, the history of previous views upon the subject were studied and understood as never before, and broader biological relations gradually seen. The summer, and yet another year, were passed upon this tiny muscle, for he had seen that its laws and structure are fundamentally the same in frogs and men, that just such contractile tissue has done all the work man has accomplished in the world, that muscles are the only organ of the will. Thus, as the work went on, many of the mysteries of the universe seemed to centre in his theme; in fact, in the presence and study of this minute object of nature he had passed from the attitude of Peter Bell, of whom the poet says,

"A cowslip by the river's brim
A yellow cowslip was to him,
And it was nothing more,"

up to the standpoint of the seer who "plucked a flower from the crannied wall," and realized that could he but understand what it was, "root and all, and all in all, he would know what God and man is." Even if my friend had contributed nothing in the shape of discovery to the great temple of science, he had felt the *omne tulit punctum* of nature's organic unity, he had felt the profound and religious conviction that the world is lawful to the core; he had experienced what a truly liberal education, in the modern as distinct from the mediæval sense, really is. We may term it non-professional specialization.

Perhaps the most thorough and comprehensive government reports ever made in any language are those of the English parliamentary commissioners on endowments. The first of these occupied nearly nineteen years, and fills nearly two-score heavy folio volumes. In all, about twenty thousand foundations, new and centuries old, large and small, devoted to a vast variety of uses, good and questionable, were reported. The conclusions drawn from this field of experience, which is far richer and wider in England than elsewhere, was, that, of all the great popular charities, higher education has proven safest, wisest, and best, and that for two chief reason: first, because the superior integrity and ability of the guardians who consented to administer such funds, the intelligence and grateful appreciation of those aided by them, and the strong public interest and resulting publicity, all three combined to hold them perpetually truest to the purpose and spirit of the founders; and secondly, because in improving higher education, all other good causes are most effectively aided. The church can in no other way be more fundamentally served than by providing a still better training for her ministers and missionaries. Charity for hospitals and almshouses is holy, Christ-like work, but to provide a better training for physicians and economists, teaches the world to see and shun the causes of sickness and poverty. Sympathy must always tenderly help the feeblest and even the defective classes, but to help the strongest in the struggle for existence, is to help not them alone, but all others within their influence.

Of all the many ways of supporting the higher education, individual aid to deserving and meritorious students is one of the most approved. In the University of Leipzic, e.g., four hundred and seven distinct funds can aid eight hundred aud forty-nine students. Of these funds, the oldest was established in 1325, and they are increasing in number, more new ones having been given between 1880 and 1885 than in any entire decade before. In size they range from thirty-five thousand to fifty dollars; in Berlin, from one hundred and forty thousand to one of less than forty dollars. In cases where conditions are specified, the most frequent limitation is to students from a certain locality, and next, to those of a certain family. By the older founders students of theology were more often preferred, but the more recent funds are for medicine, law, philology, and pure science; and a fund of over two hundred thousand lately given the University of Marburg is for advanced students in those sciences which underlie medicine. These funds are often given, named for, held, and sometimes awarded by churches or their pastors, magistrates, heads of fitting schools, boards of education, representatives of prominent families, for students of their name, the donor himself or herself, individual professors, etc., subject of course to satisfying the university examiners. Many are tenable for one, more for three, and some for five and six years. The funds must be invested with pupilary security, and with interest commonly less than four per cent. In Cambridge and Oxford provision is made for nearly one thousand fellows and eight hundred scholars, not to mention the exhibitions at Oxford. The fellowships are more lucrative, and are designed for more advanced men than are provided for in the German universities, the fellows aiding the master in internal administration. In England, besides the religious and other founders, as in Germany, the great historic industrial and mercantile corporations provide many of the fellowships and scholarships, particularly those of the sixteenth and seventeenth centuries; and they are granted by bishops, curates, heads of business corporations, masters of the great schools, heads or fellows of colleges. In France, where these foundations were swept away by the Revolution, stipends and bursaries are provided annually by the government. New appropriations for the most advanced students of all was the secret of the remarkable Ecole Pratique des Hautes Etudes, founded in 1868, of which a recent report just printed for the Exposition says, condensing its substance, that its purpose has always been to foster scientific zeal with no shade of temporal interest, that it restored the almost obliterated idea of higher education, gave unity to scientific interests throughout France, and made her feel the scholarly desiderata of the age; made young professors not only well instructed, but trained in good methods; that, although its profound researches are not manifest to the public, it has given a more scientific character to all the faculties, and rendered a service to the state out of all proportion to its cost. In France individuals co-operate with the state in this work.

Has there ever been devised a form of memorial to, and bearing the names of, husbands, wives, children, or parents, by which even the smallest funds could be bestowed in a way more lastingly expressive of the individuality, spirit, and the special lines of interest of the donor, more worthy the dead and more helpful to the highest ends of life? Since the first endowment of research in the Athenian porch and grove, thousands and thousands of donations of this sort have borne tangible witness to the sentiment so often and vividly taught by Plato, that, in all the world, there is no object more worthy of reverence, love, and service than eugenic, eupeptic, well-bred, gifted young men, for in them is the hope of the world.

The more advanced our standards are to be, the fewer will be our students, and the more expensive their needed outfit of books and apparatus. If we divide our running expenses only by the number of students our present fellowships and scholarships allow us to receive out of our two hundred and fifty applicants, the amount we spent per student, the first year, will probably be without a parallel. Besides this, for a number of students with important researches on hand, we are expending hundreds of dollars each for their individual needs, and should be glad to do so for more as good men. The best students very often graduate with empty pockets, but with their zeal and power at its best, and when an extra year or two would make a great difference in their entire career. Also, as the field of knowledge grows more complex, the economy of energy needed for concentration is impossible without the leisure secured by comfortable support.

Connected with all the protection, exemptions, and privileges so dearly prized and tenaciously clung to by the mediæval universities, there have always been dangers, sometimes grave and not yet entirely obviated. The new charity is often popularly called a science as well as a virtue. Its axiom is that no man has a right to give doles to beggars without satisfying himself personally or through some agency to that end that his gift will do good and not

harm to the recipient. History, and I may add personal observation, shows that the same general law holds true to some extent in universities. I believe they should not award fellowships to men fresh from college (save in the very rarest cases), unless they were able to guide and direct as well as to follow their work in every detail. A fellow should be encouraged and stimulated by a daily and familiar intercourse with the professors. His methods, reading, and researches should be kept at their best, and the entire resources of the institution should be a soil for his most rapid and helpful growth. Students thus served, even if their gratitude does not prompt them, as in some late instances in Germany, to study, revive and try to conform with piety to the ideal of ancient and almost forgotten donors, whose provisions they enjoyed, will not be lacking in appreciation. To appoint a man to use such funds in electing among undergraduate courses, or to take his chances among the confusing multifarious subjects offered in foreign institutions is, I believe, in most cases of small utility, and in some cases that I know, positively harmful. May the methods of exclusion we are studying be so effective that neither our precious funds nor the precious energy of our instructors be wasted upon the idle, stupid, or unworthy students, now too often exposed in vain for four years to the contagion of knowledge.

"Education used to be a question for ladies and for schoolmasters," said a French statesman last spring, but it is now not only a question of state, on which the support of all great institutions depends, but the great question into which all others issue if profoundly discussed or studied. So greatly do republics need the whole power of education, and so serious is their struggle for existence against ignorance and its attendant evils, that it has well been said that the problem whether this form of government be permanent is at bottom a question of education. But monarchies are no less dependent upon the education of their leaders and servants. In his famous address declaring that if Germany was ever to be free and strong, it must be by becoming the chief educational state of Europe, must realize the platonic republic in which the education of its youth was the highest care of the rulers, Fichte laid down the policy which has been one of the chief causes of the wonderful development of that country. Moreover, evolution, which shows that even life itself is but the education of protoplasm, cells, and tissues, that the play-instinct in children and the love of culture in adults not only measure the superfluous individual energy over and above that required by the processes necessary to life, but are perhaps largely the same, also makes it plain that the hunger for more and larger education of life is but the struggle of talent to the full maturity and leadership which is its right.

For myself, I have no stronger wish or resolve than that, in the peculiarly arduous labors I expect, I may never forget that this institution should be a means to these high purposes, and not degenerate to an end in itself: and may it be as true of our graduates to remotest time, as it is of us in a unique way and degree to-day, that we could not love Clark University so much, loved we not science and education more.

HEALTH MATTERS.

The Influenza.

A SINGULAR characteristic of the present epidemic of influenza is its delay in visiting the British Isles. It seems to have been rampant in Paris and in Germany for some time before it crossed the channel, and victims are claimed for Boston even before the existence of the disease in England was acknowledged. This naturally raises the question whether it is a disease really brought from a distance. Is it anything more than the general prevalence of catarrhal affections, of colds and coughs, which the time of year, and the remarkably unsettled weather we have lately experienced, make readily explicable without any foreign importation? Indeed, is influenza, after all, anything more than a severe form of the fashionable complaint of the season?

To answer the last question first, and so to put it by, there can be little doubt that influenza is a distinct, specific affection, and not a mere modification of the common cold.

The symptoms, the history of the disease, and its distribution, all justify us in treating it as a distinct and specific disease, which when it is prevalent will rarely be mistaken, though, with regard to isolated and sporadic cases, difficulties of diagnosis may arise. About its nature, or its affinities with other diseases, it is unnecessary to speculate. It will be sufficient to inquire what its recorded history in the past justifies us in expecting as to its behavior in the future. There are few cases in which history proves so important an element in the scientific conception of a disease as it does in that of influenza. For hardly any disease shows a more marked tendency to occur in epidemics — that is, in outbreaks strictly limited in point of time. After long intervals of inaction or apparent death, it springs up again. Its chronology is very remarkable. Though probably occurring in Europe from very early times, it first emerged as a definitely known historical epidemic in the year 1510. Since then, more than 100 general European epidemics have been recorded, besides nearly as many more limited to certain localities. Many of them have in their origin and progress exhibited the type to which that of the present year seems to conform. We need not go further back than the great epidemic of 1782, first traceable in Russia, though there believed to have been derived from Asia. In St. Petersburg, on January 2, coincidently with a remarkable rise of temperature from 35° F. below freezing to 5° above, 40,000 persons are said to have been simultaneously taken ill. Thence the disease spread over the Continent, where one-half of the inhabitants were supposed to have been affected, and reached England in May. It was a remarkable feature in this epidemic that two fleets which left Portsmouth about the same time were attacked by influenza at sea about the same day, though they had no communication with each other or with the shore.

There were many epidemics in the first half of this century; and the most important of them showed a similar course and geographical distribution. In 1830 started a formidable epidemic, the origin of which is referred to China, but which at all events by the end of the year had invaded Russia, and broke out in Petersburg in January, 1831. Germany and France were overrun in the spring, and by June it had reached England. Again, two years later, in January, 1833, there was an outbreak in Russia, which spread to Germany and France successively, and on April 3, the first cases of influenza were seen in that metropolis: "all London," in Watson's words, "being smitten with it on that and the following day." On this same fateful day Watson records that a ship approaching the Devonshire coast was suddenly smitten with influenza, and within half an hour forty men were ill. In 1836 another epidemic appeared in Russia; and in January, 1837, Berlin and London were almost simultaneously attacked. Ten years later, in 1847, the last great epidemic raged.

Many interesting points are suggested by this historical retrospect. What is the meaning of the westward spread of influenza, of cholera, and other diseases? Is it a universal law? To this it must be said that it is by no means the universal law, even with influenza, which has spread through other parts of the world in every kind of direction, but it does seem to hold good for Europe, at least in the northern parts. The significance of this law, as of the intermittent appearance of influenza, probably is that this is in Europe not an indigenous disease, but one imported from Asia. Possibly we may some day track it to its original home in the East, as the old plague and the modern cholera have been traced.

As regards, however, the European distribution of influenza, it has often been thought to depend upon the prevalence of easterly and north-easterly winds. There are many reasons for thinking that the contagium of this disease is borne through the air by winds rather than by human intercourse. One reason for thinking so is that it does not appear to travel along the lines of human communications, and, as is seen in the infection of ships at sea, is capable of making considerable leaps. The mode of transmission, too, would explain the remarkable facts noticed above of the sudden outbreak of the disease in certain places, and its attacking so many people simultaneously, which could hardly be the case if the infection had to be transmitted from one person to another.

Another important question, and one certain to be often asked, is suggested by the last; namely, whether influenza is contagious. During former epidemics great care was taken to collect the ex-

perience of the profession on this point, and its difficulty is shown by the fact that opinions were much divided.

The constancy of type of influenza, the mode of its transmission, its independence of climatic and seasonal conditions, all suggest that its cause is "specific," — that is, having the properties of growth and multiplication which belong to a living thing.

Whether the disease affects the lower animals is not absolutely certain, but the human epidemic has often been preceded or accompanied by an epidemic among horses of a very similar disease. It is pretty well known that such a disease is now prevalent among horses in London.

It is important that there should be observed and recorded during the present outbreak, as carefully as the great demands at such a period upon the time and strength of practitioners will permit, the cases they are called to. There are some especial points upon which more light is needed. Any observations which bear upon the accompanying insomnia, or upon the question of contagiousness should be noted with precision. The questions of relapse, of recurrence, of remission, of second attacks after complete recovery from a first attack, should all receive further elucidation from the present outbreak. The duration of the epidemic in different localities, its behavior with reference to climatic changes, the direction and force of the winds, etc., merit close attention. It can scarcely be doubted that the poison is a microphyte multiplying in the air, and yet there is reason to believe that it sometimes travels, and that not slowly, against the course of the winds. It will be interesting to learn whether the "influence" was encountered by our European "squadron of evolution" in its voyage across the Atlantic. We have heard that a month ago cases occurred on a steamer crossing the Pacific Ocean from Japan to San Francisco.

There has been a somewhat greater variation in the symptoms in different cases than is ordinarily encountered in most acute diseases dependent upon recognized specific poisons, although very possibly it may prove that these may be classified under two heads. It is desirable to note how far the present cases of influenza resemble and wherein they differ from dengue.

It must, of course, be borne in mind that the mild, moist, open, variable season which has thus far prevailed, predisposes to catarrhal troubles; and again that a prostrating affection like this "influenza" brings as an accompaniment or sequel to the weak, bronchitis and pneumonia. It is, on the other hand, remarkable that in not a few of the severest cases of "influenza" lately encountered, catarrhal affections of the mucous membranes have been very slight.

NOTES AND NEWS.

DURING the past summer, at the Agricultural Experiment Station of Cornell University, investigations have been made on the general subject of the deterioration of farm-yard manure, in three main directions; namely, (1) What loss does horse-manure suffer when thrown out in a pile unsheltered from the weather? (2) What loss does mixed farm-yard manure suffer when piled in a close pile so that fermentation is very slow; but without protection from rainfall? (3) Is there an appreciable loss of valuable matter when manure simply dries without fermentation? The results of one season's trial seemed to show that horse-manure thrown in a loose pile and subjected to the action of the elements will lose nearly one-half of its valuable fertilizing constituents in the course of six months; that mixed horse and cow manure in a compact mass, and so placed that all water falling upon it quickly runs through and off, is subjected to a considerable, though not so great a loss, and that no appreciable loss takes place when manure simply dries. Professor Shelton, from the results of somewhat similar experiments carried on at the Kansas Agricultural Experiment Station, concludes as follows: "The moral which the experiment plainly emphasizes is, that, farm-yard manures must be hauled to the field in the spring; otherwise the loss of manure is sure to be very great, the waste in the course of six months amounting to fully one-half the gross manure and nearly forty per cent of the nitrogen that it contained." To show that a large number of the farmers in the State are uninformed in this matter, or at least not sufficiently alive to its importance to take proper care of their manure, Mr. I. P. Roberts and Mr. Henry H. Wing, who had charge of the investigation, have had engravings made of photographs of two actual "farm steadings" as they were found to exist, early last spring. These show particularly the watery, miry condition of the yards and the heaps of manure under the eaves. These are not isolated cases, but are fairly representative of a large number of similar views that were taken in one day in the course of a not very extended walk in a single locality, and that a dairy district. From what they have seen from car windows in their journeys through the State, much the same condition of things prevails generally.

— In a recent paper on zoogeography, in *Humboldt*, as condensed in *Nature*, Dr. Lampert states that a good many wolves are still captured in the east and west provinces of Germany, e.g., about fifty annually in Lorraine. In France, 701 wolves were destroyed in 1887; in Norway, only 15. It is estimated that in Russia the yearly loss in domestic animals through wolves is over ten million dollars, and the loss of game from the same cause, over thirty-five million. The German mole swarms apparently, in the neighborhood of Aschersleben, where 97,519 individuals were taken last year, and rewards amounting to nearly five hundred dollars were paid. In great part of Germany, however (Upper and Lower Bavaria, East and West Prussia), it is not met with. Mecklenberg and Pomerania are its northern limits at present. The beaver is nearly extinct in Germany, but a new settlement of thirty individuals was recently discovered at Regenwehrsberg, not far from Shönebeck, on the Elbe. A recent catalogue of diurnal birds of prey in Switzerland (by Drs. Studer and Fatio) gives thirty-two species. The disappearance of the golden vulture is here noteworthy. Early in this century it was met with in all parts of the Alpine chain; whereas now, only a very few individuals survive on the inaccessible heights of the Central Alps.

— An interesting inquiry into prehistoric textiles has been recently made by Herr Buschan. As stated in *Nature*, he examined tissues with regard to the raw material used, to their distribution in prehistoric Germany, to their mode of production, and to their alteration by lying in the ground. With certain chemical re-agents he was able to distinguish the various fibres, though much altered. The oldest tissues of Germany (as we now know it) come from the peat-finds of the northern bronze period. On the other hand, some articles of bone found in caves of Bavarian Franks, and evidently instruments for weaving or netting (bodkins, knitting needles, etc.), show that already in the Neolithic period textiles were made. The art of felting probably preceded that of weaving. Herr Buschan sums up his results as follows: (1) in the prehistoric times of Germany, wool (mostly sheep's) and flax were made into webs, but no hemp; (2) the use of wool preceded that of flax; (3) the wool used was always dark; (4) most of the stuffs were of the nature of huckaback (not smooth); (5) the textiles have, on the whole, changed but little in course of time. The author has some interesting observations on the oldest kinds of loom. The pile-builders on the Pfaffiker, Niederwyl, and Boden Lakes were busy weavers; and they knew how to work flax fibres not only into coarse lace, fish-nets, or mats, but into such finer article as fringes, coverlets, embroidery, and hair-nets.

— A point of great importance for the progress of Western science in the Chinese Empire is whether it should be taught in the Chinese or in a foreign language. The subject has been frequently discussed, and quite recently the opinions of a large number of men most prominently engaged in the education of Chinese were collected and published in a Shanghai magazine, the *Chinese Recorder*. The editor says that nine-tenths of these authorities are of opinion that the Chinese language is sufficient for all purposes in teaching Western science. One gentleman states that Chinese students can only be taught science in their own language, and that the long time necessary for them to acquire English for this purpose is wasted; another says that "science must be planted in the Chinese language in order to its permanent growth and development;" a third sees no reason why the vernacular should not be enough to allow the Chinese student to attain the very highest proficiency in Western science, although he admits that there is at present a want of teachers and text-books. Professor Oliver of the Imperial University at Pekin says he has never found English

necessary, but has always taught in Chinese. Professor Russell of the same institution finds Chinese sufficient for popular astronomy. On the other hand, Mr. Tenney says that it can only be for the most popular views of science that the vernacular is sufficient. "It is impossible," he says, "for scholars who are ignorant of any European language to attain any such excellence in modern sciences as to enable them to bear comparison with the finished mathematical and scientific scholars of Europe and America." Thus, he continues, as a medium of thought, any Western language is incomparably superior to Chinese in precision and clearness; the student acquainted with a foreign language has a vast field of collateral thought open to him which does not and never will exist in Chinese, and he can keep abreast of the times, which the Chinese student who must depend on translations cannot do. The relation of the Chinese student "to the world of thought is analogous to that of a blind and deaf person in the West, whose only sources of knowledge are the few and slowly increasing volumes of raised-type letters which make up the libraries of the blind." As has been said, however, the weight of opinion is against Mr. Tenney.

— The special board of engineers appointed by the Secretary of War to examine and report upon the most available point on the Gulf coast west of the Mississippi for a deep-water harbor have selected Galveston. Their report is now before Congress. The expense of improving Galveston harbor so as to fulfil the requirements is estimated at $6,200,000.

— It is generally recommended that cows at pasture in the summer should have a supplementary grain ration, and a large number of the more progressive farmers pursue this practice with an evident belief that it is profitable. In the absence of data as to the value of this practice it was deemed worth while to conduct, as carefully as might be, a somewhat extended experiment intended to afford, if possible, some light on the point in question. To this end a trial was instituted at the Cornell Agricultural Station, and conducted by I. P. Roberts and H. H. Wing. The experiment was made with six cows, selected from the University herd, making two lots mated in pairs, as nearly alike as was possible in age, breeding, time since calving, yield of milk, and time to next calving. The conclusion reached as the result of the experiment is, that, while all the data so far go to show that it did not pay to give cows on good pasture a supplementary grain ration, yet there is not as yet sufficient data to warrant recommending those who follow this practice to give it up. So far as results in butter are concerned, they are so close as to be almost identical. It is quite possible that the milk yield may have been more influenced by the "milking habit" of the cows than by the grain fed. By milking habit is meant the tendency that different cows have to milk for a longer or shorter period after calving. All the cows used in the experiment had been in milk for a considerable period, four of them about five months, and the other two considerably longer. It is not only possible but quite probable that these last two were more influenced by the individual tendency to "run dry" than by the extra grain feed in the ration. Several conditions arose during the course of the experiment that may or may not have influenced the results; and while in a certain sense they might be considered as foreign to the real discussion of the result, it seems worth while to mention them in this connection. (1) The rain-fall at Ithaca in the growing season of 1889 was phenomenal, especially in the months of June and July, the amounts in inches being as follows: June, 6.74; July, 6.73; August, 3.32; September, 2.57, while the average for the past 11 years has been June, 3.52; July, 3.95; August, 3.02; September, 2.44, and during the time of the experiment, June 8 to September 21, rain fell on forty-nine days. The pastures remained green, fresh, and luxuriant throughout the whole season. The grass, almost entirely blue-grass, grew continuously; but, owing to the gravelly character of the soil, the grass did not become soft and watery, as often happens in soils that are naturally more moist. Perhaps had there been the usual midsummer drought with its accompaniment of parched pastures, the results from the supplementary grain ration would have been more marked. (2) A striking feature of the experiment was the large increase in the percentage of fat in the milk of lot 2 during the period from Aug. 4 to Sept. 7 inclusive, and a similar slight increase in the milk of lot 1 for the same period. This period coincided almost exactly with the period of least rainfall and highest temperature of the whole summer. From Aug. 5 to Sept. 5 inclusive, there was but one rain of any considerable amount, with some half dozen light showers on various intervening dates. Thus in the only time during the whole course of the experiment in which the conditions approached those of an ordinary season, there seemed to be the greatest effect from the grain ration. (3) Another peculiarity that seems to be traced to climatic conditions was seen in the last two weeks of the experiment. Beginning on Sept. 6, more or less rain fell on every day but one till the close of the experiment on the 21st. During this period the weather was almost continually cloudy and what may be expressively termed "raw." From Sept. 7 to 21, the percentage of fat in the milk of lot 1 fell from 4.47 to 4.10, or nine per cent, while the fat in the milk of lot 2 in the same period, decreased from 5.77 to 4.61, or twenty per cent. (4) In view of the fact that a citizen of a neighboring State has been imprisoned for selling milk that was below the legal standard of twelve per cent of solids, it seems worth while to state that while, when the average analysis for three days is taken into account, the milk in this experiment was far above the required standard, yet there was one day when the milk from one lot fell below the legal requirement of 12 per cent total solids, and several others on which the percentage of total solids came dangerously near the "dead line." Had a sample been taken on that day by the State authorities the experimenters would have been liable to conviction under the law, and to a fine of not more than two hundred dollars and to imprisonment for not more than six months. It seems that no law can be just that fixes an arbitrary standard for the purity of milk which may depend upon the results of a single analysis.

— Cocoa-nut butter is now being made at Mannheim, and, according to the American Consul there, the demand for it is steadily increasing. The method of manufacture was discovered by Dr. Schlunk, a practical chemist at Ludwigshafen. Liebig and Fresenius knew the value of cocoa-nut oil or fat, but did not succeed in producing it as a substitute for butter. The new butter is of a clear whitish color, melts at from 26° to 28° C., and contains 0.0008 per cent water, 0.006 per cent mineral stuffs, and 99.9932 per cent fat. At present it is chiefly used in hospitals and other State institutions, but it is also rapidly finding its way into houses or homes where people are too poor to buy butter. The working classes are taking to it instead of the oleomargarines, against which so much has been said during the last two or three years.

— In a recent number of *Humboldt*, as quoted in *Nature*, Herr Fischer-Sigwart describes the ways of a snake, *Tropidonotus tessellatus*, which he kept in his terrarium in Zurich. It was fond of basking in the sun on the top of a laurel, from which it climbed easily to a high cherry-tree fixed against a wall, its night quarters. Sometimes, after lying still for hours, it would hasten down into a small pond (about four square yards surface) containing gold-fish, and hide itself for a long time, quite under water, behind some stone, or plants, the tongue constantly playing. When a fish came near, the snake would make a dart at its belly. Often missing, it would lose patience, and swim after the fishes, driving them into some corner, where it at length seized one in the middle of the belly, and carried it to land, much as a dog would a piece of wood. Curiously, the fish, after being seized, became quite still and stiff, as if dead. If one then liberated it, the skin of the belly was seen to be quite uninjured, and the fish readily swam away in the water. The author thinks the snake has a hypnotic influence on its prey (and he had observed similar effects with a ringed snake). It would otherwise be very difficult for the snake to retain hold of a wriggling fish. The snake usually carried off the fish some distance to a safe corner, to devour it in peace.

— The International Marine Conference at Washington concluded its labors with the end of the year. The work it has done, though not so much as had been anticipated, will be of value to the merchant marine of all maritime nations. The chief work of the conference related to the rules of the road at sea and the prevention of collisions. One important reform recommended is uniformity in the buoyage system in all parts of the world, and others

relate to uniformity in surveying laws; in the reporting, marking, and removing of dangerous wrecks, derelicts, and other obstructions to navigation; and in the transmission of weather signals and storm warnings. This, we trust, is only the first of a series of similar conferences.

— The November meeting of the Chicago Institute of Education was quite a lively affair in comparison with the usual solemnity of the occasion, as we learn from *Intelligence*. The paper was by Fernando Sanford of the Englewood High School on the "Disciplinary Value of Scientific Study." It was a well-knitted plea for the genuine study of science, and for the formation of the habits of seeing and stating propositions that the actual study of nature produces. It deprecated the usual text-book study of science as unworthy of a place in any respectable school. The paper laid considerable stress on the idea that every pupil should interrogate nature for himself and find his own answers; that every subject should be taught by investigating it as if nothing had before been known about it. The president, Mr. Howland, wanted to put in a few words which he thought it possible the audience would not wish to remember more than three minutes, and he hoped they would not. Nevertheless, he wanted to say, that, while it was a charming paper, possibly the best one on the subject he ever heard or read, he did not believe in its doctrine at all. He did not believe that it is so necessary or so advantageous for children to handle the actual objects, to make so many experiments, to verify so many statements. The proposition that school children should investigate departments of science as if nothing had previously been known about them, and that the science learned from text-books is worthless, struck him as absurd. The other day he visited a school in which the pupils were studying a squirrel. He listened to their discovery of the number of toes it had, the way its joints bent, etc., etc. After all, what good did it do them? What did they learn about the squirrel that they did not know before? If children had got to study science just as if the world had already learned nothing, where is the blessing of living in this nineteenth century? of inheriting the accumulated intelligence of the ages? He didn't believe we should throw away all that past generations have discovered; in other words, all our books, and start our pupils in the study of nature where the human race began. He believed he had as clear and complete an idea of a camel before he ever saw one as he had afterwards. Talk about pupils proving that a floating body will displace its own weight of the fluid! What for? He never proved it or saw it proved. Yet he knew it, knew it as absolutely as if he had performed the experiment a hundred times. He didn't believe there ever was a time when he didn't know it. And so of the great mass of facts and principles which the paper would require to be taught inductively. Life is too short for us to indulge so freely in the time-wasting process of induction. He didn't believe in it. Let the pupil have the full benefit of his inheritance, and start with the present instead of with the beginning of time. And besides, man himself is the important element in this world. He and his institutions are more worth studying than all the rest beside. He would much rather study man than the rocks or the trees. It would be a misfortune if the advice of the paper were followed in our schools.

— The endeavor to establish a botanic garden in the City of Montreal, three years ago, though it met with great opposition at the time, says *Garden and Forest*, is likely to be realized at no distant day, though the original plan has been greatly modified. For some time past efforts have been directed toward the establishment of a garden in connection with McGill University, and the end has been so far attained that a portion of the grounds, embracing somewhat more than three acres, has been set apart for that purpose, the intention being to occupy eventually about six acres. During the past season a pond for aquatic plants has been constructed, and walks and beds have so far been laid out that planting will begin with the opening of spring. There are already in the grounds upward of one hundred native and exotic trees and shrubs, besides a fair collection of herbaceous plants. These will be added to from the native flora. There are also on hand several hundred specimens raised from seed received from the Imperial Botanic Gardens of St. Petersburg, and the Royal Gardens, Kew, all of which have been raised and cared for in private grounds and conservatories. Active efforts are being made for the construction of a conservatory, which it is hoped may be erected soon. It is the intention to adapt the garden to the purposes of collegiate work and the representation of the native flora, together with such exotic species as may be hardy and prove otherwise desirable.

— According to the San Francisco *Examiner*, Mr. Adolph Sutro is experimenting with cinchona-trees on his estate on the neighboring sea-coast. He hopes to acclimatize at least some of the varieties from which quinine is produced; and, if so, will doubtless be more than repaid for his enterprise.

— The "flower festivals" of the Japanese are often referred to without clear explanation of their number and character. As explained in *Garden and Forest*, five are annually celebrated. At the New Year's feast, on the first day of the first month, the chief plants used are bamboos, firs, *Prunus Mume* and *Adonis Amurensis*. The first two are set by the house-door, and the others are displayed in the living-room. At the second, or "girls' festival," which is held on the third day of the third month, *Prunus Persica* is the favorite plant. At the third, or "boys' festival," on the fifth day of the fifth month, one sees chiefly the shobu (*Iris lævigata*); while at the fourth, or "ladies' festival," on the seventh day of the seventh month, no flowers are favored, but songs are written on bits of paper fastened to leafy stalks of bamboo and set on high in the garden. The last feast occurs on the ninth day of the ninth month, and then the chrysanthemum is honored by old and young alike. These various celebrations have always been held in accordance with the dates of the old national calendar; but now that the Gregorian calendar has been introduced, it is found difficult to procure the proper plants on the proper day. The great imperial feast in honor of the crysanthemum has no special time set for it, but is held whenever the flowers in the Emperor's garden are in most perfect condition.

— Those who have read of the Rauhe Haus at Horn, near Hamburg, Germany, that remarkable and unique institution of Immanuel Wichern, will recognize in it a prototype of that little industrial community which more than two years ago was established in Columbia County, New York, under the name, "The Burnham Industrial Farm." The two are alike in purpose, in spirit, and in the methods of training employed. Wichern's experiment is, however, widely known, and its success has been demonstrated in its beneficent results, while Burnham Farm is yet in its infancy, unknown even to many of the good people of our own State. The Burnham Industrial Farm, as described in *The State Charities Record*, was organized to save boys who are tending toward the criminal classes. The lack of proper classification or facilities therefor in the reformatory institutions of the State, forcing the boys committeed who have not yet become depraved or incorrigible into the companionship of those in whom criminal habits are fully developed, was the condition which was strongest in urging the establishment of a home like this, far removed from the city, on a large farm in healthful surroundings, where these truant and vagrant boys not yet incorrigible might be sent, might live under good moral influences and have opportunity for the training of hand and mind. The farm, formerly an old Shaker settlement, comprises 580 acres of land, under a fairly good state of cultivation, in a "region of pure air and lovely fields and forests." Lake Queechy bounds it on one side and the mountains look down upon it. The farm is organized on the family plan. The cottages left by the Shakers have become the home each of a group of boys. The system of awards and punishments is that of Mettray. There is a department of manual training for the boys where those showing special aptness are taught full trades, and others prepared to enter trades as advanced apprentices. Some will be taught farming, some gardening, and all, that labor is ennobling. The discipline is firm yet kind, and each boy has some one interested in him individually. There are no walls about the farm; everything is free and open. Though established less than three years ago there are already good results to be seen. Fifty-two boys have been at the farm, and of those more than twenty have, after a training of a year or more, been sent back to their parents or to places found for them, cured of bad tendencies.

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BOOK-REVIEWS.

Justice and Jurisprudence: an Inquiry concerning the Constitutional Limitations of the Thirteenth, Fourteenth, and Fifteenth Amendments. Philadelphia, Lippincott. 8°. $3.

THIS book disarms criticism by its purpose. It is an appeal by "The Brotherhood of Liberty" in behalf of the lost civil rights of the colored people in the United States. Equal civil rights were supposed to have been legally conferred upon our colored citizens by the amendments to the Constitution after the war, especially the fourteenth, and by Senator Sumner's famous "civil rights bill," approved March 1, 1875. Shortly after the war there followed a general acquiescence, and many decisions by the minor courts, and many statutes in the several States, practically enforcing, as far as laws could do it, the equal civil rights of all citizens, without regard "to color or previous condition of servitude."

The way these rights were lost, as far as their legal guaranties are concerned, is soon told after they reached that "grave of liberty," the Supreme Court of the United States. The main points are these: The Constitution of Louisiana after the war provided that "all persons shall enjoy equal rights and privileges upon any conveyance of a public character." A law was passed by that State accordingly, similar to Senator Sumner's civil rights bill, making it a fineable offence to exclude a colored person, for that reason, from public accommodations. Mrs. De Cuir (colored) was thus excluded from the white ladies' cabin of a steamboat, and recovered a judgment for $1,000, fine, therefor. The State courts affirmed that judgment. But when the case came before the Supreme Court of the United States it was reversed — and reversed on a ground that has never ceased to be a surprise; to wit, that the law was "a regulation of interstate commerce, and, therefore, to that extent, unconstitutional and void" (*Hall v. De Cuir*, 95 *U. S. Repts.*, 485, 1877). For the United States only have jurisdiction over such commerce, and the States cannot regulate it.

The colored people and their friends were astounded at this decision. They insisted that the State Constitution and laws thus stricken down as void had nothing to do with commerce or property, but were confined to acts in regard to persons and their rights and protection. The two matters are disparate, like trying to measure legal rights by pounds or miles. Like, for instance, the demands upon Gov. Seward to return fugitive slaves because they had carried off the calico on their backs.

But there is no appeal — but to the people — from a decision of the Supreme Court, and so it was legally settled that a State could practically do nothing to enforce the equal rights and privileges of colored citizens, because commerce was king, and had to go on just as it used to do when the Dred Scott decision was in force.

Still it was hoped that the United States courts would sustain the United States civil rights law, and thus enable the general government to do what the States could not, — protect all citizens in their equal rights and privileges in public assemblies and conveyances. Five cases arising under this United States civil rights law came before the United States Supreme Court and were decided together in 1883. The court held that the Fourteenth Amendment "is prohibitory upon the States only," and does not authorize any direct legislation, "but only a correction" of State legislation; "such as may be necessary and proper for counteracting and redressing the effect of State laws or acts." Therefore the United States civil rights laws were declared unconstitutional and void. (*The civil rights cases, U. S. R.*, 109, 3). The colored people and their friends have never been able to adequately express their indignation over this decision. They held many meetings for that purpose, and the book before us may be regarded as their protest in good, solid, bound form. The points they make were to a large extent presented most ably and indignantly in a dissenting opinion by Mr. Associate Justice Harlan, in which he lays aside ordinary judicial reserve, to tell the majority of the court that, "The opinion in these cases proceeds, it seems to me, upon grounds entirely too narrow and artificial. I cannot resist the conclusion that the substance and spirit of the recent amendments to the Constitution have been sacrificed by a subtle and ingenious verbal criticism. . . . Constitutional provisions, adopted in the interest of liberty, and for the purpose of securing, through national legislation if need be, rights inhering in a state of freedom, and belonging to American citizenship, have been so construed as to defeat the ends the people desired to accomplish, which they attempted to accomplish, and which they supposed they had accomplished, by changes in their fundamental law" (*same case, p.* 26).

The narrow, ingenious, and subtle criticism by which the Fourteenth Amendment was defeated by this decision, is in limiting the "provisions" of the amendment, all of which Congress is authorized to enforce, to the single negative and corrective provision over the States, whereas the plain purpose and intention of the whole of the provisions were to directly secure all citizens in equal rights; and to that end, and as a necessary incident only, the States are also restricted from violating them by their own laws. The very first one of the provisions places the whole subject within the jurisdiction of the United States, and then next follows the restraint upon States from conflicting action. But the court does not even quote in its opinion the first and main sentence and provision of the amendment, and so leaves the power of Congress to be limited and applied only to the correction of the States. "Never was a conclusion more lame, impotent, and absurd!" was the outcry of the friends of liberty everywhere. Had Senator Sumner been alive, this complete overthrow of the great object of his later life would have broken his heart. Under that decision, of course, the States will not do any thing, and the United States cannot. The colored people are thus left with the empty name of

"citizen," but neither State nor nation can legally do any thing to give effective support to that proud title.

Such is the state of the law, the details of which are presented and condemned, with great variety of illustration, in the present volume. But the remedy does not seem to be presented with equal clearness. The future of the colored race in America is indeed a dark cloud. To us the only solution is the scientific one, and that is only another name for the highest morality, justice, and humanity. We have said the only appeal from the Supreme Court is to the people. To encourage such an appeal seems to be the main object and effect of this book. It is sustained by the extraordinary fact that every successful political party has had for its main purpose the reversal of the decisions of that court. The old Republican party of Jefferson came into power to reverse the decisions of the United States courts sustaining the "Alien and Sedition laws." The Democracy of Jackson came to, and did, reverse the Supreme Court decisions in favor of the United States Bank. The Republican party of Lincoln came to reverse, and did reverse, the Dred Scott and Fugitive Slave law decisions; and the Republicans with Grant, in imitation of Cromwell, actually took judges off and put others on the supreme bench, until the court reversed its own "legal tender" decisions. These are surprising instances, and they may well encourage the colored people, by such appeals as the present, to remind the people that the objects they sought to attain by the war amendments to the Constitution, as Judge Harlan declared, have been defeated by two unfortunate accidents in the Supreme Court, which it is their bounden duty to remedy. It may just now seem impossible to get a sufficient number of States to amend the amendments. But it will soon become clear that there must be some law on these subjects. The late slave States will do nothing in their present mood. Both races are thus more and more appealing to violence. The result will be that the law-abiding elements, which placed those amendments in the Constitution, must take up the work again and make them effective. Anarchy and violence cannot be tolerated in any part of our country, and the legal remedy can come only from the general government.

Then, again, we are often reminded that the problem of the happy and beneficent adjustment and co-operation of the two races cannot be solved by statutes only. Most true, but without some solid law to fall back upon, the weaker race are practically remanded to slavery, and such is their present condition. The appeal for justice should be heard, but to insure a favorable hearing, the wise, prudent, virtuous, and industrious conduct of the colored people themselves is also practically a necessary concomitant. Without that, they will not find their old friends at the North again, and of those friends they were never in greater need than now. They are certainly right in their prayer for legal protection, for some law, so plain that the Supreme Court cannot set it aside. Unless this prayer is granted, the next appeals will be more and more to violence; and with a result that recalls perhaps the darkest blot in Grecian history, which is told as follows: When the Spartans were hard pushed in war, they called out the best of their Helots to help them. The Helots responded, and were promised their liberty for their services, which, it seems, turned defeat to victory. They were ordered to repair to the temples [of justice?] to receive their emancipation. They went, with banners and garlands, but they never returned, "and," says the careful historian, "no one ever knew by what means they were severally dispatched" (*Thucydides* 4, 80). The thought that some such passage may be written about the loyal people of America, and that it may be substantially true, is not a pleasant, but a probable outlook from our present situation.

That this publication should appear anonymously is a matter to be regretted. The plain avowal of a public purpose by every American citizen is his prerogative and duty. If he is a member of the bar, it is still more a duty to relieve the country from an error of the courts affecting grave public interests, by honestly and frankly explaining the error, and indicating the remedy, as has been attempted in this article. We have entirely too much unhealthy private grumbling, and too many secret societies seeking to do covertly what no American need to be ashamed of. We believe that the colored people back of this movement would do better to give their names, and apply to Congress, by proper petition, to have the needful amendment to the Constitution submitted to the States. That would clear the atmosphere, and bring the issue to the front.

As to style and execution of this rather pretentious work, the florid and eloquent language, with pages of interesting but remotely relevant quotations, are indications of the African exuberance of rhetoric, about which, as a matter of taste, there is no disputing. That should not conceal from any one the intense earnestness, and the real ability, it often almost hides with the flowers which were meant to adorn and attract. In the next edition we suggest that the amendments, and the two decisions mainly involved, be printed *verbatim*, so that the reader can see the issues without reference to other books, which few but lawyers have at hand. T. B. WAKEMAN.

Thermodynamics, Heat-Motors, and Refrigerating Machines. By DE VOLSON WOOD. New York, Wiley. 8°. $4.

THE fact that a third edition of this work has been called for within a year of its first publication proves that Professor Wood possesses the two essential qualifications of a successful text-book maker, namely, a thorough knowledge of his subject, and the happy faculty of imparting that knowledge to others without causing a waste of energy on their part in acquiring it. As Professor Wood aptly remarks in the preface to the first edition of this work, the "giant-like processes" of Rankine and the other founders of the science "are not adapted to the wants of the average student." Of course there is no royal road to learning for the student of any branch of science, but many unnecessary obstructions have been removed from the path of learners, in recent years, by the application of scientific principles to the art of teaching; and the application of those principles to that art are well exemplified in the work under consideration. It does not attempt to bring the subject down to the comprehension of the average reader, but we think the author has met with a fair share of success in endeavoring to lead the student up, "by a more easy and uniformly graded path," to a thorough comprehension of the subject, while at the same time familiarizing him with the way by a free use of illustrations, exercises, historic references, and numerical examples.

In this revised and enlarged edition the treatment of the theoretical part of thermodynamics, including its application to the steam engine, is mainly the same as in previous ones. Additions have been made, since the first edition, on the following subjects: the vapor engine, Sterling's engine, Ericsson's hot-air engine; gas, naphtha, and ammonia engines; the steam injector and pulsometer, compressed air engines, the compressor, the steam turbine, refrigerating machines, and the combustion of fuel. There has also been added some miscellaneous matter in an addendum, besides steam, ammonia, and other tables. The ammonia tables are new, having been computed from formulas of the author.

Fuel and its Applications. E. J. MILLS and F. J. ROWAN (Vol. I of Chemical Technology, ed. by C. E. Groves and W. Thorp). Philadelphia, Blakiston. 8°. $7.50.

THE fact that any great work must usually be the product of a growth, rather than a single effort of however great a mind, is well illustrated by the process of evolution which has produced this cyclopedia of chemical technology. Those who remember the earlier editions of "Knapp's Technology," and who can compare its bulk and its extent, to say nothing of the perfection and accuracy of the editor's work, with its latest representative, just coming out under the editorship of Messrs. Groves and Thorp, will be amazed at the enormous extent to which the development of the chemical and related industries here treated of have expanded during the generation just past. The edition of Richardson and Ronalds illustrated the progress of a few years; that of Richardson and Watts presented another step in the path of improvement and growth, and we now have a substantially new work in which the editors have endeavored to give a fair synopsis of the facts and principles of science, as applied in the chemical industries, that shall satisfy, at least to a reasonable extent, the needs of the working chemist and of the chemical engineer, — a new but most important functionary in all great works, — and to give them a reference cyclopedia of their respective arts.

We have here the first part issued, a substantially bound and closely printed volume of 800 pages, full of well chosen illustrations, devoted entirely to the subject of fuel and its applications. A very good table of contents and a remarkably good index, both of essential importance in a work of this character, make it easy to find what is wanted, and to appreciate the magnitude and value of the work performed by the editors and writers. This volume is prepared by Dr. E. J. Mills and Mr. F. J. Rowan, the latter the well known engineer. It treats of the fuels, their chemical and physical characteristics, their sources, methods of exploiting, of preparation for their various applications, and their calorific value. The apparatus and methods of use of the several classes of combustibles, including the modern fuels, the mineral oils, and the gaseous combustibles, are exhibited at length and in detail, and the forms of apparatus employed in their utilization are illustrated. The theory of heat and of the heating efficiency of combustibles is well presented, and the methods of computation of heat developed and of temperatures attained are illustrated by examples. The principles of chimney draught are considered at great length, and the prevention of smoke, — a most important subject, especially in localities compelled to submit to the use of soft coals, — is well treated.

The portions in which the heating of houses by hot water and steam, and those in which the laws of heat-transmission are studied, are perhaps the most satisfactory and valuable in the book. These are matters which have rarely been as fully, and very seldom if at all, as well treated as we here find them. The book is worth its price for this part alone. Thirty pages are devoted to the study of furnaces using solid fuels, and as many more to the use of gas as fuel, including the theory and operation of the Siemens furnace and its many relatives. The work concludes with a very valuable examination of the practical effect of fuel, and includes very extensive and most admirably arranged tables of the American as well as foreign coals, their composition, their heating power, and their practical value as shown by experiment and use under ordinary conditions of metallurgical and engineering work.

Taken as a whole, this is probably the best work on the fuels and their use and applications that has ever yet been printed, and it possesses the advantage, for American chemists and engineers, that its contents are available for use in the United States as well as in Europe; and the special fuels of America are practically as fully treated, and in as available a manner, as are those of the transatlantic countries. This volume, if it may be taken as the index of usefulness for the whole cyclopedia, indicates that we may fairly expect the work, as a whole, to become the standard work of reference on its subjects, and to remain so for many years to come. Cyclopedic works of this character have usually been found to command a very large sale in this country, — witness the wonderful sale of the Encyclopedia Britannica, — and this new cyclopedia, if its sale is at all proportioned to its relative value, will find a market sufficiently extensive to handsomely repay its proprietors and contributors for their most admirable and conscientious labor.

AMONG THE PUBLISHERS.

The Open Court Publishing Company of Chicago announces an authorized translation of M. Th. Ribot's "Psychology of Attention."

— Jefferson Davis's article on Andersonville, which the Confederate leader is said to have withdrawn from the *North American Review* because its editor insisted on certain changes, will appear in *Belford's Magazine*. The Belford Company will also publish Mr. Davis's "Short History of the Confederate States."

— D. Appleton & Company have ready the third edition of David A. Wells's "Recent Economic Changes;" the second edition of "The Ice Age of North America," by G. Frederick Wright; and new editions of "California of the South," by Lindley and Widney; "The Florida of To-Day," by J. W. Davidson; and of the "Handbook of American Winter Resorts."

— The various aspects of sore throat are considered in an article by Dr. J. M. Mills in the January number of *Babyhood*, which describes a new apparatus for the treatment of tonsilitis. The directions for gargling may also be new to many mothers of young children. Startling facts are given in Dr. Dorning's paper on "The Administration of Opiates to Infants," which shows how prevalent this pernicious practice is. The comparative advantages and disadvantages of early music study for young children are discussed in another article, and there are useful hints for busy and anxious young mothers in the departments of "Nursery Helps and Novelties," "Nursery Problems" and "Mothers' Parliament."

— "Mr. Bryce's 'American Commonwealth' is out of print in England," writes Mr. Smalley to the New York *Tribune*. "The first edition in its three octavo volumes was of 1,500 copies, and is destined to become moderately scarce, for it is not likely to be reprinted in its complete form. Messrs. Macmillan are just bringing out a new and cheaper edition in two volumes, with the dangerous chapter by Mr. Goodnow omitted, or, at least, not fully reprinted. Mr. Oakey Hall has chosen to bring his action for libel against Mr. Bryce and not against the publishers, but no firm would wish to reprint an alleged libel while an action was pending; nor would Mr. Bryce himself care to."

— Charles H. Kerr & Co. of Chicago have published a discussion of the religious question by E. P. Powell, entitled "Liberty and Life." The author, having been brought up a Calvinist, has been led by the spirit of the age and his own investigations to renounce his early faith, and now stands, with many others who have passed through the same experience, on the ground of agnosticism. A large part of his book is occupied with criticisms of the old theology, which are not always in the best spirit, and are ill calculated to win converts. The part of the work to which we turned with most interest, however, is that in which he undertakes to tell us what the religion of the future will be; but we failed to find any thing new or satisfactory. All supernatural beliefs, he thinks, will be abandoned, and religion will consist mainly in cultivating our own characters and promoting the material interests of society. The book closes with one of those Utopian visions of what human life will be a hundred years hence, which have lately become so fashionable, but which, we take leave to say, are neither interesting nor edifying.

— We took up the Rev. William M. Campbell's "Footprints of Christ," published by Funk & Wagnalls, in the hope of finding something fresh in the author's conception of Christ's character and work; but in this we were disappointed. Mr. Campbell's views are those now held by the mass of Protestant theologians, according to which Christ is to be looked upon chiefly as a model of moral perfection, absolutely free from sin, and exhibiting all the virtues in their fulness; while the old theory of the supernatural being, or divine Logos, is hardly alluded to. From its own point of view the book is fairly good. Mr. Campbell endeavors to trace the various shades and lineaments of Christ's character, the special excellences which at different times he exhibited; and though his views are largely traditional and his method uncritical, his work is not without merit for moral instruction. We like in particular the stress he lays on the stronger and more rugged elements in the character of Jesus, which preachers are apt to underestimate, but which are really among his most prominent traits. But a perfect treatment of the subject requires a different method from that of this book.

— The announcement is made of the change of title from *Building* to *Architecture and Building* by that well known weekly. In making a change the desire has been to indicate more fully the character of the paper than is signified by the name of *Building*. *Building* has, especially of late years, devoted itself to the interest of architecture as a profession, and while it has made itself valuable and interesting to builders, this interest has been rather from the architectural side than otherwise. Yet the name has led many to suppose that it was being published rather as a representative of the builders than of the architects, and to overcome every possible misapprehension of this character in the future they have adopted the present title as better representing the character of the journal. Quite a change is made in the make-up. The two supplements that have heretofore been regular weekly features will be omitted, and departments substituted for them. In place of

the trade supplement will be given the department of "Industrial Progress," which they purpose making a useful feature of future issues. Recognizing that architecture, however artistic, is not pure art, and that its practitioners cannot draw solely upon their inner consciousness for the development of their designs, but must regard the demands of their clients for the latest improvements both in structure and fittings, they propose in this department to place before their readers new and valuable inventions, materials, and appliances as they are placed on the market, together with appropriate notices of those valuable reference books, the trade catalogues, as they appear. The "building news" will also appear in a regular department, and two new departments, "Architectural Engineering" and "Sanitary Engineering," will be given careful attention.

— The first number of the third volume of *The American Journal of Psychology* (published now by Clark University at Worcester, Mass.) is now in press, and will appear in January, 1890, and succeeding numbers thereafter quarterly. The typography of the journal has been changed and improved. A new department of minor contributions has been added for briefer records of original observation and research in laboratories and elsewhere, and for historical chapters upon various phases of psychological science. The digests and critical reviews of European literature, which have before formed so important a feature of the journal, will be continued, and made as complete as possible. Their scope will also be enlarged so as to include, besides the fields already represented, the psychological parts of criminology and anthropology. The editorial staff will be increased, and articles of unusual value and interest are promised. The price remains five dollars per year. The first and second volumes will also be furnished unbound at five dollars per volume till further notice.

— D. Appleton & Co. will publish immediately, "Around and About South America," by Frank Vincent, who relates his experiences of twenty months, made useful with maps and plans and fifty-four full-page illustrations; "An Epitome of Herbert Spencer's Synthetic Philosophy," by F. Howard Collins, with preface by Herbert Spencer; "James G. Birney and His Times," the genesis of the Republican party, with some account of Abolition movements in the South before 1828; and "The Religion of the Semites," in which the fundamental institutions are treated by Prof. Robertson Smith, and the *International Scientific Series* will receive a new volume on "The Physiology of Bodily Exercise," by Fernand Lagrange.

— Ginn & Company have just issued "An Elementary Treatise on the Method of Least Squares," by George C. Comstock, professor of astronomy in the University of Wisconsin and director of the Washburn Observatory. This treatise has grown out of attempts by the author to so present the subject to students that a working knowledge based upon an appreciation of its principles might be acquired with a moderate expenditure of time and labor. Believing that the ultimate warrant for the legitimacy of the method is to be found in the agreement between the observed distribution of residuals and the distribution represented by the error curve, Professor Comstock has abandoned altogether the analytical demonstrations of the equation of that curve, and presents it as an empirical formula, representing the generalized experience of observers. The evidence in support of a formula of this kind is cumulative, the few curves presented in illustration being considered as samples of the kind of evidence existing. Prominence is given to the distinction between accidental and systematic errors, and the limitations which result from the difference between these two classes of errors is insisted upon.

— *The Ophthalmic Review* begins its new volume with an American editor, Dr. Edward Jackson of Philadelphia, who succeeds Dr. James Anderson of London. It will hereafter contain original articles from American as well as English ophthalmic surgeons; with notices of all ophthalmological papers published here or abroad, and full reviews of the more important of them. The *Review* is now edited by J. B. Lawford, M.D., London; Karl Grossman, Liverpool; Priestley Smith, Birmingham; John B. Story, M.D., Dublin, and Edward Jackson, M.D., 215 South Seventeenth Street, Philadelphia, to whom all American communications concerning editorial matters, copies of papers, books for review, etc., should be addressed. The *Review* has hitherto devoted its space almost entirely to English and foreign contributions. Its success in this field has led the editors and publishers to increase its scope by including an index of American articles on ophthalmological subjects, reviews of the most important papers, original articles by well-known men, and reports of the meetings of the American Ophthalmological Society, and the section on ophthalmology of the American Medical Association.

— Gebbie & Co., Philadelphia, have just published a book on the drama, entitled "Players and Playwrights I Have Known: a record of the English stage from 1840 to 1880," by John Coleman.

— Funk & Wagnalls, have published "The Patience of Hope and Other Sermons, by the late Rev. Joseph H. Wright, with a brief Sketch of his Life," edited by Oliver J. Thatcher, Professor in the United Presbyterian Theological Seminary, Allegheny, Pa.

— The first number of *Kate Field's Washington* has made its appearance. It is a "national independent review," will be published every Wednesday, at Washington, and partakes largely of the individuality of its talented editor. Four dollars per year, ten cents per copy.

— The Belford Co. have in preparation "A New Encyclopædia of American Biography," intended to not merely cover the ground usually occupied by such publications, but to make special mention of the men and women who are doing the work and forming the thought of our own time. Mr. James R. Gilmore ("Edmund Kirke") is the editor.

— Mr. Justin Winsor is engaged upon a biographical and historical work to be entitled "Christopher Columbus: an examination of the historical and geographical conditions under which the Western Continent was disclosed to Europe, with an inquiry into the personal history of Cristoval Colon." Houghton, Mifflin & Co. will be the publishers.

— Dr. J. E. Oliver, of Boston, well known as a careful and intelligent student of American history, has edited, says the Boston *Transcript*, "the diary of William Pynchon, of Salem, and his book will be published at an early day. This diary was written during the middle and later years of the eighteenth century, and gives an accurate picture of Salem's social and political life in that interesting period. It will be issued by the Riverside Press."

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

What Dr. Flint has to Say about the Nicaragua Footprints.[1]

In replying to Dr. D. G. Brinton's article of Nov. 18, 1887, issued by the American Philosophical Society, and republished in 1888 (No. 86) by the Philosophical Society of London, I entirely overlooked Dr. Brinton's quotations of Pablo Levy as authoritative for geological reference. I desire to correct the erroneous impressions caused by Levy's geological idiosyncrasies.

The volcanic convulsions that modelled the existing features of Nicaragua were acting in remote times only, in its south-western part. The lakes occupying the old craters give no indications of disturbance, while those of historical times have not changed the contour of their surface, except in small effusions of lava. The largest volcanoes are between Nindiri and Managua. The ash-eruptions of Cosequina, on the north-western confines of Nicaragua, have diminished in volume, and may be considered as extinct. Monotombo, on the north-western shore of Lake Managua, has had various ash-eruptions, but its contour remains about the same as when visited by the early Spaniards. Omotepe still keeps its cone-like contour. The last eruption in 1883 was not accompanied by trembling. Lava was thrown out near the old crater on the

[1] Extracts from a letter of Dr. Earl Flint of Revas, Nicaragua, to Hilborne T. Cresson of Philadelphia.

eastern slope, doing but little damage, however, as it was some distance from the town on that side. The ashes injured the crops on the eastern slope, and also those about Rivas. Smoke continued about three years in interrupted emissions, with violent rumbling, but no trembling of the earth. Like Monotombo, it is out of the axial line of the older and extinct volcanoes which lie between them and the primitive Cordilleras. If a line be drawn from Omotepe to Tipitapa, and thence to Cosequina, including Monotombo, the volcanic region of this district, in remote and recent times, is included within it.

This volcanic district referred to was the first occupied by early man, and even at the present time it is the most thickly populated. Strange to say, those who have written about this portion of Nicaragua, either in a historical or scientific sense, have entirely ignored it. Especially is this true in regard to its geology. Knowing this to be true, I requested Mr. I. Crawford, who is in the employ of the government, to give me his views in regard to the geological formation of this state. His remarks upon the subject are as follows.

"Geology, in the larger part of Nicaragua, promises many interesting and valuable revelations to scientists searching for evidences of time and life. It is generally supposed by the world at large, that Nicaraguans are rocked to sleep by earthquakes, but you know that this is a mistake. So far, I have not been obliged to tread in the footprints of scientific predecessors. The geology and mineralogy of this region has never been studied before. Organic matter in this country is not a kind of infusoria from active and extinct volcanoes; neither has all the organic matter in Nicaragua been incubated in the yet warm craters of extinct, nor singed by hot eruptions from active, volcanoes. Having been ordered by the commissioners of Granada to make a typical collection for exhibition at Paris, I was obliged to hurry over the mountains and ravines of this country in order to accomplish the work in time for shipment to France. The collection of geological and mineralogical specimens that I formed demonstrates that Nicaragua is not the volcanic region that Spanish gold-hunting and Indian-murdering priests declared it to be. This mistake has been copied so frequently by careless investigators that at present it passes unquestioned by our great European and America scientific associations. It is well known, that, so far, there never has been even a superficial examination of the geology and mineralogy of the region we speak of. Levy's history of Nicaragua contains so many evidences of its unreliability, that any person upon reading it is impressed at once with the fact that Levy is not relating what he saw, or obtained from reliable sources, in regard to the geology of this country: he is simply drawing upon his imagination. What a sad example for members of scientific associations who hurry into print, copying and publishing as facts things that they have not investigated, thus perplexing hardworking searchers for truth. I quote here the following paragraphs from one of my recent reports to the government of Nicaragua. 'On account of diversity in the geological formations, and for the sake of easy reference, I divide this country (Nicaragua) into three parts, called eastern, central, and western. The eastern is bounded on its south-western part as follows; commencing at 87° west longitude, from Greenwich, and 30° 30′ north latitude, and extending by an irregular line to 85° 50″ west longitude, and 12° 45″ north latitude, thence to 85° 9″ west longitude, and 11° north latitude. The geological formation of the eastern division in the northern part is composed of eozoic and lower Silurian rocks, minerals, and metals; some merely horizontal, others at various angles of inclination. The Silurian, which rests unconformably on the eozoic, is in places covered by alluvium formations. The middle and south-western parts of this eastern division are eozoic-Silurian and in some cases Devonian, each of the eras, in various places, well defined, but in that undisturbed condition in which the primitive upheaval and subsequent contractions left them, resting at various angles of inclination. No evidence of earthquakes, no volcanoes, no volcanic craters, are to be found in any part of this eastern division.' We call particular attention to this fact, and have been so much occupied by field work, in the mountains and ravines, that it has been impossible to publish a detailed account of it. The specimens collected will, however, keep fresh and tell the true story. In reference to glaciation, and moraines deposited by the glaciers, I found on the mesas near Metapa, at Totumbli, rocks and moraines deposited by the glaciers, and traced them toward the Pacific Ocean.

"North-eastward for about 7 leagues there is an elevated plain adjoining that part of the valley of Sebaco, in which, at the Rio Viejo, I found a large deposit of petrified bones of quaternary and tertiary animals. In my necessarily hurried examination of the deposit where the bones were found, I recognized no bones of the human body, but several bones of parts of the head.[1] There were also a few teeth of large marsupials. These unexpected discoveries in this hitherto supposed hotbed for volcanoes I have not yet carefully examined, but hope that time will soon be given for its future study. Particular attention is called to these peculiarities in the geological formation of this part of Nicaragua, which are not in harmony with, but opposed to, statements and maps of all historians about the geology and mineralogy of Nicaragua. I was too much hurried in my examinations to satisfy myself as to whether the bones were older, or were deposited, or which were the older formation, they or the glacier. The nearest moraines and glacier-marked rocks that I noticed were about two leagues distant, 200 feet higher than where the bones are. The glacier rocks may have been strewn over the valley on a surface deposit of 200 feet directly over the bones, or, as the valley was — I have some reason to believe — once much deeper than at present, most probably the moraines and glacier-marked rocks falling in the valley were washed down the Rio Viejo by large floods into the present Lake Managua, and therefore the deposit of bones would have been made subsequent to the glacier period."

A word about the glacial period and its relation to the fossil remains mentioned in the extracts of parts of Mr. Crawford's letter as occurring in the cuttings of the Rio Viejo and the great plain of Sebaco, emptying into Lake Managua, and his uncertainty about them. As they occur some 200 feet lower than the moraines to the north-east, requiring another visit to arrive at the truth, we must say that those on the large stretches of lowland, north of Lake Nicaragua, occur under like circumstances. These plains extend back to the base of the old Cordilleras. Their upper surface is composed of black alluvium lying along the northern bowlders, which were the make-up of an inland sea, or ocean inlet, shut in by the upheaval, after which the waters flowed back to the foothills, from, or due to, an accumulation of rainfalls washing down the alluvium. On the plain mentioned, north of the lake, were found the bones of what Professor Baird said belonged to *Elephas primogenitas;* while in the river banks to the east, formed of conglomerate detritus, stratified, and volcanic material (shown by pebbles of scoria, worn smooth), laborers, while excavating there in 1874, encountered a fossil human skeleton, some twenty feet below the surface.

Clear demarcations of geological epochs are found in this locality; and the question of ice age here will be decided in the near future so clearly that scientists will feel satisfied. It may be interesting also to mention, that, in 1863, while passing from Tipitapa to Talolinga, I noticed glacial deposits; also, on a hill back of San Carlos, sharp fragments of quartz rock of large dimensions are of glacial deposition. I called the attention of Professors Henry and Baird to these facts years ago, and requested the geologist of the first canal survey to visit the localities named, but he could not do so on account of press of work. In a letter to the *American Antiquarian* I asserted that the fossils mentioned were above the clay formation,[2] under the ash-eruption that covered the vegetation, whose fossil leaves may determine the geological period of Nicaragua, or the time of its disappearance. The coincidence of the fossil leaves with those in the sedimentary rocks formed here after the uplifted coast range, produced by the cataclysm, goes to show that the glacial age here was disappearing. Near by, to the north-east, the glaciers crowded on towards the fierce fires from the summits of the old Cordilleras, trying to assert a supremacy in that conflict of elements, both vieing in their work of desolation. The eternal

[1] A distinction between the bones of the human body and head is evidently here intended by Mr. Crawford and Dr. Flint. — H. T. Cresson.

[2] The ash-eruption did not extend north of the lakes to where the bones occur It was an epoch of repose, of long duration, during which the accumulation of alluvium was deposited around the lakes and over the glacial deposits in the location mentioned.

hills, supporting them, were unmoved; ashes and ejected scoriæ were spread upon their declivities, and thus, aided by subsequent rains and a tropical sun, has unburied the hidden bones of various animals in the water-ways. While those of the mastodon are also exhumed, their compeers of Siberia await for a distant future to regain a tropical sun. Which of the two is the older? That any lived after the disappearance here of the glaciers, proves nothing. With proper surroundings, they might exist to-day.

I desire to state clearly that the Rev. Stephen D. Peet's assertion that Dr. Brinton makes out on my own testimony that the foot-prints did not belong to eocene times, is in error, and needlessly so, as he had received from me an explicit denial of any connection of sand with the shells. The leaves, or dust of leaves, if any were with the shells, came from trees growing around the lake. No volcanic force has disturbed the location, at least in historic times. The sandal, or some covering to protect the feet, the Rev. Mr. Peet knew was ascribed to an impression sent to Harvard, from a location forty miles distant from those at the quarry, to the south-west, and on the other side, of the range of extinct volcanoes.

I never said that the "molten streams of lava found their way into Lake Managua." There is nothing of the kind found there on the lake border. Layers of tufa, made up of volcanic detritus, is the formation of all the district we speak of ; and at Masaya, Juotepi, etc., the Tiscapa lava flow spoken of by Levy must have occurred to that gentleman in his dreams. If Dr. Brinton had not quoted Levy in connection with my attempt to explain the history of the impressions I sent him, no such erroneous data would have gone forth in regard to the outbursts of lava that occurred. The mountain of Masaya, between Nindri and Managua, is the only notable locality. It passed over the old tufa. Monobracho also ejected lava, and it spread over the plain to the south-west of Granada. These mountains were in action long subsequent to those mentioned.

The Rev. Mr. Peet's assertion that Harvard and the National Museum have only slabs with impressions of feet to judge from, is also incorrect. If he will re-peruse his own *Antiquarian*, he will find there bitter complaints, on my part, in regard to the lack of care in the examination of fossils found with and separate from them, which alone would identify their geological age. His aim is undoubtedly to keep up the controversy. Truth is certainly not obtained by making direct denials of phenomenal occurrences that Dr. Brinton and Mr. Peet never saw or investigated. The "big-toe" argument will not apply to an arched instep. A long *os calcis* and a flat-footed race have the big toe perfect. Let us wait until one of the fossil feet are found. Before belittling finds of the class mentioned they should be compared with similar ones occurring under volcanic formations in other countries whose geological examination has been determined by competent men. "The great volcanic outburst that overran northern and central California," says Dr. L. G. Yates of Santa Barbara, "covered the relics of a race who were there, and lived there, previously, whose implements were found under Table Mountain, a bosaltic formation, two hundred feet in thickness. These relics are unique, and were made, and covered by lava, so long ago, that the river bed down which the lava ran (and where it still lies, forming the summit) is now high above the surrounding country, forming the Table Mountain, and where the mountains which were on either side of the old river-bed have been washed away, and their places now occupied by valleys and river-beds, and since which time the whole surface of the country has been changed, with a new surface soil, a new vegetation, and a new fauna."

Facts of this nature, by men of Dr. Yates's character, should not be ignored. No sceptic can doubt that man existed there in as remote times as here in Central America. I have often reported that there was a resemblance in the geological finds of the two. California has no greater variety of minerals; gold, silver, tin, lead, bismuth, platinum, nickel, zinc, iron, etc., are among the metals.

I want to call the attention of scientists to this neglected spot in Nicaragua, and convince them that man existed here long prior to the glacial era. Will some of the scientists in the United States do me the favor to look over the few shells sent by me to the National Museum. These specimens will tell the exact time (geologically) when man lived here in the caves, and subsisted on the very oysters (i.e., from the shells). The specimens may be seen among those I forwarded a few years ago, and which are now in some part of the National Museum.

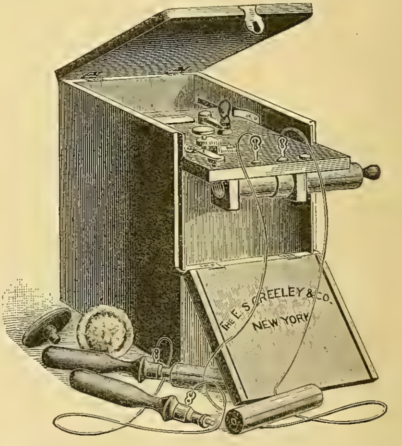
Science Text-Books.

Is there to be found a really good "Physics" for lads of twelve to fifteen, as good as Shaler's "Geology" and Packard's "Zoology"? Several firms publish and manage to "introduce" a lot of old rubbish as science text-books. It is a scandal that ought to be ventilated. I have just opened a "History" sent out by a firm that professes to patronize and popularize science, and my boys are promptly told, "For the history of the Creation, Deluge, and Dispersion, the reader is referred to the Scriptural narrative." It needs some patience to get through this *Aufklavüng* from stuff to real science. P.

INDUSTRIAL NOTES.

New Electro-Medical Apparatus.

AN improved form of Laclanche Faradic battery for the use of physicians and surgeons, is shown in the accompanying illustration. In this battery the exciting fluid is a simple and inexpensive solution of sal ammoniac and water, which will last without renewal from six to twelve months. The zinc element is a pencil of pure metal, the position of which is never disturbed, whether the battery is in action or not. It usually lasts over a year, and is re-



placed at slight expense. The carbon element does not require renewal, as a rule, oftener than once in two years.

The battery has a handsomely polished hard-wood case, opening at the top and at the front. It is provided with a metallic handle, which, together with all the metallic parts of the machine itself, is nickel-plated. The case measures nine and a quarter inches high, five inches and a half wide, and seven inches and a half long. In the case is a commodious electrode pocket containing a pair of interchangeable electrode handles, a pair of nickel-plated hand electrodes, and a sponge electrode. The battery cell is inclosed in an inner compartment, which, while it is closed up and completely separates the cell from the rest of the apparatus, is arranged with a sliding cover to give convenient access to it whenever required.

A feature of special importance is the fact that the cell and all its working parts are mounted on a polished ebonized slide, with automatic electrical contacts beneath its surface. The act of pulling out this slide a short distance serves to start the machine, and closing it up cuts out the cell and stops the action. This makes it impossible to close the case without cutting out the cell. This battery is manufactured by E. S. Greeley & Company of this city.

The New Disk Clutch.

AMONG the many interesting devices shown at the recent marine exhibition in Boston was a novel and ingenious disk clutch, the invention of Mr. Walter Hart of this city. This device is intended primarily as a safety boat-lowering apparatus, though it is equally efficient for hoisting boats or merchandise, by either manual, steam, or electric power. The apparatus consists of a pedestal, to be fastened to the deck or elsewhere, which supports two disk-clutches, one at each end of a horizontal shaft. The ropes or falls by which the boat or other article is suspended are placed in these disks, by which they are clutched in such a way as to prevent slipping. The motion of these disks is controlled by a hand-wheel, by which the speed of revolution of the shaft and consequent lowering or hoisting of the boat is governed. The machine is compact and powerful, and attracted much favorable attention among men interested in nautical affairs.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva tristula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmola patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes, etc., wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred. — James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics. — D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write. — J. M. Keck, Chardon, Ohio.

"I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities." — P. C. Truman, Volga, Brookings Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida. — Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

A collection of fifty unclassified shells for the best offer in bird skins; also skins of California birds for those of birds of other localities. Address Th. E. Slevin, 2413 Sacramento St., San Francisco, Cal.

I have forty varieties of birds' eggs, side blown, first class, in sets, with full data, which I will exchange for books, scientific journals, shells, and curios. Write me, stating what you have to offer. — Dr. W. S. Strode, Bernadotte, Fulton County, Ill.

Readers of Science

Corresponding or visiting with Advertisers, will confer a great favor by mentioning this paper.

CALENDAR OF SOCIETIES.

Royal Meteorological Society, London.

Dec. 18. — The following is a list of the papers read at the meeting: "Report of the Wind Force Committee on the Factor of the Kew pattern Robinson Anemometer," by Mr. W. H. Dines, who has made a large number of experiments with various anemometers on the whirling machine at Herrham; "On testing Anemometers," by Mr. W. H. Dines, B.A; "On the Rainfall of the Riviera," by Mr. G. J. Symons, F.R.S; and "Report on the Phenological Observations for 1889," by Mr. E. Mawley. This latter paper was a discussion of observations on the flowering of plants, the appearance of insects, and the song and nesting of birds, etc.

Philosophical Society, Washington.

Jan. 4. — The following Communications are expected: H. A. Hazen, Brocken Spectra; W. J. McGee, On the Southern Extension of the Columbia Formation.

Academy of Sciences, New York.

Jan. 6. — The Regular Business Meeting will be held, after which the following paper is announced: — W. Goold Levison, Notes on Pyrotechnical Photography (illustrated with the lantern).

Boston Society of Natural History.

Jan. 1. — F. W. Putnam, G. Frederick Wright, W. O. Crosby, Warren Upham and G. H. Barton, Discussion of the question of "The Climatic Conditions of the Glacial Period."

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Christian Union, The	3.00	5.80
Cosmopolitan, The	2.00	4.80
Critic	3.00	5.80
Eclectic Magazine	5.00	7.80
Edinburgh Review	4.00	6.80
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Electrician and Electrical Engineer	3.00	5.80
Electrical Review	3.00	5.80
Engineering and Mining Journal	4.00	6.80
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Forest and Stream	4.00	6.80
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STATISTICS OF LEPROSY IN THE UNITED STATES.—In view of the general impression that leprosy is spreading in this country, it is desirable, in the interest of the public health, to obtain accurate information on this point. The undersigned is engaged in collecting statistics of all cases of leprosy in the United States, and he would ask members of the profession to aid in this work by sending a report of any case or cases under their observation, or coming within their knowledge. Please give location, age, sex, and nationality of the patient, and the form of the disease,—tubercular or anæsthetic; also any facts bearing upon the question of contagion and heredity. Address Dr. Prince A. Morrow, 66 West 40th Street, New York.

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EIGHTH YEAR.
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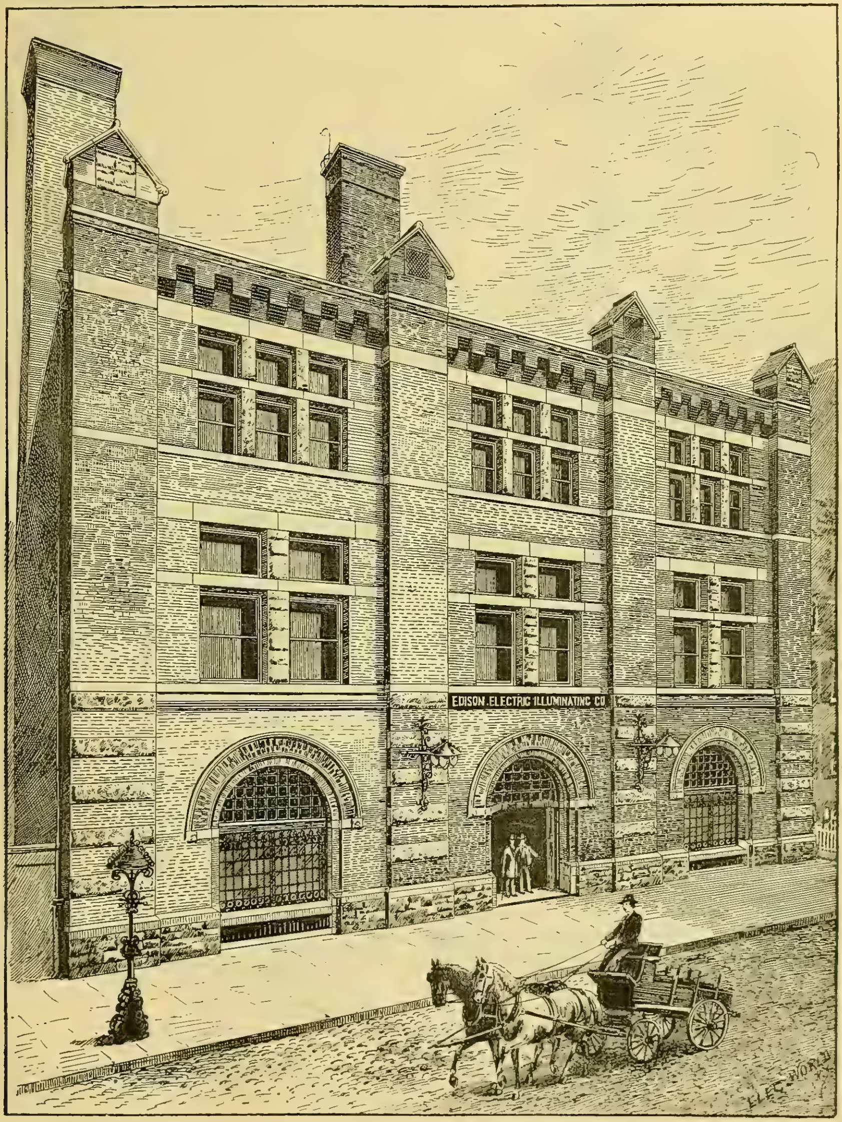

FIG. 1.—EDISON CENTRAL STATION, BROOKLYN, N.Y. (See page 36).

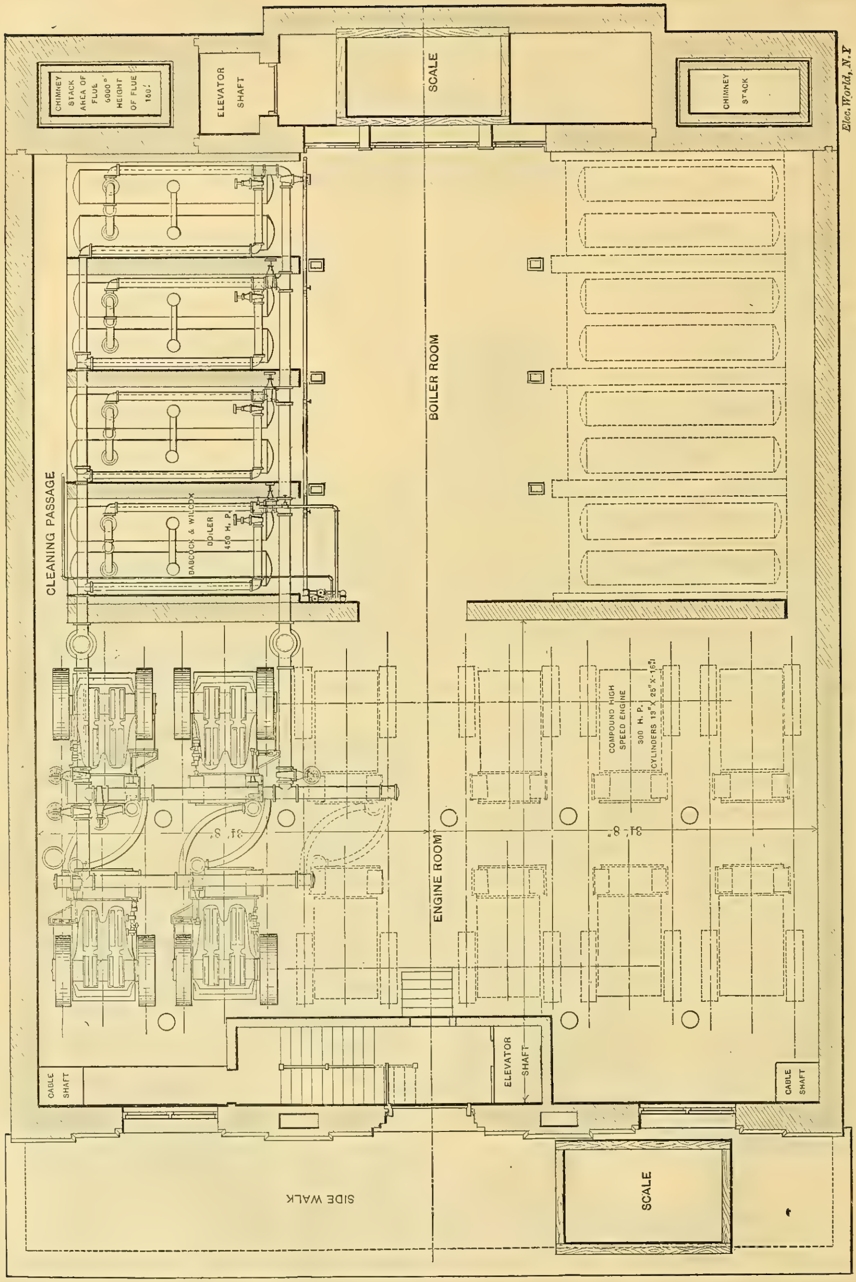

FIG. 2.—PLAN OF ENGINE AND BOILER ROOM, EDISON BROOKLYN STATION (See page 36).

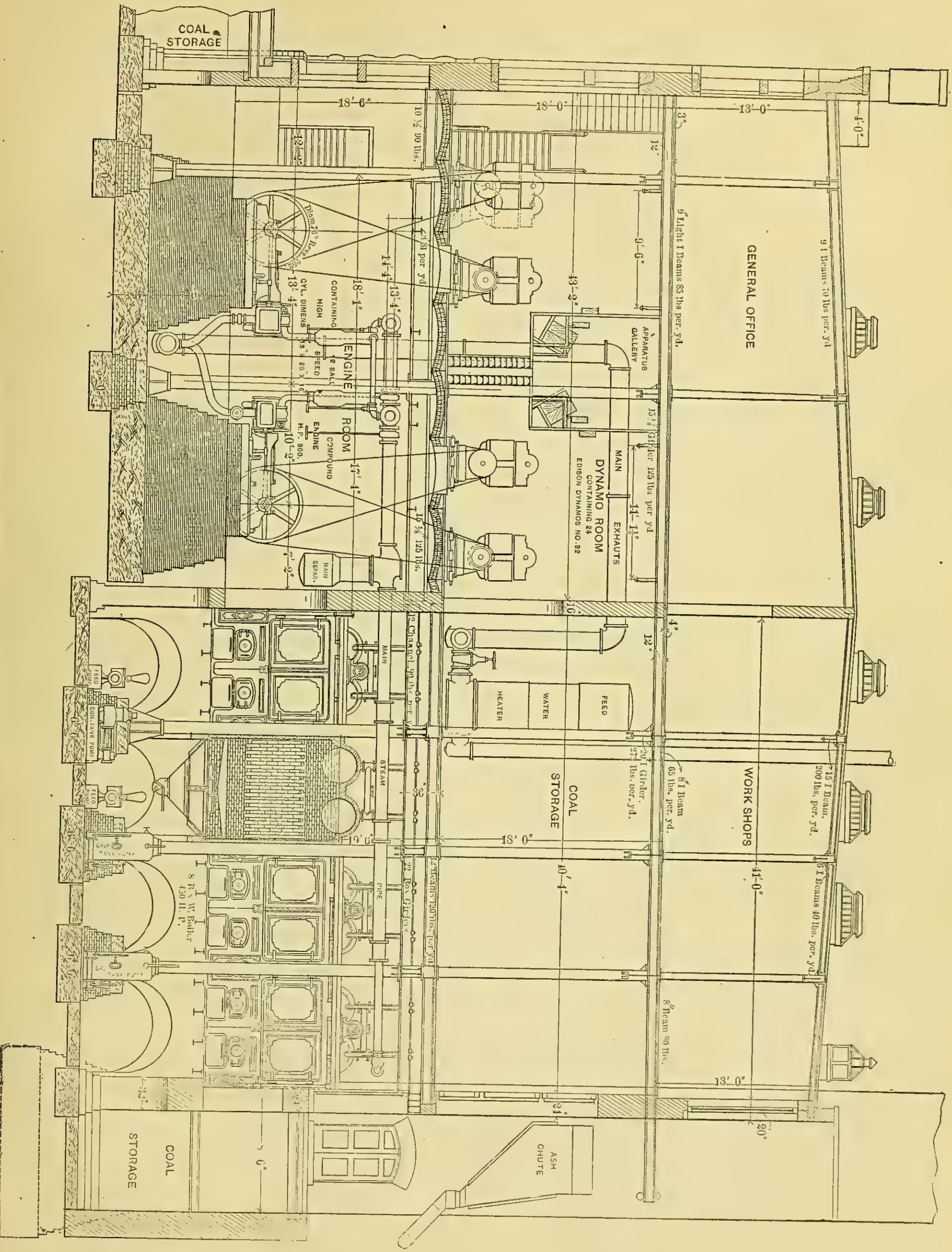

FIG. 3.—VERTICAL SECTION, EDISON BROOKLYN STATION (See page 36).

Elec. World, N.Y.

THE EDISON ELECTRIC LIGHT STATION IN BROOKLYN.

WE illustrate in this issue the central station of the Edison Illuminating Company recently completed in Brooklyn, N.Y. Fig. 1 is a view of the Pearl Street front of the building, Fig. 2 is a plan of the engine and boiler room, and Fig. 3 is a vertical section of the station. The station is designed for an ultimate capacity of 36,000 lights of 16 candle-power each. At present only about one-third of the plant is installed, that being sufficient to supply the immediate demands. The rest will be added as required.

The building, which is fire-proof throughout, is seventy-four by a hundred feet, three stories high, and is located practically in the centre of the district to be supplied. Besides the generating plant, supply rooms, store rooms, etc., the building has ample room for offices, thus enabling the company to centre all departments of its business under one roof.

Under the sidewalk are located large reserve coal vaults, the coal for immediate use being in a storage room on the second floor, over the boiler room. On the first floor are the engine and boiler rooms; the dynamos and electrical apparatus generally are on the second floor, and the third is taken up by store and supply rooms and by a suit of handsomely fitted offices. Under the engine room is a solid bed of concrete four feet thick, laid entirely apart from and independent of the wall foundations. Upon this rest the foundations for the twelve engines. In this manner all jar from the engines is absorbed or neutralized, none of it being transmitted to walls or floors.

The engines are high-speed compound Ball engines, of three hundred horse-power each, the high-pressure and low-pressure cylinders being respectively thirteen and twenty-five inches in diameter and sixteen-inch stroke of piston. These are said to be the heaviest and largest engines of their class ever built. The general arrangement of engines and boilers is shown in the plan, Fig. 2.

Steam is supplied by eight Babcock & Wilcox sectional boilers of the largest type, arranged in two groups or batteries of four each. Each boiler has about 2,800 square feet of heating surface — between six and seven square feet for each horse-power developed. The boiler room has all necessary arrangements for the convenient working of the plant. The ash-pits under the boilers, into which the ashes are raked from the furnaces, discharge into a car running on a track in the basement, which is then hoisted on an elevator, thus avoiding all shoveling and handling. The coal is elevated to the store-room, whence it is fed down to the boilers through chutes, on each of which is a special coal-scale, so that every day's supply is known, and the economy of the plant is constantly recorded. Water meters, in a similar way, record the quantity of water used. Two main steam pipes extend from the boilers to the engines, each engine and boiler being connected to both pipes, so that any boiler or engine may be disconnected without interfering with the operation of the others.

The front half of the second story is devoted to the electrical plant. The space is arranged for twenty-four Edison dynamos, each engine being belted directly to two dynamos. The dynamos run at a speed of 650 revolutions per minute, and each has a normal capacity of fifteen hundred sixteen-candle power lights. In both engine room and dynamo room overhead travelling cranes are arranged, for the convenient handling of heavy pieces of machinery.

Through the centre of the dynamo room runs what is called the "electrical gallery," to which are brought all the cables from the dynamos. In the centre of this gallery, within easy reaching distance of one person, are arranged all dynamo swtches, dynamo field-boxes, ampère meters, etc., so that one man in this gallery has all the electrical apparatus under his immediate control.

From this gallery seventeen feeders run to different parts of the district to be supplied with lights. The three-wire system being used, each feeder consists of three cables, a positive, a negative, and a neutral. By the arrangement of apparatus in the gallery, the man in charge can see at a glance the total load on the dynamos, and through what feeders and in what part of the district this load is being distributed. The underground system or net-work of wires throughout the district is all united by large mains; and the regulation of current is such that at no time is there a difference of potential of more than one volt throughout the district.

The underground system, as at present laid out, is arranged for a total of twenty thousand lights, and may be readily extended as the demand warrants. It covers an extreme distance of a mile from the station in one direction, and about three-quarters of a mile in the other, in an excellent business and residential district, from an electric lighting point of view.

The Edison system of underground tubing, which has proved so successful, has been introduced here, with many improvements and additions. The maximum drop under full load is one per cent on the mains, and there are only four sizes of tubes used in the mains, ranging respectively from 100,000 to 250,000 circular mils. Mains, as here introduced, are in larger-sized tubes than have heretofore been used, allowing more insulation compound to be introduced into the tube. All three wires in the mains are of the same size.

The Edison system of distribution is too well-known to need any extended description. Service connections can be taken off at the coupling boxes every twenty feet. At all street crossings are placed main junction boxes with busses, into which all mains at each street-crossing are brought, thereby uniting and tying the mains together at every corner, to obtain uniform distribution and pressure, and to allow more readily of a proper inspection of the system. At these boxes each main is protected by an ampère safety catch of proper size, except the neutrals, which are coupled with solid copper catches. Into certain of these junction boxes the feeders running direct from the station are connected to the system of mains. In case any feeder is disconnected, for any cause, it will not in any way affect the system, as the main which it is directly feeding will be supplied from the other feeders. In case of any accident or short circuit on the main, it does not throw off the service from any customer, as the mains are fed out to the point of trouble from both directions. Five of the feeders, instead of running to only one point of distribution, run to a certain point, and from there to two or three other points. This is to obtain better control and distribution over the system. This underground system, after completion and being thoroughly tested and started in operation, showed an insulation resistance on the whole system of over 700,000 ohms, said to be the best result in that direction ever achieved in an underground system.

THE BASIN OF THE KONGO.

A GREAT deal of interesting information concerning the Kongo, gathered from trustworthy sources, is given in the December number of the *Scottish Geographical Magazine*. The estuary of the river, between Banana Point and Shark Point is eight miles across, and soundings have indicated depths of sixty fathoms. The current at the mouth is very rapid, certainly not less than three knots an hour, or a little over five feet per second. Taking the vertical section at the mouth to be a triangle, the base of which measures eight miles and the altitude sixty fathoms, it will be found that about 1,060,000 tons of water are poured into the sea per second. The effect of this huge volume is perceptible as far as six degrees of latitude northwards from the mouth of the river, or to a distance of 360 nautical miles, so that a vessel making for Banana feels this formidable resistance after crossing the Equator, and its speed is diminished. Sailing-vessels have often to wait for weeks for a spring-tide, or a strong wind springs up, and enables them to enter the river.

Another phenomenon is the current caused by the water at the edge of the stream losing its onward velocity, and being forced back towards the land, where it spreads itself out along the coast. The ports along this coast, such as Kabinda, Loango, etc., are only roadsteads with but little shelter. Vessels have to be loaded and unloaded by lighters towed by small tugs. The lighters are sometimes overturned, when their cargo, if it be palm-oil, for instance, floats, and the owners know where it will be found on the shore. For example, any article that falls into the sea off Landana,

two miles out to sea, will arrive at the shore near Sette Cama. This current is not felt beyond Cape Lopez, for its effect is neutralized by the rivers Gabun and Ogowé.

When a vessel coming from the north arrives at about thirty miles from the mouth of the river, it crosses a clearly marked line on the surface of the water. On the side of this line towards the Atlantic the water is of the greenish, milky color which announces the proximity of land; on the other, it has the characteristic color of the river, a brownish yellow. The ship has now entered the waters of the river, though the land is scarcely yet visible. The pilot-signals, buoys, and landmarks set up by the Government, render it a very easy task to take a ship into the port of Banana. After skirting the bank at the point, she enters at once into a magnificent bay, where a whole fleet could ride at anchor. This port far surpasses all others along the coast, and it is astonishing that no one thought of occupying a spot so favorably situated at the mouth of one of the mightiest rivers of the globe until some slave-traders in the present century took up their quarters at Banana Point. Cases of illness are rare, and invalids speedily recover in this healthy spot. The heat is rendered supportable by the sea-breeze, which blows from ten o'clock in the morning.

The basin of the Kongo and its affluents has an area of about 386,000 square miles, more than thirty-three times the area of Belgium, and nearly as large as Holland, Belgium, France, Switzerland, Italy, and Ireland united. The navigable waters of the basin measure together about 7,140 miles in length. The length of both banks of the navigable waterways, 14,280 miles, is about that of the coast-line of Europe from North Cape to Constantinople. In addition to this, the Lower Kongo extends for about 120 miles from the mouth to Matadi, where the region of cataracts commences, and consists of two portions differing considerably in character. From Matadi to the Ile des Princes, or thereabouts, wild scenery, steep mountains, and torrents falling headlong into the river show that the volcanic forces which formed the region of the cataracts extended their energy over this district also. Below this island the river expands at once to double, and a little lower down to three times, its former breadth, and at last measures about twelve miles across instead of two miles and a half. It is studded with numerous islands, larger streams flow into it, its banks and the hills beside it are rounded, and the whole country has a tame appearance. Between Boma and Ponta da Lenha the islands are only banks of sand covered with grasses and sickly-looking shrubs, but below that point they bear a luxuriant vegetation.

A further diversity in the vegetation and soil is caused by the tides. The salt water ascends the river as far as Malella, so that, while the islands above are covered with oil-palms, baobabs, and wild cotton, on those towards the mouth of the river the effect of the tide may be seen in the increase of bamboos and the diminishing number of palms, etc. The latter islands are submerged at exceptionally high tides, whereas those above Malella have a fairly dense population. As soon also as the fresh water is entered, alligators and hippopotami are met with.

The navigation of the Lower Kongo is rendered difficult and dangerous by the rapid changes that take place in the depths of the channels. Some twenty years ago steamers always followed the northern bank between Ponta da Lenha and Boma, for the Fetish Rock passage was practicable only for crafts drawing less than six feet, whereas now this passage has a depth of about 190 feet, while opposite Kanga a boat drawing eleven feet of water would certainly touch ground. Several other similar cases might be quoted. Again, when the tidal waves are urged forwards with more than usual violence by the wind, which generally blows from the sea from ten o'clock in the morning, the struggle of these waves with the waters of the river is so fierce that it is felt as far as Binda, ninety-three miles from the mouth. At such times boats are obliged to keep close to the banks, or they would be swamped immediately. Ocean steamers ascend as far as Boma, and small steamers belonging to the Kongo State ply along the river up to Matadi. From the soundings taken by Captain Boyé, however, which show that the channel is nowhere less than sixty feet deep, it is considered that large steamers may safely ascend to Matadi at a speed of nine to ten knots. The large quantities of water which are poured into the river during the rainy season cause great changes of level. The water rises gradually through June, July, and August, and attains a maximum height between the 13th and 25th of September, after which it decreases up to the middle of February, and attains a second but lower maximum at the end of April.

North of the river, between Banana and Ponta da Lenha, lies an arid plain. The soil is a compact clay interspersed with lagoons, which are flooded at high tide, and are covered with impenetrable vegetation, chiefly papyrus. At a distance of from three to twelve miles from the river the country entirely changes its aspect: here hills, 300 feet high, are separated by broad valleys, and the soil is light, and no doubt very fertile. Fifty to fifty-five miles from the river, Mayumba — i.e., the land of forests — is entered, which supplies the greater part of the merchandise shipped from the ports of the Lower Kongo, and of the coast between that river and the Gabun.

Four tribes inhabit this country; the Mussorongos, who dwell on both banks of the river and the islands between Ponta da Lenha and Banana, the N'Zaadi along the river to the east of the Mussorongos, the Kacongos to the north of these tribes, and, beyond the Kacongos again, the Mayumbas. The natives have a gentle disposition, and their barbarities are due entirely to the old-established rites of fetichism. They attack a village on slight provocation, but disturbances among the inhabitants of the same village are very rare. Drunkenness, except perhaps at the great feasts, is not a common vice. They are by no means impervious to new ideas, and, if the Government can put down the tribal wars, they will probably make great progress in civilization.

Between Matahdi and Stanley Pool merchandise has at present to be carried overland at great expense. A railway has therefore been projected to connect the upper and lower parts of the river, and thus provide a cheaper and more commodious means of transport from the interior. The distance, as the crow flies, is 174 miles, but the railway, in order to take advantage of the formation of the ground, and avoid all great engineering difficulties, will be extended to a length of 264 miles. The cost is estimated at £1,000,000 sterling.

A new edition of three sheets of M. Lannoy de Bissy's map of Africa, which embrace the greater part of the Kongo territory, has been published. Several important changes may be observed in this edition, particularly near the cataract region. The French Rouvier Mission has furnished more complete and exact information than has hitherto been attainable regarding the course of the Kuilu and the country north of Manyanga; and the Belgian Cambier Mission has supplied details concerning the country on the south bank, between Matadi and Leopoldville. The survey for the railway has also determined the position of many points more exactly. The position of Mboko Songo has been removed about 20′ towards the north, and therefore the sources of the Chiluango, in the neighborhood of this place, have undergone a similar displacement, whereby the basin of the Kongo, and consequently the territory of the Kongo State, have been enlarged. The middle course of this river has also undergone changes in direction, and its affluents, the Luisa and Luali on its right bank, and the Lukula, on its left, are represented as the important streams they really are. The tributaries also which enter the Kongo in the region of the cataracts are put down from their sources to their confluences.

Between Stanley Pool and Kwamouth the river runs swiftly between mountains often six hundred to one thousand feet high, and covered with forests. Only at Msuata is this barrier broken. Here the land rises from the shore in terraces, and is inhabited. As far as Chumbiri the river widens very gradually, but above it expands considerably, and is generally very broad all the way to Stanley Falls: it is often fifteen, and sometimes as much as twenty-one, miles across. Between Bolobo and Lukokela a marshy tract occurs, a slight blemish on this beautiful river.

All along the banks of the Upper Kongo are frequent villages, and even towns. Bolobo, for instance, has a population of 30,000 souls, public squares, and regularly built streets. Considering the enormous length of waterways, and the fertility of the soil, the new railway, by which all the exports must reach the Lower Kongo, should prove a success.

NOTES AND NEWS.

A NEW stamp-cancelling machine is being tried in the Philadelphia post-office. It is operated by electricity, and is said to cancel the stamps on letters at the rate of 25,000 per hour, automatically registering the number cancelled.

— The death of Prof. Lorenzo Respighi, Director of the Osservatorio Campidoglio, Rome, which occurred on Dec. 10, is a great loss to science.

— Mr. Robert T. Hill has resigned the position of assistant professor of geology in the University of Texas, in order to devote his attention solely to geological investigations.

— An attempt is being made to secure the erection of an international monument to James Watt at Greenock, his birthplace. It is proposed that the memorial shall be a large and thoroughly equipped technical school.

— The *Detroit Journal* desires to receive, by postal card, the address of all living male and female descendants of Revolutionary officers and soldiers of 1776, and, when possible, the name and State of the ancestor.

— Dr. Sargent, Professor of Physical Culture at Harvard, utters a word of caution about over-exercise. He says, according to *The Medical and Surgical Reporter*, that those who have been most successful in heavy gymnastics are also subject to nervous complaints.

— The "Annual Catalogue" for 1889–90 is sent this year to every graduate of Harvard College whose address is known. The annual reports of the president and treasurer are sent regularly to every graduate who has informed the secretary of the university that he desires to receive them. Graduates are requested to advise the secretary of changes in their addresses.

— Test borings recently made on the line of the Nicaragua Canal show that the entire divide to be traversed by the deep cut consists of solid basalt, at least to a depth of 165 feet, as far as the borings extended. This is a most favorable showing for the construction company, as it settles at once the important question of slopes in the greater part of the cut.

— An article on the new plants introduced into cultivation during the year just past appears in *Garden and Forest* for January 8th, and in the same number Mr. Geo. Nicholson continues his description of the gardens of the Riviera. One phase of the national forest problem is discussed editorially, and a novel theory of the function of the so-called "knees" of the Bald Cypress is set forth in a communication from Dr. Robert H. Lamborn.

— At a recent meeting of the Photographic Society of Geneva, Switzerland, Professor H. Fol presented a paper on resemblances in married couples. According to the *British Journal of Photography*, he stated that, out of seventy-eight young couples photographed for the purpose of his investigations, he found that in twenty-four cases the resemblance in the personal appearance of the husband and wife was greater than that of brother and sister, in thirty cases it was equally great, and in only twenty-four was there a total absence of resemblance.

— The Meteorological Summary for the Year 1889, prepared by Professor F. H. Snow, of the University of Kansas, from observations taken at Lawrence, shows that the most notable meteorological features of the year 1889 were the remarkable absence of extremes of heat and cold, resulting in a very mild winter and a very cool summer; the abundant and well-distributed rainfall, making this one of the three wettest years on the twenty-two years record; the phenomenally warm December, whose mean temperature was six and one-half degrees above that of November; the low wind velocity; the small amount of snow; and the unusual number of fogs, averaging a little more than two per month.

— The attention of graduates of Harvard University is invited to the fact that for several years the secretary of the university has voluntarily acted as a medium of communication between persons seeking to secure educated young men to assist them in teaching, professional work, or business, and students or graduates of the university desirous of obtaining such employment. For this purpose the secretary keeps a list of graduates engaged in teaching, another of students about to graduate who wish employment immediately thereafter, and a third of students who desire temporary work in summer vacations. The results have been satisfactory, except in respect to obtaining advantageous summer employment for students. From one to two hundred students apply for summer work each spring, but a comparatively small number obtain it through the secretary's aid. The co-operation of the alumni is invited in all three branches of this work.

— Dr. Hadjime Watanabe, an official of the Japanese agricultural service, delivered an interesting address on the chrysanthemum at the recent celebration in Berlin of the centennial of the plant's introduction into European cultivation. According to the report of his words published in *Garden and Forest*, the Japanese divide chrysanthemums into two groups, "nogiku" or wild single, and "niwagiku" or double cultivated flowers; and the latter are subdivided into four kinds — the ordinary autumn-blooming sorts, the summer-blooming, the winter-blooming, and those which bear flowers at all four seasons. The single flower is not neglected by the horticulturist, but is prized for its very simplicity, and is usually planted at the foot of rocks, intermingled with grasses, to give a landscape design a naturalistic air. In treating the double-flowered plant when it is desired to produce individual flowers of the largest possible size, then all the branches but one are gradually removed, and on this one only an isolated blossom is allowed to mature. On the other hand, when as many flowers as possible are sought without regard to conspicuous size, the main stem is brought to the greatest possible development, and all its branches are preserved until the blooming season arrives, when, if some show no buds, they are cut away. The sturdiest possible plants are chosen for this purpose, and the speaker referred to some upon which more than three hundred flowers had been counted. Two forms are in favor for these many-flowered "kikus," one of which gets its name from its resemblance to a thick broom, while the other is a more artificial, fan-like shape. A Japanese proverb says "it is easy to grow the flowers of the kiku, but difficult to grow its leaves," and the speaker declared that the plants are judged from this standpoint. The amateur's chrysanthemums are usually "very poor and faulty in foliage, although they may bear fine flowers; but those which one sees at an 'art-gardener's' are clothed from top to bottom with leaves regularly disposed and of a beautiful fresh color." The most common method of propagating the plant is by root-division, but several others are employed. In one, a single leaf with a bud at its base is plucked, lightly covered with earth and laid in a shady place, where it eventually takes root. Gardeners who own rare varieties therefore forbid the visitor a near approach to their plants, as it would be easy to pick a leaf of the proper kind and conceal it in the pocket for future planting.

— The question of the relative food value of dried corn fodder and of corn silage has been much discussed, and, judging from the fact that the discussion still continues, has not yet reached its final solution. One important element in determining this question is the relative percentage digestibility of the fodders, that is, the proportion of the ingredients of each one which the animal fed upon them is able to utilize. Some recent experiments conducted by H. P. Armsby and W. H. Caldwell at the Pennsylvania State College Agricultural Station are a contribution to this branch of the question. The material used in this experiment was ordinary field corn fed to two Devon steers. The corn was prepared in three different ways, — as rapid-filled silage, slow-filled silage, and field-cured fodder. As a result of the experiment, it was found that the dry matter of the field-cured fodder was more digestible than that of the rapid-filled silage, and this again was more digestible than that of the slow-filled silage. The digestibility of the albuminoids and of the total protein is very nearly the same in the fodder and the silage. These results do not show the effect of the process of ensilage upon the digestibility of green fodder, but only the difference in the final effects of two processes for preserving fodder. The digestibility of the green material was not determined, but in all similar investigations the digestibility of the freshly cut fodder has been invariably found to be greater than that of the same fodder after being subjected to the ordinary processes of curing. In all probability, therefore, the freshly cut corn fodder

would have proved more digestible than was either the silage or the fodder. The experiment shows merely that the process of ensilage lowered the digestibility of the material more than the process of field-curing. Furthermore, the relative digestibility of corn fodder and silage is but one element in determining their relative value. It would be a mistake to condemn silage because it appears to be slightly less digestible than the field-cured material. In forming a judgment of the comparative value of the two processes, account must be taken not only of the digestibility of the resulting fodder, but of the amount of material lost in the process, and of the nutritive value as well as the digestibility of the product; and also of its influence upon the health of the animals, and of the important practical questions of the relative convenience and economy of harvesting, storing, and handling.

— A few years ago some of the leading photographers in London went to the expense of equipping their establishments with engines and dynamos, so that, by means of the electric light, they might be to some extent independent of the sun in their work. The results were satisfactory though the cost of equipment and maintenance was high. Most of these photographers have now discarded their engines and dynamos, though still adhering to the electric light. They find it much less expensive and satisfactory to take their current from the street mains of the different electric light companies, paying only for the quantity consumed.

— In a recent lecture by Dr. A. W. Schüddekopf, on "Universities and University Life in Germany," after a short sketch of the history of German Universities, showing how they have gradually developed from the schools founded by the Church for the education of persons intending to enter its service, the lecturer explained the constitution of German Universities, their officials and teaching staff, with a digression illustrating the high social position of a German professor, despite the fact that his salary seldom exceeds $1,500 or $2.000 a year. The Lecture also explained at some length the position of a "privat-docent," a class of teachers peculiar to German Universities, who receive no salary for their work, but render their services gratis in the hope of being some day appointed to a professorship. He also reminded his audience of an important distinction made in Germany between the "professor ordinarius" who has a seat in the Senate of his University and is eligible for all the honorary offices — rectorship, deanship, etc., — and the "professor extraordinarius," who does not enjoy these privileges. Dr. Schüddekopf then proceeded to describe the German Universities as teaching centres. He compared the English system of higher education with the German system, stating that Universities of an exclusively examining character do not exist in Germany; whereas, on the other hand, the educational feature of Oxford and Cambridge life is absent from German Universities. The latter are of a teaching and examining character at the same time. The lecturer next laid emphasis on the looseness of the discipline for the students, compared with that maintained in England, and explained the possibility of such laxness by the greater average age of the student — it being necessary for every person matriculating at a German University to have pased his "maturitätsexamen" at his gymnasium, which is rarely tried by persons under nineteen or twenty years of age. The German student is much less frequently examined than his English brother; but then what an ordeal when it comes! Unlike the English system there is little or no paper work, the candidate being examined *vivâ voce*, more importance being attached to the grasp he shows of his subject, and his manner of manipulating it, then to his knowledge of facts. Besides the *vivâ voce*, candidates have to write one or several "dissertations," which may take many months to prepare. Dr. Schüddekopf reminded his audience that, in Germany, University degrees are not considered to qualify candidates for masterships, for a license to practice medicine, and other offices, except in the case of candidates for a University professorship; but that candidates for such offices must have passed the "staatsexamen," which in most cases is much more difficult than the degree examinations. Relating his own experiences in passing his "staatsexamen," Dr. Schüddekopf caused a tremor to run through a sympathetic audience when he told that, after a year passed in writing "dissertations" on philological and philosophical subjects, he underwent nine hours *vivâ voce* examination in one day by eight German professors in as many different subjects! The majority of German students — except in the faculty of medicine — do not take a degree at all, but only pass their "staatsexamen." It is the custom in Germany for a student to have been to several Universities before settling down at one for examination purposes — a system which the lecturer thought a very good one, on account of the facility it affords the student for becoming acquainted with the leading men in his subject.

— For the benefit of delegates and others attending the eleventh convention of the National Electric Light Association, to be held at Kansas City, Feb. 11–14, arragements have been made with the Pennsylvania Railroad to provide a vestibule train to be known as the "Electric Limited," to be run through without change to Kansas City, via Chicago and the Chicago, Burlington, and Quincy Railroad. This train will leave Jersey City on Sunday, Feb. 9, at 9.45 A.M., arriving at Chicago, Monday morning, at 9 A.M. Monday will be spent in Chicago, the Chicago Electric Club having kindly invited the Eastern delegates to enjoy its hospitality during their stay in that city. The "Electric Limited" will leave Chicago on Monday evening at 5 o'clock, arriving at Kansas City early Tuesday morning. Passengers should be careful to take the ferry at foot of Cortlandt or Desbrosses Streets, New York, not later than 9.30 Sunday morning. No effort has been spared by the transportation committee in obtaining the very best equipment, and the committee is assured that this train will be the finest ever run out of New York. It will be composed of the latest Pullman vestibule sleeping cars, lighted by electricity, a dining car, composite car containing barber shop, bath room, card room, library, writing desk, smoking room, etc., and an observation car with a large open room luxuriously furnished, as well as an observation platform. The train will be supplied throughout with fixed and portable electric lamps. Special accommodations will be provided for members accompanied by their wives. The rate of fare going, including sleeping car accommodations, will be $39.75, and inasmuch as it is necessary to guarantee a certain number of people in order to secure this superb train, it is important that those who propose attending the Convention notify, with remittance, as promptly as possible, C. E. Stump, chairman transportation committee, *Times* Building, New York. Extensive preparations have been made to render this one of the most interesting conventions ever held, and it is expected that members will do their utmost to induce as large an attendance as possible.

— In the town of St. Emilion, near Bordeaux, France, is a remarkable monolithic church, probably one of the most curious of its class. According to Mr. J. H. Parker, who describes it in a recent issue of the *American Architect*, it is cut entirely out of the solid rock, and is of early Romanesque character. The precise date is uncertain, but it appears most probable that the work was commenced in the eleventh century, and carried on through the whole of the twelfth. A fragment of an inscription remains, the characters of which agree with the eleventh century; but some of the French antiquaries attribute it to the ninth. Others consider it as merely the crypt of the church above on the top of the rock; but that church is of much later character, and it is much more probable that the subterranean church was first made, and the other built long afterwards, when the country was in a more settled state. This church is one hundred and fifteen feet long by eighty feet wide. It consists of three parallel aisles, or rather a nave and two aisles, with plain, barrel-shaped vaults, if they can be so called, with transverse vaults or openings, and round arches on massive square piers. The imposts are of the plain early Norman character, merely a square projection chamfered off on the under side, but one of them is enriched with the billet ornament. There are recesses for tombs down the sides, and a fourth aisle or passage has been cut out on the south side, apparently for tombs only, as it has recesses on both sides to receive the stone coffins. Still farther to the south, but connected by a passage, is a circular chamber in an unfinished state, with a domical vault, and an opening in the centre to a shaft which is carried up to the surface. Whether this was intended for a chapter-house, or for a sepulchral chapel in imitation of the Holy Sepulchre, is an undecided point. This sub-

terranean church or crypt is necessarily lighted from one end only, where it is flush with the face of the rock; and these openings are filled with flamboyant windows, which are very evident insertions. On the surface of the hill over this church, but with a large space of solid rock intervening, is the tower and spire belonging to it. The tower is of late Norman and transitional character surmounted by a flamboyant crocketed spire. There is a kind of well or flue cut through the rock under the tower into the church below, apparently for the bell-ropes. In the church are remains of early painting, and some shallow sculpture, the character of which appears to be of the twelfth century. Adjoining the church, on the south side, is a detached chapel of transition Norman work, with an apse vaulted with good ribs and vaulting shafts. A considerable part of the old painting is preserved. Some of the ribs are painted with zig-zags. Under this chapel is a crypt or cave cut out of the rock, called the Grotto of St. Emilion, with a spring of water in it. The work is of the same early character as the other vaults.

— A factory chimney, said to be the highest in the world, is now being erected at the Royal Smelting Works, near Freiburg, in Saxony. The horizontal flue from the works to the chimney is 1,093 yards long; it crosses the river Mulde, and then takes an upward course of 197 feet to the top of the hill upon which the chimney is being built. The base of the structure is thirty-nine feet square by thirty feet in height, on which is placed a short octagonal transition, from which the round shaft starts. This is 430 feet high, or together with the base, 460 feet high, with an inside diameter of twenty-three feet at the bottom, and sixteen feet and six inches at the top. It will take 1,500,000 bricks, and the cost is about thirty thousand dollars.

— Complaints of overpressure in schools are as numerous and universal in Sweden as in many other Continental countries. Sweden is, in fact, one of the countries where this fact has first roused the public interest, as has been proved by Professor Dr. Key several years ago, in a pamphlet full of trustworthy statistical information, and showing that anæmia, chlorosis, and other diseases are due to, or are at least greatly promoted by, the existing overwork in the schools. Another weighty charge against the present school-system is that it, to a great extent, promotes the ordinary contempt for manual work among the young, and tends to engender disinclination for the practical professions, handicrafts not being sufficiently "genteel." Complaints of a too great influx at the universities are, therefore, as common in Sweden as in Germany, and the other Scandinavian countries. These unhappy results of the secondary education are now acknowledged by nearly every body, but they were foreseen by some patriotic men, who, thirteen years ago, founded a school, which, after its headmaster, got the name of "Palmgren's Practical Work-School." However, one must not infer from the name that it gives instruction solely in manual work. It was also intended to give a liberal education, and has now gloriously proved its efficiency in that respect, as some of its pupils have, during the last two years, successfully obtained their matriculation degree. The school-lessons are here somewhat fewer than in ordinary schools, and instruction in manual work — Sloyd — is obligatory for all pupils. Moreover, children who do not attend the school-lessons are admitted to the Sloyd instruction at a very moderate fee. Instruction is also given to men and women in sewing, embroidering in gold and silver, lace-making, macramé, etc. Further in bookbinding, pasteboard-work, joinery and turning. There are also courses at the school, of three months each. for future male and female Sloyd-teachers. Besides instruction in Sloyd-work, these students have lessons in drawing and the pedagogics of Sloyd. They have also to instruct children in Sloyd for one to two hours a day, under the superintendence of their teachers. During the summer holidays a shorter course is given for ordinary teachers. To give the reader an adequate idea of the interest which nearly all classes in Sweden take in Sloyd, the Swedish correspondent of the *Journal of Education* mentions that Colonel Ankarcrona, Commander of the Royal Swedish Lifeguards, has ordered that Sloyd-instruction is to be given twice a week to the guardsmen, by experienced teachers from Mr. Palmgren's school. This step has been taken to give the soldiers some pleasant and useful recreation when they are off duty. Apart from the moral influence it may exert, it will evidently be a great advantage for the soldiers to learn the rudiments of a trade in the barracks, which hitherto have not been a school for useful and profitable arts in Sweden any more than in other countries.

— The Standing Executive Committee of the Convention of American Instructors of the Deaf, of which Dr. E. M. Gallaudet Kendall Green, Washington, D.C., is chairman, have had under consideration the suggestions made in many quarters that, in view of the probability of a notable national celebration being held in 1892, in this country, the Convention, which would naturally meet in 1890, be postponed until the jubilee year. It is well known that an invitation to hold the next Convention at the New York Institution for the Deaf and Dumb was accepted some time ago, and that it was intended, through invitations to professional brethren in other countries, to give the Convention an international character. Since this plan was decided on it has become practically certain that there will be held, in 1892, one or more great exhibitions calculated to attract visitors even from foreign countries, and that, consequently, during that year, low rates of travel to and in our country will be offered, all of which would tend to induce a larger attendance at such a Convention from abroad, and probably from the States, than could be expected at any other time within the next decade. The influence of such a Convention, held when great numbers of people, both foreign and native, would be assembled at the place where the Convention would be likely to meet, would give its proceedings an influence and importance they could hardly have under other circumstances. The weight of these considerations has led the Committee to decide, unanimously, to postpone the meeting of the next Convention until 1892. The authorities of the New York Institution have kindly renewed their offer of hospitality, but the Committee are of opinion that it will be wise to defer their decision as to the place of holding the Convention until the plans for the national celebration are more fully developed than they now are.

—Life at Girton is described in *The Women's World* in this way: An early breakfast, served from eight to nine (some industrious students begin their day with a private breakfast party at five or six, and only partake of the college meal as an afterthought), is followed by a morning devoted, almost without exception, to private study, or to attendance at lectures given in college by the resident lecturers, or at the numerous courses in Cambridge now thrown open to women. The early hours of the afternoon, which by common agreement of the students are considered "noise-hours," are usually given to recreation, tennis being the most popular form of outdoor amusement, and pianos, with an occasional fiddle, having full swing indoors. After luncheon coffee-parties are also a common occurrence, the entertainment being of the most informal description, while the hostess seldom scruples to dismiss her guests or leave them to entertain themselves if she has work or lectures on hand. From three until the six o'clock dinner silence reigns again in the college. Many classical and mathematical lectures are given at this time by Cambridge lecturers, who come out to the college for the purpose, and the students who have not lectures usually, though not so universally as in the morning, devote a part or the whole of these hours to private study. After dinner again informal coffee or tea parties are frequent, and friends generally meet in a haphazard kind of way, which, perhaps, may be best described as "loafing" into each other's rooms. In the May term this "loafing" takes place round the grounds, and an interesting study of shawls might be made from the windows overlooking the lawn and tennis courts. The formal social duty of calling on freshers is performed in this after-dinner hour, most of the college business is transacted, meetings are held, and subscriptions to the various societies paid. In the May term it is the favorite hour for tennis, and in all three terms the fire-brigade has a fortnightly practice immediately after "hall." Some of the poorer specimens of Girtonians think this a little severe, as the practice often includes a double-quick march from end to end of the long corridors; but the officers are inexorable, and catalogue all who brave their scorn and fight shy of the brigade as "ill or lazy." From half-past seven to nine are "silence hours" again, and then, or later in the evening, an hour or two's work is com-

monly done — freshers with "little-go" on the brain, are reported to get in four or five before retiring for the night, but they generally learn in a term or two that it does not pay. Nine P.M. is the orthodox hour for knocking off work, and for the more elaborate forms of social intercourse, club meetings, occasional dances, small debates, and so forth — above all, for the regulation formal tea-party. There are certain points about this entertainment peculiar to college life, if not to Girton, says the *Women's World*, notably the fact that the guests bring, not their own mugs merely, but a whole trayful of refreshments. The college custom is to send to all the rooms a tray, with a roll and butter, and the materials for whatever beverage — tea, coffee, cocoa, or plain milk — is preferred by each student, and this custom greatly facilitates the discharge of the social duty. For it is understood that when a student gives a nine-o'clock tea-party all the guests take their own trays, the hostess providing only the hot water, and such luxuries as cake and jam. Thus, at 9 P.M., in all the corridors, is presented the striking spectacle of students hurrying in all directions — sharp corners are very dangerous at this time — to their respective entertainments, balancing trays in one hand, and in the other, unless they are such old hands as to know the college blindfold and avoid all pitfalls of boots, water-cans, and unexpected angles, carrying candles in case the festivities should outlast the college lights. It is at these parties that new students are first initiated into college society, and so strong is the instinct of hospitality that the "freshman" must be of a remarkably gregarious disposition who does not find tea-parties, which she experiences in their most formal tedious aspect, grow decidedly monotonous after a few weeks.

— The high price of gum acacia has led Trojanowsky to seek for a substitute, says an exchange, and this he believes may be found in the mucilage of flaxseed. By boiling the seed with water and precipitating the strained decoction with twice its volume of alcohol, he obtained a substance which, after drying, consisted of opaque, yellowish-brown irregular fragments, somewhat brittle, but not easily reduced to powder, dissolving in water to a turbid mucilaginous solution; of this, five grains were sufficient to emulsionize an ounce of cod liver oil. The large quantity of alcohol, however, required for the precipitation, and the difficulty of drying the adhesive product being such serious objections, further experiments were made, and, by still employing flaxseed as the source of the mucilage, and treating with sulphuric acid, a gum more closely resembling acacia was obtained. His method is to boil one part of flaxseed with eight of dilute sulphuric acid and eight parts of water, until the mixture, which at first thickens, becomes quite fluid; this is then strained through muslin, and to the strained fluid is added four times its volume of strong alcohol, the precipitate being collected on a filter, washed with alcohol, and dried. The gum is in the form of translucent, grayish-brown, brittle fragments, easily pulverized, and without odor or taste, and thirty grains will emulsionize an ounce of cod liver oil.

— An insect destructive to wheat, but previously unknown in this country, has appeared in considerable numbers on the Cornell University farm at Ithaca. Mr. J. H. Comstock, professor of entomology at Cornell, who has been making a study of the insect, says that he does not know of its occurrence anywhere else in this State; but as it is extremely abundant on the University farm, it is doubtless spread over a considerable area. It was first observed there two years ago, by one of the students, the late Mr. S. H. Crossman, while making an investigation of wheat insects. On examining the stalks of wheat at harvest time by splitting them throughout their length, it was found that some of them had been tunnelled by an insect larva. This larva had eaten a passage through each of the joints, so that it could pass freely from one end of the cavity of the straw to the other. In addition to tunnelling the joints, they had also fed more or less on the inner surface of the straw between the joints. If infested straws be examined a week or ten days before the ripening of the wheat, the cause of this injury can be found at work within them. It is at that time a yellowish, milky-white worm, varying in size from one-fifth of an inch to half an inch in length. The smaller ones may not have bored through a single joint; while the larger ones will have tunnelled all of them, except, perhaps, the one next to the ground. As the grain becomes ripe the larva works its way toward the ground; and at the time of the harvest the greater number of them have penetrated to the root.

— The Boston correspondent of *The Book Buyer* quotes an amusing letter sent by Mr. Aldrich to Professor E. S. Morse, ex-president of the American Association for the Advancement of Science. Professor Morse, it should be said, has a handwriting quite indescribable in illegibility: "My Dear Mr. Morse: It was very pleasant to me to get a letter from you the other day. Perhaps I should have found it pleasanter if I had been able to decipher it. I don't think that I mastered any thing beyond the date (which I knew) and the signature (which I guessed at). There's a singular and a perpetual charm in a letter of yours; it never grows old, it never loses its novelty. One can say to one's self every morning, 'There's that letter of Morse's. I haven't read it yet. I think I'll take another shy at it to-day, and maybe I shall be able in the course of a few years to make out what he means by those t's that look like w's and those i's that haven't any eyebrows.' Other letters are read and thrown away and forgotten, but yours are kept forever — unread. One of them will last a reasonable man a lifetime."

— No subject can be of more vital importance to the farmers of Indiana than the economical utilization of their fodder crops, since their success with live stock and in the dairy must be directly proportional to the economy of this utilization and depend for success or failure on the skill exercised in feeding. Careful inquiry and observation extending over the entire State, by the State Agricultural Experiment Station, of which Dr. H. E. Stockbridge is the director, forces the inevitable conclusion that as much nutriment in the form of fodder is wasted every year as actually finds it way into the digestive systems of the farm animals of the State. The two great fodder crops necessarily considered in this connection are hay and corn stover. Though perhaps both are equally worthy of consideration, and the utilization of each equally capable of improvement, the December bulletin, by J. Troop, pertains only to the former. It is the intention of the station to devote special attention to the production, curing, and feeding of hay during the coming season. That the results of the work may be most effective, however, it seems necessary that a preliminary discussion of the grasses of the State is called for, and to meet this demand the present bulletin is issued. It does not purport to be a scientific treatise on the grasses of Indiana; its sole aim is to offer the farmers of the State the briefest possible description of every grass known to grow within its borders, together with the chief characteristics and relative value for feeding purposes of each, in the hope of placing the farmers in possession of such information as will enable them to determine for themselves the character and adaptations of grasses with which their experience may bring them in contact. Recognizing the fact that plant determination by mere description is necessarily attended by serious difficulties, a large number of illustrations have been utilized as conveying the most perfect impression possible of the actual appearance of the grasses discussed. So far as the actual importance of the work thus begun may become to the agricultural interests of Indiana, the relations existing between tilled land and grass land in the State must be pertinent. The area of tilled land in Indiana is 56.4 per cent of the area of the State, while the grass-land area is 11.8 per cent, the average for the entire United States being respectively 41.6 per cent and 11.5 per cent. The ratio existing between these two varieties of farm land is, for Indiana, as 1 of grass land to 5.4 of tilled land, and for the entire country, 1 of grass to 3.7 of tilled land, — figures showing conclusively that Indiana can lay small claims at present to either a grazing, stock, or dairy pre-eminence, and that she falls far short of producing her best proportion of the grass of the country, and fails in maintaining a just or most profitable relation between these two staple divisions of farm lands. Indeed, Indiana ranks in the second series of States in the production of grass, and in the third series in average value of milch cows and live stock, facts which must possess a definite relation to the proportion existing between grass product and area of tilled lands, and enforcing the proverb, "the more grass the more stock, the more stock the more manure, the more manure the more crops."

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE WAITOMO CAVES, NEW ZEALAND.

IN a report to the Surveyor-General of New Zealand, Mr. Thomas Humphries gives an interesting description of a visit which he and a small party made in June last to the Waitomo caves, King Country, in the North Island of New Zealand. The Waitomo River, a tributary of the Waipa, which passes through these caves, lies about eighty-five miles south of Auckland in a direct line, though it is about twenty miles further by rail and road. The caves are about ten miles from Otorohanga railway station. The country around is undulating. A quarter of a mile before the caves are reached, the Waitomo, of about twenty feet in width, is seen emerging from the side of a hill, under which it has meandered through limestone caverns of various sizes for about twenty chains. A light canoe can be taken along the river through the caves to within a few chains of its egress, where further progress is barred by the roof coming down to the water.

At the entrance to the cavern the stream is eight feet deep. The natives have never had the courage to enter. The entrance to the cave, thirty feet wide and twenty feet high, is in the face of a cliff. It is beautifully arched, with numerous moss and lichen-covered stalactites. In a canoe the visitor is taken in, ninety feet from the entrance, and landed on a silt-covered beach. By the aid of candles, for all is now dark, he finds himself among ponderous stalactites, three to six feet thick, reaching from the roof, twenty feet high, to within a foot of the ground. Everywhere, all over the extensive and intricate caverns, are seen stalactites and stalagmites of immense size, in vast numbers, with marvellous beauty of form and color. At one place the dark vault was studded with thousands of glow-worms, giving the vault the appearance of a starlit sky.

Passing down the left bank of the stream for one hundred and forty feet, over a large deposit left by floods, the party crossed it by means of a foot-bridge. From the entrance to the bridge the cavern averages fifty feet broad, and from twenty to thirty feet high. After crossing the bridge, a sharp turn to the right is made up a steep incline for a distance of seventy feet, to the foot of a ten-foot ladder, which leads to a narrow passage four feet wide and fifteen feet high, the entrance to the "Grand Cavern." Here is the bottom of the "well," a narrow shaft running up to another series of caves over the lower ones, where it is again met with in the gallery above. The well is four feet across, perfectly true, as if made by human hands, and its sides beautifully marked with horizontal streaks, formed of laminated lime-stone. In the Grand Cavern is an immense mound of material evidently fallen from the roof.

Beyond the Grand Cavern the roof rises and forms two domes, one fifty feet high. High up, forty feet, is the entrance to another cavern. Beyond the dome there is a sudden fall, the roof lowering so much that the visitor has to stoop. The length of the Grand Cavern, at the end of which the stream is again met with, is two hundred and fifty feet. It varies in width from fifteen to forty feet, and from twenty to fifty feet in height. Up to this point the color is a dull brown and a light yellow; but in the upper galleries, thirty feet above, there are alabaster and Parian-marble-like scenes of unsurpassed loveliness.

Twenty feet above the Grand Gallery is the "Organ Gallery," so-called from the appearance of the great stalagmitic mass one hundred and fifty feet from its entrance, rising tier upon tier, like the front of an organ with marble pipes. From the Grand Gallery the Main Gallery above is reached by a twenty-five-foot ladder, and sixty feet along it the "well" is reached. Here it is twelve feet in diameter, with smooth sides of hard limestone, and the sound of moving water below. This is forty-five feet above where it was first seen. Fifty feet along from the upper well is a "fairy grotto," and through an archway thirty feet in length the "Banquet Chamber" is reached, where the surveyor and his friends found a hot dinner had been provided by the natives who own the caves. At the end of this chamber is the White Terrace, a stalagmitic mass rising in a series of terraces. From this the upper entrance to the caves is reached, high in a wooded cliff, sixty feet above and directly over the lower entrance. Mr. Humphries describes in glowing terms other galleries and caves, but this may suffice to show, that, notwithstanding the destruction of the Rotomahana Terraces, New Zealand has still plenty of wonders.

THE WENSTROM DYNAMO.

SOME months ago a description and illustrations of the Wenstrom dynamo were given in these columns. A dynamo of this make was recently sent to the electrical testing bureau of the Johns Hopkins University, where it was submitted to a series of tests, the results of which are given below, under the signatures of Drs. G. A. Liebig, Louis Duncan, and W. F. Hasson. It may be mentioned here that the dynamo tested was designed to give an output of 400 ampères, at 110 volts, running at a speed of 500 revolutions per minute; while the speed under which the tests were made was only 330 revolutions per minute.

"The dynamo-electric machine sent to us for examination, a report of which is contained in the following pages, was described by the manufacturers as an 800-light dynamo, and was stated to absorb energy, when doing full duty, at the rate of about sixty-horse-power.

"Having our source of motive power and testing apparatus already in place for the purpose of conducting some experiments on other dynamos, the following tests were made (through the kindness of Mr. F. Hambleton, who consented to allow the bureau the use of a part of the works under his charge), at the plant of the Consolidated Gas Company of this city [Baltimore].

"Here we had set up an Armington & Sims engine of about seventy-horse power capacity; belted to which was a Tatham

dynamometer, which in turn was connected by a belt with the dynamo under examination. At a convenient distance from the dynamo were located the lamps and resistances (resistance coils), through which the current furnished by the former was allowed to flow, as well as the various instruments employed in the electrical measurements. Steam for the engine was furnished by a set of boilers located near by, but in a separate building.

"The source of motive power was, as stated before, an Armington & Sims engine, rated, nominally, at about seventy horse-power when supplied with steam at about eighty pounds pressure. The normal speed of the engine was about 275 revolutions per minute, but this could be varied within limits of a considerable range, without any serious interference with the action of the governor.

"For measuring the power supplied to the dynamo, there was employed a dynamometer originally designed by W. P. Tatham of Philadelphia. This instrument was the same as that used some years ago by the committee appointed by the Franklin Institute of Philadelphia to conduct the competitive tests of dynamos exhibited at the Electrical Exhibition held in Philadelphia in 1885. A description of the apparatus will be found in the *Jonrnal of the Franklin Institute*, November, 1885.

"For measuring the current furnished by the machine, there were employed two methods, the full-load current being 400 ampere, — too great for any single instrument in our possession, — a part of this was measured by a Thomson balance, and part by observing the potential difference between the ends of several heavy strips of German silver immersed in oil. The latter method is known generally as the method of fixed resistances, and the apparatus referred to was standardized by observing the difference of potential at its terminals, when a current of known value, as measured by the Thomson balance, was allowed to pass through it.

"In the measurement of electromotive force there was used a Weston voltmeter, received only a few days previously from the laboratory of Mr. Edward Weston, where it had been standardized. This, however, as well as the other measuring apparatus, was, after the completion of the test, carefully calebrated in the physical laboratory of this university.

"It may be stated that owing to the construction of the measuring apparatus employed, and also to the circumstances that a considerable distance separated the instruments used from the dynamo, no magnetic influence could have interfered with the accuracy of their indications. Before measuring the power absorbed by the dynamo, the dynamometer was run without load, in order to determine its own friction. This amount of power consumed was, in all cases, subtracted from subsequent measurements. The friction of the dynamo itself was determined by running it on open circuit, and with the brushes removed.

"The order of making the tests was as follows: first, the dynamometer was run without load; second, the dynamo was run on open circuit, brushes removed (this measurement gives friction of dynamo); third, the dynamo brushes were placed in position (this measurement represents losses due to friction in bearings, losses due to heating of field magnet wires, losses due to reversals of magnetism of armatures, core, and losses due to Foucault currents in the armature). These losses are, for a given speed, nearly constant. After this, the dynamo circuit was made, and measurements of power, current, and electro-motive force at different loads were begun. The following table gives the results of the several determinations.

Current.	Electro-motive force.	Horse Power.	Dynamometer Horse Power.	Loss.	Losses, Friction, Reversals, etc.	Losses Current^2 × Resistance.	Efficiency.
134.8	114.0	20.6	24.97	4.4	4.4	17	82.5
194.1	115.6	30.1	35.3	5.2	4.5	.38	85.2
371.6	98.3	49.0	54 5	5.5	3 5	1.30	89.9
400.0	110.0	58.9	64.7	5.8	4.1	1.50	91.0

"Speed of dynamo, 330 revolutions per minute."

A NEW USE FOR THE PHONOGRAPH.

AT a meeting of the Massachussetts Medical Society on Nov. 20, A. N. Blodgett, M.D., made some interesting remarks on the use of the graphophone or phonograph in taking and recording the clinical history of a patient. As reported in the Boston *Medical and Surgical Journal*, Dr. Blodgett spoke as follows: —

"Some time ago my attention was called to this instrument, about which I had known something, although not in its present state of perfection. It occurred to me that this might be of interest to physicians in various ways, and particularly to those connected with public institutions. As you have seen, by speaking into the mouth-piece a record can be produced upon the yielding cylinder of wax, which will remain permanent, and can be reproduced a great many times.

"Last night Mr. Thomas and I made experiments at the City Hospital on a patient just admitted to the accident room. His clinical history was taken; but it was not in all respects a success, because he had an injury preventing his speaking with much force, it being a fracture of the ribs. But we got a record from an actual patient in an actual examination which was reproducible and could be understood. Later we got another record from a hypothetical patient; namely, one of the house-officers of the hospital, who was questioned in the same way as would be an ordinary patient admitted under circumstances which precluded any previous knowledge of him or his condition. That record was more distinct, could be very well understood, and I am sure any one with a little practice could use this machine in a way to obtain durable and trustworthy records from the lips of the patient.

"An instrument of this kind might be made portable, and a visiting physician in a hospital might give his directions into the funnel, when they would be recorded upon a small cylinder, which can be put upon another machine, and the physician's directions as to treatment or his description of lesions can thus be accurately recorded. This record is got by means of the graphophone, which is used a great deal in conjunction with the typewriter. I know how difficult it is to get full directions in the wards from the visiting physician, and here we have the means of an absolute record. In medico-legal cases I think it would be of great service because the utterances of the patient could be reproduced at an indefinite period afterward, and I should suppose would be evidence in the case."

HEALTH MATTERS.

Hallucinations in Alcoholism.

DR. F. W. MANN, in a paper upon alcoholic hallucination read before the Detroit Medical and Library Association, brings together some facts and theories which are published in the *Physician and Surgeon*, November, 1889: —

"The visual hallucinations of alcoholics are exceedingly varied. They may be hideous, grotesque, or awful, or they may be gorgeous, splendid, or inspiring. Unpleasant features usually predominate, and the patient is puzzled and tormented by the presence of rats, mice, beetles, worms, fleas, and other insects. This condition of zoöscopic hallucination is one of the commonest among the phenomena of alcohol poisoning.

"I do not recall having seen any explanation of the reason why animals enter so largely into the composition of the primary illusions of alcohol. These illusions a little interrogation of the patient will usually substantiate as present. A patient only the other day declared how he saw a rhinoceros, several huge elephants, and strange-looking reptiles browsing in the yard.

"A word should be said on the snake hallucination. Disorders of this kind are associated in the popular imagination with excesses in the use of alcohol. 'Seeing snakes' is in reality not a common experience. The two or three cases we have seen convince us, however, there is some basis for esteeming this one of the occasional retributions of excessive zeal in devotion to Bacchus.

"The snake hallucination is difficult to explain. Disturbances in the peripheral organs of vision seem hardly competent to account for such aggravated symptoms, although there are facts suggesting the plausibility of such an explanation. A patient in a

room where the pattern of the wall-paper or the carpet abounds in geometrical figures and circles, is apt to find these endowed with gyratory movement, and as a result may come to imagine snakes about him. But the usual causes of this hallucination seem central in origin and due to pre-existing imaginative impulse. Why should this impulse assume the snake form? May not the explanation lie in the facts of nascent consciousness? We know that stimuli cannot be co-ordinated without some ganglion through which they are brought into relation. In effecting this co-ordination the ganglion must necessarily be subject to the influences of each stimulus and must undergo a succession of changes. This action and its re-action implying perpetual experiences of resemblances and differences constitutes, according to psychologists, the raw material of consciousness. Therefore, as a corollary of this process, Herbert Spencer asserts, that, as 'consciousness is developed, some kind of instinct becomes nascent.' That there is a nascent instinctive dread of the serpent in man and monkey is obvious. There is every reason for it. The early history of our race abounds with record and tradition of that internecine strife between man and the serpent. We find the serpent permeating all his mythology, a chief feature of his legends, inscribed on his monuments, engraved on his symbols, and worshipped as his God.

"Even before this period the dread of the serpent may have been implanted in our human neuroplasm. Dr. A. E. Brown recently made some experiments in the Philadelphia Zoölogical Gardens, and found that monkeys, who, born and reared within the gardens, had never seen a reptile, yet exhibited great fear and curiosity when a snake was placed in their cage. An alligator or turtle caused no surprise whatever. Other animals, like the ox and the hog, were either perfectly indifferent, or manifested no fear of the snake."

Dr. Frank W. Brown said: "I cannot altogether agree with the Doctor as to the important part taken by nascent consciousness in the creation of these hallucinations. I do not think that nascent consciousness enters largely into the formation of the most common of all forms, primary hallucinations; that is, into those first, simple hallucinations which, if continued (and the majority of them are not), may grow to be more elaborate. Nascent consciousness does, however, have much to do with the elaboration. In the graphic descriptions of the struggles of the legal gentleman it would be interesting to know whether he conceived the snakes before the sentence of the judge, or whether they grew in his construction of that sentence; for in the former case they would be a primary hallucination and in the latter an outgrowth of elaboration. Primary hallucinations, I think, arise largely from misinterpreted perceptions — false cognition. The nerve cells, weakened by continued onslaught of alcohol, no longer possess the power of discrimination: they are content to resolve perceptions in the slightest possible way. Just as in that pathological state characterized onomatopoiesis, where the patient lapses into that simple language which names animals by their sounds, so may the weakened nerve-cells of the alcoholic be content to picture living things at the behest of a suggestive touch.

"Bugs, ants, mice, and rats are common hallucinations, but they are generally found first on the body and then afterwards in the room and on the furniture. The appearance first on the body can be explained on the supposition that the hallucination was created by a dermic sensation, or of formication, which would quickly lead, through imperfect cognition, to the conception of a bug or an ant, and then secondarily manifested as a visual hallucination. When seen first on walls or bed, they may be suggested by the so-called *muscæ volitantes*, not uncommon in delirium. As a refinement of this idea, could not the primary hallucination of snakes be brought about through misinterpretation of a *cutis anserina*, which sweeps coldly, wave-like, and rhythmically over a portion of the body? If this process seems complicated, it might explain the infrequency of snakes as an hallucination. Other hallucinations arising in the way I have indicated can be brought about by the red flashes, dust, retinal irritation, which often precedes active delirium, and which suggest a fire, or, more elaborated, a hell; ringing in the ears, a cataract, etc. As to the part taken by nascent consciousness in the creation of the reptiles in the snake case given by the Doctor, I might say that he has been a witness against himself, in that he has not exaggerated in his vivid description of those miserable forefathers of ours in their sometimes unsuccessful attempts to avoid their most uncanny if not most horrible enemy, and from whom we consequently derive one of our most pronounced examples of nascent consciousness. If, then, nascent consciousness be a leading factor in the production of hallucinations, why do snakes so seldom appear as one of their manifestations?

"As to the suggestions given by figures on carpets or wall-paper, they create illusions, not hallucinations, as their origin deals with defective cognition influenced by the imagination, rather than with the nascent consciousness."

The Sense of Smell.

There is no other cranial nerve which presents so much to puzzle the physicist, the anatomist, and the physiologist as the olfactory. The course of its fibres, from the nasal mucosa to the cortex in the temporo-sphenoidal lobe, is devious and obscure, but the phenomenon of matter of various kinds imparting the sensation of odor by contact with the periphery of the first nerve is still more mysterious. With regard to light and color and all the sounds of the octave, we have long been able to conceive of their reception and differential appreciation by the cortex as due to vibration and variation in vibration rates. The wave theory accounts satisfactorily for these visual and auditory phenomena.

There are some well-known facts concerning the olfactory sense which have always been matters of daily familiarity, but which we have not as yet scientifically interpreted. For instance, as Dr. F. Peterson points out in the *New York Medical Journal*, some odors, though mingled together, can still be dissociated and recognized by the olfactory nerve-ends, whereas others, on the contrary, overwhelm one another, so that one only may be perceived, the others being completely suppressed. This antogonism has been little studied, and has been generally dismissed by the physiologist under the assumption of a chemical process occurring in the mixture. As illustrating this internecine warfare among smells, the odor of almonds conquers that of musk; certain ethereal oils destroy the unpleasantness of iodoform; orris-root is employed against bad breath; sulphuric ether overcomes Peruvian balsam; camphor makes the odors of the oils of lemon and juniper, of petroleum, of cologne, and of onion disappear; and coffee and cloves have the reputation in our drawing-rooms of being inimical to certain spirituous exhalations.

There seems, then, to be a sort of strife between odors of various kinds, a strife inexplicable upon any simply chemical theory; and it is more than probable that the vibratory hypothesis must needs be accepted to account for the sensation of smell as well as for those of light and of sound. Not long ago Professor Haycroft (*Brain*, July, 1888) made some investigations upon the olfactory sense, from which he drew the conclusion that the sense of smell as well as that of taste depended upon the rate of vibration of gaseous particles; and he found, moreover, a relation existing between the molecular weights and vibrations of bodies and the odors which they exhaled.

More recently Dr. Zwaardemaker, of Utrecht (*Fortschritte der Medicin*, Oct. 1, 1889), has been studying the same subject in a manner to throw additional light upon the difficult problem. He has constructed an instrument which he calls an olfactometer. It consists simply of a glass tube, one end of which curves upward, to be inserted into the nostril. A shorter movable cylinder, made of the odoriferous substance, fits over the straight end of this glass tube. On inhaling, no odor will be perceived so long as the outer does not project beyond the inner tube. The further we push forward the outer cylinder the larger will be the scented surface presented to the in-rushing column of air, and the stronger will be the odor perceived.

Should one desire to study the effect of mingling two odors, it is only necessary to saturate the cylinder of the olfactometer with one scented body, and another cylinder with another. By the juxtaposition of the ends of the two cylinders, the lengths being accurately determined, the air rushing in upon inhalation through the tubes must take up and mingle the two odors. Dr. Swaardemaker found by this means that whenever one outweighed the

other, he perceived the one or the other smell, but that when both were in exact equilibrium, either no odor at all was perceived, or at most a very weak and uncertain impression was made, which partook of the qualities of neither of the two substances employed.

But as some sort of union of the gaseous molecules could not be altogether excluded by this method, such as an indifferent osmotic or physical combination preventing sensory perception, it was deemed expedient to make use of a double olfactometer in experiments of this character. The instrument consists merely of two of the olfactometers described above, one for each nostril. By the use of the double olfactometer one may easily convince himself that even in this procedure one odor will overwhelm another, rubber, for instance, causing the smells of paraffin, wax, and tolu to disappear. Even with very strong excitants there is never a mingling of sensations. Either the one or the other odor is distinguished by one or the other nostril, until, by careful equilibration of the two, no sensory effect is at all perceived. Sensibility is absolutely eliminated. Each nasal half becomes in this manner completely insensible to the odor inhaled through it, although its sensitiveness is really the same as before.

We are constrained to believe that there is something in the vibratory theory already applied to sight and hearing, to account for these remarkable facts in the domain of smell, and that is the interference of molecular waves with each other, producing in the former cases darkness and silence, and in the latter temporary anosmia.

NEUTRALIZATION OF THE BACILLUS OF TETANUS. — In June last Professor Sormani of Milan announced to the Lombard Institute of Sciences the results of his experiments on the neutralization of the tetanigenous microbe — results which seemed to justify his conclusion that iodoform, iodol, and corrosive sublimate are absolutely destructive to the bacillus in question. To these disinfecting agents he has, says the *Lancet*, as the result of further experiments, added three more — namely, chloroform, chloral hydrate, and camphorated chloral, the latter being, he alleges, in a marked degree efficacious; while camphor and camphorated alcohol he found inert. On a general review of the whole, however, he gives the preference to iodoform. Seven rabbits were inoculated with materials charged with the tetanigenous virus. From six of these, after an interval of twelve hours, the foreign body was removed during the period of incubation; from the seventh the substance was removed only when the first symptoms of local tetanic convulsions had declared themselves. In all these animals the wound was scraped and thereafter freely medicated with iodoform. The seventh rabbit died of tetanus. Of the first six five were saved. From this Dr. Sormani concludes that medication of wounds with iodoform ought to be practised before the setting in of the first tetanic symptoms. Nevertheless, even during declared tetanus, the application of iodoform to the wound is capable of disinfecting it and of removing from it all trace of virulence. Wounds and sores treated with iodoform, especially wounds or sores contaminated with earth, yield results highly welcome to the surgeon — such medicacation preventing the access of that fatal tetanic symptom which, having once declared itself, leaves but little chance for skilled interference. Dr. Sormani gave confirmatory proof of his thesis by cases of tetanus in hospital, where iodoform opportunely applied saved the patients, and where, from its use having been unfortunately suspended, two lives were sacrificed.

BOXING THE EARS AND ITS RESULTS. — We would fain hope that, in deference to repeated warnings from various quarters, the injurious practice of boxing the ears, once common in schools, is fast and surely becoming obsolete. It is too much to say that this desirable end has yet been realized. Certainly the recent observations of Mr. W. H. R. Stewart do not give color to any such view. In a pamphlet on "Boxing the Ears and its Results," lately published, and referred to in the *Lancet*, Dec. 21, 1889, he briefly summarizes his own experience in the matter. Notwithstanding the toughness of the aural drum-head, its tense expanse will rupture only too readily under the sudden impact of air driven inward along the meatus, as it is in the act of cuffing; and Mr. Stewart shows that in one instance at least this injury resulted from a very slight though sudden blow. Given early and skilled attention the wound may heal very kindly, but if the beginning of mischief be overlooked, as it often has been, further signs of inflammation soon follow, and a deaf and suppurating tympanum is the usual result. There is practical wisdom in the statement that this consequence most readily follows in the case of the poorly developed and underfed children who abound in every board school. In them an earache would probably receive no very strict attention, and disease might for a time work havoc unimpeded. Where chronic suppuration exists already, and it is only too common, a random knock on the ear may, and has resulted, in fatal brain complications. The close connection between ear and brain should never be forgotten, and the reflection that injury to the former organ most easily terminates in total deafness, and in suppuration which may any day take a fatal course, should assist in the preservation of a sometimes difficult patience.

BOOK-REVIEWS.

First Lessons in Political Economy. By FRANCIS A. WALKER. New York, Holt. 12°.

PRESIDENT WALKER in this work has undertaken to bring economic science down to the comprehension of a younger class of students than have hitherto pursued the subject, those from fifteen to seventeen years of age. To accomplish this task is not easy, and the author himself expresses some misgiving as to the success of his undertaking; for he has not treated his theme in a childish, or so-called popular, way, but in a thoroughly scientific manner and with the same closeness of reasoning that is employed in larger treatises. How far his book is adapted to its purpose only actual trial, as he says, can tell; but if the subject can be made comprehensible to such young pupils, we should think this work well fitted to do so. It is perhaps as simple in style as a treatise on economics can be, and it is in the main free from controversial matter. It contains, however, some things that might better have been omitted; such, for instance, as the discussion of the multiple standard of deferred payments, which is of no practical importance, and is out of place in an elementary work.

The book is divided into two parts, the first treating of production and exchange, the second of distribution and consumption, and the various subdivisions are in general well made. President Walker's views are so well known that we need not state them, and in most cases we find ourselves in accord with them. His theory of profits, however, we cannot agree with, and we fail to see the cogency of the reasoning by which he endeavors to support it. He holds that "prices are determined by the productive capability of the lowest class of employers who are actually producing for the supply of the market; and all excess of those prices, over the cost of production in the hands of the more capable men of business, goes to these latter, individually as profits" (p. 222). But it seems to us that prices are determined rather by the higher class of employers, who by superior ability or larger command of capital often force prices down so that the lower class of employers are driven out of business. Moreover, President Walker, like other economists, overlooks the fact that the highest profits, as a rule, are not made in production at all, but in exchange. But though we cannot agree with all the author's views, we shall be glad if his work should be successful in teaching economics in the high schools.

AMONG THE PUBLISHERS.

THE fourth volume of M. Grandeau's "Etudes Agronomiques," just issued, contains a review of British and American agriculture, as represented at the Paris Exhibition.

— M. Victor Giraud, the African explorer, has just published the narrative of his explorations in the African Lake Region from 1883 to 1889. The work contains many illustrations.

— The fifth part of the second volume of the *Internationales Archiv für Ethnographie* has been issued. It maintains in all respects the high level reached by previous numbers. Among the contributions are an article in German, by F. Grabowsky, on death,

burial, and the funeral festival among the Dajaks; and one in English, by Prof. H. H. Giglioli, on a singular obsidian scraper used at present by some of the Galla tribes in southern Shoa.

— Mr. Charles Hallock, the founder of American journalism on field and water sports, and one of the most eminent writers on outdoor life, is now permanently associated in the editorial conduct of *The American Angler.*

— Harper & Brothers have just published Stanley's letters, telling the story of Emin's rescue, accompanied by illustrations and a map showing the traveller's route from the Kongo to the coast. Sir William Mackinnon, chairman of the Emin Pasha Relief Committee, adds some interesting material to the volume. It is of course understood that this book will not in any way trench upon Mr. Stanley's great work, which cannot possibly be published for several months.

— The J. B. Lippincott Company publish this week "A Conversation on Mines Between Father and Son," a lecture on the atmosphere and explosive gases by William Hopton, to which are added questions and answers to assist candidates to obtain certificates for the management of collieries; and "A Text-Book of Assaying," by J. J. and C. C. Beringer, for the use of students, mine managers, etc.

— D. Lothrop Company publish this week a little volume addressed to all workers with hand and brain, entitled "The Shop," devoted to the possibilities and probabilities of social, home, church, and political reform, by Albert E. Winship, editor of the *Journal of Education.*

— The second report of the committee appointed by the British Association to inquire into, and report upon, the present methods of teaching chemistry, which was presented at the Newcastle meeting, and to which attention was called in *Nature* a short time ago, has now been put on sale by the Council. It may be obtained from the office of the Association, 22 Albemarle Street, London, W.

— A new fortnightly scientific periodical is about to be published in Paris. It will be entitled *Revue Générale des Sciences Pures et Appliquées,* and will deal with the mathematical, physical, and natural sciences, and with their applications in geodesy, navigation, engineering, manufactures, agriculture, hygiene, medicine, and surgery. According to the preliminary statement, the new periodical will take as its model the method of exposition adopted in *Nature.* The editor is M. Louis Olivier, and the list of contributors includes many of the most eminent French men of science. The first number will appear on January 15, 1890.

— In the article which Herbert Ward will contribute to the February *Scribner's,* on "Life Among the Congo Savages," there will be an account of the human sacrifices which take place on the death of an African chief. Mr. Ward's article is to be a description of the manners and customs which prevail in that region which Stanley has opened to commerce. Colonel W. C. Church, in his first article on John Ericsson, in the same number, relates that, as the last hour in the life of the great engineer was drawing to its close, he called to his bedside his faithful friend and secretary, and, looking into his face with a smile, said: "Taylor, this rest is magnificent; more beautiful than words can tell." William Henry Bishop, the American novelist, tells in the February *Scribner's* of a recent visit to Galdós, the author of "Doña Perfecta," in his Madrid home. "He came into the room with a hard-at-work air and a cigarette between thumb and finger. He is a dark, slender man, of good height, rather loose-jointed, forty-four years old, and with a young look." Galdós, it is said, has had himself elected to the Chamber of Deputies in order to have a chance to study legislative manners at first hand for literary material. W. H. Mallock, author of "Is Life Worth Living?" who has written for the number an article on Hungarian castles — the fruit of a recent visit to that country — says: "Hungary still remains a very interesting study; and though it may at first disappoint those who expect to find in it castles and peasants like the back scene of an opera, it retains enough of the substance, if not of the surface, of the past to throw a considerable light on what has really been achieved, in the way of changing or bettering the conditions of life generally, by that extraordinary movement which we especially associate with the present."

— The article which is likely to attract most attention in the January number of the *New England Magazine* is that on "The New England Meeting-House and the Wren Church," by Mr. A. R. Willard. Mr. Willard shows how Sir Christopher Wren, who was rebuilding the sixty or seventy London churches, after the Great Fire in 1666, just as our New England fathers were getting able to build meeting-houses with towers and steeples, set his stamp upon our entire church architecture, in city and country, almost from that time to this. The article is illustrated with pictures of Wren's steeples and of our own old meeting-houses. The other illustrated articles are on Montreal in Winter, and the Boston Musical Composers. Professor Jameson of Brown University, in a paper entitled "Did the Fathers Vote?" shows, in a way that is gratifying to those who believe in progress, that however neglectful we are of our political duties, we are in this respect ahead of our fathers in the "good old times" that the croakers talk about. Mr. William F. Dana writes about the Behring Sea Controversy. Mrs. Nina Moore Tiffany begins a series of "Stories of the Fugitive Slaves," telling here of the escape of William and Ellen Craft. Edward Everett Hale, in his "Tarry at Home Travel," talks this month about the Boston Parks and about Concord. Edward Everett Hale, jr., contributes a chapter of colonial history, under the head of "Edward Bendall and the 'Mary Rose.'" "Candlelight in Colonial Times" is another bit of New England history. Browning receives notice in two articles, one by Mr. Robert Niven of London, on "Browning's Obscurity," the other by Miss H. E. Hersey, on "Browning in America," the latter accompanied by a portrait from a recent London photograph. There is an "Old South Lecture" on "Thomas Jefferson and the Louisiana Purchase," by one of the young Old South essayists, Robert Morss Lovett, now a student in Harvard College.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name i in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

A New Telephone Invention.

WE see by a late number of the New York *Electrical World* that two Canadian gentlemen have made the important discovery that telephone trunk lines may be duplexed the same as telegraph wires. This has hitherto been considered impossible on account of the great dissimilarity between telegraph and telephone currents. It is on this account chiefly that long-distance telephony is more expensive than telegraphy, as only two persons can use the same wires at the same time. By means of the new invention it is claimed that four persons can use the same wires simultaneously and without the least interference. Advantage is taken of the double wire system now in general use on inter-urban trunk lines. Transmitters and receivers are used with double coils, and the apparatus is connected with both branches of the double-wire trunk line. One set of transmitters generates electrical impulses in the two wires in opposite directions, while the other set generates impulses in the two wires in the same direction. By means of these reversing coils one set of apparatus will actuate and be actuated by a set similarly connected, while, on the other hand, it will not affect nor be affected by apparatus with coils dissimilarly connected. In the one case the electrical impulses move only in the metallic circuit formed by the two wires of the trunk line. In the other case the circuit is completed through the subscriber's ground wires. If this invention is found to work as satisfactorily in actual practice as it is claimed to work experimentally, it will necessarily very materially reduce the working expense of long-distance telephone lines.

R.

Toronto, Ont., Jan. 9.

A Peculiar Pipe from the Susquehanna.

I BEG to present the outlines of an Indian pipe which may be interesting as representing the figure of one of the Delaware "Totems." The relic is composed of a dark green steatite, carved into an admirable image of a turtle. Fig. 1 represents the back of the animal, which is well polished and distinctly marked with the lines shown in the figure.

FIG. 1.

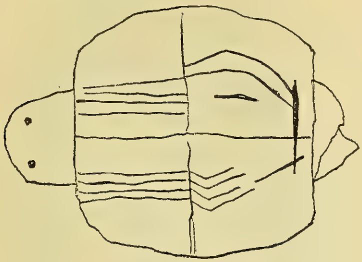

FIG. 2.

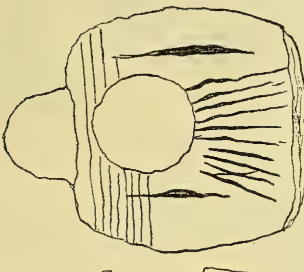

FIG. 3.

Fig. 2 represents the under surface, which contains the cavity of the pipe and the ornamental(?) markings. The hole for the stem is well drilled, of a smooth bore, and inclined at the angle given in the sketch. This unique specimen was found some thirty years since, by a friend of mine, on the present site of the village of Fairview on the Susquehanna, in close proximity to an old Indian burying ground. HARVEY B. BASHORE.

West Fairview, Pa., Jan. 5.

Soils and Alkali.

THE last bulletin of the Colorado State Agricultural Experiment Station at Fort Collins published in October and entitled "Soils and Alkali" is issued in the name of Prof. D. O'Brine.

The subject treated is one of acknowledged importance, and for this reason and the fact that it is issued under the auspices of an institution expressly endowed by Act of Congress for the purpose of scientific investigation, renders the fact to which I beg leave to call your attention, especially lamentable.

The first eleven pages of this bulletin are, so far as statement of facts are concerned, practically extracted verbatim from a recent work of my own entitled "Rocks and Soils," and published by Messrs. Wiley & Sons of New York, little more than a year ago.

In support of this assertion I enclose extracts from the bulletin mentioned and from my own work, a comparison of which in parallel columns will demonstrate absolutely the truth of my assertion. I may add further that the specimens extracted embrace only a small portion of the subject matter to which the same assertion would hold true; they are offered however as specimens and *specimens only*.

STOCKBRIDGE (p. 159).

"The quantity of water thus required and evaporated by different agricultural plants during the period of growth has been found to be as follows:

One acre of wheat	exhales	409,832 lbs of water.
" " " clover	"	1,096,234 " " "
" " " sunflowers	"	12,585,994 " " "
" " " cabbage	"	5,049,194 " " "
" " " grape-vines	"	730,733 " " "
" " " hops	"	4,445,021 " " "

O'BRINE (p. 8).

"The quantity of water required and evaporated by different agricultural plants during the period of growth has been found to be as follows:

One acre of wheat	exhales	409.832 lbs of water.
" " " clover	"	1,096,234 " " "
" " " sunflowers	"	12,585,994 " " "
" " " cabbage	"	5,049,194 " " "
" " " grape-vines	"	730,733 " " "
" " " hops	"	4,445,021 " " "

STOCKBRIDGE (p. 160).	O'BRINE (p. 8).
"Deitrich estimates the amount of water thus exhaled by the foliage of plants to vary from 250 to 400 times the weight of dry organic matter formed during the same time."	Dietrich estimates the amount of water exhaled by the foliage of plants to be from 250 to 400 times the weight of dry organic matter formed during the same time.
STOCKBRIDGE (p. 165).	O'BRINE (p. 9).
"Hoffmann concluded that the quantity of matter dissolved from the soil by water varied between 0.242 and 0.0205 per cent of the dry earth."	Hoffman has estimated that the quantity of matter dissolved from the soil by water varied from .242 to .0205 per cent of the dry earth.
STOCKBRIDGE (p. 166).	O'BRINE (p. 9).
The sources of the heat of the soil are three; namely, solar heat, as the sun's rays; heat of chemical decomposition within the soil; and the original or plutonic heat of the earth, proceeding from the still molten earth interior. The latter source though great in itself yet is so removed from the surface, and the radiation there is so rapid, that this heat is of no considerable value to the plant. The heat of decomposition, though considerable in soils rich in organic matter, occurs only in the presence of comparatively high temperatures, and is therefore not manifest except in soils not needing its action to influence their behavior towards vegetation. The sun, therefore, remains the only source of heat of material importance as related to the production of plants from the soil."	The heat comes from three sources: Solar heat, as the sun's rays; heat of chemical decomposition within the soil, and the original heat of the earth's interior. The latter cannot be of any value to plants; the heat of chemical decomposition is not of any value, except in a few special cases. The sun, therefore, remains the only source of heat of practical importance in relation to the production of crops from the soil.
STOCKBRIDGE (p. 125).	O'BRINE (p. 4).
"Oats, rye and buckwheat thrive with the lowest amount of organic matter, requiring but from one to two per cent, while wheat and tobacco evidently require most among common agricultural products growing best in those soils containing from five to eight per cent of dry organic matter.	Oats, rye and buckwheat thrive with the lowest amount of organic matter, requiring from one to two per cent. Wheat and tobacco seem to require most among the common agricultural products, and do their best upon soils containing from five to eight per cent of organic matter.
STOCKBRIDGE (p. 127).	O'BRINE (p. 5).
The ammonia thus resulting from putrid fermentation undergoes a further decomposition known as nitrification, resulting like the original putrefaction from the action of oxidizing microbes through the activity of which ammonia becomes transformed into nitric acid."	This ammonia undergoes a further decomposition called *nitrification*, resulting, like the original putrefaction, from the action of oxidizing *microbes*, and changes the ammonia into nitric acid.
STOCKBRIDGE (p. 124).	O'BRINE (p. 5).
"Of the entire weight of all plants not more than five per cent in any case is of soil, or mineral, origin; the remaining ninety-five per cent is wholly of atmospheric origin; most of which becomes added to the soil-mass on the death and decomposition of the plants."	Of the total weight of the plants, about five per cent is of soil or mineral origin; the remaining ninety-five per cent is wholly of atmospheric origin; most of which becomes added to the soil mass on the death and decomposition of the plants.
STOCKBRIDGE (p. 154).	O'BRINE (p. 7).
"And it is a fully accepted fact that, other things being equal, that soil is invariably most fertile which exists in the finest state of division, whose particles are the smallest."	It is a fully accepted fact that, other things being equal, soil is *invariably* most fertile which exists in the finest state of division, whose particles are the smallest.
STOCKBRIDGE (p. 157).	O'BRINE (p. 8).
"Liebenberg has shown, however, that the action in the soil may be either upwards or downwards according as the atmosphere is dry or supplies soil-saturating rain."	Liebenberg has shown that this movement may be either upwards or downwards, according as the atmosphere is dry or supplies soil-saturating rain.

Before deciding to request the publication of this statement of facts I requested an explanation of Prof. O'Brine, in response to

which request he asserts that the material published over his own name was furnished him in the form of notes by a late colleague who has unfortunately died since the publication of the bulletin in question. These notes were furnished, it is claimed, with the assertion that they were "recent," but that the abstractor had forgotten their source, but supposed that such things were "common property."

I desire to offer no opinion as to the probabilities of such an occurrence, and distinctly disavow all intention of publishing any aspersion concerning a fellow worker. My only claim is that the material published in the October bulletin of the Colorado station was originally mine, and that it was utilized without credit either to myself or the alleged abstractor of the notes in question.

Further, that the order in which the statements made occur is identical with the order in which they occur in the pages of my work alluded to, and that, as is demonstrated in the last extract made, even where my own language is not used verbatim without credit, the *order followed* and the *subject matter presented* are identical with my own. For instance: in discussing the conditions modifying soil temperatures, paragraphs with topic titles were given to "Vegetation," "Condition of Atmosphere," "Angle of Contact," and "Electricity" in exactly the order followed in the last extract made.

Moreover, that frequently tables are given with the identical words of introduction used by myself, although so far as I know the original exists only in German, and the translation and the authority were originally published by myself, though the bulletin alluded to refers to the original in, however, the identical language used by myself as translator.

I desire to make no comments; indeed, none seem to be required. I simply desire publication of the actual facts as a simple matter of justice to myself and to the numerous scientific workers who must be interested parties. H. E. STOCKBRIDGE.

Queries.

49. INFLUENZA. — Has epidemic influenza been known to cross the equatorial line, in either direction? E. W. GREENOUGH.

Sunbury, Pa., Jan. 13.

INDUSTRIAL NOTES.

A New Electric Motor.

A NEW electric motor just brought out by the United States Electric Lighting Company is shown in the accompanying illustrations. It is manufactured in several sizes, from an eighth of a

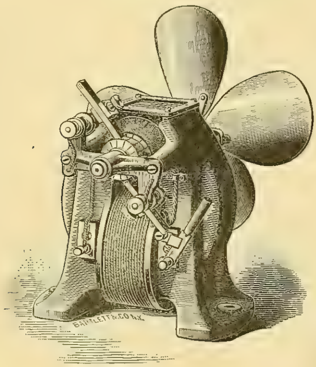

FIG. 1.

horse-power up to twenty horse-power, and wound for any potential up to five hundred volts. In designing these motors, the aim has been to give a very low armature resistance combined with great strength of field, thus securing high efficiency in a motor of comparatively small size. The relative magnetic intensity of field and armature in these motors is so proportioned that the brushes require a minimum of attention, sparking under any condition of load being eliminated. A great mechanical advantage in their design

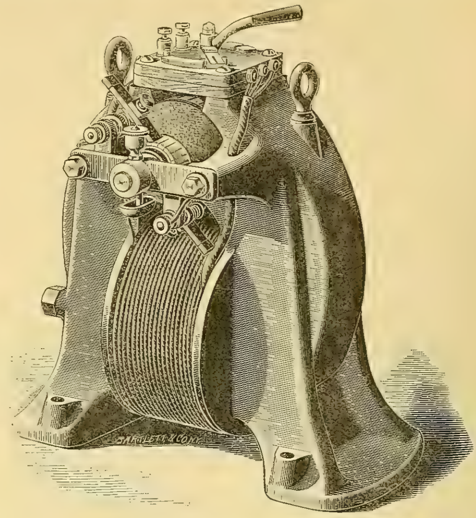

FIG. 2.

is that all armature wires and bands are thoroughly protected from injury by the arrangement of the pole-pieces. The starting device for throwing the motor in or out of circuit is on the motor itself,

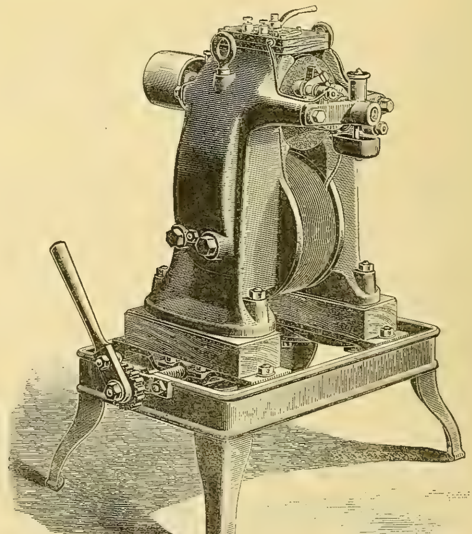

FIG. 3.

resistance boxes being dispensed with. For motors taking a potential above 220 volts a special starting device is used. Fig. 1 shows the motor with fan attachment; Fig. 2 is a motor of larger size, and Fig. 3 shows a motor adjustably mounted on a base.

Publications received at Editor's Office, Dec. 16–Jan. 11.

BIGELOW, F. H. The Solar Corona. Washington, Government. 22 p. f°.
BOOTH, M. B. Beneath Two Flags. New York, Funk & Wagnalls. 288 p. 12°. $1.
BRYANT, W. C. Ulysses Among the Phæacians (Riverside Literature Series). Boston, Houghton, Mifflin, & Co. 72 p. 12°. 15 cents.
COMSTOCK, G. C. An elementary Treatise upon the Method of Least Squares. Boston, Ginn. 68 p. 8°.
DENOMINATIONAL Schools. A Discussion by Cardinal Gibbons, Bishop Kane, E. D. Mead, and John Jay. Syracuse, Bardeen. 71 p. 8°.
ECKER, A. The Anatomy of the Frog. Tr. by G. Haslam. London and New York, Macmillan. 449 p. 8°. $5 25.
EDUCATION, Report of the Commissioner of. 1887–'88. Washington, Government. 1209 p. 8°.
GRAY, A. Absolute Measurements in Electricity and Magnetism. 2d ed. London and New York, Macmillan. 384 p. 16°. $1 25.
GRAY, T. J. Methods of Instruction and Courses of Study in Normal Schools. Syracuse, Bardeen. 19 p. 8°. 15 cents.
HARRIS, W. T. Art Education the True Industrial Education. Syracuse, Bardeen. 9 p. 8°. 15 cents.
HARRIS, W. T. The Educational Value of Manual Training. Syracuse, Bardeen. 14 p. 8°. 15 cents.
HINSDALE, B. A. Pedagogical Chairs in Colleges and Universities. Syracuse, Bardeen. 11 p. 8°. 15 cents.
JUSTICE and Jurisprudence: An Inquiry Concerning the Constitutional Limitations of the Thirteenth, Fourteenth, and Fifteenth Amendments. Anon. Philadelphia, Lippincott. 578 p. 8°. $3.
MARINE-HOSPITAL Service of the United States, Annual Report of the Supervising Surgeon-General of the, for the Fiscal Year 1889. Washington, Government. 477 p. 7°.
METEOROLOGY, Bibliography of. Part II. — Moisture. Ed. by O. L. Fassig. Washington, Government. 4°.
OBSERVER, The., Natural History and Popular Science. Vol. I., No. 1. m. Portland, Conn., E. F. Bigelow. 8 p. 50 cents.
RAINFALL in the United States, Charts Showing the Normal Monthly. Washington, Government. 4°.
SMITH, C. F. Honorary Degrees as Conferred in American Colleges. Syracuse, Bardeen. 9 p. 8°. 15 cents.
THERMAL Repulsion, The Cosmic Law of. An Essay suggested by a Comet's Tail. Anon. New York, Wiley. 60 p. 12°. 75 cents.
TODD, D. P. Photographs of the Corona taken during the Total Eclipse of the Sun, January 1, 1889. Washington, Smithsonian Inst. f°.
PENNSYLVANIA State College, Report of the, for the Year 1888. Part II.—Agricultural Experiment Station. Harrisburg, State. 242 p. 8°.
POWELL, E. P. Liberty and Life. Chicago, C. H. Kerr Co. 208 p. 12°. 75 cents.
ULRICH, E. O. Contributions to the Micro-Palæntology of the Cambro-Silurian Rocks of Canada. Part II. Montreal, Brown & Co. 50 p. 4°.
WALKER, F. A. First Lessons in Political Economy. New York, Holt. 323 p. 12°.

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I wish to purchase Vol. 7 of the *American Chemical Journal*, either bound or unbound. State price. Address, Wm. L. Dudley, Vanderbilt University, Nashville, Tenn.

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Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred. — James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakespeariana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics. — D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write. — J. M. Keck, Chardon, Ohio.

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Lead, zinc, mundic, and calcite. — Lulu Hay, secretary Chapter 350, Carthage, Mo.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Jan. 7.—Capt. John G. Bourke, U.S.A., Vesper Hours of the Stone Age; Major J. W. Powell, Remarks on the Archæology of North America; Dr. W. J. Hoffman, Remarks on Ojibwa Ball-Play; Mr. Walter Hough, Prometheus.

Connecticut Academy of Arts and Sciences, New Haven.

Jan. 15.—D. C. Eaton, Some notes on Lotus; Wm. H. Brewer, Further notes on the Race-Horse.

Appalachian Mountain Club, Boston.

Jan. 8.—Mr. Warren Upham, A Recent Visit to Lake Itasca; Rev. E. F. Merriam, A Short Account of his Ascent of Parlin Pond Bald Mountain, Maine.

Boston Society of Natural History.

Jan. 15.—The discussion of the question, "What were the Climatic Conditions of the Glacial Period?" The Section of Entomology will meet on Jan. 22.

Engineers' Club, St. Louis.

Jan. 8.—The Executive Committee submitted the following programme of meetings and papers for the year 1890. It has not been possible to assign exact dates as proposed by the members contributing, but the arrangement submitted, it is thought, will be found satisfactory: Jan. 8, Method for Definite Location of Gauge Line on Car Wheels, B. F. Crow; Deflection of Framed Structures, J. B. Johnson. Jan. 22, Fuel Gas, William B. Potter. Feb. 5, Tests of Water Works Engines, George W. Dudley; Spiral Springs, Nathan W. Perkins, Jr. Feb. 19, The Pemberton Concentrator, Frank Nicholson; The Substructure of the Cairo Bridge, Edward H. Connor. March 5, Elevated Railroads, George H. Pegram. March 19, The Smoke Problem, William B. Potter. April 2, A National Federation of Engineering Societies, J. B. Johnson. April 16, Railway Inclines, Isaac A. Smith; The Reproduction of Drawings, David C. Humphreys. May 7, Compound Locomotives, Arthur T. Woods; Granitoid Curb and Gutter, Otto Schmitz. May 21, River Pollution in the United States, Charles C. Brown. June 4, Report of Committee on Collection of Local Data, S. B. Russell, Chairman. Sept. 17, The Telescope: Its Optical Qualities and Application to Measurements, O. L. Petitdidier. Oct. 1, History of a Few Railway Culverts, Charles I. Brown. Oct. 15, Pumping Machinery, James M. Sherman. Nov. 5, The Graphical Representation of the Output of the Steam Engine, F. E. Nipher. Nov. 19, Selection of Committee on Nomination of Officers; Stripping Coal, Lewis Stockett. Dec. 3, Annual Meeting—Nominations of officers for the year 1891; annual reports of officers and committees. Dec. 17, Announcement of result of election for officers; address of retiring president. Mr. B. F. Crow then read a paper on "Method for Definite Location of Gauge Line on Car Wheels." He discussed the matter principally with reference to street railway practice, showing the lack of uniformity, and the difficulty of determining definitely the gauge of any street railway or pair of wheels. He explained a simple method for settling the matter, and illustrated it with blackboard sketches. Mr. Crow exhibited a number of patterns of various forms of street rail and wheel. He recommended the proposed method for general adoption. Messrs. J. B. Johnson, Robert Moore and J. A. Seddon took part in the discussion. Professor J. B. Johnson then read a paper on "Deflection of Framed Structures," to which he had added a discussion of the distribution of stresses over redundant members. The professor's discussion was general in its application, and presented a method for determining the stresses in those forms of truss which had been usually considered indeterminate, and consequently to be avoided. The method of using the formula was fully explained, and illustrated by an example from a Pratt truss. The discussion was participated in by Messrs. Hubbard, Pegram, Seddon, Nipher, and Moore. Mr. Pegram called attention to the importance of this question, as it was usually given far too little study by engineers. He explained a simple method, which he had used in determining the camber of a bridge. He also called attention to the fact that the load was increasing at the rate of one half of one per cent per month.

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Macmillan's Magazine	3.00	5.80
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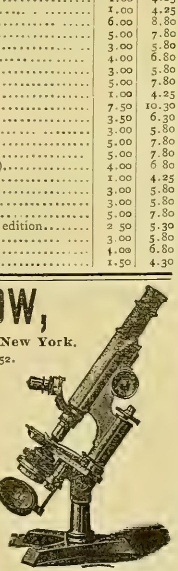

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SCIENCE

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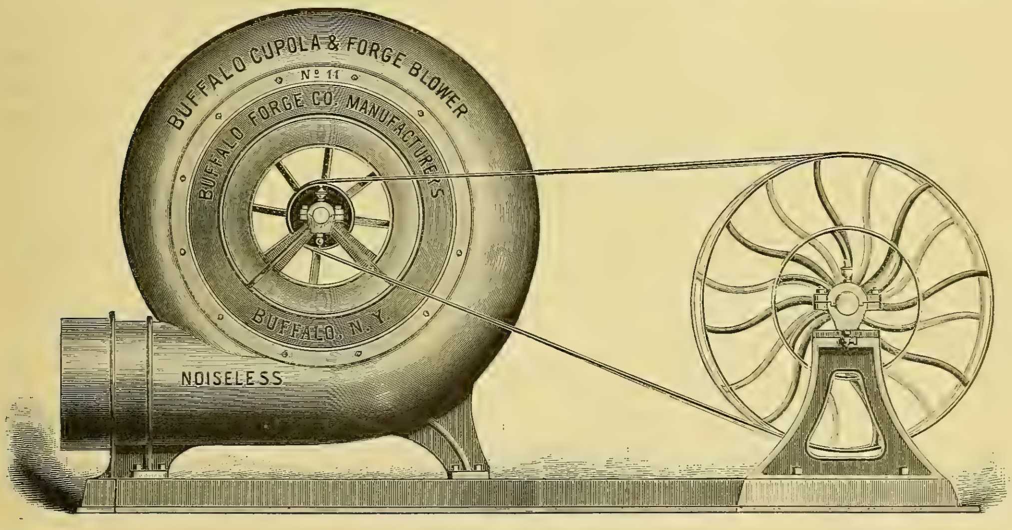
A STEEL PRESSURE-BLOWER.

THE annexed engraving illustrates a steel pressure-blower on a recently perfected pattern of adjustable bed with countershaft, designed and constructed with special reference to high-pressure duty, such as supplying blast for cupola furnaces, forge-fires, and sand-blast machines, also for forcing air long distances. By means of a tightening-screw, the blower may be moved upon the bed while running at full speed, taking up any slack, giving both belts a uniform tension, which is regulated at the will of the operator. This is a very important point in preventing the inconvenience and loss incurred by a stoppage during heat when blowers are used for cupola purposes. By the use of this adjusting device, a great saving is made in the wear and tear of belts, for a simple turn or two of the nut on the adjusting-screw, and a retightening of the holding-down bolts, take but a moment, and accomplish the same end as relacing the belts, which usually is put off until the belt will run no longer on account of slack. Special attention should be directed to pressure-blower belts, on account of the high rate of speed at which they must necessarily run; and absolutely perfect alignment of the countershaft with the blower is essential in order to secure smooth running and even tracking, as well as to avoid undue wear of belts by slipping.

A telescopic mouth-piece is employed on this blower, in order that the piping may not be disarranged in moving the machine on the bed, and the countershaft is long enough to carry tight and loose pulleys for the main driving-belt. A self-oiling device fitted to the countershaft enables it to be run at high speeds for long stretches with immunity from heat or cutting. A distinguishing feature of these blowers is the solid case, the peripheral portion of the shell being cast in one solid piece, thus dispensing with objectionable joints. The journals are long and heavy, and have cap-bearings secured by bolts held firmly in place by lock-nuts. It is made by the Buffalo Forge Company, Buffalo, N.Y.



A STEEL PRESSURE-BLOWER.

THE TOBACCO-PLANT.

AFTER the cereals, there is perhaps no plant so extensively cultivated and utilized as the tobacco-plant. It is grown and employed as a narcotic in almost every country of the world, and it has been calculated that one-fourth of the human family use it.

At the Colonial Exhibition in London, according to the *Journal of the Society of Arts*, the dried leaf and its preparations were shown by India and every one of the British possessions, and the Paris Exhibition has supplemented this display by showing its extensive production in Europe, North and South America, eastern Asia, the Pacific Islands, and the continent of Africa.

It is somewhat difficult to obtain trustworthy information regarding the world's trade in tobacco, because so much is used up locally in different countries. It is probable that the total area under cultivation is not far short of 6,000,000 acres. For the year 1886 certain official returns are available, which show that the United States, India, and Hungary are the largest producers.

The area under tobacco in acres was, in the United States, 752,520; India, 641,000; Hungary and Austria, 149,468; Germany,

49,312; France, 37,156; Algeria, 20,478; Italy, 12,061; Holland, 3,218, — a total of 2,106,213 acres.

The consumption of tobacco in the United Kingdom is large and progressive, and the revenue derived from it last year was nearly $43,750,000. The average consumption is largest in Holland, — nearly 7 pounds per head; in the United States, about 4½ pounds; in Hungary, Denmark, Belgium, and Germany, from 3 to 3¾ pounds. In the Australian colonies it is also high, — 3½ pounds; in France it is about 2 pounds; and in the United Kingdom, under 1½ pounds.

The yearly production of tobacco in Cuba is about 300,000 bales, and 181,000,000 cigars are also exported. The Spaniards have hitherto monopolized the trade in cigars, alleging that parts of the soil of Cuba were alone suited to the production of Havana tobacco. This assertion is now disproved, for with good choice of seed, soil, and leaf, and skilled manufacture, Jamaica is said now to send into the market as excellent a cigar as was ever shipped from Havana, and at a far cheaper rate. In the Philippines 100,000 hundredweights of tobacco are produced. The Dutch possessions in the Eastern Archipelago ship a large quantity of excellent tobacco, which is held in high repute in Europe. The imports of Sumatra tobacco in Holland now average 140,000 bales; and of Java tobacco, 130,000 bales.

Although there are about fifty species of the genus *Nicotiana* known, only three or four are much cultivated for the leaf. The two principal commercial forms are by some botanists treated as varieties, and not as distinct species. These are *N. tabacum*, the most extensively cultivated kind of plant, which may be at once recognized by its longish pink flowers and tapering oval-lanceolate sessile leaves; and *N. rustica*, which has short greenish flowers, and stalked ovate, cordate leaves. The leaves are coarser and more crumpled than those of the preceding. This is popularly known as the Turkish form, but is most probably a native of Mexico and California. *N. repanda* is not very extensively cultivated, but is said to yield some of the finest qualities of Cuban tobacco. *N. Persica* furnishes the Persian or Shiraz tobacco. *N. angustifolia*, a species found in Chili, yields a very strong tobacco.

The West Indian, Latakia, and American tobaccos are obtained from cultivated plants of *N. tabacum;* while the Manila, Turkish, and Hungarian are reported to be derived from *N. rustica*. In India *N. rustica* is only cultivated to a very limited extent, and chiefly in eastern Bengal and Cachar, and the leaf is never exported to Europe. *N. tabacum* has become an abundant weed in many parts of India. The gross annual value of the tobacco harvest in Bengal may be roughly estimated at $10,000,000, but the quantity exported is small, averaging only $65,000 in value.

Of the species, *N. macrophylla* is considered to possess the qualities that distinguish a good tobacco in the highest degree. Some of the Havana tobaccos belong to this species. Madras, where the climate is admirably suited for the growth of tobacco, stands first with regard to the development of this industry in India. Dinnigul is the great tobacco district, and cheroots are manufactured at Trichinopoli. The islands in the delta of the Godavery also yield what is called Lunk tobacco, the climate being suitable; and the plants are raised in rather poor light soil, highly manured and well watered. No better evidence could be afforded of the universal use of this plant than the extensive display which was made of it in every section of the Paris Exhibition; and although most of the cases were under seal of the customs, yet many of the kiosks were privileged to sell, such as the Dutch, Belgian, Spanish, Mexican, etc., although the sale and manufacture is a government monopoly in France, and licenses are only granted to privileged people.

WHAT STANLEY HAS DONE FOR THE MAP OF AFRICA.[1]

IT is nineteen years this month since Stanley first crossed the threshold of Central Africa. He entered it as a newspaper correspondent to find and succor Livingstone, and came out burning with the fever of African exploration. While with Livingstone at Ujiji he tried his 'prentice hand at a little exploring work, and between them they did something to settle the geography of the north end of Lake Tanganyika. Some three years and a half later he was once more on his way to Zanzibar, this time with the deliberate intention of doing something to fill up the great blank that still occupied the centre of the continent. A glance at the first of the maps which accompany this paper will afford some idea of what Central Africa was like when Stanley entered it a second time. The ultimate sources of the Nile had yet to be settled. The contour and extent of Victoria Nyanza were of the most uncertain character. Indeed, so little was known of it beyond what Speke told us, that there was some danger of its being swept off the map altogether, not a few geographers believing it to be not one lake, but several. There was much to do in the region lying to the west of the lake, even though it had been traversed by Speke and Grant. Between a line drawn from the north end of Lake Tanganyika to some distance beyond the Albert Nyanza on one side, and the west coast region on the other, the map was almost white, with here and there the conjectural course of a river or two. Livingstone's latest work, it should be remembered, was then almost unknown, and Cameron had not yet returned. Beyond the Yellala Rapids there was no Kongo, and Livingstone believed that the Lualaba swept northwards to the Nile. He had often gazed longingly at the broad river during his weary sojourn at Nyangwé, and yearned to follow it, but felt himself too old and exhausted for the task. Stanley was fired with the same ambition as his dead master, and was young and vigorous enough to indulge it.

What, then, did Stanley do to map out the features of this great blank during the two years and nine months which he spent in crossing from Bagamoyo to Boma, at the mouth of the Kongo? He determined, with an accuracy which has since necessitated but slight modification, the outline of the Victoria Nyanza; he found it to be one of the great lakes of the world, 21,500 square miles in extent, with an altitude of over 4,000 feet, and border soundings of from 330 to 580 feet. Into the south shore of the lake a river flowed, which he traced for some 300 miles, and which he set down as the most southerly feeder of the Nile. With his stay at the court of the clever and cunning Mtesa of Uganda we need not concern ourselves; it has had momentous results. Westwards he came upon what he conceived to be a part of the Albert Nyanza, which he named Beatrice Gulf, but of which more anon. Coming southwards to Ujiji, Stanley filled in many features in the region he traversed, and saw at a distance a great mountain, which he named Gordon Bennett, of which also more anon. A little lake to the south he named Alexandra Nyanza; thence he conjectured issued the south-west source of the Nile, but on this point, within the last few months, he has seen cause to change his mind. Lake Tanganyika he circumnavigated, and gave greater accuracy to its outline; while through the Lukuga he found it sent its waters by the Lualaba to the Atlantic. Crossing to Nyangwé, where with longing eyes Livingstone beheld the mile-wide Lualaba flowing "north, north, north," Stanley saw his opportunity, and embraced it. Tippo-Tip failed him then, as he did later; but the mystery of that great river he had made up his mind to solve, and solve it he did. The epic of that first recorded journey of a white man down this majestic river, which for ages had been sweeping its unknown way through the centre of Africa, he and his dusky companions running the gauntlet through a thousand miles of hostile savages, is one of the most memorable things in the literature of travel. Leaving Nyangwé on Nov. 5, 1876, in nine months he traced the many-islanded Kongo to the Atlantic, and placed on the map of Africa one of its most striking features. For the Kongo ranks among the greatest rivers of the world. From the remote Chambeze that enters Lake Bangweolo to the sea, it is 3,000 miles. It has many tributaries, themselves affording hundreds of miles of navigable drains; waters a basin of a million square miles, and pours into the Atlantic a volume estimated at 1,800,000 cubic feet per second. Thus, then, were the first broad lines drawn towards filling up the great blank. But, as we know, Stanley two years later was once more on his way to the Kongo, and shortly after, within the compass of its great basin, he helped to found the Kongo Free State. During the years he was officially connected with the river, either directly or through those who served under him, he went on filling up the blank by the exploration of other rivers,

[1] J. Scott Keltie, in Contemporary Review, January, 1890.

north and south, which poured their voluminous tribute into the main stream; and the impulse he gave has continued. The blank has become a network of dark lines, the interspaces covered with the names of tribes and rivers and lakes.

Such then, briefly, is what Stanley did for the map of Africa during his great and ever-memorable journey across the continent. Once more Mr. Stanley has crossed the continent, in the opposite direction, and taken just about the same time in which to do so. Discovery was not his main object this time, and therefore the results in this direction have not been so plentiful. Indeed, they could not be; he had left so comparatively little to be done. But the additions that he has made to our knowledge of the great blank are considerable, and of high importance in their bearing on the hydrography, the physical geography, the climate, and the people of Central Africa.

Let us rapidly run over the incidents of this, in some respects, the most remarkable expedition that ever entered Africa. Its first purpose, as we know, was to relieve, and if necessary bring away, Emin Pacha, the governor of the abandoned Equatorial Province of the Egyptian Sudan, which spread on each side of the Bahr-el-Jebel, the branch of the Nile that issues from the Albert Nyanza. Here it was supposed that he and his Egyptian officers and troops, and their wives and children, were beleaguered by the Mahdist hordes, and that they were at the end of their supplies. Emin Pacha, who as Eduard Schnitzer was born in Prussian Silesia, and educated at Breslau and Berlin as a physician, spent twelve years (1864–1876) in the Turkish service, during which he travelled over much of the Asiatic dominions of Turkey, indulging his strong tastes for natural history. In 1876 he entered the service of Egypt, and was sent up to the Sudan as surgeon on the staff of Gordon Pacha, who at that time governed the Equatorial Province. In 1878, two years after Gordon had been appointed governor-general of the whole Sudan, Emin Effendi (he had Moslemized himself) was appointed governor of the Equatorial Province, which he found completely disorganized and demoralized, the happy hunting-ground of the slave-raider. Within a few months Emin had restored order, swept out the slavers, got rid of the Egyptian scum who pretended to be soldiers, improved the revenue, so that instead of a large deficit there was a considerable surplus, and established industry and legitimate trade. Meantime the Mahdi had appeared, and the movement of conquest was gathering strength. It was not, however, till 1884 that Emin began to fear danger. It was in January of that year that Gordon went out to hold Khartoum; just a year later both he and the city fell before the Mahdist host. Emin withdrew with his officers and dependents, numbering probably about fifteen hundred, to Wadelai, in the south of the province, within easy reach of Albert Nyanza.

Rumors of the events in the Sudan after the fall of Khartoum reached this country; but no one outside of scientific circles seemed to take much interest in Emin till 1886. Rapidly, however, Europe became aware what a noble stand this simple *savant*, who had been foisted into the position of governor of a half-savage province, was making against the forces of the Mahdi, and how he refused to desert his post and his people. Towards the autumn of 1886 public feeling on the subject rose to such a height that the British Government, which was held to blame for the position in the Sudan, was compelled to take action. Our representative at Zanzibar, as early as August of that year, instituted inquiries as to the possibility of a relief expedition, but in the end, in dread of international complications, it was decided that a government expedition was impracticable. In this dilemma, Sir (then Mr.) William Mackinnon, chairman of the British India Steam Navigation Company, whose connection with East Africa is of old standing, came forward and offered to undertake the responsibility of getting up an expedition.

The Emin Pacha Relief Committee was formed in December, 1886, and government did all it could to aid, short of taking the actual responsibility. Mr. H. M. Stanley generously offered his services as leader, without fee or reward, giving up many lucrative engagements for the purpose. No time was lost. The sum of £20,000 had been subscribed, including £10,000 from the Egyptian Government. Mr. Stanley returned from America to England in the end of December; by the end of January he had made all his preparations, selecting nine men as his staff, including three English officers and two surgeons, and was on his way to Zanzibar, which was reached on Feb. 21. On the 25th the expedition was on board the "Madura," bound for the mouth of the Kongo, by way of the Cape: nine European officers, sixty-one Sudanese, thirteen Somalis, three interpreters, 620 Zanzibaris, the famous Arab slaver and merchant, Tippo-Tip, and 407 of his people.

The mouth of the Kongo was reached on March 18; there the expedition was transshipped into small vessels, and landed at Matadi, the limit of navigation on the lower river. From Matadi there was a march of 200 miles, past the cataracts to Stanley Pool, where the navigation was resumed. The troubles of the expedition began on the Kongo itself.

The question of routes was much discussed at the time of organizing the expedition, the two that found most favor being that from the east coast through Masai-land and round by the north of Uganda, and that by the Kongo. Into the comparative merits of these two routes we shall not enter here. For reasons which were satisfactory to himself, — and no one knows Africa better, — Mr. Stanley selected the Kongo route; though had he foreseen all that he and his men would have to undergo he might have hesitated. As it was, the expedition, which it was thought would be back in England by Christmas, 1887, only reached the coast in November, 1889. But the difficulties no one could have foreseen, the region traversed being completely unknown, and the obstacles encountered unprecedented even in Africa. Nor, when the goal was reached, was it expected that months would be wasted in persuading Emin and his people to quit their exile. Not the keenest-eyed of African explorers could have foreseen all this.

Want of sufficient boat accommodation, and a scarcity of food almost amounting to famine, hampered the expedition terribly on its way up the Kongo. The mouth of the Aruvimi, the real starting-point of the expedition, some 1,500 miles from the mouth of the Kongo, was not reached by Mr. Stanley and the first contingent till the beginning of June, 1887. The distance from here in a straight line to the nearest point of the Albert Nyanza is about 450 miles; thence it was believed communication with Emin would be easy, for he had two steamers available. But it was possible that a détour would have to be made towards the north so as to reach Wadelai direct, for no one knew the conditions which prevailed in the country between the Aruvimi mouth and the Albert Nyanza. As it was, Mr. Stanley took the course to the lake direct, but with many a circuit and many an obstruction, and at a terrible sacrifice of life. An intrenched camp was established on a bluff at Yambuya, about fifty miles up the left bank of the Aruvimi. Major Barttelot was left in charge of this, and with him Dr. Bonny, Mr. Jameson, Mr. Rose Troup, Mr. Ward, and 257 men; the rear column was to follow as soon as Tippo-Tip provided the contingent of five hundred natives which he had solemnly promised. Although the whole of the men had not come up, yet every thing seemed in satisfactory order; explicit instructions were issued to the officers of the rear column; and on June 28, 1887, Mr. Stanley, with a contingent consisting of 389 officers and men, set out to reach Emin Pacha. The officers with him were Captain Nelson, Lieutenant Stairs, Dr. Parke, and Mr. Jephson.

Five miles after leaving camp the difficulties began. The expedition was face to face with a dense forest of immense extent, choked with bushy undergrowth, and obstructed by a network of creepers through which a way had often to be cleaved with the axes. Hostile natives harassed them day after day; the paths were studded with concealed spikes of wood; the arrows were poisoned; the natives burned their villages rather than have dealings with the intruders. Happily the river, when it was again struck, afforded relief, and the steel boat proved of service, though the weakened men found the portages past the cataracts a great trial. It was fondly hoped that here at least the Arab slaver had not penetrated; but on Sept. 16 two hundred miles from Yambuya, making 340 miles of actual travel, the slave camp of Ugarowwa was reached, and here the treatment was even worse than when fighting the savages of the forest. The brutalities practised on Stanley's men cost many of them their lives. A month later the camp of another Arab slaver was reached, Kilinga Longa, and there the treatment was no better. These so-called Arabs, whose

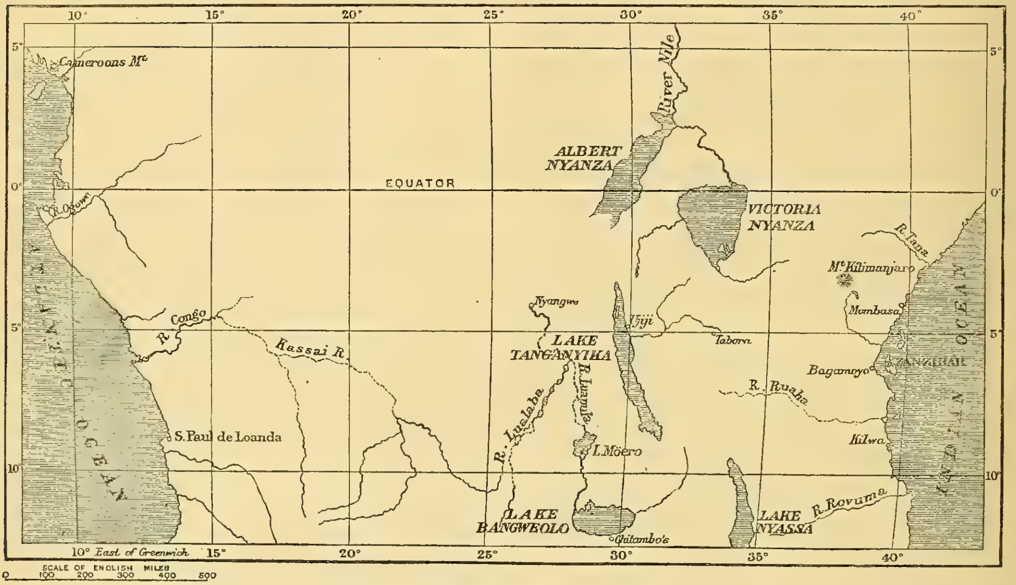
caravans consist mainly of the merciless Manyuema, from the country between Tanganyika and Nyangwé, had laid waste a great area of the region to be traversed by the expedition, so that between Aug. 31 and Nov. 12 every man was famished; and when at last the land of devastation was left behind, and the native village of Ibwiri entered, officers and men were reduced to skeletons. Out of the 389 who started, only 174 entered Ibwiri, the rest dead, or missing, or left behind, unable to move, at Ugarowwa's. So weak was everybody that seventy tons of goods and the boat had to be left at Kilinga Longa's with Captain Nelson and Surgeon Parke.

A halt of thirteen days at Ibwiri, with its plenty of fowls, bananas, corn, yams, beans, restored everybody; and 173 sleek and robust men set out for the Albert Nyanza on Nov. 24. A week later the gloomy and dreaded forest suddenly ended; the open country was reached; the light of day was unobstructed; it was an emergence from darkness to light. But the difficulties were not over; some little fighting with the natives on the populous plateau was necessary before the lake could be reached. On the 12th the edge of the long slope from the Kongo to Lake Albert was attained, and suddenly the eyes of all were gladdened by the sight of the lake lying some three thousand feet almost sheer below. The expedition itself stood at an altitude of 5,200 feet above the sea. But the end was not yet. Down the expedition marched to the south-west corner of the lake, where the Kakongo natives were unfriendly. No Emin Pacha had been heard of; there was no sign even that he knew of Stanley's coming, or that the messenger from Zanzibar had reached him. The only boat of the expedition was at Kilinga Longa's, 190 miles away. Of the men, 94 were behind sick at Ugarowwa's and Kilinga Longa's; only 173 were with Stanley; 74 of the original 341 were dead or missing; and, moreover, there was anxiety about the rear column.

Stanley's resolution was soon taken. Moving to the village of Kavalli, some distance up the steep slope from the lake, the party began a night march on Dec. 15, and by Jan. 7 they were back at Ibwiri. Here Fort Bodo, famous in the records of the expedition, was built. The men were brought up from the rear, and on April 7 Stanley, with Jephson and Parke, once more led the expedition to Lake Albert, this time with the boat and fresh stores. Meantime, Stanley himself was on the sick-list for a month. This time all the natives along the route were friendly and even generous, and on April 22 the expedition reached the chief Kavalli, who delivered to Stanley a letter wrapped in American cloth. The note was from Emin, and stated that he had heard rumors of Stanley's presence in the district; it begged Stanley to wait until Emin could communicate with him. The boat was launched, and Jephson set off to find Emin. On the 29th the "Khedive" steamer came down the lake with Emin, the Italian Casati, and Jephson on board. The great object of the expedition seemed at last to be all but fulfilled.

But the end was not yet. There was the party at Fort Bodo; there were the sick further back with whom Lieutenant Stairs had not returned when Stanley left the fort; and, above all, there was the rear column left at Yambuya with Major Barttelot. It would take some time for Emin to bring down all his people from Wadelai and other stations. So after spending over three weeks with the vacillating Emin, Stanley, on May 25, was once more on the march back to Fort Bodo to bring up all hands. He left Jephson, three Sudanese, and two Zanzibaris with Emin, who gave him 102 natives as porters, and three irregulars to accompany him back. Fort Bodo was reached on June 8, and was found in a flourishing state, surrounded by acres of cultivated fields. But of the fifty-six men left at Ugarowwa's only sixteen were alive for Lieutenant Stairs to bring to Fort Bodo. As there was no sign of the rear column nor of the twenty messengers sent off in March with letters for Major Barttelot, Stanley felt bound to retrace his steps through the terrible forest. This time he was better provisioned, and his people (212) escaped the horrors of the wilderness.

Fort Bodo was left on June 16, Stanley letting all his white companions remain behind. Ugarowwa's camp was deserted, and he himself, with a flotilla of fifty-seven canoes, was overtaken far down the river on Aug. 10, and with him seventeen of the carriers sent off to Major Barttelot in March; three of their number had been killed. On the 17th the rear column was met with at Bonalya, eighty miles above Yambuya, and then for the first time Stanley learned of the terrible disaster that had befallen it — Barttelot shot by the Manyuema, Jameson gone down the Kongo (only to die), Ward away, and Troup invalided home. No one but Dr. Bonny: of the 257 men only seventy-two remaining, and of these only fifty-two fit for service. No wonder Mr. Stanley felt too sick to write the details; and until we have the whole of the evidence it would

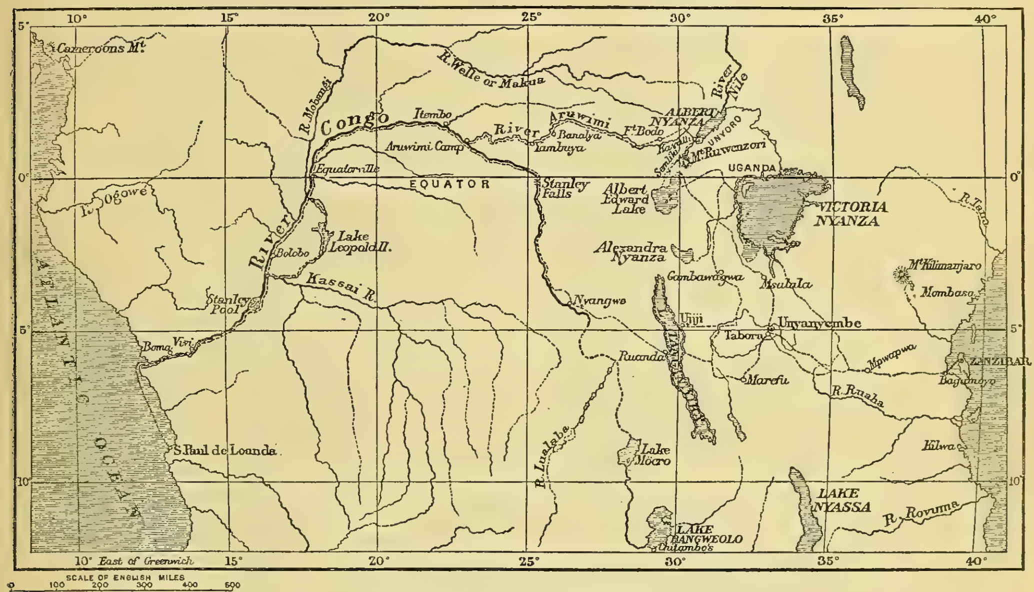


CENTRAL AFRICA, BEFORE STANLEY.

be unfair to pronounce judgment. One thing we may say: we know, from Mr. Werner's recently published "River Life on the Congo," that before Major Barttelot left Yambuya to follow Stanley it was known to Mr. Werner, to more than one Belgian officer, to several natives, and to the Manyuema people with Barttelot, that instructions had been given by Tippo-Tip to these last to shoot Major Barttelot if he did not treat them well. Yet no one cared to warn the major, and he was allowed to depart to his almost certain fate. The thing is too sickening to dwell upon. It was at this stage that Stanley sent home his first letters, which reached England on April 1, 1889, twenty months after he started from the Aruvimi, and over two years after he left England. The relief was intense; all sorts of sinister rumors had been floated, and most people had given up the expedition for lost.

Once more back through the weary forest, with the expedition re-organized. A new route was taken to the north of the river through a region devastated by the Arab slavers; and here the expedition came near to starvation, but once more Fort Bodo was reached, on Dec. 20. Here things were practically as Stanley had homeward march was comparatively free from trouble, and full of interest; and on Dec. 6 Mr. Stanley once more entered Zanzibar, which he had left two years and ten months before. Such briefly are some of the incidents of the rescue expedition; let us now as briefly sum up the geographical results.

When Stanley left for Africa in January, 1887, there remained one of the great problems of African hydrography still unsolved, what is known as the problem of the Wellé. Schweinfurth and Junker had come upon a river at some points which seemed to rise in the neighborhood of the Albert Nyanza, and appeared to flow in a north-west direction. The favorite theory at the time was that the river Wellé was really the upper course of the Shari, which runs into Lake Chad far away to the north-west. But as the Kongo and its great feeders on the north, and the lay of the land in that direction, became better known, it began to be conjectured that after all the Wellé might send its waters to swell the mighty volume of the great river. Stanley, I know, hoped that, among other geographical work, he might be able to throw some light on the course of this puzzling river. But, as we see now, the



CENTRAL AFRICA, AFTER STANLEY.

left them; there was no sign of Emin, though he had promised to come to the fort. The combined expedition marched onwards, and Mr. Stanley, pushing on with a contingent, reached the lake for the third time, on Jan. 18, only to learn that Emin and Jephson had been made prisoners by Emin's own men; the Mahdists had attacked the station and created a panic, and all was disorganization and vacillation. At last, however, the chief actors in this strange drama were together again: and Mr. Stanley's account of Emin's unstable purpose; the long arguments with the Pacha to persuade him to come to a decision; the ingratitude and treachery of the Egyptians; the gathering of the people and their burdensome goods and chattels preparatory to quitting the lake, — these and many other details are fresh in our memories from Stanley's own letters. But the main purpose of the expedition was accomplished, at however terrible a cost, and however disappointing it was to find that after all Emin was reluctant to be "rescued." When the start was made from Kavalli's, on April 10 last, fifteen hundred people in all were mustered. An almost mortal illness laid Stanley low for a month shortly after the start, and it was May 8 before the huge caravan was fairly under way. Some fighting had to be done with the raiders from Unyoro, but on the whole the cares and troubles that fell upon him prevented him going much out of the way to do geographical work. While, however, Stanley was cleaving his way through the tangled forest, Lieutenant Van Gèle, one of the Free State officers, proved conclusively that the Wellé was really the upper course of the Mobangi, one of the largest northern tributaries of the Kongo. But another and kindred problem Stanley was able to solve. Before his journey, the mouth of the river Aruvimi was known; the great naval battle which he fought there on his first descent of the river is one of the most striking of the many striking pictures in the narrative of that famous journey. But beyond Yambuya its course was a blank. The river, under various names, "Ituri" being the best known, led him almost to the brink of the Albert Nyanza. One of its upper contributories is only ten minutes' walk from the brink of the escarpment that looks down upon the lake. With many rapids, it is for a great part of its course over five hundred yards wide, with groups of islands here and there. For a considerable stretch it is navigable, and its entire length, taking all its windings into account, from its source to the Kongo, is eight hundred miles. One of its tributaries turns out to be another river which Junker met farther north, and whose destination was a puzzle, the Nepoko.

Thus this expedition has enabled us to form clearer notions of the hydrography of this remarkable region of rivers. We see that the sources of the Kongo and the Nile lie almost within a few yards of each other. Indeed, so difficult is it to determine to which river the various waters in this region send their tribute, that Mr. Stanley himself, in his first letter, was confident that the southern Lake Albert belonged to the Kongo, and not to the Nile system; it was only actual inspection that convinced him he was mistaken. How it is that the Ituri or the Aruvimi and other rivers in the same region are attracted to the Kongo and not to the Nile is easily seen from Mr. Stanley's graphic description of the lay of the country between the Kongo and the Albert Nyanza. It is, he says, like the glacis of a fort, some 350 miles long, sloping gradually up from the margin of the Kongo (itself at the Aruvimi mouth 1,400 feet above the sea), until ten minutes beyond one of the Ituri feeders it reaches a height of 5,200 feet, to descend almost perpendicularly 2,900 feet to the surface of the lake, which forms the great western reservoir of the Nile.

But when the term "glacis" is used, it must not be inferred that the ascent from the Kongo to Lake Albert is smooth and unobstructed. The fact is that Mr. Stanley found himself involved in the northern section of what is probably the most extensive and densest forest region in Africa. Livingstone spent many a weary day trudging its gloomy recesses away south at Nyangwé on the Lualaba. It stretches for many miles north to the Monbuttu country. Stanley entered it at Yambuya, and tunnelled his way through it to within fifty miles of the Albert Nyanza, when it all of a sudden ceased and gave way to grassy plains and the unobstructed light of day. How far west it may extend beyond the Aruvimi he cannot say; but it was probably another section of this same forest region that Mr. Paul du Chaillu struck some thirty years ago, when gorilla-hunting in the Gaboon. Mr. Stanley estimates the area of this great forest region at about three hundred thousand square miles, which is more likely to be under than over the mark. The typical African forest, as Mr. Drummond shows in his charming book on "Tropical Africa," is not of the kind found on the Aruvimi, which is much more South American than African. Not even in the "great sponge" from which the Zambesi and the Kongo draw their remote supplies do we meet with such impenetrable density. Trees scattered about as in an English park in small open clumps form, as a rule, the type of "forest" common in Africa; the physical causes which led to the dense packing of trees over the immense area between the Kongo and Nile lakes will form an interesting investigation. Mr. Stanley's description of the great forest region, in his letter to Mr. Bruce, is well worth quoting: —

"Take a thick Scottish copse, dripping with rain; imagine this copse to be a mere undergrowth, nourished under the impenetrable shade of ancient trees, ranging from 100 to 180 feet high; briers and thorns abundant; lazy creeks meandering through the depths of the jungle, and sometimes a deep affluent of a great river. Imagine this forest and jungle in all stages of decay and growth — old trees falling, leaning perilously over, fallen prostrate; ants and insects of all kinds, sizes, and colors murmuring around; monkeys and chimpanzees above, queer noises of birds and animals, crashes in the jungle as troops of elephants rush away; dwarfs with poisoned arrows securely hidden behind some buttress or in some dark recess; strong, brown-bodied aborigines with terribly sharp spears, standing poised, still as dead stumps; rain pattering down on you every other day in the year; an impure atmosphere, with its dread consequences, fever and dysentery; gloom throughout the day, and darkness almost palpable throughout the night; and then if you will imagine such a forest extending the entire distance from Plymouth to Peterhead, you will have a fair idea of some of the inconvenience endured by us from June 28 to Dec. 5, 1887, and from June 1, 1888, to the present date, to continue again from the present date till about Dec. 10, 1888, when I hope then to say a last farewell to the Kongo Forest."

Mr. Stanley tries to account for this great forest region by the abundance of moisture carried over the continent from the wide Atlantic by the winds which blow landward through a great part of the year. But it is to be feared the remarkable phenomenon is not to be accounted for in so easy a way. Investigation may prove that the rain of the rainiest region in Africa comes not from the Atlantic, but the Indian Ocean, with its moisture-laden monsoons. And so we should have here a case analogous to that which occurs in South America, the forests of which resemble in many features those of the region through which Mr. Stanley has passed.

But the forest itself is not more interesting than its human denizens. The banks of the river in many places are studded with large villages, some, at least, of the native tribes being cannibals. We are here on the northern border of the true negro peoples, so that when the subject is investigated the Aruvimi savages may be found to be much mixed. But unless Europe promptly intervenes, there will shortly be few people left in these forests to investigate. Mr. Stanley came upon two slave-hunting parties, both of them manned by the merciless people of Manyuema. Already great tracts have been turned into a wilderness, and thousands of the natives driven from their homes. From the ethnologist's point of view the most interesting inhabitants of the Aruvimi forests are the hostile and cunning dwarfs, or rather pygmies, who caused the expedition so much trouble. No doubt they are the same as the Monbuttu pygmies found farther north, and essentially similar to the pygmy population found scattered all over Africa, from the Zambesi to the Nile, and from the Gaboon to the east coast. Mr. Du Chaillu found them in the forests of the west thirty years ago, and away south on the great Sankuru tributary of the Kongo Major Wissmann and his fellow-explorers met them within the past few years. They seem to be the remnants of a primitive population rather than stunted examples of the normal negro. Around the villages in the forest, wherever clearings had been made, the ground was of the richest character, growing crops of all kinds. Mr. Stanley has always maintained that in the high lands around the great lakes will be found the most favorable region for European enterprise; and if in time much of the forest is cleared away, the country between the Kongo and Lake Albert might become the granary of Africa.

To the geographer, however, the second half of the expedition's work is fuller of interest than the first. Some curious problems had to be solved in the lake region, problems that have given rise to much discussion. When in 1864 Sir Samuel Baker stood on the lofty escarpment that looks down on the east shore of the Albert Nyanza, at Vacovia, the lake seemed to him to stretch illimitably to the south, so that for long it appeared on our maps as extending beyond 1° south latitude. When Stanley, many years later, on his first great expedition, after crossing from Uganda, came upon a great bay of water, he was naturally inclined to think that it was a part of Baker's lake, and called it Beatrice Gulf. But Gessi and Mason, members of Gordon Pacha's staff, circumnavigated the lake later on, and found that it ended more than a degree north of the equator. So when Stanley published his narrative he made his "Beatrice Gulf" a separate lake lying to the south of the Albert Nyanza. Mr. Stanley saw only a small portion of the southern lake, Muta Nzigé, but in time it expanded and expanded on our maps, until there seemed some danger of its being joined on to Lake Tanganyika. Emin himself, during his twelve years' stay in the Sudan, did something towards exploring the Albert Nyanza, and found that its southern shore was fast advancing northwards, partly owing to sediment brought down by a river, and partly due to the wearing away of the rocky bed of the Upper Nile, by which much water escaped, and the level of the lake subsided. Thus, when Baker stood on the shore of the lake in 1864, it may well have extended many miles farther south than it does now. But where did the river come from that Mason and Emin saw running into the lake from the south? As was pointed out above, Stanley at first thought it could not come from his own lake to the south, which he believed must send its waters to the Kongo. But all controversy has now been ended. During the famous exodus of the fifteen hundred from Kavalli to the coast, the intensely interesting country lying between the northern lake, Albert, and the southern lake, now named Albert Edward, was traversed. Great white grassy plains stretch away south from the shores of Lake Albert, which under the glitter of a tropical sun might well be mistaken for water; evidently they have been under water at a quite recent period. But soon the country begins to rise, and round the base of a great mountain boss the river Semliki winds

its way through its valley, receiving through the picturesque glens many streams of water from the snows that clothe the mountain-tops. Here we have a splendid country, unfortunately harassed by the raids of the Wanyoro, in dread of whom the simple natives of the mountain-side often creep up to near the limit of snow. Up the mountain, which Lieutenant Stairs ascended for over ten thousand feet, blackberries, bilberries, violets, heaths, lichens, and trees that might have reminded him of England flourish abundantly. Here evidently we have a region that might well harbor a European population. The mountain itself, Ruwenzori, a great boss with numerous spurs, is quite evidently an extinct volcano, rising to something like nineteen thousand feet, and reminding one of Kilima Njaro, farther to the east. It is not yet clear whether it is the same mountain as the Gordon Bennett seen by Stanley in his former expedition, though the probability is that, if distinct, they belong to the same group or mass. Apart from the mountain the country gradually ascends as the Semliki is traced up to its origin in Lake Albert Edward. Mr. Stanley found that, after all, the southern Nyanza belongs to the great Nile system, giving origin to the farthest south-west source of Egypt's wonderful river, which we now know receives a tribute from the snows of the equator.

The southern lake itself is of comparatively small dimensions, probably not more than forty-five miles long, and is nine hundred feet above the northern Lake Albert. Mr. Stanley only skirted its west, north, and east shores, so that probably he has not been able to obtain complete data as to size and shape. But he has solved one of the few remaining great problems in African geography. The two lakes lie in a trough, the sides of which rise steeply in places three thousand feet, to the great plateaus that extend away east and west. This trough, from the north end of Lake Albert to the south end of Lake Albert Edward, is some two hundred and sixty statute miles in length. About one hundred miles of this is occupied by the former lake, forty-five by the latter, and the rest by the country between, where the trough, if we may indulge in an Irishism, becomes partly a plain, and partly a great mountain mass. But this trough, or fissure, a glance at a good map will show, is continued more or less south and south-east in Lakes Tanganyika and Nyassa, which are essentially of the same character as Lakes Albert and Albert Edward, and totally different from such lakes as Victoria Nyanza and Bangweolo. Here we have a feature of the greatest geographical interest, which still has to be worked out as to its origin.

There is little more to say as to the geographical results of the Emin Pacha Relief Expedition. There are many minute details of great interest, which the reader may see for himself in Mr. Stanley's letters, or in his forthcoming detailed narrative. In his own characteristic way, he tells of the tribes and peoples around the lakes, and between the lakes and the coast; and it was left for him on his way home to discover a great south-west extension of Victoria Nyanza, which brings that lake within one hundred and fifty miles of Lake Tanganyika. The results which have been achieved have been achieved at a great sacrifice of life and of suffering to all concerned; but no one, I am sure, will wish that the work had been left undone. The few great geographical problems in Africa that Livingstone had to leave untouched, Stanley has solved. Little remains for himself and others in the future beyond the filling-in of details; but these are all-important, and will keep the great army of explorers busy for many years, if not for generations.

USEFUL PLANTS IN GUATEMALA.

IN a report on the trade, commerce, and industries of the Republic of Guatemala for 1888, the British Consul to that republic draws attention to the various vegetable products cultivated in the country. Coffee is described as the most important agricultural product, and, from its excellent quality, fetches a high price in the market. The area of land planted has possibly doubled in the last few years, and owing to failure in the last year's crop in Brazil, and the consequent rise in the value of the product, an unusually large acreage of fresh land is now being planted, and greater care taken with the present estates, many old plantations being renewed and added to. It is expected that next year, or the year after, 1,000,000 quintals will be produced, bringing, exclusive of consumption, a wealth of $11,500,000 to $12,500,000 to the country. There is still a quantity of good land available for purchase. Sowing is generally done in June; and when about seven inches high, the young plants are transplanted into nurseries, watered in the dry season, and protected from the sun until ready to be planted out. About 100,000 quintals of coffee are yearly consumed in the country.

Sugar stands next among the most important vegetable products. Cacao cultivated in Guatemala is of superior quality, and at one time it was an important article of export, but has of late years greatly fallen off; and at the present time only about 400,000 pounds are produced, scarcely more than is required for interior consumption. The government are encouraging farmers to turn their attention to this branch of culture, and some new plantations have been made. The seeds have been distributed in considerable quantities in various parts of the south, the sowing has shown good results, and it is expected that the cultivation of this valuable plant will be much increased. It takes about six years from the time the seed is sown before a crop is produced; but after that period each shrub will yield one pound three times a year, and last for a hundred years. There is little cost in cultivating or gathering, and no machinery is required; so that, though there is some time to wait before new plantations give any return, the ultimate profit is considerable. A slightly earlier result may be obtained by surrounding the plantation with lime or orange trees, well preparing the land, and shading the plants with suitable trees.

A quantity of coca-seed (*Erythroxylon coca*) was last year imported from Peru for distribution among the people in a suitable zone for its growth; but the result was unsatisfactory, from the bad quality of the seed, and fresh means are being taken to extend the cultivation of this plant.

Pepper and cinnamon are grown in the department of Alta Verapaz. Good seed has been imported from Ceylon, and planting is extending in that fertile district, while satisfactory results have been obtained in the department of Escuintla, where a few plantations have been made.

Rice is a very large article of consumption in the republic, and the government have established at San José works for perfecting machinery to separate the husk.

Good tobacco is grown, but little attention is paid to the mode of preparing it. The production is being encouraged by the gratuitous circulation of the best seed procurable from Havana, the United States, and Sumatra, and many new plantations are being made.

In spite of endeavors made to protect the rubber or caoutchouc trees, the production of rubber continues to decrease, and only in Verapaz and Peten are trees found in any quantity; while the growers show no signs of replacing those that are worn out. Holes are made in the stems to extract the sap, and alum, saltwort, or some other juice, used to coagulate it. It might be made a profitable industry if proper knowledge and appliances were brought to bear. A few new plantations are being made in one or two low-lying farms; about 3,000 quintals are annually exported. The plant yielding Guatemala rubber is *Castilloa elastica.*

Among other products grown are maize, beans, peas, and potatoes in sufficient quantity for home consumption; sarsaparilla and vanilla grow wild on the mountains all over the country. The price of sarsaparilla has fallen greatly. There was scarcely any exported last year, and in 1887 it only reached the value of $8,105. The quality of the vanilla is good, but, though it figures as an export, it is not cultivated for that purpose.

Banana-planting in the east is occupying much attention as a profitable industry, some 200,000 trees being now yearly planted for the supply of the United States market. About 120,000 bunches are at present exported annually. Peruvian (*Bœhmeria nivea*) was also introduced three years ago, and more than 600,000 shoots were distributed with a view to its general cultivation, but exportation of the fibre has not met with satisfactory results. Indigo-works are subsiding in the country, though a few still exist in the east, and means are being taken to encourage them. Indigo was exported to the value only of $465 in 1888, though formerly a very large trade was done in it. The industry in cochineal has almost entirely disappeared: for thirty years it was the principal article of export, and now the little produced is used for native consumption, aniline dyes having ruined the trade.

HEALTH MATTERS.

THE BLOOD IN PHTHISIS AND CANCER. — Dr. G. Neubert has examined the blood in twenty-four cases of phthisis at various stages, says *The Lancet*, and found that in nine the number of corpuscles was normal, in three it was above, and in twelve more or less below, the average. On the whole, there was an average diminution of about eight per cent. The increase noted in three cases might perhaps be attributed to profuse night-sweats. The hæmoglobin showed a reduction to seventy-three per cent in the females, and eighty-five per cent in the males. There was no notable change in the number of leucocytes, but it was observed that multi-enucleated forms predominated. In five cases of cancer of the œsophagus, and four of cancer of the stomach, there was an invariable diminution in the number of red corpuscles, and also notably of hæmoglobin. It is inferred that the hæmoglobin, being the more "sensitive" element of red corpuscles, is more profoundly affected in cachexia than the stroma of the corpuscles. A distinction was made between the anæmic and marasmic types of cancer, the latter exhibiting an average reduction of thirteen per cent of corpuscles, while the hæmoglobin fell to eighty-seven per cent of the normal; the former showing a corpuscular reduction of thirty-five per cent, while the hæmoglobin was as much as seventy per cent.

THE "NORMAL" DIET. — According to Dr. G. Munro Smith, in the *Bristol Medico-Chirurgical Journal*, the daily destructive metabolism, which is the great criterion of work done, does not vary much among different occupations. Premising that he does not consider moderate over-eating injurious, he finds that very many men eat considerably more than the most liberal tables: it is not an uncommon thing for an average-sized man on very moderate work to eat twenty-five or twenty-seven ounces of chemically dry food a day. Women eat much less than men, after making allowances for differences in weight and work. Where a man eats nineteen ounces, a woman of the same weight and of active habits eats only fourteen or fifteen ounces. On a diet from which all meat is excluded, he has found that twelve to thirteen ounces *per diem* will comfortably feed a hard-working man. A moderate amount of stimulants appears to increase the average: moderately free drinking diminishes it. A diet consisting of one part of nitrogenous to seven or eight non-nitrogenous is a good combination: it is greatly exceeded on the nitrogenous side by the majority of men and women, especially the former. A diet of twelve to fourteen ounces of chemically dry food, digestible, with the ingredients in proper proportion, is sufficient to keep in good health an average-sized man on moderate work. The majority of people (in England) eat literally twice as much as this.

TOLERANCE OF OPERATIONS ON THE LIVER. — Professor Ponfick of Breslau has been for a number of years engaged in making experiments in regard to the relation between the liver and certain anomalies in the formation of blood. In the course of these investigations he has made some striking discoveries, which, although not directly connected with the object of his investigations, are yet of great importance. One of the most curious results of his experiments has been the discovery that the animal functions may be conducted without serious disturbance even after the loss of a very large portion of so important an organ as the liver, says *The Medical and Surgical Reporter* of Oct. 12, 1889. In some cases, operating with strict antisepsis, he succeeded in removing as much as three-fourths of the liver, either at several sittings or in one single operation; and the animals upon which he experimented did not lose their lives, nor seem to be seriously disturbed in their health. In hundreds of experiments, in which he removed sometimes one lobe and sometimes another, the animals remained, in a considerable number of cases, perfectly well for months, and even for as long as a year. Clinical experience has already taught us that the whole of the liver is not absolutely essential to health, because large portions of this organ have been practically destroyed — as in the case of echinococcus and profound fatty infiltration — without any disturbance of the general functions of the body. But this, as Ponfick says, is hardly to be compared with the sudden and immediate removal of large portions of an organ which is supposed to be so important to health. The explanation of this curious fact seems to be that the liver has a wonderful power of reproduction. Ponfick found, that, within a few days after the removal of portions of the liver, the work of its reproduction began, and that it proceeded with great rapidity to completion. In certain cases he found that within a period of a few weeks as much was reproduced as had been removed; that is, twice as much as had been left behind. These investigations have an interest altogether outside of that which is absolutely scientific, because it cannot fail to influence the development of abdominal surgery, if it is understood that large portions of the liver may be removed without serious danger to life.

LEPROSY HERE AND ELSEWHERE. — Dr. Hansen, the Norwegian discoverer of the bacillus of leprosy, came over to this country a while ago to trace the history of leper immigrants who had settled in Wisconsin, Minnesota, and Dakota. Of 160 original leper immigrants, he was able to find only 13; a few more may be living, but nearly 147 are dead. Of all their descendants, so far as great-grandchildren, not one has become a leper. In this country the disease does not increase, nor does it appear to be hereditary. The failure to spread here is thought to be due to the improved conditions of living which the immigrants are able to secure on this side of the ocean. The *Sanitary Inspector*, in speaking of a leper lately found at Brentwood, Eng., says that many persons believe that leprosy has entirely disappeared from England, yet there has probably never been a year in which a score of lepers could not be produced, and that, though England used to have lepers enough, leprosy has become a very rare disease since English homes and English roads have been kept clean.

PHTHISIS IN HIGH ALTITUDES. — From a report in the *Lancet* by Dr. L. Schrötter on the distribution of phthisis in Switzerland, it would seem that the inhabitants even of high altitudes are by no means so free from phthisis as we are wont to suppose. The tables of deaths for the eleven years 1876–86 show that phthisis is endemic in every part of Switzerland, not a single district being free from it. On the whole, the deaths from this cause are fewer in the high than in the low lying districts, but it cannot be said that the mortality from this cause is inversely proportionate to the altitude. Wherever there is a large industrial population, the phthisis mortality is considerable. Industrial populations always suffer much more than agricultural populations where the altitude is the same.

NOTES AND NEWS.

THE San Francisco *Bulletin* says that the California beet-sugar experiment is a success. Last year 2,000 acres were planted, and yielded 13,500 tons of sugar-beets, from which were extracted 1,650 tons of sugar. This was done at the Watsonville factory, which ran forty-seven days. The beets brought an average of five dollars a ton, and the farmers feel satisfied that they can raise them at a profit. They have guaranteed to greatly increase the acreage this year, and the output will probably be more than doubled.

— The United States consul at Bahia describes a substance called turfa, lately discovered in Brazil, at a place called Maratiu, about sixty miles south of Bahia. Turfa has been found to contain the main ingredient now extracted from it by distillation, viz., petroleum, or, as it is locally called, "brazolina" or "petroleo nacionale," besides paraffine, gasoline, and lubricating-oils resulting from the process. A company was formed, and the concession purchased. Machinery has been imported from England, and from four hundred to four hundred and fifty hands are employed at the mines. The company, it is stated, will manufacture fifty tons of candles per month; and if the enterprise should prove a success, it will probably interfere with the trade in kerosene, candles, and lubricating-oils which the United States now has with Brazil and with the countries south of Brazil.

— The thirty-seventh annual meeting of the American Society of Civil Engineers was held at the society's rooms in this city last week, beginning on the 15th. The society now has a total membership of 1,335. The Norman medal was awarded to Mr. Theodore Cooper, for a paper on American railroad-bridges; and the

Rowland prize, to Mr. James D. Schuyler, for a paper on the construction of the Sweetwater dam, near San Diego, Cal. An important report was submitted by the committee on impurities in domestic water-supply. In the opinion of the committee, the organization to inquire into the sources of impurities in drinking-water, and the methods of remedying them, should be a national one, and the work should properly be taken up by the American Society. The committee recommended that all printed information on this subject should gradually be collected and catalogued, and that the society should own and maintain a complete collection of such literature. The report was accepted. On the 16th about four hundred members of the society and invited guests paid a visit to the government torpedo station at Willet's Point, the Brooklyn navy yard, and other points of interest. The officers of the society for the ensuing year are as follows: president, William P. Shinn; vice-presidents, A. Fteley, Mendes Cohen; secretary and librarian, John Bogart; treasurer, George S. Greene, jun.; directors, Charles B. Brush, Theodore Voorhees, Robert Van Buren, William Ludlow, William G. Curtis.

— The American Society for Psychical Research, after existing for five years, with its headquarters in Boston, and publishing some six hundred pages of "Proceedings," at last, for pecuniary reasons, terminated its corporate existence on Jan. 14. The English society of the same name is heir to its documentary possessions, and is to keep Dr. Richard Hodgson, late secretary of the American society, as its own secretary in America. A majority of the associates of the American society have joined the English society, forming the nucleus of an American branch. Professors S. P. Langley of Washington, H. P. Bowditch of Boston, and W. James of Cambridge, are appointed vice-presidents of the Society for Psychical Research in America; but, apart from their advisory functions, there is no "organization" here, — a circumstance which will doubtless contribute to economy and efficiency of work. It is to be hoped that a solid moral and pecuniary support to the society may be extended from this country. The annual assessment of American associates is three dollars. They receive for this the published "Proceedings," which appear quarterly, and the monthly "Journal," printed for circulation in the society only. Those who wish may become full "members" of the English society, with voting and other privileges, by the annual payment of ten dollars. Meetings of the branch will be held periodically for the readings of papers and discussion. Those who desire to join the society or to obtain information should address the secretary, R. Hodgson, No. 5 Boylston Place, Boston.

— In accordance with the intention of its honored founder, the trustees of the Missouri Botanical Garden, St. Louis, propose to provide adequate theoretical and practical instruction for young men desirous of becoming gardeners. It is not intended at present that many persons shall be trained at the same time, nor that the instruction so planned shall duplicate the excellent courses in agriculture now offered by the numerous State colleges of the country, but that it shall be quite distinct, and limited to what is thought to be necessary for training practical gardeners. Scholarships, not exceeding six in number, will be awarded by the director of the garden, prior to the first of April next. Applications for scholarships, to receive consideration, must be in the hands of the director not later than the first day of March. During the first year of their scholarship, garden pupils will work at the practical duties of the garden nine or ten hours daily, according to the season, the same as regular employees of the garden, and will also be expected to read the notes and articles referring to the subject of their work, in one or more good journals. In the second year, in addition to five hours' daily work of the same sort, they will be given instruction and will be required to do thorough reading in vegetable-gardening, flower-gardening, small-fruit culture, and orchard-culture, besides keeping the run of the current papers. In the third year, in addition to five hours of daily labor, they will be instructed and given reading in forestry, elementary botany, landscape-gardening, and the rudiments of surveying and draining, and will be required to take charge of clipping or indexing some department of the current gardening papers for the benefit of all. In the fourth year, besides the customary work, they will study the botany of weeds, garden vegetables, and fruits, in addition to assisting in the necessary indexing or clipping of papers, etc., and will be taught simple book-keeping, and the legal forms for leases, deeds, etc. The course for the fifth year, in addition to the customary work, will include the study of vegetable physiology, economic entomology, and fungi, especially those which cause diseases of cultivated plants; and each pupil will be expected to keep a simple set of accounts pertaining to some department of the garden. In the sixth year, in addition to the manual work, pupils will study the botany of garden and green-house plants, of ferns, and of trees in their winter condition, besides the theoretical part of special gardening, connected with some branch of the work that they are charged with in the garden. From time to time, changes in this course will be made, as they shall appear to be desirable, and the effort will be made to give the best theoretical instruction possible in the various subjects prescribed; but it is not intended to make botanists or other scientific specialists of garden pupils, but, on the contrary, practical gardeners. Applications for scholarships, and any inquiries regarding them, are to be addressed to William Trelease, director of the Missouri Botanical Garden, St. Louis, Mo.

— The Mexican Government, according to the *Engineering and Mining Journal*, has issued a decree fixing June 30, 1890, as the date for the definite withdrawal from circulation of worn coin and of the coins known as reales, medios, cuartillas, and tlacos. Holders of such coins may before such date exchange them at their nominal value for decimal currency at the National Bank in the City of Mexico, or at its agencies throughout the republic. The mints will recoin the old money into decimal pieces. After the date fixed for the exchange of the old coinage at its nominal value, it may still be exchanged at the mints; which, however, will only redeem it according to its weight and fineness, and not according to the value stamped on it. From and after July 1, 1890, all commercial transactions must be effected on a decimal basis, infractions of this rule being punished by a fine of twenty-five dollars for the first offence and fifty dollars for every subsequent offence. Notaries, in drawing up contracts, are forbidden to mention the coins of the old system, even for the sake of greater clearness, on penalty of a fine of from fifty dollars to one hundred dollars. Any one who, after June 30, shall attempt to pass a coin of the ancient system will incur the same penalties as those awarded for passing illegal coinage.

— The Mexican Government, says the *Economiste Français*, has recently undertaken an inquiry into the internal condition of the country. The following are some of the results obtained by the inquiry: The population of Mexico has increased during the period comprised between the years 1880 and 1888 by 1,487,701 persons; that is to say, 185,962 annually, or an average increase of 2 per cent. The revenue, which amounted in 1880 to $21,936,165, reached the figure of $32,126,508 in 1888, — an increase of $10,190,343. Landed property in Mexico was valued in 1880 at $366,055,052, and at $473,519,871 in 1888. At the end of 1880 there were 15 railway lines in working, with a length of 655 miles. At the end of the year 1888 the lines numbered 47, with a total length of 5,063 miles. In 1880 there were 10,501 miles of telegraph line. In 1888, the telegraph system, including the coast cables, comprised 27,704 miles. The number of telegrams despatched by the Federal Government lines, which amounted in 1880 to 381,607, exceeded 671,000 in 1888. Postal business showed a great increase: the number of letters and newspapers carried in 1880 amounted to 5,788,182, and in 1888 to 27,390,288. From the establishment of the mint, up to the year 1888, the amount of gold coined represented a value of $112,671,000; of silver, $2,194,111,828; and of copper, $5,940,338; making a total of $3,312,723,266. During the economic year 1886–87, the value of the imports into the Republic was $52,252,275; and of the exports, $49,191,930. As regards public instruction, the progress is very marked: the number of schools, which in 1880 was only 8,535, rose in 1888 to 10,726, while the number of scholars increased during the same period from 435,935 to 543,977. Finally, lighthouses have been established in the ports of Vera Cruz, Coazacoalcos, Alvarado, Frontera, Celestun, Sisal, Tampico, Campêche, and Progreso in the Gulf of Mexico, and at Guaymas and Mazatlan on the Pacific.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column i likewise open.

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CONTENTS:

THE FISKE RANGE-FINDER.

IT has long been recognized as a prime necessity of effective gunnery at sea that the gunners shall know at each instant the exact distance of the ship or object at which they are to shoot. To realize this, we must reflect, that, if two ships are approaching each other at the rate of even twelve knots each, their distance apart is changing at the rate of 13⅓ yards per second. This means that in less than 4 seconds the distance or range will change 50 yards, which represents the distance apart of two consecutive graduations of the sight-bar of a modern rifle-gun: in other words, the sight-bars of high-powered guns are usually graduated to 50 yards, and it is necessary for effective shooting that an error of 50 yards must not be made in estimating the distance and timing the discharge of the gun as the ship rolls from side to side. But if this change of 50 yards be made in 4 seconds, it is plain that we must have an instrument that will give the range with less than 4 seconds' delay, and give it, at the very least, with less than 50 yards error. Such an instrument is called a "range-finder." A description of a new and exceedingly clever, as well as thoroughly scientific device, for ascertaining the range and position of distant objects, designed by Lieut. Bradley Allan Fiske, forms the subject of this article.

The invention consists of a new method of finding the range and position of a distant object, which depends upon the determination of a fractional portion of a conducting body bearing in length a ratio to the angle included between two lines of sight directed upon said distant object and the measurement of the electrical resistance of said length.

The accompanying drawings are (Fig. 4 excepted) all electrical diagrams, not drawn to scale, and symbolically represent the invention. In Fig. 1 is shown a Wheatstone bridge, in one member (a) of which is arranged a body of conducting material in arc form, and a movable arm traversing the same. In Fig. 2 is shown a Wheatstone bridge having arcs and movable arms arranged in two members, a b. In Fig. 3 is shown a Wheatstone bridge in which arcs connect adjacent members, as a c and b d, and movable arms sweeping over said arcs are connected to the battery. Fig. 4 is a mathematical diagram illustrating the method of determining the angle ATC. Fig. 5 shows a disposition of the range-finder in connection with a dead-beat galvanometer; and Fig. 6, the same in connection with the slider. Similar letters of reference indicate like parts.

In Fig. 1, let a b c d represent the four members of an ordinary Wheatstone bridge, and g the transverse member, in which is connected the galvanometer g'. A battery f is also connected to the bridge in the usual way. In the members c and d are placed the fixed resistances c' and d', and in the member b the variable resistance b' also, as usual. One wire from battery f, however, connects to the end of member c, and also to the pivot l of a swinging arm i. The extremity k of arm i moves over and maintains electrical contact with an arc h of conducting material, which has one extremity j connected, as shown, to the member a of the bridge. It is obvious that when the arm i is in the position shown in full lines in Fig. 1, then the current will traverse the whole arc h; and when said arm is in the position indicated by dotted lines (Fig. 1), then the arc h will be cut out, and the current will pass directly to member a. Now assume the arc h to be made of such material, and so proportioned that its electrical resistance to a current traversing it will be proportional to the length of arc included between the contact end k of arm i and the connecting-point j of member a with said arc. Therefore the resistance interposed in the member a of the bridge will be commensurate with the angle j l k; and if this resistance be known, the angle is also known. Let it now be assumed that the galvanometer g' and variable resistance b' be located at some point distant from the moving arm i, from which said arm is invisible or inaccessible. Clearly, then, an observer stationed at the galvanometer g' and resistance b' can, by noting the galvanometer and adjusting the resistance in the usual way, determine the resistance equilibrating any position of arm i along the arc h, and so discover the angle of adjustment of said arc; or, having adjusted the resistance b' at some given figure, the observer may, by simply noting the galvanometer or any other suitable indicating device, visual or audible, determine when the arm i is placed at a desired angle corresponding to the adjusted resistance, and this indicating device may obviously be at the place where the moving arm is located, so that the operator there may thus know when he has placed the arm at the predetermined point or at the distant station, so that the operator in charge of the resistance b' may know that the arm has been adjusted properly; or two indicating devices in the same circuit may give warning to both operators, as above, simultaneously.

Referring now to Fig. 2, it will be apparent, that, in lieu of the variable resistance b' in the member b, there is arranged an arc h' and swinging arm i'. The arc h' is connected at one end j' to the member b, and the swinging arm i' makes contact at one end k' with said arc, and to its pivot l' is connected the member d. The arrangement and construction of arc h' and arm i' are similar to those of arc h and arm i: consequently, when the arm i is set at a certain point on the arc h, the arm i' must be set at the corresponding point on the arc h', in order that the resistance of the lengths of the arcs h h' respectively between the point k and point h and point k' and point h' may balance; hence, if the arm k be set at a certain angle, the observer at arm k may recognize that angle by noting the position of the arm k and the galvanometer, as before. It will be observed, however, that the effect of moving the arm i over arc h is practically to lengthen or shorten or to interpose more or less resistance in the member a of the bridge, and by

operating the arm i' a like effect is produced in the member b. The resistances or lengths of the members c and d remain unchanged.

Referring now to Fig. 3, there is shown an arrangement which forms the basis of the specific embodiment of the invention, more particularly hereinafter described. In said Fig. 3 the arc h is connected at its respective ends j J to the members a c, and the arc h' is similarly connected at j' J' to the members b d. The battery-wires connect to the pivots l l' of the arms i i', as before. Now, when the arm i is moved from its middle position on its arc toward j, less resistance is caused in the member a, and more resistance in member c; and when moved in the opposite direction, the reverse occurs. So, also, a similar effect is produced by moving arm i'; and thus the resistance offered by all four members of the bridge may be affected instead of that due to only two of them, and differential results may be obtained, as will more fully be apparent in the following description of a device for measuring distances, such as a range-finder for guns.

Referring to Fig. 4, let T be the position of the object the distance of which from the point A it is desired to ascertain. Let AB be any short base-line. Draw AC at right angles to BT, EA parallel to BT, and prolong AT as to D. By trigonometry

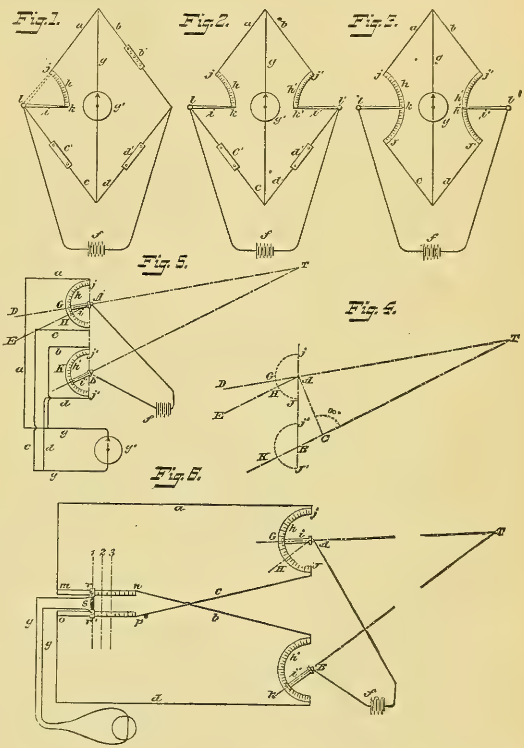
$$\left.\begin{matrix}\mathrm{AC}=\mathrm{AT}\ \sin\ \mathrm{ATC}\\ \mathrm{AT}=\mathrm{AC}\ \mathrm{cosec}\ \mathrm{ATC}\end{matrix}\right\}\ \text{and}\ \left\{\begin{matrix}\mathrm{AC}=\mathrm{AB}\ \sin\ \mathrm{ABC},\ \text{whence}\\ \mathrm{AT}=\mathrm{AB}\ \sin\ \mathrm{ABC}\ \mathrm{cosec}\ \mathrm{ATC}.\end{matrix}\right.$$

AB, being the measured base-line, is known, and the angle ABC at the point of observation is easily determined, so that the angle ATC remains to be found; but ATC=DAE, and DAE is subtended and measured by the arc GH. Arc GH=arc jH—arc jG, and arc jH=arc J'K: hence arc GH=arc j'K—arc jG.

In Fig. 5 the diagrams Figs. 3 and 4 are combined; i i', as before, being swinging arms traversing the arcs h h', and the connections a b c d of the bridge being present also, as before. Let the arms i and i' represent alidade-arms or telescopes, both directed upon the object T. The arcs jG and j'K not being equal. the bridge will not balance; but when the telescope i is moved to the line EH, then the bridge will balance; but the distance thus moved is the arc GH, the length of which may be read off from the arc h itself. It will be seen, therefore, that the operation of determining the distance AT becomes, by the aid of this apparatus, exceedingly simple. The observers at the respective telescopes i and i' direct their lines of sight upon the object. The observer at i notes the angle jAG, or length of arc jG. He then moves the telescope i until the galvanometer g', which may be placed conveniently near his position, shows no deflection, and notes the angle jAH, or length of arc jH. The difference between the arcs jG and jH equals the arc GH, whence the angle ATB, and hence the distance AT, is found by the observer at the arm i, or, in other words, by an observer at the base-line. The disposition of the apparatus whereby an observer at a point distant from said base-line may at once read off the distance AT from a suitable scale will now be explained.

Referring to Fig. 6, the members a and b of the bridge are connected to opposite extremities of a bar m n of conducting material and the members c d are connected to the extremities of a similar and parallel bar o p. Adjustable upon said bars o p and m n is a slider r r', having a middle portion s of insulating material, so that the current from bar m n, for example, does not pass across said slider r r' to bar o p, but proceeds by the wire g through the galvanometer g''. Suppose, now, that the telescopes i and i' are sighted upon the distant object T, as before, and that the slider r is at the middle point 1 of the parallel bars m n and o p: the resistances in the bridge will obviously not balance. It has already been explained in connection with Fig. 5, how, by moving telescope i to the point H, the resistances might be balanced; and if that were done, with the arrangement shown in Fig. 6, the fact would obviously be indicated by a deflection of the galvanometer-needle; but now let it be assumed that the telescope i, after being sighted upon the object T, is not moved, or, in other words, that the observers respectively at the two telescopes i and i' simply adjust their instruments in line with T. Obviously, then, the distance of the bridge from r to G (member a) is less than the distance from r to k (member b) by the length of the arc GH. Similarly the distance on the bridge from r' to G (member c) is greater than the distance from r' to k (member d) by the length of arc GH.

Now let the resistance per unit length of the bars m n o p be made equal to or with some definite relation to the resistance per unit length of the arcs h h', and lay off on bar m n a distance r 3 and on bar o p a distance r' 3, said distances being such that the resistance due thereto will be equal to that of the arc GH. Clearly, if the end r of the slider be moved to the position 2 on bar m n, the member a will be increased and the member b will be diminished by the distance r 2, which offers a resistance equal to one-half that of arc GH; and if the end r' of the slider be moved to the position 2 on bar o p, then the member c will be decreased and the member d increased by the distance r' 2, which also has a resistance equal to one-half of arc GH. As both ends of the slider move simultaneously, it follows that when its extremities are



adjusted in the position 2, then the bridge will balance and the galvanometer-needle will again be at zero. Applying this practically, let the bars m n o p be laid off in suitable scale-divisions from r to n and i' to p. The two telescopes i and i' being sighted on the object, the distant observer watches the needle, and moves the slider r r' along the bars m n o p until it returns to zero. The scale marked on the bars then shows an indication corresponding to the length of arc GH, or, if desired, actual distances corresponding to such indications.

If the object be moving, the operation of determining its distance is as easy as though it were stationary, and the indications are instantaneous and continuous. With a 290-foot base-line on board the "Chicago," one instrument being mounted in the bow and one in the stern, the average error in the official trial before a board of electrical and gunnery experts was less than six-tenths of one per cent. The set of instruments about being sent to the "Baltimore" is expected to give still more accurate results.

BOOK-REVIEWS.

The Chemistry of Photography. By RAPHAEL MELDOLA, F.R.S. New York, Macmillan & Co. 12°. $2.

THIS book consists of nine lectures which were delivered as a special course at the Finsbury Technical College. With the chemistry of photographic materials, their preparation, properties, and re-actions, and with the practical details of photographic manipulation, the author does not deal, but confines his attention to the consideration of the chemical changes which occur in photographic processes, or the chemistry of photography, properly so called. His object is to present the principles involved in these processes, to show what point has been reached in the explanation of them, and to stimulate further investigation. He hopes, too, "that the present work may contribute toward convincing" purely scientific chemists "that there are many important problems still awaiting solution in this field of research." Each lecture is followed by an appendix containing directions for performing well-selected experiments in illustration of the text. As the lectures were originally addressed to an audience of chemical students and photographers, some elementary knowledge of chemistry is assumed.

The amateur picture-maker who is content "to push the button" and let some professional photographer "do the rest," or who has no ambition beyond the knowledge of the simple manipulative details which enable him to mix his solutions successfully and make passable photographs, will find little to interest him in this book. But all who have felt the real fascination of the "dark room," and desire to know more of the nature of the mysterious action of light and the "developer" on the responsive film, will give it a hearty welcome. The reader must not, however, look to have all his questions satisfactorily answered, or all his difficulties solved; for the subtile re-actions caused by light in the salts of silver are among the most perplexing problems known to chemistry, and photochemical theories are to a large extent still in the speculative stage. Mr. Meldola does not attempt to conceal this fact. He distinctly and repeatedly points out the insufficiency of certain hypotheses in regard to the nature of photochemical processes, and, as it happens, gives in his own constructive efforts one or two striking illustrations of the difficulties which beset the theorist in this obscure region, and tend to lift his feet from the solid ground of experimental facts. It should be said, however, that his theoretical suggestions are free from any undue assertiveness, and are advanced chiefly from the motive that they "may serve as a stimulus to further experimental inquiry" (p. 214). They will perhaps attain this object quite as much through their evident inadequacy and the criticism they will undoubtedly provoke as in any other and more direct way.

Lecture II. is devoted to the discussion of the composition of the darkened product formed from silver chloride under the influence of light. This is a subject of fundamental importance, for the identity of the material of the latent image with this darkened substance is universally admitted. Mr. Meldola rejects the generally accepted subchloride theory, and attempts to show that the product in question is probably an oxy-chloride. The argument against the subchloride is that its existence "is only inferred from the analogy with the metals of the copper group, and is not the result of the analysis of the pure compound" (p. 40). This is hardly a fair statement of the case. It is true that the argument from analogy is flimsy: it does not deserve the attention the author bestows upon it. It is true that no satisfactory direct proof of the existence of the subchloride has been obtained through its isolation and complete analysis; but it is also true that the loss of chlorine which occurs when silver chloride is exposed to light, and the fact that metallic silver is not the result of the action, as well as the whole mass of observation on the effect of light on this and other salts, indicate very strongly that the darkened substance is a *reduction product;* and Cary Lea's brilliant work, two or three years since, on the photo-salts of silver, furnishes weighty evidence that this product is a subchloride united with a larger amount of unchanged normal salt after the manner of a "lake." The most that can reasonably be said against the subchloride theory is that it is not yet absolutely proven by the isolation and analysis of the substance. This is no sufficient ground for its rejection, unless a better theory can be formulated. Mr. Meldola thinks that such is found in the hypothesis that the change produced by light is probably due to the formation of an oxy-chloride of the formula $Ag_4\,O\,Cl_2$. This he supports on an experiment of Robert Hunt's in which oxygen was found to disappear during the darkening of silver chloride, some conclusions of Dr. W. R. Hodgkinson the experimental evidence for which does not seem to have been yet published, and an appeal to the analogy supplied by the darkening of thallous and cuprous chlorides on exposure to light; the change in the case of the latter "being in all probability due to the formation of an oxy-chloride" (p. 57).

Now, not only is direct proof of the existence of the alleged oxy-chloride wanting, but its formation during the action of light is opposed to all the evidence which points to the reducing nature of that action; for the oxy-chloride is in no sense a reduction product, oxygen simply taking the place of chlorine in a complex molecule.

The hypothesis is further in direct contradiction to certain well-known facts which the author has apparently overlooked in his study of the matter, though he gives them place in the discussion of other points. Thus on p. 75 it is stated that hydrogen acts as a sensitizer, accelerating the photo-decomposition of silver chloride; on p. 227, that action goes on under a film of benzene even to the point of reversal; and again on p. 197, that the invisible image is destroyed by oxidizing agents. An action which takes place in hydrogen, or under a liquid destitute of oxygen, and which is undone by oxidizing agents, can hardly consist in formation of an oxy-chloride. It is, in fact, a weak and untenable hypothesis. Not only does it offer the same difficulty which Mr. Meldola urges as a chief argument against the subchloride theory, but it breaks down completely when confronted with facts which the latter readily explains. It is interesting to note that since the appearance of the book, Mr. Lea has published in the *American Journal of Science* a clever bit of experimental work which disposes of the oxy-chloride hypothesis in the most final manner. Mr. Lea found that silver chloride, poured in the molten condition into naphtha, blackened instantly in sunlight, and that a black iodine product was formed by the action of light on metallic silver covered with naphtha containing iodine in solution; that is, the darkened substance is produced under conditions which rigorously exclude all possibility of the presence of moisture or of oxygen in any shape.

In his discussion of the action involved in the reversal of the image on the photographic plate under prolonged exposure to light, or "solarization," as it is often called, the author again shows his lack of that comprehensive grasp of facts and principles which is an essential qualification for all sound theorizing.

The explanation which he proposes for this most perplexing phenomenon is, that in a gelatino-bromide plate, for instance, the bromine lost at first by the silver salt under the influence of light is taken up by the gelatine in which the salt is embedded, until "the vehicle becomes brominated up to a certain degree of saturation; complex bromo-derivatives, or additive compounds, or oxidized products, are formed, and these at length begin to re-act with the reduction product aided by the external oxygen" (p. 225). His conception of the mechanism of the process is clearly given in the closing sentences of Lecture VI.: "A ray of light falling upon a sensitive plate is like the motive power driving a dynamo-machine which is feeding a storage-cell. When the charge of the latter has reached a certain point, it is capable of reversing the motion of the system, and of converting the dynamo into a motor. The sensitizer plays the part of such a storage-cell. When it becomes charged, i.e., halogenized, to a certain amount, the chemical energy stored up in it begins to run down, and reversal takes place." Or, to take an equally pertinent but simpler illustration, the ray of light is like a weight resting on a piston which works in a cylinder full of air. The piston sinks under the weight; but when the compression of the air has reached a certain point, it is capable of reversing the motion of the piston and raising the weight! It does not require a scientific training to see that this is absurd. It is a scheme for perpetual motion. We have every reason for believing that the law of the conservation of energy applies to chemical as well as to mechanical action, and it is obvious that under this law Mr. Meldola's explanation is preposterous.

Aside from these unfortunate ventures, speculative regions, and a certain tendency to looseness of statement, which is, however, in most cases annoying rather than misleading, we find much to commend in the book. It presents the most complete and connected discussion of photochemical theories with which we are acquainted, is in the main accurate in its statements of experimental facts and the explanations which have been proposed for them, and thus forms an important and valuable contribution to the literature of the subject. It is rich in suggestion to the chemist, and will undoubtedly fulfil the author's hope of attracting new workers to this field for experimental inquiry.

Evolution. Popular Lectures and Discussions before the Brooklyn Ethical Association. Boston, James H. West. 12°. $2.

THIS book consists of fifteen different papers, originally prepared for a popular audience, but designed to present the evolution theory in a thorough and scientific manner. They are by many different authors, and deal with all the leading aspects of the subject. The two opening papers treat of the life and work of the two chief expounders of the new doctrine, Darwin and Spencer; then follow others on the evolution of the earth and the solar system; then the biological department is dealt with; while a considerable portion of the book is devoted to the evolution of morals, religion, and society. The essays, or lectures, are in the main well adapted to the special object in view, that of making evolutionary doctrines better known to popular audiences and general readers; for the writers seem to have taken pains to make their subject plain, and to have had good success in doing so. Each lecture, as originally delivered, was followed by a discussion, in which views opposed to those of the lecturer, and even to the evolution theory generally, were sometimes expressed, and which seem to have been of considerable interest; but the report of them in this volume is rather too brief to give an adequate idea of them.

The views expressed in the various lectures are, of course, in the main those of Darwin and Spencer; but we notice, nevertheless, a decided disagreement with those thinkers on certain points. Thus Professor Raymond regards the theory of natural selection as inadequate to account for the derivation of species, and intimates that "Darwin's formula left out more important factors than any of those it contained;" and Professor Cope expressed a similar opinion. Again, Mr. Chadwick, speaking of Spencer's proposed reconciliation of science and religion, says that he "cannot conceive a more senseless and ridiculous reconciliation than this;" and he elsewhere speaks of it as "the disreputable compromise between science and religion." We notice, as the most prominent fact in the series of discussions, that when the subject of religion was introduced, a great divergence of opinion was immediately manifest; one, at least, of the speakers expressing the extremest materialistic views, while the views of others were strongly spiritualistic, and of others still pantheistic. Indeed, it looks very much as if the evolution school was likely to divide, as the Hegelian school did after its founder's death, into three distinct branches, — one theistic, another pantheistic, and the third atheistic. However, we have no desire to set up as prophets; and so we close by recommending this collection of essays to those who wish for a simple but accurate exposition of the evolutionary philosophy.

An Appeal to Pharaoh. The Negro Problem and its Radical Solution. New York, Fords, Howard, & Hulbert. 16°. $1.

THE anonymous author of this work is very much troubled about the negro problem, and he here devotes two hundred pages to a proposed solution of it. He dwells at great length on the fact that the black and the white races in this country show no sign of intermingling even socially, and paints in extraordinary colors the antipathy that exists between them. He maintains that in the Southern States the two races are farther apart in feeling, and less disposed to social intercourse with each other, than they were when slavery prevailed; and he fears that this estrangement will increase with the progress of time. In the North, too, he asserts that the separation of the two races is scarcely less marked; and for this race antipathy there is, in his opinion, no cure. Moreover, he predicts that all sorts of evils will result from this antipathy in the future; that race conflicts of one kind or another will continually arise; and that there will never be harmony between the North and South till the negro is got rid of. And so he proposes to send the whole body of seven million blacks back to Africa, whether they will or no. A colony is to be planted on the Kongo or somewhere else, and the negroes are to be transported thither, the United States paying for their passage, and also furnishing them a little money with which to begin their new life. The author fears that his scheme will be pronounced impracticable, and devotes a great deal of space to showing how it could be put into execution. To our mind, however, the scheme is not so much impracticable as inhuman; though its inhumanity is perhaps exceeded by its silliness. If the negroes should choose to emigrate, there is no objection to their doing so; but this proposal to compel them to go is one to which the American people will not listen. The negro is here to stay, and men like the author of this book must make up their minds to treat him with justice and fairness; and when they do so, all danger of trouble between the two races will disappear.

The Psychology of Attention. By Th. RIBOT. Chicago, Open Court Publ. Co. 12°. 75 cents.

THIS work is an authorized translation from the French, and originally appeared in the pages of the *Open Court*. It might better have been entitled the "physiology" of attention, for it treats almost entirely of the motions and other physical phenomena that accompany attention, and has very little to say about attention itself. The author defines attention as "an intellectual state, exclusive or predominant, with spontaneous or artificial adaptation of the individual;" yet when he comes to treat the subject he neglects the intellectual state entirely, and confines himself to its physical and emotional accompaniments. The thesis that he attempts to prove is that every species of attention is invariably accompanied by certain motor changes in the bodily frame, and that these are so essential to attention that they may almost be said to constitute it. In other words, after defining attention as an intellectual state, M. Ribot treats it as if it was a bodily state. Moreover, he fails to show that attention is always accompanied by motions or motor phenomena. Of course, in the case of sense-perception the motor element in attention is apparent; but in the case of abstract thought it is not at all apparent to the ordinary consciousness, and M. Ribot does not make it any more so. Nevertheless there is much in his book that will be interesting, especially to students of psychophysics. The work is divided into three parts, treating successively of spontaneous, voluntary, and morbid attention; and under all these heads are presented facts and ideas that will serve towards a more perfect theory of attention hereafter.

AMONG THE PUBLISHERS.

THE supplement to *Harper's Weekly* of Jan. 18 contains an interesting article on recent discoveries in the Kongo basin, detailing "the geographical surprises and new-found peoples of the past five years." The article is from the pen of C. C. Adams, and is illustrated by a large map and several other engravings.

— The picturesque forest pavilion at the Paris Exposition is illustrated and described in *Garden and Forest* for Jan. 15, where we find, as well, an account of the delightful voyage down the Rhone, so seldom made by tourists, and a picture of a positively unique orchid, *Phalænopsis F. L. Ames.*

— The closing volume of C. A. Fyffe's "History of Modern Europe" is now in the hands of Cassell & Co. The volume embraces the period from 1848 to 1878, and throws, we understand, considerable light on the complex problems in European politics which led to the Franco-Prussian war.

— More than twelve thousand letters and manuscripts of John Ericsson, the great engineer, have been put in the hands of Col. W. C. Church, to use in the preparation of his biography. The first of two articles on Ericsson, by Col. Church, will appear in the February *Scribner's*, with some illustrations from rare sources, among them the reproduction of an engraving made by Ericsson at the age of eighteen. G. Frederick Wright, president of Oberlin College, will have a short article on the curious and very ancient image thrown up not long ago by an artesian well at Nampa, Idaho.

— Robert Clarke & Co. announce the following important publications: "Fort Ancient," an account of the great prehistoric earthwork of Warren County, O., by Warren K. Moorhead of the Smithsonian Institution; "A History of the Girtys," the curious record of certain "renegades" of the American revolution, by Willshire Butterfield; and "Monographs of the Kentucky Geological Survey," by John R. Prooter, director.

— William Hodge & Co., Glasgow, will shortly publish by subscription a book entitled "Trial by Combat," by George Neilson. The author traces the history of the judicial duel in both England and Scotland, and he claims that, by this comparative treatment, he is enabled to throw light on many hitherto unexplained features in the law and practice of both countries. In particular, he deals with the duel on the borders under the march laws, and with the famous combat of the clans on the Inch of Perth, in 1396.

— Francis Galton, F.R.S., contributes an article entitled "Why do we measure Mankind?" to the February number of *Lippincott's Magazine*. Mr. Galton shows the importance of being measured, weighed, and otherwise tested, according to the modern method, by a competent examiner, and especially the importance of applying this system of measurements to young people, in order to determine their capacity and fitness for special pursuits. Another timely article, "The Salon Idea in New York," is contributed by C. H. Crandall. The author thoroughly believes in the *salon* idea, and holds that the *salon* ought to, and perhaps will, become a great power in our social and political life. The former power and influence of the French *salons* are touched upon, and pictures are given of many charming literary drawing-rooms in New York City.

— Messrs. Ginn & Co. announce for publication "Plant Organization," by R. Halsted Ward, M.D., professor of botany in the Rensselaer Polytechnic Institute, Troy, N.Y. This book is a guide to the study of plants. It consists of a synoptical review of the general structure and morphology of plants, clearly drawn out according to biological principles, fully illustrated, and accompanied by a set of blanks for writing-exercises by pupils. It also provides for some easy microscopical work, if desired. Though requiring a very thorough study and exact understanding of the plants which may be selected for study, the work is so systematized and simplified as to be adapted to the use of beginners, in connection with personal instruction or with any text-book of botany however elementary, and either with or without the employment of technical botanical terms. The work, which is designed for private students or for classes in academies, seminaries, high schools, etc., is now issued in a second and revised edition, after having proved its value.

— From Providence, R.I., comes a new monthly, the *Board of Trade Journal*, which will publish from month to month the record of the meetings of the Board of Trade, its reports, business statistics of various kinds, and other matter pertaining to the business interests of Providence and vicinity. The numbers that have already appeared are well gotten up, and full of interesting matter.

— Messrs. Cassell & Co. announce that they have secured the publication of the memorial volume to the late Henry W. Grady. The book, which will be ready for publication within a few weeks, has been compiled by his co-workers on the Atlanta "Constitution," and edited by Joel Chandler Harris. It will contain a complete life of Mr. Grady, and such of his writings and speeches as best represent his gifts as writer and orator.

— With the growth of interest in this country in all out-door sports it is natural to expect an improvement in the supply of articles intended to make the enjoyment of such relaxation the greater. One evidence of this development of a new phase of American life is shown in a catalogue of sportsmen's supplies we have received this week from Henry C. Squires, 178 Broadway, New York. This catalogue is intended for those who, having given little or no thought to out-door sports, desire information. It is supposed that such persons desire to know not merely the prices of articles, but, to some extent, what they want and why they want it. The catalogue aims to give such information as will aid those seeking fire-arms, fishing-tackle, or camping goods in securing what is best suited to their needs. Not only does this catalogue give the prices and describe the goods, but Mr. Squires has introduced a large number of the very best illustrations, picturing scenes incident to out-door sports, and tending to render this catalogue unique in its typographical attractiveness. But this is not all, for these pictures — for they are real pictures, and not the crude cuts so often disfiguring printed pages — are likely to arouse an interest for the life they depict in those who have known little of it, and to rekindle the desires of those who may have put sports aside.

— A. L. Burt has issued a volume on "Fugitive Facts," edited by Robert Thorne. It comprises short articles, alphabetically arranged, on topics constantly arising in conversation and general reading, on which it is hard to find accurate and definite information. The queries in the correspondence departments of periodicals and newspapers have suggested many of the subjects treated. The editor has added an appendix, devoted to short selections of constantly used medical terms and short dictionaries of mythology and music.

— G. P. Putnam's Sons will publish shortly a new volume, in The Story of the Nations Series, entitled "The Story of the Barbary Corsairs," by Stanley Lane Poole, with the collaboration of Lieut. J. D. Jerrold Kelley of the United States Navy; and two new books in The Questions of the Day, on "Railway Secrecy," by John M. Bonham, and "American Farms," by J. R. Elliot.

— The December number of the Riverside Literature Series (published quarterly during the school year 1889–90 at 15 cents a number, by Houghton, Mifflin, & Co., Boston) contains "Waste Not, Want Not, and The Barring Out," from Maria Edgeworth's "Parent's Assistant." The great popularity which the "Parent's Assistant" has had, ever since its publication in 1822, has induced the publishers to include some of the stories from this book in the Riverside Literature Series. The stories selected are interesting and simple: the lessons which they inculcate are the advantage of frugality and the disadvantage of a blind party spirit. The same publishers announce that they have in press for early publication a book by John Fiske on civil government. This book treats in a simple way of the government of towns, cities, states, and the nation, and will be a most valuable book for schools and families.

— Andrew D. White will resume his "New Chapters in the Warfare of Science" in the February *Popular Science Monthly*. The forthcoming chapter will be on "Comparative Mythology." It deals with the myths invented to explain strangely shaped or distributed rocks, taking the story of Lot's wife, which has gone through many curious variations, as a special example. "The Localization of Industries" is the subject of an article by J. J. Menzies, to appear in the February number, which will throw light on the most important problem before Congress this winter. It tells what lessons science draws from the course of industrial evolution in regard to encouraging the establishment of industries in a country. A searching examination of Henry George's taxation doctrine, by Horace White, will appear under the title, "Agriculture and the Single Tax." Mr. White maintains that the interdependence of all industries disposes of the claim that agriculture has enough advantage over other occupations to warrant laying the burden of all taxation upon it, and he asks whether the scheme of "economic rent" would include paying a bounty to farmers whose profits are a minus quantity. A second instalment of "Letters on the Land Question," from Huxley, Spencer, and others, including an especially able review of the question by Auberon Herbert, will be printed.

— Fords, Howard, & Hulbert have published a small volume by Martin W. Cooke on "The Human Mystery in Hamlet," the object of which is to present a new view of the character of Hamlet himself. The theories of Hamlet's character that critics have heretofore advanced are many and various, but Mr. Cooke's theory is quite different from them all. He holds that the dramatist's object in exhibiting the career of Hamlet was to portray "the conflict between his will and his passions, . . . the strife between the higher forces of the being and the lower." Or, as he elsewhere expresses it, "the theme of Hamlet is the interior life of humanity in this world, striving to harmonize its actions with a supernaturally imposed law of rectitude, which it recognizes but ever fails to fulfil." Now, we confess that this theory is less satisfactory to us than any of its predecessors, for we cannot see the least indication of a *moral* conflict in Hamlet's action or conversation — indeed, we should say that the moral element was conspicuously absent; nor can we see the propriety of calling the command of a ghost "a supernaturally imposed law of rectitude." Students of Shakspeare will take an interest in reading Mr. Cooke's work, but we doubt if they will agree with its conclusions.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

Physical Fields.

PROFESSOR DOLBEAR'S interesting article on "Physical Fields," that appeared in your issue of Dec. 27, was called to my notice, and I have read it with considerable attention. It seems to me that he is entirely wrong in some of his premises, and that his conclusions are therefore, some of them, untenable. With your permission, I will point out where I differ with him.

His use of the term "stress" is certainly not correct. He says, under the head of "The Electric Field," "The phenomena are explained as due to the stress into which the neighboring ether is thrown by the electrified body. . . . Experiment shows that this kind of a stress travels outwards with the velocity of 186,000 miles a second, or the same as that of light."

It does not seem to me to be proper to say that a stress travels: it rather exists. In this particular case he is referring to the phenomenon of electrification, which is a static effect or condition. As I understand Maxwell, and Hertz and Thompson and Lodge, they do not any of them believe that electrification involves motion in any way whatever. It is a condition which is dual in its character. The negative exists because of the existence of the positive, not because of propagation from one to another. They also believe that one cannot exist without the other: the very existence of one, therefore, involves the existence of the other. The element of time, and therefore of rate of propagation, must be eliminated entirely.

What he does mean is, that an impulse due to the yielding to this stress is propagated, etc.

Again he says, "If this assumed electrified mass of matter were the only matter in the universe, any electric change in the mass would ultimately re-act upon the whole of space, and be uniform in every direction." This statement involves a contradiction of terms, for how can we have a condition of stress that is uniform throughout all space? It is certainly true that under static conditions, or under conditions of stress generally, where there are two bodies or more concerned, the field is distorted by their mutual re-action (that constitutes the stress); but I maintain that where there is but a single body in space, there can be no such thing as stress in that space outside of the body itself. If the body in question be but a mathematical point, there can be no stress at all. There can be no tension on a cord that is perfectly free to move.

The same criticism is made upon his remarks under the head of "The Magnetic Field." In the case of the magnet the justice of my criticism will be, perhaps, more apparent. Were it possible to conceive of a magnetic particle with but a single pole, could we imagine that pole surrounded by a magnetic field? Our conception of the ultimate particle of magnetic matter endows it with two parts, which re-act upon each other. If there were but a single particle of magnetic matter in space, the "lines of force" would form closed curves within that particle, passing from pole to pole: they could not, without violating all the laws of stress, radiate off into space, as he says they would.

Under the third head, "The Thermal Field," we come to a very different class of phenomena. Here, as in the case of light, we have vibration: we have distinctively a condition of motion of the ethereal medium. We have passed from a state of rest, — a static condition, — a state of potential, to one of movement, — a kinetic condition.

He says, "A hot body has a field, as well as an electrified or a magnetized body:" so it has, but his fundamental and fatal error is in not being able to discriminate between the two kinds of field. The magnetic, the electric, and we may add the field of the force of gravity, are purely static, purely potential, whereas the luminous and thermal fields are kinetic. In the former there can be no propagation, as the element of motion is entirely wanting. Add to these fields of stress the element of motion, and they at once become kinetic, and will then obey the laws of kinetic fields.

A potential field without motion will exist forever: a kinetic field requires the continual addition of energy for its maintenance. Move a magnet, or the earth relatively to any other magnet or body, and kinetic fields are produced. Move an electrified body,

or cause its field to change in any possible way, and we have again a kinetic field.

If, however, there be but a single body in space surrounded by a potential field, the movement of that body, while the movement in itself will constitute kinetic energy, still would not convert the potential energy into kinetic.

He says, "So, if there were but a single hot body in the universe, it would impart its energy to the ether and approach infinitely near absolute zero; while an electrified body or a magnet would be perfectly insulated, and, so far as is known, would lose none of its properties, however long it was thus kept. There is no static condition in heat phenomena: exchange is constant. These facts indicate that light or radiant energy is no more an electro-magnetic phenomenon than magnetism is a thermal phenomenon, but that it is one of a distinct order."

The only difference is that in one case there is stress alone, and in the other there is motion, a yielding of that stress. Take away motion from one, or add motion to the other, and the phenomena are identical in kind.

It is the difference between a reservoir full of water on a hill, and that same water in the act of falling from its elevation. It requires an expenditure of energy to fill the reservoir, — to produce the stress or static or potential condition, — but involves no expenditure of energy to maintain that condition. We have in the elevated reservoir of water the analogue of magnetism, electrification, gravity. Let this water fall from its position, and we have something that corresponds to light, — the galvanic current, heat, etc. It requires the expenditure of energy to get these forms of energy, and it requires the expenditure of energy to maintain them.

We must regard electricity as motion; electrification, one kind of stress which is capable of producing electrical vibrations; magnetism may be another. We may compare magnetism, electrification, and gravitation to different tensions of a given string on a violin; and electricity, light, heat, etc., as the tones produced by that string when struck under these varying tensions.

NELSON W. PERRY.

Cincinnati, O., Jan. 15.

The Orthography of "Alleghany."

THIS name appears in several forms, all of which are in common use; and it goes without saying, that in each particular locality there is a disposition to insist on the local orthography of the word. Thus, in the city and the county in western Pennsylvaina, "Allegheny" is the form officially recognized. In the county of New York, "Allegany" is the adopted form. The range of mountains, however, almost always appears under the form "Alleghany." I know of but one exception to this custom; namely, that used by the Engineer Department of the Pennsylvania Railroad: there the range appears as "Allegheny."

In looking up the history of this word, I found nothing authoritative bearing upon the subject in the literature of the State Geological Survey; but a search among the earlier maps of the State throws light on the subject, a number of which were placed at my disposal through the courtesy of Mr. McAlister of Philadelphia.

On Adlum and Walter's map, 1790, the name appears in one form only, "Allegany." On Reading McDowell's map, 1792, it appears as "Allegheny" mountains and "Allegany" River. On Morris's map, drawn by Barnes, 1848, "Allegheny" is the form used for both river and range.

The first and only early map on which I could find the more common form, "Alleghany," is in Mitchell's "Atlas," edition of 1853. These maps were drawn by Mr. Young, and it is more than likely that the same form appeared on previous editions of this atlas. It is only a matter of justice to say here that Mr. Young was the real author of Mitchell's "Geography" and "Atlas."

Thus it seems that the earliest authorized form of the word is "Allegany." When, however, "Allegheny" was adopted, it was evidently the intention to preserve the long sound of *a* by the French *e*; but, in order to avoid softening the preceding guttural consonant, *h* was interpolated, thereby converting "Allegany" into "Allegheny." Subsequently, when the *a* was again restored, the *h* was needlessly left in the word, — needlessly because there would be no probability of a guttural becoming softened before *a*. It is evident, therefore, that while the change to "Allegheny" may be considered of questionable propriety, the now recent form "Alleghany" is an unauthorized monstrosity.

JACQUES W. REDWAY.

Philadelphia, Jan. 18.

Mocking-Birds' Phrases.

WHILE idling at Colonial Beach last spring, the varied phrases of the mocking-bird attracted my attention. One phrase, "pen and ink, pen and ink, pen and ink" was startlingly articulate, and often repeated. So I took my pencil and noted what I heard. Changes of rhythm and changes of vowel brought out with wonderful clearness all the following phrases, apparently from only two birds. The phrases were interspersed with an occasional trill, a whistle, and a mew.

Hurry up! hurry up! hurry up!
Chip chip chip chip chip!
Teetle teetle teetle teetle!
Birdie birdie birdie birdie!
Pen and ink pen and ink pen and ink!
Twitter twitter twitter!
Take care′ take care′ take care′!
Whit whit whit whit!
Tit it it it it it it!
Pee′wit pee′wit pee′wit!
Chivy chivy chivy!
Look away′ look away′ look away′!
Give′ it up give′ it up!
Wit wit wit wit wit wit wit!
Johny Johny Johny!
Hear hear hear hear hear!
Ladle ladle ladle!
Go there′ go there′ go there′!
Not yet not yet not yet!
Wait a wee wait a wee!
Git out git out git out!
Hooray hooray!
Don't go away don't go away!
Chirrup chirrup chirrup!
Say away say away!
That is just′ it that is just′ it!
Look out look out!
Too too too too!
Tut tut tut tut!
Look here′ look here!
That'll do that'll do!
Wheat wheat wheat!
Chickee′ chickee′ chickee′!
Will you sing′ will you sing′ will you sing′?
Teazle teazle teazle!
Chew chew chew!
Took took took took!
Tweet tweet tweet!
Tik tik tik tik!
Cheep cheep cheep!
Pick it up pick it up!
Beauty beauty beauty!

There were many more, for which I could not on the instant find representative words. I have not attempted to record any from memory. The above were noted just as they were heard.

A. MELVILLE BELL.

Washington, D.C., January, 1890.

Musical Flames.

THE well-known experiment of making sounds by holding a tube over a jet of burning gas (usually hydrogen) is often omitted in chemistry classes because no suitable tubing is at hand. A fact not noted in any text-book I have seen, and unknown to all teachers that I have consulted, has been brought to light in my classes; viz., a bottle will serve in place of a tube. A "philosopher's candle" properly burning will yield a fine sound if capped by a wide-mouthed bottle, as a quinine bottle or large test-tube. Of course, this is according to the principles of acoustics, but it seems strange that no text-book gives it. I should like to know if this fact is known to any one else.

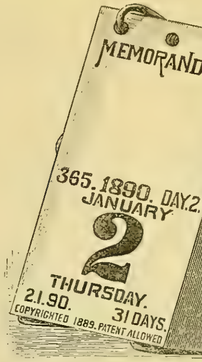
T. BERRY SMITH.

Fayette, Mo., Jan. 14.

INDUSTRIAL NOTES.

The Hulin Diary Calendar.

THIS unique memorandum calendar, manufactured by John S. Hulin, stationer, this city, combines a diary and a calendar in one. It consists of a book of daily leaves, which are made of thin writing paper, so that ink may be used. The upper part of each leaf, and the whole of the underlying page, is left blank, thus furnishing three times the writing space of the ordinary memorandum calendar; and on the lower part is the day of the week, the month, and also the date, in plain letters and large figures, as may be seen in the accompanying cut. The diary calendar is intended to obviate the defects of the ordinary calendar pad, by which (as each page's notes are daily torn off and thrown away), if one wants to recall a circumstance or engagement, look up an address, or verify a date, he has no means of doing so. By the use of this book, however, which (as each daily sheet is turned behind the others) preserves these numerous memoranda, records of events are kept which would otherwise have been thrown away, and which may prove of value some day. A memorandum book for the whole year is thus supplied in which the expired dates are preserved through the year, or as long as may be desired. Each date shows the number of days in each month, and (for the convenience of business-men in figuring interest) the day of the year, thus rendering it easy to calculate the number of days from one date to any other of the cur-



rent or approaching year. On the covers are calendars for the present and coming years, together with a perpetual calendar.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Jan. 18. — Edwin Willits, On the Scientific Work of the Department of Agriculture; J. P. Iddings, On the Relation between the Mineral Composition and the Geological Occurrence of Certain Igneous Rocks in the Yellowstone National Park.

Department of Mineralogy, Brooklyn Institute, Brooklyn, N.Y.

Jan. 22. — George F. Kunz, The Minerals Exhibited at the Paris Exposition.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

I wish to purchase Vol. 7 of the *American Chemical Journal*, either bound or unbound. State price. Address, Wm. L, Dudley, Vanderbilt University, Nashville, Tenn

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmola patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes.etc.,wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred.—James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.— D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write. — J. M. Keck, Chardon, Ohio.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida. — Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

A collection of fifty unclassified shells for the best offer in bird skins; also skins of California birds for those of birds of other localities. Address Th. E. Slevin, 2413 Sacramento St., San Francisco, Cal.

I have forty varieties of birds' eggs, side blown, first class, in sets, with full data, which I will exchange for books, scientific journals, shells, and curios. Write me, stating what you have to offer. — Dr. W. S. STRODE, Bernadotte, Fulton County, Ill.

Lead, zinc, mundic, and calcite. — Lulu Hay, secretary Chapter 350, Carthage, Mo.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

GEOLOGICAL REPORTS.—Where would I be likely to find for sale the 5 "Annual Reports of the Geological Survey of New York," published in 1837–1841, and also the 4 vols. "Geology of New York," published in 1843, and both being issued by the State. Charles Fry, 54 Devonshire St., Boston, Mass.

WANTED.—A position in an Academy, Normal or High School, as teacher of the Natural Sciences and Modern Languages. Latin taught in addition if necessary. Address G., Box 441, Hanover, N.H.

STATISTICS OF LEPROSY IN THE UNITED STATES. — In view of the general impression that leprosy is spreading in this country, it is desirable, in the interest of the public health, to obtain accurate information on this point. The undersigned is engaged in collecting statistics of all cases of leprosy in the United States, and he would ask members of the profession to aid in this work by sending a report of any case or cases under their observation, or coming within their knowledge. Please give location, age, sex, and nationality of the patient, and the form of the disease, — tubercular or anæsthetic; also any facts bearing upon the question of contagion and heredity. Address Dr. Prince A. Morrow, 66 West 40th Street, New York.

WANTED. — The addresses of makers of small Dynamos suitable for a college laboratory. Address, T. S., Box 71, Gambier, Ohio.

WANTED.—To correspond with conchologists in America, especially in California, with a view to exchange. Many British land, fresh water, and marine duplicates; some foreign. Address Mrs. FALLOON, Long Ashton Vicarage, Bristol, England.

A YOUNG SCOTCHMAN desires an appointment in America. Three years in English Government Office. Good references. Address "Jack" care J. Lawson & Coy, 17 Princes St., Aberdeen, Scotland.

I WILL ASSIST in photographic or optical laboratory in return for experience and convenience of perfecting original appliances. Address E. C. Owen, care of Gibson & Simpson, 9½ Adelaide Street East, Toronto, Canada.

AN ANALYTICAL CHEMIST is open to an engagement in mining, metallurgy, calico printing, and bleaching, or as research chemist in alkali manufacture. Address "Alkali," care of SCIENCE.

LIGHTNING. — Concise descriptions of the effects of lightning discharges are desired. State whether the object struck was provided with a lightning rod, the character of the rod, and the way in which it was set up. Beginning at the top, describe briefly the effects. State whether there was any smoke or dust raised, and whether there was any odor. Any reports of recent and of especially interesting discharges will be published in *Science*.—Science, 47 Lafayette Place, New York.

WALKER PRIZES IN NATURAL HISTORY.

The Boston Society of Natural History offers a first prize of from $60 to Sioo, and a second prize cf $50, for the best memoir, in Eng:ish, on one of the following subjects: 1. On the Adaptive Resemblances of Plants in Different Natural Orders. 2. On the Processes Involved in the Production of Soils. Memoirs must be handed to the Secretary before April 15th, 1890. Prizes will not be awarded unless the papers are deemed of adequate merit. For further particulars apply to

J. WALTER FEWKES, Secretary.

Boston, Mass., Dec. 18th, 1889.

One Thousand Dollar Prize!

THE AMERICAN SECULAR UNION offer a prize of ONE THOI SAND DOLLARS for the best essay, tre atise, or manual, to aid teachers in our Public Schools in instructirg children in the purest principles of morality without inculcating religious doctrines. For particulars apply to R. B. WESTBROOK, 1707 Uxford St.

PHILADELPHIA, Nov. 1889.

SCIENCE

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EIGHTH YEAR.
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THE KNEES OF THE BALD CYPRESS: A NEW THEORY OF THEIR FUNCTION.[1]

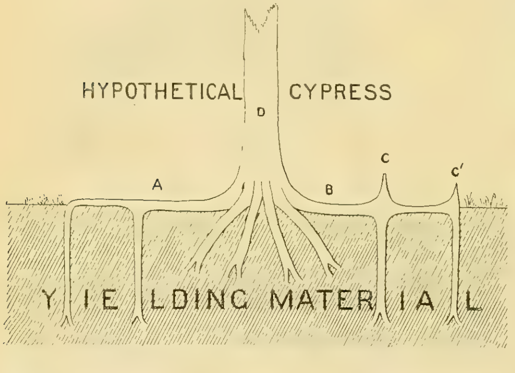
FROM time to time, during and since my first visit to our southern tier of States in 1876, I have examined, sketched, and photographed the roots of the deciduous cypress, the *Taxodium distichum* of Richard. I was attracted to the tree because of the singular beauty of its form and foliage, and by the unusual boldness with which it raises its great gray, smooth column, sometimes over a hundred feet, perpendicularly, above and upon what an engineer would pronounce a most dangerous foundation, — loose submerged sand, the saturated morass, or the soft alluvium of low river-margins. But, notwithstanding this seeming insecurity, I have never found a healthy cypress that had fallen before the fierce hurricanes that sweep through the southern forest-lands. It is a pleasure to follow Bartram in his enthusiastic burst of admiration for this tree as he writes of it in east Florida one hundred and sixteen years ago: "This Cypress is in the first order of North American trees. Its majestic stature is surprising. On approaching it we are struck with a kind of awe at beholding the stateliness of its trunk, lifting its cumbrous top toward the skies and casting a wide shade on the ground as a

DENUDED ROOTS OF THE BALD CYPRESS, SHOWING KNEES AND UNDERGROUND STRUCTURE.

[1] Copyright, 1890, by *Garden and Forest*, through whose courtesy we are able to reproduce it, with the illustrations.

dark intervening cloud, which from time to time excludes the rays of the sun. The delicacy of its color and the texture of its leaves exceed everything in vegetation. . . . Prodigious buttresses branch from the trunk on every side, each of which terminates underground in a very large, strong, serpentine root, which strikes off and branches every way just under the surface of the earth, and from these roots grow woody cones, called Cypress knees, four, five and six feet high, and from six to eighteen inches and two feet in diameter at the base." Elliot (Botany of South Carolina and Georgia, 1824, p. 643) says, "This cypress resists the violence of our autumnal gales better than any other of our forest-trees." By my friend, Dr. J. S. Newberry, whose extended geological labors have led him to examine many widely separated cypress-bearing regions in the Mississippi valley and elsewhere, I am assured that he remembers no instance of the overthrow by the wind of a living *T. distichum.*

The surprising and characteristic temerity of the tree is accompanied by another striking peculiarity: it almost invariably, in soft soils, throws upward from the upper surface of its roots conspicuous protuberances that are known as "cypress knees." Professor Wilson, who has made a careful and valuable study of the species in the forests of southern Florida, and also by cultivation, writes, regarding the formation of these protuberances, "The small roots, which are six or eight inches below the sur-



face, grow upward, . . . and, upon reaching the surface, turn and go down into the soil;" . . . "at each point where the root comes to the surface, begins later the development, on its upper side, of the so-called 'knees.'" In the organ of the Pennsylvania Forest Association *Forest Leaves* (December, 1889), is an excellent article by Professor Wilson on the *T. distichum*, and a remarkably fine engraving of a tree with enormous knees.

These seemingly abnormal growths have attracted much attention, and for more than half a century have furnished an enigma to the solution of which scientific travellers have addressed themselves. Michaux made a careful study of the cypresses, and in his "Sylva," published in 1819, says, "The roots are charged with protuberances eighteen to twenty-four inches high. [I have ridden among them in central Florida in temporarily dry upland basins, where they arose to my breast as I sat upon the saddle, and were not less than seven feet in height above the root.] These protuberances are always hollow, and smooth on the surface, and are covered with a reddish bark, like the roots, which they resemble in softness of wood. They exhibit no sign of vegetation, and I have never succeeded in obtaining shoots by wounding the surface and covering it with earth. They are peculiar to the cypress, and begin to appear when it is twenty to twenty-five feet high." Michaux adds, with the frankness natural to a scientific mind, "No cause can be assigned for their existence." Hoopes says, in his "Book of Evergreens" (1868), "No apparent function for which the knees are adapted has been ascertained." And Veitch, who seems to have studied the protuberances in England, gives in his "Manual" (1881, p. 216) a picture of a tree growing at Ilesworth, surrounded by scores of knees, and says, "They are peculiar to this cypress, and no cause has been assigned for their existence." That the question continued in this unilluminated condition until recently, was shown in 1882, when I had the privilege of visiting, in company with the highest botanical authorities, Dr. Gray, Thomas Meehan, John H. Redfield, John Ball, Professor Carruthers, and others, the classic collection of trees planted by William Bartram on the borders of the Schuylkill. There we examined a fine cypress and the knees it had produced. Dr. Gray then told me that the use to the tree of the knees was unknown. I remarked that they might be a means of raising a point on the root above surrounding water, to the end that a leaf-bearing shoot could readily sprout therefrom. To this suggestion he made the same statement made by Michaux and above recorded. Unaware that the subject had been so thoroughly investigated, I have since that period examined hundreds of living "knees" in southern swamps, and found upon them no trace of bud, leaf, or sprout, except where some seed may have lodged in a decayed or depressed portion of the surface, and there taken root.

In 1887 I had the good fortune to find a number of cypress-trees under such unusual conditions that their aforetime subterranean anatomy could be studied without obstruction; and I reached a conclusion respecting the use to the tree of the protuberances, which I have retained in my note-book, awaiting an opportunity to make some further illustrative sketches before placing it before botanists. Some recent publications on the subject, by widely and favorably known authors, have, however, ascribed to the cypress-knees the sole function of aërating the sap of the parent tree, and this idea bids fair to become embedded in botanical literature. Therefore this communication comes to you earlier than I had purposed sending it.

Stretches of the shore of Lake Monroe, in central Florida, are closely set with large cypress-trees. They grow in various kinds of bottom,—clay, mud, and sand. Those of which I shall here speak stood in sand so loose that, when the level of the water was lowered, the waves readily washed it away, and carried it into the depths of the lake. Some four vertical feet of the root-system was thus finely exposed. After several days spent in examining a score or more large trees that had been thus denuded, I became convinced that the most important function of the cypress knee is to stiffen and strengthen the root, in order that a great tree may anchor itself safely in a yielding material.

The word "anchor" is indeed an apt one here; for the living root, curved to its work, and firmly grasping the sandy bottom, suggests vividly the best bower-anchor that a man-of-war may throw into similar loose sands, when threatened by the very atmospheric forces that the *Taxodium* has been fitting itself to resist since tertiary times. Professor Shaler, in a most interesting treatise on the nature and associations of *T. distichum*, shows that the cypress which existed in the miocene age has since then probably gradually changed its habitat from the drier ground to to the swamp areas.

Truly a most admirable and economical arrangement to stiffen and strengthen the connection between the shank of the anchor and its fluke is this knee; and usually in the living anchor the fluke branches or broadens as it descends, so that its effectiveness is greatly increased, like the sailor's anchor of many flukes, or the "mushroom anchor" that he may have learned to depend upon where the bottom is softest.

The accompanying picture is from a photograph that I made in 1887 of the lower portion of a tree that rises some seventy feet above the shore line of Lake Monroe. The original surface of the sand was near the level of the higher roots. The picture shows the manner in which this peculiar species throws out horizontal roots from its conical (usually hollow) buttressed base. At different distances from this conical base these horizontal roots project strong branches more or less perpendicularly into the earth. Where such perpendicular "flukes" branch from the main horizontal "shank," it will be seen, there is formed a large knob, which is the "knee" under discussion This knee, when fully developed, is generally hollow, comparatively soft, gnarled, and very difficult to rupture, so that it has the quality

of a spring that becomes more rigid as it is extended or compressed out of its normal shape. My friend Thomas Meehan informs me (Dec. 17, 1889) that he has "observed a case where the interior hollow makes an annual layer of bark equally with the exterior," and he is of the opinion that "it is by the decay of the outer layer of this inside course of bark after several years that the knob becomes hollow." If this habit is general, it is an admirable means of forming and of preserving undecayed, at the smallest cost to the tree, a living elastic strengthener at the forking of the roots. When in a hurricane the great tree rocks back and forth on its base, and with its immense leverage pulls upon this odd-shaped wooden anchor, instead of straightening out in the soft material, as an ordinary root might, thus allowing the tree to lean over and add its weight to the destructive force of the storm, it grips the sand as the bower-anchor would do, and resists every motion. The elasticity at the point of junction allows one after another of the perpendicular flukes attached to the same shank to come into effective action, so that before being drawn from the sand or ruptured the combined flukes present an enormous resistance.

The drawing opposite I have made for the purpose of simplifying the discussion. It shows an hypothetical cypress with two roots of the same length and diameter,— one with knees, the other without them. The superior strength of the stiffened root would seem sufficiently evident; but, with the view of obtaining the judgment of a mind thoroughly trained in questions of this nature, I submitted the drawing to my friend, Charles Macdonald, late director of the American Society of Civil Engineers, whose eye has been accustomed to estimating the value of strains in structures by an active experience of twenty-five years, and who has just finished the largest drawbridge in America, at New London. Mr. Macdonald ageeed with me that the root B, which is trussed with the knees C and C′, would very largely exceed in capacity for holding the tree firmly in yielding material the root A, which is similar but destitute of knees. This greatly increased security against destruction by storms is, I think, a sufficient advantage to account for the existence and maintenance of an organ that draws so slightly upon the vitality of the plant.

It is proper to record here another observation that may explain the existence of the elevated, narrow point which the knee sometimes develops, and which rises higher than the curved growth that would be necessary to secure the maximum resistance to compression and extension. The home of the cypress is in broad level river-margins subject to periodic overflow, where hundreds of square miles become covered with a shallow bed of slowly moving water, or in basin-like depressions, sometimes of vast extent, where from time to time water rises above the level of the horizontal roots. Then these stake-like protuberances, rising into and through the current formed by the drainage or by the winds, catch and hold around the roots of the parent trees many thousand pounds of "plant-food" in the form of reeds and grass, or small twigs among which dead leaves become entangled. The tree that exclusively possesses this source of nutrition is at an advantage over all others in the neighborhood; and the higher these attenuated "drift-catchers" rise in the stream, the more drift will they arrest, for the highest stratum of water is richest in float. The theory that some distinguised writers have suggested that the knee is a factor in the aëration of the sap and that the tree's death is prevented by such aëration taking place in the upper portion of the knee during periods of high water, would seem to need careful experimental confirmation. Where Nature forms an organ whose purpose is to preserve the life of the individual, she takes special care to adapt such organ to the function it is depended upon to perform. In this case the rough, dry bark of the knee offers a most imperfect means of access for the oxygen or other gases of the atmosphere to the interior vessels of the plant, and instead of presenting broad surfaces of permeable membrane, formed for transmitting elastic fluids, at its upper extremity the protuberance becomes more narrow, and presents less surface as it rises, so that when, during periods of high water, the life of the tree is most jeopardized, the life-saving organ attains its minimum capacity. In the presence of this manifest want of adaptation, it also seems important for the acceptance of the aërating theory, that some one should experimentally show that the aërating organ of the cypress really aërates to an extent sufficient to make it of material advantage to the plant. The chemical theory of the cypress knee seems to be but a revival of the elaborate hypothesis of Dickinson and Brown, published in their memoir on *T. distichum* in the *American Journal of Science and Arts*, in January, 1848. These industrious observers discard the mechanical theory entirely, and consider both the spongy knees, and, strangely enough, even the spreading base of the tree, as organs of communication with the air, forgetful that the successful and most celebrated lighthouse in the world—the Eddystone—was avowedly modelled after a similar spreading tree-base for the purpose of withstanding the storm shocks of the English Channel. By means of a curious drawing they show how the swollen portions of the base rise "to the top of the highest water level, which must, in some instances, attain an elevation of at least twenty-five feet;" thus continuing the functions and the structure of the knees, "up the body of the tree to the atmosphere."

It was long ago observed that no knees are developed when the tree grows in upland upon a firm bottom, in which ordinary simple roots can obtain in the ordinary way the hold necessary to resist overturning forces, and where there is no stratum of water to transport food. So conservative is Nature, that she reverts to an original or adopts a simpler form of root even in a single generation, if the need for the more complicated arrangement ceases to exist.

Finally, I may perhaps be permitted to add an observation regarding the roots of other trees that trench upon the same soils affected by the cypress, and often take advantage of the anchors it sets so boldly in treacherous bottoms. These trees project their cable-like, flexible roots in every direction horizontally, interlacing continually until a fabric is woven on the surface of the soft earth like the tangled web of a gigantic basket. Out of this close wicker-work, firmly attached to it, and dependent for their support upon its integrity, rise the tree-trunks. Thus slowly, and by a community of growth and action, a structure is formed that supplies for each tree a means of resisting the storms. Such communities of trees, provided with ordinary roots, advance against and overcome enemies where singly they would perish in the conflict. The cyclone, the loose sand, the morass,— these are the enemies they contend with, as it were, in unbroken phalanx, shoulder to shoulder, their shields locked, their spears bristling against the foe; but the graceful plumed cypress, the knight-errant of the sylvan host, bearing with him his trusty anchor,— the emblem of hope,— goes forth alone and defiant, afar from his fellows, scorning the methods of his vassals, and planting himself boldly amid a waste of waters, where no other tree dare venture, stands, age after age, erect, isolated, but ever ready to do battle with the elements. Twenty centuries of driving rain and snow and fierce hurricane beat upon his towering form, and yet he stands the there, stern, gray, and solitary sentinel of the morass, clinging to the quaking earth with the grasp of Hercules, to whom men were building temples when his wardenship began.

ROBERT H. LAMBORN.

THE GESNER RUST-PROOF PROCESS.

IN *Science* of Dec. 27, 1889, we printed a report by Professor Haupt on the hydrogen process of protecting iron against corrosion. Since that report was made, a long and exhaustive series of experiments have been carried out by Dr. G. W. Gesner of this city, with the result of greatly improving the process, making it more uniform in its effects, simpler in operation, and less expensive in cost. The general features of the process are the same as described in Professor Haupt's reports, but the operations have been so simplified that the process may now be worked on a commercial scale by any workingman or laborer of ordinary intelligence, after a little practice and instruction.

Dr. Gesner has now in constant operation in Brooklyn a plant

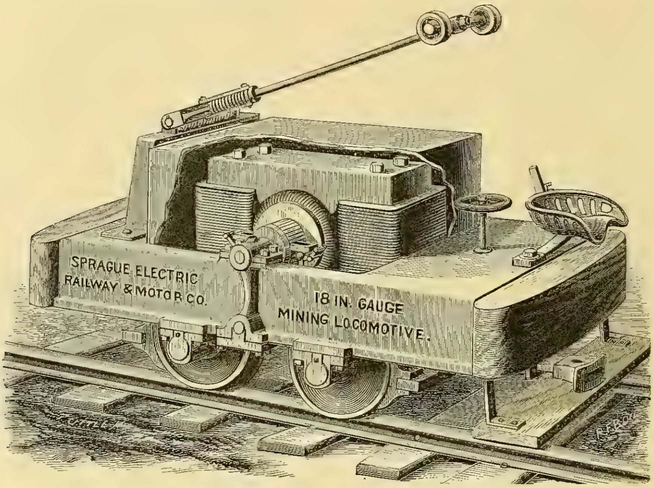
for the treatment of iron and steel by this process. As the plant is small at present, attention is mainly given to small articles, such as steel and iron shingles for roofing, builders' hardware, artistic ironwork, furniture springs, polished parts of steam-engines and other machinery, boiler-tubes, nuts and bolts, water-meters, steam-radiators, and similar easily handled articles; but the intention is to apply the process, on a larger scale, to architectural and structural iron and steel, telegraph wire, and probably to iron and steel plates for boiler construction, ship-building, and similar uses.

As described by Professor Haupt and Dr. Gesner, this process does not produce a magnetic oxide upon the surface of the metal, as is the case in other processes for making iron rust-proof, nor does it alter the dimensions of the articles treated. It changes the body of the surface of the metal into a compound of hydrogen, iron, and carbon, which is designated a double carbide of hydrogen and iron, as determined by analysis. Being an integral part of the metal, it cannot scale or peel off; and it prevents indefinitely the rusting of the metal through exposure to the weather, steam, damp earth, etc. It is also found that cast iron is to some extent annealed in the process, and its pores filled, so that thin cast-iron pipe which before treatment would leak at five pounds pressure per square inch, will stand a pressure of fifty pounds without leakage after undergoing the process. It also improves the quality of steel.

The following is the report of Barton H. Coffey, M.E., of the Henry Warden Iron Works, Philadelphia, on the results of tests to determine the effect of the hydrogen treatment on the physical properties of iron and steel:

"These tests were determined upon to decide if the hydrogen anti-corrosive treatment had any adverse effect, and if so to what extent, upon the strength and resilience of wrought iron and steel suitable for boiler, ship, and bridge purposes. Five test-pieces of iron were cut from a single plate one-half inch thick, and five more similarly from a three-eighth inch steel plate. These were machined to suitable sizes for the standard eight-inch test-piece, giving a section of about .71 of a square inch for the iron and .51 of a square inch for the steel. Three of each of these sets were forwarded to Dr. Gesner for treatment, who retained one and returned the remainder. The tests were made with a 200,000-pound Olsen machine, and the measurements with Brown & Sharpe micrometer gauges, and are believed to be accurate."

The results were recorded upon test-blanks, which it is unnecessary to reproduce here, it being sufficient to summarize the results as given in the report. "The pieces were gauged both before and after treatment, and showed no change. The tests show practically no effect whatever upon the iron, with the exception of a slight decrease in the elongation. As the area is not reduced, it would be impossible, without further evidence, to say whether or no the ductility were affected. At any rate, the ductility being so low, this small reduction, if proved to exist, would be of comparative unimportance in affecting the value of the metal. The steel is benefited. The annealing undergone during the treatment has softened it to some extent. It has lost about five per cent in strength, but gained five per cent in elongation. This metal, as originally, would not have come up to specifications, being insufficient in stretch. The treatment has not reduced the tensile strength below the assigned limit, at the same time it has brought the elongation up to requirements. Pieces of both iron and steel were bent cold to an angle of forty-five degrees without showing any fracture or scaling of the treated surface."



THE STOREY ELECTRIC MINING LOCOMOTIVE.

In conclusion, the report says, "The hydrogen process does not affect the value of iron and steel for engineering purposes. The treatment benefits steel by the annealing undergone in the process. The treated surface possesses elastic properties of the highest value."

ELECTRIC LOCOMOTIVE FOR METAL MINES.

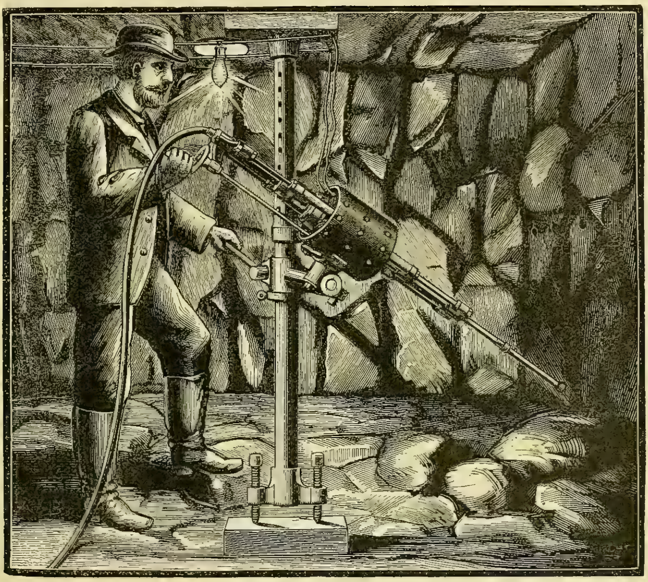
WE show in another part of this issue a view of a new electric rotary diamond drill, manufactured by the Sprague Electric Railway and Motor Company of New York, which has shown gratifying results in the tests to which it has been put, and which promises to fulfil a long-felt want in electric mining. On this page we show another special electric mining application; i.e., an electric locomotive. This locomotive is simple, powerful, and compact, and is built with special reference to the rough usage and arduous duties required of such a machine.

The gauge of the accompanying locomotive is eighteen inches, but it can be accommodated to any gauge in ordinary commercial work. In order to protect the machine from damage, all the working parts are completely boxed in, as shown in the view. The speed of the motor is under complete control by a switch which throws the winding of the field into

different electrical combinations, thus varying the speed of the motor without the use of any wasteful resistance. The direction of rotation is also governed by the same switch, so that the operation of the motor is very simple, and it can be put in charge of an ordinary workman.

Any system of conveying the current from the dynamo to the locomotive can be used, either using the rails as one side of the circuit for the return of the current, or else employing a complete metallic circuit by the use of a double overhead trolley wire. In this latter case, a trolley pole, shown in the view, carrying at its upper end two trolley wheels for making running contact with the overhead wires, is attached on the rear of the locomotive car.

This mining locomotive is now being manufactured by the Sprague Electric Railway and Motor Company from designs made by Mr. I. E. Storey. One of the most noticeable advances made in modern mining science is the adoption of electricity as a medium for transmitting power and producing light, and such applications as the above indicate the growing demand of mining companies for just such apparatus, and the ability of the leading electric companies to supply the need.



ELECTRIC MINING DRILL.

ELECTRIC ROTARY DIAMOND DRILL.

THE accompanying view shows a new electric mining rotary drill which has shown good results in experimental work, and which will soon be applied to regular mining-work in several leading mines.

A good electric mining drill has always been desired by miners, and this drill seems to meet all the requirements. It is light, compact, simple, and easy to operate. The motor is completely incased, so that it is impossible for dust, dirt, or stray stones to lodge in the working parts. The whole drill is mounted on an adjustable frame, so that it can be very easily set in any position desired, or set at work at any part of the mine.

The current for operating the drill is supplied at a constant voltage or potential, the number of volts depending on the potential used for transmitting power throughout the mine. If lamps are needed, they can be supplied with current from the same wires which supply current to the drill, and, when in such use, are connected in multiple arc across the main current wires.

These drills are manufactured and sold by the Sprague Electric Railway and Motor Company of New York, under patents granted to Mr. I. E. Storey. We understand that the Sprague Company is now at work on, and will soon be able to furnish, a number of special mining applications, among which is an electric percussion drill.

THE LATEST THEORIES ON THE ORIGIN OF THE ENGLISH.[1]

WHEN, one is sometimes tempted to ask in sheer weariness, will any man be able to say the last word on that question of the West which bids fair to be as eternal as any question of the East, — the question whether we, the English people, are ourselves or somebody else? That formula is not a new one. Some of us have, in season and out of season, through evil report and good report, been fighting out that question for not a few years. If it is wearisome to have to fight it out still, there is some little relief in having to fight it out in a wholly new shape and with a wholly new set of adversaries. It is an experience which has at least the charm of novelty when we have to argue the old question, who are we, whence we came, from a point of view which might make it possible, with the exercise of a little ingenuity, to avoid ever using the words "Celt," "Briton," or "Roman" at all. On the other hand, the strife in its new form has become more deadly; the assault has become more threatening. Hitherto we have fought for victory, for dominion, for what, if one adopted the high-polite style of a lord mayor's feast, one might call "the imperial instincts of the Anglo-Saxon race." We have had to fight to prove our greatness against people who told us that we were not so great as we thought. Angles and Saxons, we were told, were only one element, perhaps a very inferior element, in the population of Britain. Still nobody denied that we had some place in the world, some place in this island. It might be a very small place compared with that of the Celt who went

[1] From The Contemporary Review for January.

before us, or of the Norman who came after us. Still we had some place. Nobody denied that there had been Angles and Saxons in the isle of Britain. Nobody denied that those Angles and Saxons had had some share in the history of the isle of Britain. Nobody—save, I believe, one thoroughgoing man at Liverpool — denied that those Angles and Saxons had supplied some part, however mean a part, to the tongue now spoken over the larger part of Britain. Nobody, I fancy, ever denied that to the mixed ancestry of the present inhabitants of Britain, Angles and Saxons had contributed some elements, however paltry. The fight seemed hard, and we did not know that there was a harder fight coming. For now the strife is not for victory or dominion, but for life. The question is no longer whether Angles and Saxons have played a greater or a less part in the history of Britain: it now is, whether there ever were any Angles or Saxons in Britain at all, perhaps whether there ever were any Angles or Saxons anywhere; or, more truly, the question takes a form of much greater subtlery. Our new teachers ask us, sometimes seemingly without knowing what they are asking, to believe a doctrine that is strange indeed. The latest doctrine, brought to its real substance, comes to this: we are not Angles and Saxons; we did not come from the land of the Angles and Saxons; we are some other people who came from some other land; only by some strange chance we were led to believe that we were Angles and Saxons, to take the name of Angles and Saxons, and even to speak the tongue which we should have spoken if we had been such. Or, to come back to the old formula with which we began, we are not really ourselves, but somebody else; only at some stage of our life we fell in with ingenious schoolmasters, who cunningly persuaded us that we were ourselves.

On the old controversy I need not enter again now. That controversy might have been much shorter if clever talkers would have taken the trouble to find out what those whom they were talking about had really said. Many statements have been made, many jokes have been joked, many outcries have been raised, some ingenious names have been invented, nay, even some arguments have been brought, and all about doctrines which no man in this world ever held. Personally I have nothing more to say on the matter. I have had my say: any body that cares to know what that say is may read it for himself.[1] I will make only one remark on a single statement which I have casually lighted on, and which is, on the whole, the very strangest that I have ever seen. I find in a volume of a series which comes under the respectable name of "The Society for Promoting Christian Knowledge" — a series to which Oxford professors and examiners contribute, a book which has a book by Mr. Rhys before it and a book by Mr. Hunt after it—this amazing saying: "Florence uses the strange expression that Eadgar was chosen by the Anglo-Britons."[2] Strange indeed if Florence had ever used it; but to say that he did use it surely goes beyond the admitted literary and "stylistic" license of making people, old or new, say what they never did say. But the saying is instructive: it shows how some writers, sometimes more famous writers, now and then get at their facts. One received way is to glance at a page of an original writer, to have the eye caught by a word, to write down another word that looks a little like it, and to nvent facts that suit the word written down. To roll two independent words into a compound word with a hyphen is perhaps a little stronger, but only a little. Florence says some thing about Englishmen in one line, and something about Britains in another line not far off. Roll them together: make a new fellow to Anglo-Saxons and Anglo-Catholics, and we get the "strange expression," and the stranger fact, about Eadgar and the "Anglo-Britains." Yet even with a creator of "Anglo-Britons" we may make peace for the present. There is allowed to be something "Anglo" in the matter; and that for the present is enough. The old question was, after all, simply one of less and more. There was some "Anglo" something, only how much? He who shall say that the present English-speaking people of Britian are Angles and Saxons who have assimilated certain infusions, British and otherwise, and he who shall say that the English-speaking people of Britian are Iberians, Celts, Romans, any thing, who have received just enough of Anglian and Saxon infusion to be entitled to be called "Anglo Britons," maintain doctrines that differ a good deal from one another. Still it is only a difference in degree. Both sides may encamp together in the struggle with the new adversaries. Whether the Angle assimilated the Briton or the Briton assimilated the Angle, there was some "Anglo" element in the business. It is serious for both to be told that there never was any "Anglo" element at all; while, according to one view, there could hardly have been Briton enough to have the "Anglo" element, if there had been any, hyphened on to him.

We have in this matter to deal with two writers, whom it may seem somewhat strange to group together. M. Du Chaillu has startled us, one may venture to say that he has amused us, by a doctrine that a good many tribes or nations which have hitherto gone about with tribal or national names had no right to any national names at all, but only to the name of an occupation. The Franks of the third century, the Saxons of the fifth, were not Franks or Saxons, but "Vikings." Being "Vikings," they may have been Suiones, Swedes, Danes, Norwegians: but the chief thing is to be "Vikings;" they belong to the "Viking age." On this teaching I shall say a few more words presently. I want just now to point out that, according to the Viking doctrine, we must have come from lands farther to the north than we have commonly thought. And this doctrine I wish to contrast with another, which has been less noticed than one might have expected, according to which we must have come from lands much farther to the south than we have commonly thought. Of these two doctrines, the first comes to this, that Angles and Saxons are all a mistake. There was no migration into Britian from the lands which we have been taught to look on as the older England and the older Saxony: the name of Angle and Saxon came somehow to be wrongly applied to people who were really Suiones or others entitled to be called Vikings. I am not sure that I should have thought this doctrine, at least as set forth by M. Du Chaillu, worthy of any serious examination, had it not been for the singular relation in which it stands to the other slightly older teaching, which, when we strive to obey the precept, "*Antiquam exquirite matrem,*" bids us look, not farther to the north than usual, but farther to the south. According to this teaching, there may have been some Saxons from North Germany among the Teutonic settlers in Britian, but the main body came from a more southern land. These two doctrines, very opposite to one another, but both upsetting most things which we have hitherto believed, have been put forward in a singularly casual way. Some will perhaps be a little amazed when for the southern doctrine I send them to Mr. Seebohm's well-known book, "The English Village Community." There it certainly is: it is not exactly set forth by Mr. Seebohm, but it has at least dropped from him; and the opposite doctrine has not much more than dropped from M. Du Chaillu. Both teachings are thrown on the world in a strangely casual sort, as mere appendages to something held to be of greater moment. Still M. Du Chaillu does put forth his view as a view; Mr. Seebohm lets fall his pearls, if they be pearls, seemingly without knowing that they have fallen from him. I am not going to discuss any of Mr. Seebohm's special theories, about manors or serfdom, about one-field or three-field culture. Mr. Seebohm's views on these matters, whether we accept them or not, are, as the evident result of honest work at original materials, eminently entitled to be weighed, and, if need be, to be answered. And in any case we can at least give our best thanks to Mr. Seebohm for his maps and descriptions of the manor of Hitchin, a happy survival in our day of a state of

[1] I must refer to what I have said on "Teutonic Conquest in Gaul and Britain" in "Four Oxford Lectures" (Macmillan, 1888), and to the essay on "Race and Language" in the third series of Historical Essays.

[2] Anglo-Saxon Britain, by Grant Allen, B.A., p. 147. The real words of Florence (959) are: "Rex Mercensium Eadgarus, ab omni Anglorum populo electus anno ætatis suæ 16, adventus veri Anglorum in Britanniam quingentesimo, 363 autem ex quo sanctus Augustines et socii ejus in Angliam venerunt." No words could be more carefully chosen.

things which in most places has passed away. What I have to deal with now, as far as Mr. Seebohm is concerned, is to be found in one or two passages in his book, in which, as I have hinted, he lets fall, in a perfectly casual way, doctrines which go far to upset all that has hitherto been held as to the early history of the English folk.

Now, a wholly new teaching on such a matter as the beginning of our national life in our present land is surely a matter of some importance. If it is true, it is a great discovery, entitled to be set forth as a great discovery, with the proudest possible flourish of trumpets. The new teaching should surely be set forth in the fullest and clearest shape, with the fullest statement of the evidence on which it rests. But with Mr. Seebohm the new doctrine drops out quite suddenly and incidentally, as a point of detail which does not very much matter. The belief as to their own origin which the English of Britain have held ever since there had been Englishmen in Britain seems to Mr. Seebohm not to agree with his doctrines about culture and tenures of land. It is by no means clear that there is any real contradiction between the two, but Mr. Seebohm thinks that there is. He is so convinced of the certainty of his own theory, that the great facts of the world's history must give way if they cannot be reconciled with it. The strange thing is, that Mr. Seebohm does not seem the least proud of his great discovery: he hardly seems to feel that he has made any discovery. He is less excited about a proposition which makes a complete revolution in English history than some are when they think that they have corrected a date by half an hour, or have proved some one's statement of a distance to be wrong by a furlong. All turns on the "one-field system" and the "three-field system." The three-field system existed in England, it existed in certain parts of Germany; but it did not exist in those parts of Germany which were inhabited by Angles and Saxons. Therefore, if Britain had any Teutonic settlers at all, they must have come from some other part and not from the land of the Angles and Saxons. Only, to judge from Mr. Seebohm's tone, the question whence they came, or whether they came from anywhere, is a question hardly worth thinking about, compared with matters so much more weighty as the system of "one-field" or of "three."

Our first foreshadowing of what is coming is found at p. 372 of Mr. Seebohm's book: "Now, possibly this one-field system, with its marling and peat-manure, may have been the system described by Pliny as prevalent in Belgic Britain and Gaul before the Roman conquest, but certainly it is not the system prevalent in England under Saxon rule. And yet this district where the one-field system is prevalent in Germany is precisely the district from which, according to the common theory, the Anglo-Saxon invaders of Britain came. It is precisely the district of Germany where the three-field system is conspicuously absent. So that although Nasse and Waitz somewhat hastily suggested that the Saxons had introduced the three-field system into England, Hanssen, *assuming that the invaders of England came from the north* confidently denies that this was possible. 'The Anglo-Saxons and the Frisians and Low Germans and Jutes who came with them to England cannot (he writes) have brought the three-field system with them into England, because they did not themselves use it at home in North-west Geermany and Jutland.'[1] He adds that even in later times the three-field system has never been able to obtain a firm footing in these coast districts."

It is wonderful indeed to find the origin of the English people thus dealt with as a small accident of questions about marling and peat manure. Hanssen confidently denies that the Angles and Saxons could have brought the three-field system into Britain from their old home; and, if it be true that the three-field system was never known in their older home, he assuredly does right confidently to deny it; only why should so much be made to turn on the different modes of culture followed in the continental and the insular English land? If the one-field system suited the soil of the old Angeln and the old Saxony, while the three-field system better suited the soil of East Anglia or Sussex, surely our Angles and Saxons would have sense enough to follow in each land the system which suited that land. If they found that the kind of husbandry which suited the soil of their old home did not suit the soil of their new home, they would surely invent or adopt some other kind of husbandry which did suit it. But in any case, if the acceptance of a certain doctrine about the "one-field system with its marling and peat-manure" involves nothing short of all that Mr. Seebohm assures us that it does involve, it would surely have been worth while to think about the marling and the peat-manure a second time by the light of what had hitherto been looked on as the broad fact of the history of England and Europe. These last may be wrong; but they are surely at least worthy of being thought over before they are cast aside. But with Mr. Seebohm the "common theory" — that is, the recorded history of the English people — is not worth a thought: it may go anywhere. "Hanssen assumes that the invaders of England came from the north." That will do for the present: let them come from any land, so that it be not a land that practises "the one-field system with its marling and peat-manure."

Some way further on (p. 410) Mr. Seebohm has another pasage, in which, seemingly with the same words of Hanssen before him, he throws out, still very casually but not quite so casually as before, an exactly opposite doctrine: "We have already quoted the strong conclusion of Hanssen that the Anglo-Saxon invaders and their Frisian Low German and Jutish companions could not introduce into England a system to which they were not accustomed at home. It must be admitted that the conspicuous absence of the three-field system from the north of Germany does not, however, absolutely dispose of the possibility that the system was imported into England from those districts of middle Germany reaching from Westphalia to Thuringia where the system undoubtedly existed. *It is at least possible that the invaders of England may have proceeded from thence rather than, as commonly supposed, from the regions on the north coast.*"

It is hardly worth while to stop to comment at any length on the confusion of thought implied in such phrases as "Anglo-Saxon invaders of England." As there can be no *Anglia* till there are *Angli*, they would literally imply that a band of Angles first came into Britain by themselves, that they set up an England therein, and then sent to their hyphened kinsfolk on the mainland to come after them to share, and doubtless to enlarge, that England. But of course what Mr. Seebohm means by "invaders of England" are those who out of part of Britain made an England for certain later people to invade. We have got back to the days of our grandmothers, when our little books told us how Cæsar was "resisted by the English people, who were then called the Britons." We have perhaps got back to the days of good old Tillemont, who attributes all that was done on the native side during the Roman occupation of Britain to "les Anglois." The confusion, however, belongs to the German writer: Mr. Seebohm simply copies him. And in one point, Mr. Seebohm, after some striving with himself, has corrected a still stranger confusion of his guide. In his first edition the *Niedersachsen*, which Hanssen so oddly couples with *Angelsachsen* appear in one place as "Low-Germans," in another as "Low-Saxons." In a later revision the "Low-Saxons" have vanished.[1] But to couple "Low-German" (the whole) with Anglo-Saxons, Frisians, etc. (each of them parts of that whole) is, as a logical division, even stranger than to couple *Angelsachsen* and *Niedersachsen*. This last phrase implies "High-Saxons" somewhere; and it might not be an ill guess that they are the same as the

(*Continued on p.* 75.)

[1] The text of Hanssen, Agrarhistorische Abhandlungen, i. 496, stands thus: "Allein die Angelsachsen und die welche mit ihnen nach England gezogen sein mogen; Friesen, *Niedersachsen*, Juten, konnen die Dreifelderwirthschaft nicht nach England mitgebracht haben, weil sie in ihrer Heinat selber in nord-westlichen Deutschland und Jütland nicht betrieben hatten."

[1] In Mr. Seebohm's first edition, the word in the second extract was "Low-Saxon;" in the third it is "Low-German." Hanssen's word is *Niedersachsen*. If he is thinking of the circle of *Niedersachsen* in later German geography, it does not at all help him.

NOTES AND NEWS.

THE way in which foreign plants become "weeds," under new and favorable conditions, is illustrated by the recent case of *Melilotus alba* in our Western States. Introduced a few years ago as a garden-plant, it has spread so rapidly in the rich bottom-lands along the Missouri River, according to *Garden and Forest*, that it is fast driving out the sunflower and other native weeds. It is commonly called the "Bokhara clover."

—A meteorite of special interest to chemists has been examined by M. Stanislas Meunier. It fell at Mighenï, in Russia, on June 9, 1889; and it was evident, from a cursory inspection, that it was of a carbonaceous nature. In external appearance, as stated in *Nature*, it exhibited a deep greenish-black color, relieved by numerous small brilliant white crystals. The surface was considerably wrinkled, and blown out into swellings. The material was very friable, and readily soiled the fingers. A section under the miscroscope was observed to consist largely of opaque matter interspersed with crystals of a magnesian pyroxene and peridote. Fine particles of metallic iron and nickeliferous iron were readily collected by a magnet from the powdered rock, having all the characteristics of meteoric iron. The density of the meteorite was not very high, 2.495. About 85 per cent of the rock was found to be attacked by acids, the portion so attacked being shown by analysis to consist mainly of a silicate of magnesium and iron having the composition of peridote. On the remaining 15 per cent being heated in a current of dry oxygen gas, it readily took fire and burnt brilliantly. The products of combustion, which were allowed to pass through the usual absorption tubes containing pumice and sulphuric acid and potash, showed that the meteorite contained nearly 5 per cent of organic matter. In order to obtain some idea as to the nature of the carbonaceous substance present, a quantity of the rock was powdered and then digested with alcohol. On evaporation the alcholoic extract yielded a bright yellow resin, which was readily precipitated from the alcoholic solution by water, and much resembled the kabäite of Wöhler. The most curious chemical properties of the meteorite, however, are exhibited with a cold aqueous extract of the powdered rock. The filtered liquid is quite colorless, but exhales a faint odor due to an organic salt which carbonizes on evaporation to dryness, and may be burnt upon platinum foil. The aqueous extract further contains nearly 2 per cent of mineral matter possessing properties of a novel character. Barium-chloride solution gives a heavy white precipitate, which, however, is not barium sulphate. Silver nitrate gives a voluminous curdy reddish-violet precipitate, reminding one of silver chromate, but of quite a distinct and peculiar tint, and which blackens in a very few minutes in daylight. The substance which exhibits these re-actions is unchanged by evaporation to dryness and ignition to redness, readily dissolving in water again on cooling, and giving the above re-actions. The silver-nitrate precipitate, when allowed to stand for some time undisturbed in the liquid, becomes converted into colorless but brilliantly refractive crystals, which polarize brightly between crossed nicols under the microscope, and which are insoluble in boiling water. The properties of this new substance contained in the water extract appear to approximate most closely to those of certain metallic tellurates, but the new compound appears also to differ in certain respects from those terrestrial salts.

—We owe a new and interesting application of photography to M. Bertillon, the well-known director of the Identification Department at the Paris Prefecture of Police. M. Bertillon has been devoting himself for some months to the study of the physical peculiarities engendered by the pursuit of different occupations. According to *Nature*, the police have frequently to deal with portions of bodies and it would greatly aid their investigations to be able to determine the calling of the murdered person in each particular case. The hand is, as a rule, the part naturally most affected by the occupation; and M. Bertillon has taken a very large series of photographs, each one showing on a large scale the hands, on a smaller scale the whole figure of the workman at his work, so that one may see at a glance the position of the body, and which are the parts that undergo friction from the tools in use. From the hands of the navvy all the secondary lines disappear, and a peculiar callosity is developed where the spade-handle rubs against the hand; the hands of tin-plate workers are covered with little crevices produced by the acids employed; the hands of lace-makers are smooth, but they have blisters full of serum on the back and callosities on the front part of the shoulder, due to the friction of the straps of the loom; the thumb and the first joints of the index of metal-workers show very large blisters, whilst the left hand has scars made by the sharp fragments of metal. Experts in forensic medicine (Vernois among others) have before drawn attention to the subject; but this is the first time that an investigation has been carried out on a large scale, and in M. Bertillon's hands it should lead to the best results.

—Two new expeditions are announced in *Globus*, Bd. 65, No. vi. Joseph Martin has lately left Peking with a few companions for Lan-chow and Sin-ning, with the intention of reaching Tibet by the country of the Kuku Nor. The journey is undertaken for the purpose of geological and physical geographical investigations. This traveller is famous for his great journey in eastern Siberia, and in particular for his ascent of the Stanovoi Mountains. The well-known French traveller, Bonvalot, accompanied by Prince Henry of Orleans, has commenced a new journey in Asia, the aim of which is nothing less than to traverse the continent from north-west to south-east. The expedition is to proceed from Omsk through Semipalatinsk to Chuguchak on the Chinese frontier, then by Manas, Urumtsi, Karashar, Korla, the Lob Nor, Chamuen-Tai, Kukusai on the upper Yang-tsi-kiang, Tsiamdo, Batang, and Yunnan, to the coast at Tong-king. M. Bonvalot is, however, quite aware that his plan may very probably have to be considerably modified.

— The grass known as "Lalang" (*Imperata cylindrica*) gives the foresters of the Malay Peninsula more trouble than our own prairie-grasses give the tree-planters of the West. This Lalang is injurious, says *Garden and Forest*, by reason of its inflammability, and because it prevents any cultivation of the land covered by it, except at great expense. Wherever land is allowed to run to waste, it is soon covered with this grass, except where the soil is wet, or sandy, or shaded by trees. The annual report of the conservator of forests at Singapore refers at great length to this plant, stating that it can be exterminated by chemicals; but these are expensive, and have an injurious effect upon the trees planted in forest upon the land afterward. When trees are large enough to throw a shade, the Lalang quickly disappears, and it cannot penetrate into forest glades if but a few trees bar its progress. The gradual planting of bushes and shade-trees is recommended as the surest remedy for this grass pest.

—An interesting study has been lately made by Herr Tarchenoff (*Pflüger's Archiv*) of electric currents in the skin from mental excitation. Unpolarizable clay-electrodes, connected with a delicate galvanometer, were applied to various parts, — hands, fingers, feet, toes, nose, ear, and back; and, after compensation of any currents which occurred during rest, the effects of mental stimulation were noted. Light tickling with a brush causes, after a few seconds' period of latency, a gradually increasing strong deflection. Hot water has a like effect; cold or the pain from a needle-prick, a less. Sound, light, taste, and small stimuli act similarly. If the eyes have been closed some time, mere opening of them causes a considerable deflection from the skin of the hand. Different colors here acted unequally. It is remarkable that these skin-currents also arise when the sensations are merely imagined. One vividly imagines, for example, he is suffering intense heat; and a strong current occurs, which goes down when the idea of cold is substituted. Mental effort produces currents varying with its amount. Thus, multiplication of small figures gives hardly any current; that of large, a strong one. If a person is in tense expectation, the galvanometer mirror makes irregular oscillations. When the electrodes are on hand or arm, a voluntary movement, such as contraction of a toe or convergence of the eyes,

gives a strong current. In all the experiments, says *Nature*, it appeared that, with equal nerve-excitation, the strength of the skin-currents depended on the degree to which the part of the skin bearing the electrodes was furnished with sweat-glands. Thus some parts of the back, and upper leg and arm, having few of these, gave hardly any current. Herr Tarchenoff considers that the course of nearly every kind of nerve-activity is accompanied by increased action of the skin-glands. Every nerve-function, it is known, causes a rise of temperature and accumulation of the products of exchange of material in the body. Increase of sweat-excretion favors cooling and getting rid of those products.

—In the summer of 1887 Herr Lindenbaum found a petroleum lake on a narrow tongue of land in the north of Saghalien. It is about twenty-two miles north-east of a village named Pomor, and at about 54° north latitude. A little south of Pomor lies Baikal Bay, a good harbor, which has a depth of eight feet at low tide, and could therefore be entered by small vessels. There would be no difficulty in making a road from this place to the petroleum lake. There is also another spot, one hundred and twenty-five miles south of the former, where petroleum is said to occur.

— Herr T. Thoroddsen was in the summer of 1889 travelling in Iceland, and has given an account of his discoveries in *Petterman's Mitteilungen*, Bd. 35, No xi. The part of the island he visited lies on the western edge of Vatna Jökull, to the north-east of Hecla. A great part of this country has never been visited by any one, for the total absence of grass for horses renders travelling difficult. All the lower slopes of Torfa Jökull are covered with lava and ashes, but the substratum and the ridge itself are composed of palagonite breccia and tuff. The large river Tungnaa approaches much nearer to Torfa Jökull than it is drawn on maps. Crossing this river, Herr Thoroddsen took up his quarters by the Fiskivötn, and made several excursions in the neighborhood. The lakes abound in trout; they are small, and are represented on the maps on too large a scale. They are not surrounded by glacial *débris*, but are almost all crater lakes. Across an extensive tract of lava, totally devoid of grass, lies the Thorisvatn, which is not a very small lake, as represented on Gunnlaugsson's map, but one of the largest in the island, and not much less than Thingvallavatn. The lakes are generally enclosed by steep mountains, so that it is difficult to approach them. It has been supposed that the rivers Skapta, Hversfisfljót, and Tungnaa rise at the same place from a glacier, and they are so represented on Gunnlaugsson's map; but Herr Thoroddsen found that the Tungnaa flows in two branches from a large glacier, the edge of which extends in a long curve from the mountains south of Vonarskard to those near Fljotshverfi, that the source of the Skapta lies about nine miles farther south, and that the Hverfisfljót rises from ten to fourteen miles still more to the south. Three serrated ridges run between the Tungnaa and Skapta, from the Vatna Jökull to the Torfa Jökull. These mountains are composed entirely of palagonite breccia, and the valleys are filled with volcanic ashes and shifting sands. Between the middle and southern ridges lies a lake about twenty-three miles long, which stretches nearly to the foot of Vatna Jökull, and, though in most places very narrow, is one of the largest in Iceland. It is fed with milky water by numerous glaciers. Near the last of these, Herr Thoroddsen, on his way to the Torfa Jökull, visited several warm springs and solfataras.

— The remark made at a recent meeting of the Royal Geographical Society by the president, *apropos* of certain explorations by Mr. Theodore Bent, viz., that there is still much work for the competent observer in regions where practically no risk need be encountered, is strikingly exemplified in the account of the last voyage of that accomplished explorer along the south coast of Asia Minor, as described in the *Journal of Hellenic Studies*. Sailing along the Carian coast, he landed in the bay of Aplotheka, at the ancient town of Loryma; and, hearing there of some ruins a few hours distant, he rowed to the place, and discovered a curious little harbor with the entrance not a stone's throw in width. Thence an hour's walk brought him to some extensive ruins, which, from an inscription, he believed himself able to identify with tolerable certainty as Kasarea. The village of Phœnike being just beyond, he could also identify with certainty the little harbor as the κρῆσα λιμὴν of Ptolemy; for this harbor lies, according to that geographer, between Loryma and Phœnike. Pliny also mentions that *Portus Cressa* lies just opposite Rhodes at a distance of twenty miles, which agrees with the position. Again, a little farther along the coast, on the Gulf of Makri, Mr. Bent was able, from inscriptions on the ruins, to identify the site of a Lycian town of some importance,—Lydæ, the capital of a district known as Lydatis. A little farther on, an old Hellenic acropolis, surrounded by a few tombs, seemed, from some half-defaced inscriptions, to have been known as Lissa, though the site seems to be that assigned by Ptolemy to the town of Karya. Some of the inscriptions found in these places are of considerable interest, and the remains are described by Mr. Bent to be not without artistic merit. The whole region is now inhabited only by nomad tribes of Yuruts; and these discoveries are alluded to here merely to show how much more may be done and discovered by the explorer, within easy reach of home, than is commonly supposed. Indeed, to quote Mr. Bent's words with reference to this district alone, "Inasmuch as Pliny tells us that there were once seventy cities in Lycia and in his time thirty-six, of which he only knew the names of twenty-five, there is room for much more geographical discovery in this interesting district."

— *Garden and Forest* states that it has received at its office, as a reminder of the mild winter, a very interesting photograph of a group of Christmas roses which came from Cazenovia, N.Y., to testify how beautiful these flowers can be in mid-winter. Branches of many shrubs with fully expanded flowers were also received; and in a collection of this sort from the Meehan Nurseries at Germantown were sprays of the Cornelian cherry with the yellow stamens showing through the opening buds, and the Tartarian honeysuckle with buds just opening.

—We learn from *Nature* that remarkable phenomena are witnessed at the new observatory on the steep and isolated Säntis in northern Switzerland. Thunder-storms are extremely frequent. Thus in June and July last year, only three days were without them. As a rule, thunder peals from mid-day till evening. The noise is short, partly owing to shortness of flashes, and partly to the small amount of echo. The thunder-storms come on quite suddenly, in a clear sky. One of the surest indications of their approach is the bristling of the observer's hair. During hail the iron rods of the house give a hissing sound associated with luminous effects.

— Messrs. Houghton, Mifflin, & Co. will issue in February, as an extra number of the Riverside Literature Series, "The Riverside Manual for Teachers," containing suggestions and illustrative lessons leading up to primary reading, by I. F. Hall, superintendent of scholars at Leominster, Mass. The manual will appear later as the introductory part of "The Riverside Primer and Manual for Teachers." It points out, principally by the aid of illustrative lessons, what steps the pupil should take before beginning the primer. The primer and manual form the first book of the Riverside Reading and Language Course, which also includes "The Riverside First Reader," "The Riverside Second Reader," and, for higher grades, the regular numbers of the Riverside Literature Series. To accompany the manual and primer, Mr. Hall has designed an instruction frame equipped with three sets of language and object pictures, prepared especially for this purpose by F. T. Merrill, script and printed words and sentences, and a displaying holder. The object of the Riverside Language and Reading Course is, first, to give young children such a training as will enable them, while overcoming the mechanical difficulties of learning to read, to acquire a taste for good reading-matter, and incidentally to gain a power to express themselves orally and in writing with accuracy, good taste, and facility; and, second, to supply children of each grade with the best reading-matter that the world's literature affords.

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M. DU CHAILLU ON THE VIKING AGE.

The following from Mr. Du Chaillu, written to the editor of *The London Times*, appeared in that journal for Jan. 7: —

"As some misunderstanding has arisen in regard to the historical chapters of my book on "The Viking Age," will you allow me to give some fuller explanation of my views in regard to the earlier inhabitants and invaders of Britain?

"In studying the history and antiquities of any country which at some previous period has been overrun and occupied by a foreign power, we naturally expect to find some material traces of the invader, in the shape of monuments, inscriptions, graves, weapons, ornaments, etc. Thus Roman remains are plentiful in Germania, Gallia, and Britain, and in generations to come British remains will doubtless be found in India to tell the tale of England's dominion there. In like manner I argue that the archæological remains found in England form the strongest evidence as to who were the people who invaded Britain. The so-called Saxon, Anglo-Saxon, Anglo-Roman objects found in the British Isles correspond, down to the minutest detail, with objects found in Scandinavia and in the islands of the Baltic, and in no other place where Norsemen have not been.

"The majority of the criticisms which have come under my notice deal in sweeping statements concerning language, the views of historians, and so forth; a few have here and there ventured on the discussion of a point of detail; but none, so far as I am aware, have attempted to deal with one of my chief arguments, which is based upon the existence of the material remains to which I have referred above. The first of the maritime tribes of the north mentioned by Roman writers was the Suiones, the Sviar of the Sagas. Tacitus describes their ships, and his description exactly coincides with the vessel found at Nydam, of which an illustration is given at p. 220 of my first volume. My hypothesis that the Veneti of Cæsar were probably the advanced guard of the north is based upon the evidence that their ships, as described by Cæsar, correspond in a remarkable manner with the ships of the Norsemen.

"It is reasonable to suppose, as Tacitus makes no mention of these Suiones having come into conflict with the Romans, and as he informs us that they 'honored wealth,' that those he saw came for the purpose of trading; and this is confirmed by the quantities of Roman objects, and especially of Roman coins, distributed in finds and hoards throughout Scandinavia. To take one example only: the hoards at Hagestaborg and Singdarfe include upward of 24,000 Roman coins, forming an almost unbroken series from the time of Nero (54 A.D.) to that of Septimus Severus (211 A.D.), and none of later date. Other finds throughout the country exhibit a succession of Roman and Byzantine coins, including many of gold and silver, from the time of Augustus down to the later days of the Eastern Empire.

"Now, the general distribution of the coins and manufactured articles, and the large number of them, show, I maintain, that not the Suiones, or any one tribe alone, but all these tribes, carried on an extensive warfare and continuous commercial intercourse with the Roman Empire. The Romans, on the other hand, never penetrated into their country, their knowledge of them was very vague, and Roman writers selected a tribe here and there (as, for example, these very Suiones), and attributed to them certain characteristics and customs which in fact prevailed throughout Scandinavia. This vagueness of nomenclature is exhibited in the fact that the name Suiones disappears from history for seven centuries, until we find it again in the pages of Eginhard, who writes, 'The Danes and Suiones, whom we call Northmen.' Meanwhile, other names, as Franks and Saxons, are given to hordes of invaders and warriors whose origin and home are wrapped in mystery.

"Another point of great importance in this discussion is the enormous number of graves scattered all over the country of the Norsemen, indicating a very dense population.

"Now, it is reasonable to draw three conclusions from this evidence, which I have merely sketched in outline: (1) that we find from the days of the earliest Roman historians continuous traces of a maritime people in the north whose country the Romans and their successors never were able to invade; (2) that the Roman and early mediæval nomenclature, as bearing on this people, is so vague as to be worthless for historical purposes; (3) that the country, when we gain access to it, is found to be full of material remains indicative of a dense and warlike population, of advanced civilization, and of continuous intercourse with the outer world.

"Turning to England, we find copious remains from a very early date which are not British nor Celtic nor Roman, which have been variously labelled as Saxon, Anglo-Saxon, Anglo-Roman, and so forth, but which correspond minutely with the remains which I have described in the north. Of every such object found in England I claim that I can produce the counterpart in Scandinavia, and I challenge the historians and archæologists to show me any place in the basins of the Elbe, the Weser, and the Rhine where corresponding objects have been discovered.

"I ask again, is it or is it not reasonable to infer that these remains found in England indicate that England was invaded from the north? Is it or is it not reasonable to hold that these invaders came, not from any one special spot in the north, but that their expeditions were made jointly by many tribes combining for the purpose, as we learn from the Sagas was their customary practice?

"I have taken pains to make no statement which cannot be supported by a quotation of some recognized authority, or by reference to some established fact, and these materially corroborate each other, yet I am accused of bringing forward crude and ignorant theories.

"In conclusion, I would ask my opponents to prove to me that their account of the origin of the English people is any thing more than a theory; and, if so, I challenge them to produce the facts on which it is based."

THE LATEST THEORIES ON THE ORIGIN OF THE ENGLISH.

(*Continued from p. 71.*)

"Anglo-Saxon invaders of England," who came from somewhere in middle Germany. Only how is this doctrine to be reconciled with the "assumption" that "the invaders of England came from the north"? Taking it by itself, the southern theory comes to this: the main body of the invaders, "Anglo-Saxons," "High-Saxons," whatever they are to be called, started from middle Germany, from some point between Westfalia and Thuringia, from some part far away from marling and peat-manure; but on their road to Britain they fell in with certain companions, — Frisians, Low-Saxons, Jutes, — all seemingly from the marling and peat-manure country. In company with them, they came into Britain, to a part of it which had somehow already become "England."

This seemingly is the doctrine which is casually thrown out in the second of our quotation from Mr. Seebohm. Now, if we could only get rid of hyphened words, and talk simply of "Angles" or "English," it would help Mr. Seebohm's case not a little. The odd thing is, that, in arguing against Mr. Seebohm's case, one has first to put together his case for him. In his casual way of putting things, he does not seem to know how much might have been really said on behalf of something very like the view which he lets fall. In the older edition of Spruner's "Atlas," Mr. Seebohm would have found an English land marked for him in the very part of Germany where he would have most wished for it. There was an *Angeln* shown clearly enough between Westfalia and Thuringia, and whatever was to be said about the branch of the Angles who were held to have dwelled there was carefully brought together by Zeuss.[1] Unluckily this inland *Angeln* has vanished from the revised Spruner-Menke, as also from the new atlas of Droysen. It might therefore be dangerous to build any theories on the subject without going deeply into the whole question; but just such an Angeln as suited Mr. Seebohm's theory was there, according to the best lights, at the time that Mr. Seebohm wrote. If he was not aware of this, his stumbling by an *a priori* road on a doctrine actually supported by such respectable authorities is one of the strangest of undesigned coincidences. If he was aware of it, it is almost more strange that he should not have thought it worth while to refer to a fact or supposed fact of so much value for his case. With its help, that case could be put in a very taking shape. These central Angles, used to a three-field system, set out to go somewhither, it need not have been to Britain. On the road they fall in with companions, Saxons, Low-Saxon, Frisian, Jutish, any thing else. These seafaring folk would doubtless know the way to Britain much better than the Angles of middle Germany. They suggest the course that the expedition should take, and the united force crosses the sea in as many keels as might be needful. It may even be, if anybody chooses, that the inland Anglos, entering into partnership with the seafaring Saxons, first set foot on British soil under the style, already duly hyphened, of "Anglo-Saxons." To be sure, in Britain itself the compound name was not heard till some ages later, and then only in a very special and narrow sense. But on the mainland it was known much earlier. Paul the Deacon uses it;[2] it may have been used earlier still. So there is really a very fair case made out for "Anglo-Saxon invaders of Britain" coming from Mid-Germany, and no doubt bringing the three-field system with them. We have only to suppose that in the matter of agriculture some such agreement was made between the different classes of settlers, as we know was sometimes made among joint settlers in early times. The Sicilian Naxos reckoned as a colony of Chalkis, but it took its name from the elder Naxos. In Himera, peopled by Dorians and Chalkidians, the speech was mingled, but the laws were Chalkidian. So in the Anglo-Saxon colonization of ritain it was evidently agreed that the Angles should bring their system of three-field culture into the conquered land; the Saxons, Low-Saxons, Frisians, and Jutes, any other votaries of marling and peat-manure, had to conform to the practice of their betters.

There would still remain the question of language, — a point of which Mr. Seebohm does not seem to have thought, but on which Zeuss underwent some searchings of heart. He puts the question, without very positively settling it, whether Angles who dwelled so far south spoke High Dutch or Low. In the fifth century, indeed, the question could hardly have been of the same moment as it would have been in the ninth. The High Dutch has not as yet wholly parted company with the Low. Still the point is worth thinking of. Those who use the one-field and the peat-manure have ever belonged to the ranks of men who *eaten* and *drinken*. It may be that those who practise the three-field culture had already begun to fall off to them who *essen* an *trinken*. But one thing at least is certain: no man ever did *essen* and *trinken* in this isle of Britian. If, then, the Angles of the inland England had begun to adopt the more modern forms, something of an agreement — again like that of the Dorians and the Chalkidians — must have been come to between them and their Nether-Dutch companions. While the inland Angles had their way in the matter of three-field culture, the lesser point of language was yielded in favor of the seafaring Saxon.

Mr. Seebohm's casual theory, then, when worked out with some little care, really puts on so winning an air that it is hard not to accept it. Yet, even if we accept the existence of an inland Angeln without any doubt, Mr. Seebohm's theory at least would no thold water. It simply has against it the universal belief of Englishmen from the beginning. In the eyes of Baeda, in the eyes of the Chroniclers, in the eyes of the glee-man of Brunanburh, in the eyes of all who ever spoke or sang of the great migration of our people, the Angles, no less than the Saxons, count among the seafaring folk of northern Germany. The England from whence they came, the England which their coming was said to have left empty of men, was the England of the coast of Sleswick, not any inland England between Westfalia and Thuringia. At all events, if we are to believe otherwise, we have at least a right to ask that the question shall be thoroughly discussed on its own merits, and not tossed jauntily aside as a small point in the history of the rotation of crops. Till then, whether we believe that we were called "*ab angelica facie, id est pulcra*," or merely because we dwelled "*in angulo terræ*" we shall still go on believing that it was from the borderland of Germany and Denmark that our forefathers, set forth to work by sea their share in the wandering of the nations. It may be that some of the Anglian folk may well have strayed inland, as some of the Saxon folk may have strayed farther inland still. But the first England of history, the land from which men set forth to found the second, as from the second they set forth to found the third, was assuredly no inland region from which they had to make their way to a distant coast and there pick up Saxons or Frisians as companions of their further journey. The little England, the little "*angulus terræ*," of Sleswick was only part of it. There is no need minutely to measure how much was Anglian, how much Saxon, how much Frisian, how much belonged to any other branch of the common stock. In the days of Tacitus and Ptolemy the Angle and the Frisian were folk of the mainland only: by the days of Procopius they had won their home in the island to part of which one of them was to give his name.

We came by sea. By no other way indeed could we make our way into an island. But we came by sea in another sense from that in which Roman Cæsar came by sea before us and Norman William came after us. We came by sea not simply because the sea was the only road but because we came as folk of the sea to whom the sea was not a mere path but a true home. Of the details of the purely Anglian settlement and of the Angles themselves we know comparatively little, for the obvious reason that they lay farther off than their fellows from

[1] "Die Deutschen und die Nachbarstämme," 153, c.f. 495. It would be dangerous to enter casually and light-heartedly on questions about "Angrivarii," "Engern," and the like.

[2] Paul the Deacon speaks of "Angli-Saxones" (iv. 22, vi. 15) and "Saxones Angli" (v. 37). For other instances see Norman Conquest, i. 541.

the range of Roman knowledge. But of the Saxon shipmen and their doings we know a good deal: Sidonius has taken no small pains to show what manner of men they seemed to be in the eyes of the Roman of Gaul.[1] They first harried and then settled on both sides of the Channel. That their settlements in Britain were greater and more abiding than their settlements in Gaul was the result of many later causes. The Saxon of Chichester owes his presence on British ground to the same general effort to which the Saxon of Bayeux owed his presence on Gaulish ground. The Saxon of Chichester keeps his Saxon speech and from his land the Saxon name has not passed away. The Saxon of Bayeux has for ages spoken the Latin tongue of his neighbors, and while Sussex yet lives on the map, the *Otlingua Saxonica* has given way to other names to the *Bessin* and the department of *Calvados*. But each was planted in his new home by the force of the same movement, the Saxon wandering on the sea. And once planted in his new home, whether in the island or on the mainland, he ceased to be a wanderer by sea. He sat down and tilled the earth, and he guarded the earth which he tilled by the arms no longer of the seafarer but of the land warrior. The change is not wonderful. It has often happened in other lands, it has happened again in the same land. To be seafaring folk or to be landsmen is not always a question of what is born in the blood. Prosaic as it sounds, it is often the result of the circumstances in which men find themselves. Seafaring Corinth planted at one blow her twin colonies of Korkyra and Syracuse. Korkyra on her island met her parent on the seas with fleets equal to her own. Syracuse, planted in an island indeed, but an island that was in truth a continent, took to the ways of continents. Her landfolk were driven to take to the sea to meet the attacks of those Athenians who, two or three generations before, had been no less landfolk themselves.[2] So it was in the very land of Bayeux. When the Northmen came in their ships, neither Saxon nor Frank had ships to withstand them. Presently the seafaring Northmen, once settled in the land, changed into Norman landfolk, foremost of warriors with horse and lance, but to whom the horses of the wave had become simply means to carry them safe from Rhêgion to Messana, or from St. Valery to Pevensey.

Why, some one may ask, do I put forth again such very obvious truths as these? Because they are of no small importance, if we are to discuss the latest theory of all as to the origin of the English people. The only question is whether that theory need be discussed at all: it is hard to argue against that state of mind which, in the days when we learned logic, we used to call *ignoratio elenchi*. But if not discussed, it must be mentioned. Perhaps if this newest view of all had not come up the other day, I might not have chosen this time to talk about the views of Mr. Seebohm. But when M. Du Chaillu puts forth his theory, it at once recalls Mr. Seebohm's theory. The two stand in a certain relation to one another: neither can be fully taken in without the other. Both alike throw aside the recorded facts of history in the interest of a theory, be it a theory of the rotation of crops or a theory of the greatness of Vikings. Each theorist alike, possessed of a single thought, cannot be got to stop and think what there is to be said on the other side. M. Du Chaillu has put forth two very pretty volumes, with abundance of illustrations of Scandinavian objects. Most of them, to be sure, will be found in various Scandinavian books: still here they are, very many of them, and looking very pretty. M. Du Chaillu has given us a great many translations of sagas; but we have seen other translations of sagas, and some of them have been made by sound scholars. Criticism is hardly attempted. When the Scandinavian legend can be tested by the authentic English history, when the saga itself can be divided into the contemporary and trustworthy verse and the later and untrustworthy prose, — work, all this, which has been done over and over again by the scholar for more than one nation,—M. Du Chaillu simply gives us the sagas again, with comments now and then of amazing simplicity. The saga of Harold Hardrada, the bits of genuine minstrelsy of the eleventh century patched together by the prose of the thirteenth, has been long ago thoroughly examined in its relations to the English narratives; above all, to the precious piece of contemporary English minstrelsy preserved by Henry of Huntingdon. It might have seemed hardly needful nowadays to prove once more that the picture of the English army in the saga is simply a fancy piece drawn from an English army of the thirteenth century. There are the English archers, the English horsemen, horsemen too whose horses are sheeted in armor. If any man doubts, he has nothing to do but to compare Snorro's fancy piece with the living representation of a real English army of the eleventh century in the contemporary tapestry of Bayeux. There he will see that to the English of that day the horse was simply a means to carry him to and from the place of battle, and that the clothing of horses in armor was a practice as yet unknown to the Norman horsemen themselves. Yet after all this, so often pointed out, M. Du Chaillu volunteers a little note to say that Snorro's version proves "that the English, like their kinsmen, had horses." That we had horses, no man save Procopius[1] ever doubted; but both Brihtnoth and Harold got down from their horses when the work of battle was to begin.

It is hardly by an adversary who cannot wield the weapons of criticism better than this that we shall be beaten out of the belief that there is such a thing as an English people in Britain. Perhaps, too, we shall not be the more inclined to give up our national being when we see its earliest records tossed aside with all the ignorant scorn of the eighteenth century. The "Frankish and English chroniclers" rank very low in the eyes of M. Du Chaillu. We know exactly where we have got when we come to the old conventional talk about "ignorant and bigoted men," "monkish scribes," and the like. Among these monkish scribes we have to reckon Einhard and Count Nithard, and our own literary ealdorman, Fabius Patricius Quæstor Ethelwardas. The odd thing is that, with M. Du Chaillu, Franks and Saxons or English go together. He is at least free from his countrymen's usual weakness of claiming the Franks, their kings, their acts, and their writings, for their own. As far as his theory can be made out, it seems to be this: the Suiones of Tacitus are the Swedes, and the Suiones had ships; so far no one need cavil. But we do not hear of the Suiones or any other Scandinavian people doing any thing by sea for several centuries. But, though we do not hear of it, they must have been doing something. What was it that they did? Now, in the fourth, fifth, sixth, centuries, we hear of the Saxons doing a good deal by sea: therefore the name "Saxones" must be a mistake of the Latin writers for "Suiones." It was not Saxons, but Swedes, or at least Scandinavians of some kind, who did all that is recorded of the Saxons, and presumably of the Angles and Jutes also, in Gaul, Britain, or anywhere else. The Angles and Saxons, therefore, who have been hitherto thought to have settled in Britain in the fifth and sixth centuries, are all a mistake. They were not Anlges or Saxons at all, but Scandianvians of some kind. Hengest and Ælle were simply the advanced guard of Hubba, Sween, and Cnut. They could not have been Saxons, because, when the Northmen came against the continental Saxons of later times, they found no fleets to withstand them.

The assumption that goes through all this is, that once a seaman, ever a seaman; once a landsman, ever a landsman. These could not be seafaring Saxons in the fifth century, because we do not hear of Saxon fleets in the eighth. On the other hand, because the Suiones had ships in the days of Tacitus, as they could not have left off using ships, it must have been they who did the acts which are commonly attributed to the Saxons. A good deal is involved in this last assmuption: it is at least conceivable, and not at all unlike the later history of Sweden, that the Suiones went on using their ships, but used them somewhere else, and not on the cost of Gaul or Britain. But of the grand assumption of all—the assumption that the landsman can never become a seaman or the seaman a

[1] The great description comes in the sixth letter of the seventh book.

[2] Thucydides, vii. 21.

[1] Bell. Gotth. iv. 20.

landsman—I have spoken already. And if this be a real difficulty, it is just as great a difficulty on M. Du Chaillu's theory as it is according to the genuine records of English history. Over and over again has it been noticed as a strange thing that the settlers who came to Britain by sea, as soon as they were settled in Britain, left off their seafaring ways, and had no fleet to withstand the Danes when the Danes did come. There is in this really nothing wonderful. But if this be a difficulty in the case of Anglian or Saxon settlers, it is hard to see how the difficulty becomes any less if the settlers are rated to be Swedish, Danish, or Norwegian.

In truth, M. Du Chaillu's theory is several degrees more amazing than that of Mr. Seebohm. How did we come by our language? How did we come by our national names? We did not, according to this theory, light by the way on any of those Low-Saxon, Frisian, or Jutish companions and teachers who, in Mr. Seebohm's view, may have done so much for us. And it is a little daring of M. Du Chaillu to represent the use of the Saxon name, as applied to the ravagers and settlers of Gaul and Britian, as simply the mistake of some Latin scribe, some ignorant blunderers like Claudian or Sidonius, who wrote "Saxones" when they should have written "Suiones." The mistake went a little deeper than that. How came the Teutonic settlers in Britain to call themselves Angles and Saxons? How did their Celtic neighbors come to call them Saxons? How did the conquered land come to take, here the Anglian, there the Saxon, name? One is astonished to read n M. Du Chaillu's book, "Nor is any part of England called *Saxland*."[1] It is possible from the context that what is meant is merely that no part of England is so called in the northern sagas. But the name of "England" comes often enough in them, and "England" is as bad as "Saxland" for M. Du Chaillu's theory. It is hardly worth searching through all the sagas to see whether such a word as "Saxland" is ever found there or not. If it be so, it merely proves that no northern writers had any need to speak of Wessex, Essex, Sussex, or Middlesex by their local names. But considering that those names have been in unbroken use in the lands themselves ever since the fifth and sixth centuries, it does not much matter whether any sagaman called them so or not. It is more important, from M. Du Chaillu's point of view, to explain how West-Saxons, East-Saxons, South-Saxons, and Midde-Saxons were led into such strange mistakes as to their own name and origin.

No one denies that the Scandinavian infusion in England is real, great, and valuable; only it is an infusion which dates from the ninth century, and not from the fifth or sixth. Danish writers, without going quite so far as their champion from Valland, have often greatly exaggerated the amount of Scandinavian influence in England. They have often set down as signs of direct Scandinavian influence things which are simply part of the common heritage of the Teutonic race. But no one doubts that the Danish infusion in England was large, that in some parts it was dominant; and its influence was wholesome and strengthening. Dane and Angle, Dane and Saxon, were near enough to each other to learn from one another, and to profit by one another. They were near enough to be fused into one whole by a much easier process than that which in some parts of the island did in the end fuse together the Briton and the Teuton. Still the Scandinavian infusion was but an infusion into the already existing English mass. As we are not a British people, but an English people with a certain British infusion, so neither are we a Scandinavian people, but an English people with a certain Scandinavian infusion.

One word about the Franks, whose fate at M. Du Chaillu's hands is so oddly the same as that of the Saxons. According to him, as some Suiones were mistaken for Saxons, which gave rise to the error of looking on Saxons as a seafaring people, so also some Suiones were mistaken for Franks, which gave rise to the error of looking on Franks as a seafaring people. But this last error, at all events, never led astray any one. The Franks were not a seafaring people, nor did any body ever think that they were. The whole notion of seafaring Franks comes from two passages of Eumenios and Zôsimos which record a single exploit of certain Frankish prisoners, who seized on some ships in the Euxine and amazed mankind by sailing about the Mediterranean, doing much damage in Sicily, and getting back to Francia by way of the Ocean. This single voyage, wonderful as it was, is not quite the same thing as the habitual harrying of the coasts of the Channel, and of the Ocean too, by Saxons in their own ships. And when Ammianus speaks of Franks and Saxons laying waste the Roman territory by land and sea, the obvious meaning surely is that the Franks did it by land, and the Saxons by sea. But all things about Franks are surely outdone by a single sentence of M. Du Chaillu, standing alone with all the honors of a separate paragraph.

"In the Bayeux tapestry, the followers of William the Conqueror were called Franci and they have always been recognized as coming from the north."

Further comment is needless. We decline to be brought from the north by M. Du Chaillu, even more strongly than we decline to be brought from the south by Mr. Seebohm: for Mr. Seebohm does leave some scrap of separate national being to the "Anglo-Saxon invaders" from the English land of middle Germany; M. Du Chaillu takes away our last shreds; we are mere impostors, Suiones falsely calling ourselves Saxones. But let us speculate what might happen if M. Du Chaillu's theory should ever fall into the hands of those statesmen and princes of the Church who seem to have lately taken in hand the nomenclature of that part of mankind whom plain men may think it enough to call the English folk.[1] The other day one eminent person enlarged of the glories of the "Anglo-Saxon race," while another enlarged instead on the glories of the "British race." A third claimed the right of free discussion for all "speakers of the British language." Let gallant little Wales look out: there would seem to be some corner in its twelve (or thirteen) counties in which free discussion is just now not allowed. New names often take. In my youth the "Anglo-Saxon race" was unheard of, and the "British race" dates, I believe, only from the speech of last week, from which I quote. Why should the Suiones, so long and so unfairly cheated of their honor, not have their day at last? Set forth with a good delivery, at the end of a fine rolling period, "the imperial instincts of the Suionic race" would be as likely to draw forth a cheer as other phrases whose amount of meaning is very much the same. When will men, statesmen above all, learn that names are facts; that words, as expressing things, are themselves things; that a confused nomenclature marks confusion of thought, failure to grasp the real nature of things and the points of likeness and unlikeness between one thing and another? Leaving, then, the Anglo-Saxon race and the British race and the Suionic race, and the instincts, imperial or otherwise, of any of them, this question of the origin of our people, this great and abiding dispute whether we are ourselves or somebody else, suggests one or two practical thoughts. Here I rule no point of present controversy; I only give some hints which may possibly help those who have to rule such points.

There is an English folk, and there is a British Crown. The English folk have homes: the British Crown has dominions. But the homes of the English folk and the dominions of the British Crown do not always mean the same thing. Here, by the border stream of the Angle and the Saxon, we are at once in one of the homes of the English folk and in one — and I dare to think the noblest and the greatest — of the dominions of the British Crown. If we pass to the banks of the Indus and Ganges, we are still within the dominions of the British Crown, but we cannot say that we are any longer among the homes of the English folk. Let us pass again to the banks of the Potomac and the Susquehanna: there we have gone out of

[1] "The Viking Age," vol. i. p. 20.

[1] See the speeches of the Earl of Rosebery, Cardinal Manning, and the Earl of Carnarvon in the Times of Nov. 16, 1889. The qualification needful in all such cases must of course be understood — "if the speakers really said what the reporters put into their mouths."

the dominions of the British Crown, but we have come back again to the English folk in one of their chiefest homes. These are but plain facts—plain as the sun at noonday. It is because they are so plain, that mankind, above all orators and statesmen, will not understand them. Once more, let a man's words set forth his thoughts, and let him shape his thoughts by the facts. That is all; but if this counsel of perfection be too hard, it may be better to declaim about the "Suionic race" than about the "Anglo-Saxon race." It will lead fewer people astray.

EDWARD A. FREEMAN.

ELECTRICAL NEWS.

EDINBURGH INTERNATIONAL ELECTRICAL EXHIBITION. — The executive council decided to finally close the list of applications for space on Jan. 15, when allotment was proceeded with. The French, Italian, and Austrian exhibits are expected to be specially fine, while India, China, and Japan will all be well represented in the department devoted to general industries. The railway machinery and appliances section promises well, several of the leading railway companies having agreed to exhibit; while among electrical exhibitors are Sir William Thomson, W. H. Preece, Edison, the general post-office, Edison-Swan, Laing, Wharton & Down, Anglo-American Brush, Paterson & Cooper, United Electrical Engineering, King, Brown & Co., Mavor & Coulson, Sir William Vavasour (Limited), Elmore Copper Depositing Company, Thomson-Houston Welding Company, Newell Engine Company, Robey & Co., Electric Traction Company, Ernest Scott & Co., Ronald Scott, Woodhouse & Rawson, Butler, Jobson & Co., W. T. Glover & Co., National Telephone Company, Consolidated Telephone Construction Company, Col. Gouraud, Gent & Co., Exchange Telegraph Company, Eastern Telegraph Company. The Decauville Company propose to show a narrow-gauge railway in operation, but worked by electricity in lieu of steam. The executive council have arranged with Immisch & Co. for a ten-minutes' service of electric launches on the Union Canal between Fountainbridge and the exhibition, which will afford the public a novel and interesting mode of conveyance, and will probably constitute the first example of electric navigation for general traffic. In addition to the British electrical contingent, about one hundred and fifty electrical exhibits are expected from France, where the government have officially recognized the exhibition, and considerable numbers from other foreign countries. The financial prospects of the exhibition are regarded by the finance committee as eminently satisfactory, as, owing to the much larger sums obtained for refreshment and other concessions above those received at the former Edinburgh Exhibition of 1886, it is considered that the whole cost of the buildings, grounds, and preparations will be defrayed without drawing on the admission receipts at all, whereas in 1886 no less than $110,000 had to be made up out of admission receipts before any thing was available wherewith to meet working expenses.

FRANKFORT ELECTRO-TECHNICAL EXHIBITION.—It is proposed to hold at Frankfort-on-the-Main an international electro-technical exhibition from June 1 to Oct 31 of the present year. The exhibition will include all branches of the electrical science and industry, but as a rule only those exhibits will be admitted which show a decided improvement on those of the last special exhibitions at Munich in 1882 and Vienna in 1883. The exhibits will be divided into twelve great groups, commencing with motors for electro-technical purposes, and ending with electrical literature. Applications should be made before Jan. 15, and addressed to Mr. Leopold Sonnemann, editor of the *Frankfurter Zeitung*, Frankfort-on-the-Main.

MR. A. W. PEARSON, for many years city editor of the *Morning Bulletin*, Norwich, Conn., in addition to his regular work on the *Bulletin*, will edit the entomological department of *The Observer*, — a paper for all who love the out-door world. *The Observer* is published at Portland, Conn.

BOOK-REVIEWS.

Practical Marine Surveying. By HARRY PHELPS. New York, Wiley. 8°. $2.50.

THE author of this work, who is an officer in the United States Navy, elucidates, in a simple and straightforward manner, all the points that usually arise in a marine survey, omitting no essential detail, and yet avoiding the confusion produced by a multiplicity of explanations such as are too often indulged in by writers who aim to be practical rather than theoretical. The instructions given in the book are practical in the true sense of the word; that is, they show the student how theories are utilized in actual practice.

This work was specially prepared for use at the Naval Academy at Annapolis, where the need of such a text-book had been felt for several years by officers engaged in teaching marine surveying. The author, having been engaged exclusively in surveying work for some six years previous to his assignment to duty at the Naval Academy, was requested by the head of the department of astronomy, navigation, and surveying, to prepare a text-book on the subject of marine surveying to take the place of the one then in use. This volume is the result, and it will without doubt prove valuable not only to students at the academy, but also to others pursuing the same line of study. The methods described and explained in the work have been used in actual practice, with few exceptions, and have been found to give satisfactory results.

The author acknowledges his indebtedness to Lieut-Commander Asa Walker, U. S. N., who specially prepared the chapter on projection; and to Wharton's "Hydrographic Surveying," whence he takes the method of platting angles by means of chords. The book contains numerous illustrations and diagrams, including two excellent photo-engravings of the sounding-machine on the United States steamer "Ranger," in the chapter on sounding with wire.

Practical Hints for the Teachers of Public Schools. By GEORGE HOWLAND. (International Education Series.) New York, Appleton. 16°.

THE several chapters of this work were originally a series of lectures delivered by the author as superintendent of schools in Chicago. They are, as their name indicates, of a purely practical character, with only incidental references to educational theories, and they have been prepared with the special object of assisting teachers in their every-day work. The chief fault of the book is its desultory character, there being little attempt at an orderly development of the thought; but it is animated by an excellent spirit, and conveys many hints and suggestions that can hardly fail to be useful to bright and progressive teachers. Mr. Howland, we are glad to note, is not so excessively fond of mere method and professional training as some enthusiasts are, but insists more on the character of the teacher and the spirit with which she pursues her work. He remarks that "methods are not for their own sake—they are but means to an end;" and, again, that "the purpose of the public school, as seen in its origin and history, is intellectual culture, and those methods only can have a strong and lasting hold on the public mind which best promote this." He has some interesting remarks on school government and discipline, as to which he leans toward leniency rather than severity. He discusses the question of moral instruction in the public schools, which has been so much talked of lately, and shows very clearly that the schools exert a powerful influence on the character and conduct of the pupils, apart from any specific moral instruction. Indeed he speaks slightingly of such instruction, when given in a formal manner, and maintains that morals are best taught by the example of the teacher, the requirements of the lessons, and the social life of the school. Besides these more general topics, Mr. Howland touches on a multitude of points in teaching and school management, showing a thorough knowledge of his subject and a lively interest in it. His book is one that teachers especially will like to read.

Publications received at Editor's Office, Jan. 13-25.

AESCHINES against Ctesiphon (on the Crown). Ed. by R. B. Richardson. Boston and London, Ginn. 279 p. 12°. $1.50.
BOARD of Trade Journal. Vol. I. No. 1. *m.* Providence, R. I. 36 p. f°. $2 per year. Little & Bosworth.
CAMPBELL, W. M. Foot-Prints of Christ. New York, Funk & Wagnalls. 375 p. 8°.
COOKE, M. W. The Human Mystery in Hamlet: An Attempt to Say an Unsaid Word. New York, Fords, Howard & Hulbert. 135 p. 12°. $1.
DAVIS E. H. The Second Reading-Book. Philadelphia, Lippincott. 208 p. 12°. 40 cents
EVOLUTION. Popular Lectures and Discussions before the Brooklyn Ethical Association. Boston, J. H. West. 400 p. 12°. $2.
GILMORE, J. R., and ABBOTT, L. The Gospel Commentary. New York, Fords, Howard, & Hulbert. 840 p. 16°. $1.50.
HOPTON, W. Conversation on Mines, etc., between a Father and Son. Philadelphia, Lippincott. 326 p. 12°. $1.25.
HORNADAY, W. T. The Extermination of the American Bison Washington, Government. 180 p. 8°.
HOWLAND, G. Practical Hints for the Teachers of Public Schools. New York, Appleton. 198 p. 16°.
KANSAS. List by Counties of Newspapers and Periodicals published in, Jan. 1, 1889. Compiled by F. G Adams. Topeka, State. 38 p 8°.
MASON, W. P. Notes on Qualitative Analysis. 2d ed. Troy, N. Y., Nims & Knight. 44 p. 8°.
MERRIMAN, M., and JACOBY, H. S. A Text-Book on Roofs and Bridges. Part II. Statics. New York, Wiley. 124 p. 8°. $2.50.
MOOREHEAD, W. K. Fort Ancient. Cincinnati, Robert Clarke & Co. 129 p. 8°. $2.
OSTROM, K. W. Massage and the Original Swedish Movements; their Application to Various Diseases of the Body. Philadelphia, Blakiston. 97 p. 12°. 75 cents.
PENNSYLVANIA Geological Survey. Atlas Eastern Middle Anthracite Field. Part 3. Harrisburg, State. 8°.
—— Atlas Northern Anthracite Field. Part V. Harrisburg, State. 8°.
—— Atlas Southern Anthracite Field. Part II. Harrisburg, State. 8°.
PHARAOH, An Appeal to: The Negro Problem, and its Radical Solution. New York, Fords, Howard, & Hulbert. 205 p. 12°. $1.
RIBOT, T. The Psychology of Attention. Authorized translation. Chicago Open Court Publ. Co. 121 p. 12°. 75 cents.

AMONG THE PUBLISHERS.

IN the February *Atlantic* the Bering Sea question is discussed by Charles B. Elliott; and Mr. K. Kaneko, the head of the Japanese commission which has been visiting various countries to compare their legislative assemblies, in order to establish a Japanese parliament, has a paper on "An Outline of the Japanese Constitution." The article which will arouse the most discussion is by Gen. Francis Walker, about Mr. Bellamy and the new Nationalist party. There are four articles devoted to recent books on political and historical subjects.

— Messrs. J. B. Lippincott Company publish immediately the long-looked for book concerning Henry M. Stanley and his rescue of Emin Pacha. This work, entitled "Stanley's Emin Pacha Expedition," will be entirely authentic in every particular, as it is compiled from Stanley's own letters to the president of the society which was mainly instrumental in sending him on the journey. The book contains about four hundred pages, together with numerous illustrations and maps.

— *Public Opinion* has issued No. 3 group of "Representative Moulders of Public Opinion." The first two contain portraits of the editors of daily papers. The third is confined to the weeklies and monthlies, of which the following is a list: E. L. Godkin of the *Nation;* H. Clay Trumbull of the Philadelphia *Sunday School Times;* A. E. Winship of the Boston *Journal of Education;* Prof. W. J. Youmans of the *Popular Science Monthly;* Henry C. Bowen of the *Independent;* Mrs. Martha J. Lamb of the *Magazine of American History;* Rev. Edward Bright of *The Examiner*, New York; J. N. Hallock, *Christian at Work*, New York; Rev. A. E. Dunning, *The Congregationalist*, Boston; Rev. C. W. Leffingwell, *The Living Church*, Chicago; F. M. Somers, *Current* Literature, New York; Rev. Samuel J. Barrows, *The Christian Register*, Boston; F. M. Hexamer, *American Agriculturist*, New York; George William Curtis, *Harper's Weekly;* Rev. Charles Parkhurst, *Zion's Herald*, Boston; Rev. Lyman Abbott, *Christian Union*, New York; William H. Hills, *The Writer*, Boston; Joseph Keppler, *Puck;* Rev. John Talbot Smith, *The Catholic Review*, New York; Rev. O. P. Fitzgerald, *Christian Advocate*, Nashville, Tenn.; R. H. Edmonds, *Manufacturer's Record*, Baltimore; David M. Stone, *Journal of Commerce*, New York; Albert C. Stevens, *Bradstreets*, New York; Rev. Simeon Gilbert, *The Advance*, Chicago; Richard H. Clarke, *Catholic Quarterly*, New York; T. C. Martin, *The Electrical World*, New York; Joseph B. Gilder, *The Critic;* Rev. J. W. Mendenhall, *Methodist Review*, New York; W. J. Arkell, *Judge*, New York; L. S. Metcalf, *The Forum;* R. W. Gilder, *The Century Magazine;* E. L. Burlingame, *Scribner's Magazine;* Lloyd Bryce, *North American Review;* Allan Forman, *The Journalist*, New York; John A. Mitchell, *Life*, New York; E. H. Talbott, *The Railway Age*, Chicago; William H. Park, *Banker's Monthly*, Chicago; Howard M. Jenkins, *The American*, Philadelphia; John Boyle O'Reilly, *The Pilot*, Boston; Rev. A. T Pierson, *Missionary Review of the World*, Philadelphia; DeWitt J. Seligman, *The Epoch*, New York; Rev. Wendell Prime, *The Observer*, New York; N. D. C. Hodges, *Science*, New York; Charles W. Price, *Electrical Review*, New York; Rev. I. K. Funk, *Voice*, New York; and Rev. David H. Moore, *Western Christian Advocate*, Cincinnati.

LETTERS TO THE EDITOR.

An Insect Destructive to Wheat.

ON p. 41, No 363, of *Science*, you tell that "an insect destructive to wheat, but previously unknown in this country, has appeared in considerable numbers in the Cornell University farm at Ithaca." We beg to say that so long as thirty-five to forty years ago, and probably longer, an insect similar in appearance and behavior to the foregoing was common in the wheat-fields of middle Tennessee, though we never knew them to be sufficiently numerous to seriously reduce the yield of grain. That it was the same insect, we have no doubt.

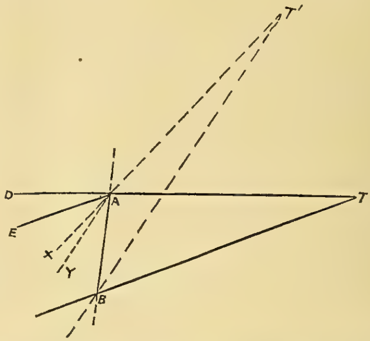
Q. C. SMITH.

Austin, Tex., Jan. 22.

The Fiske Range-Finder.

IN *Science* of Jan. 24 there is a full and comprehensive description of the Fiske range-finder, which, although interesting and very ingenious in regard to its electrical arrangement, is not so clear in its mathematical principles. I refer particularly to Fig. 4, p. 59. The error being so apparent, it cannot be conceived that the inventor has overlooked it, and I write more in a spirit of inquiry than of criticism.

Let the continuous lines in the following figure represent the essential conditions of Fig. 4, p. 59. Moving the index along the scale *mn*, *op* (Fig. 6, p. 59), a distance corresponding to the angle DAE, the bridge becomes balanced, and the reading will give the distance AT. Now let us suppose that from the position T, the object moves to T′, AT′ being equal to AT. The resulting diagram is indicated in broken lines. Moving the sliding index along the scale *mn*, *op*, as before, a distance corresponding to the angle XAY, the bridge is balanced, and the reading of the



scale will indicate the distance AT′; but this reading will by no means be the same as that obtained when the object was at T, because the angle XAY is smaller than DAE. In other words, it is impossible to construct a scale giving true distances of objects from A in terms of the angle DAE, unless we impose as a condition that one of the sight lines shall make a fixed and constant angle with the base.

The angle DAE will vary for different positions of the point T, in a circumference drawn with A as a centre and AT as a radius, having its maximum value when the triangle ATB is isosceles, and becoming O when T is in a rectilineal prolongation of the base.

THOS. L. CASEY.

New York, Jan. 27.

INDUSTRIAL NOTES.

The Anglo-American Storage-Battery.

A FORM of storage-battery invented by Mr. Charles Sorley, and manufactured by the Anglo-American Storage Battery Company of this city, is shown in Figs. 1 and 2. In the construction of the cell, the object aimed at by the inventor is to get as large an amount of active material as possible, with a correspondingly large conducting and contact surface. With a view to attaining this object, the plates of the cell are constructed as shown in Fig. 1, being built up of strips of lead bent into convolutions, as shown, and secured together so as to form a plate. The thickness of the plate, of course, depends upon the width of the strips. All the plates of the same sign are connected by means of the projecting ends of the lead strips, as shown in Fig. 1. The plates are separated and supported by insulating strips, and bound together by insulating rods, which pass through the centre of the plates. The complete cell is shown in Fig. 2.

A battery of these storage-cells has been in constant use in the Schermerhorn building in this city since May 20, 1889. Of this battery the superintendent of the building reports as follows: "In every respect it has exceeded the claims made for it, and is

saving us two and a half hours' running of engine and dynamo each day, half a ton of coal each week, and our gas bill is reduced proportionate to the number of lights we are wired for. We have never had the slightest trouble with it, and we have taken from it its rated capacity every night for the past thirty-three nights, and on Sundays from thirty-three and a third to fifty per cent in excess.'' Formerly, before the battery was put in, the dynamo ran ten hours daily, furnishing light, of course, only when running; now the dynamo runs only seven and a half hours each day, furnishing light the whole twenty-four hours where required.

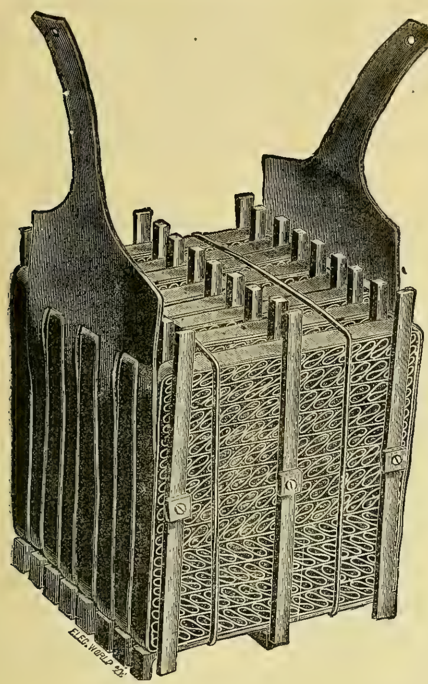


FIG. 1.

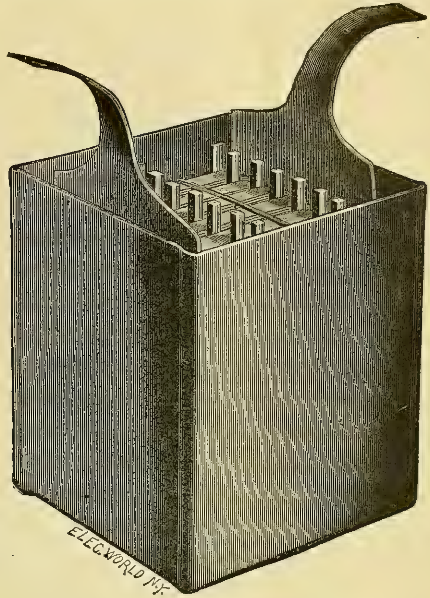


FIG. 2.

Among the claims made for these cells are their high efficiency, yielding ninety to ninety-two per cent of the current put into them; their freedom from buckling or breaking, owing to their peculiar construction; economy in use, as they can be charged in a comparatively short time; their capacity, giving about five hours and a half ampère hours per pound weight; simplicity of service, not requiring an expert electrician to superintend them; and, lastly, their long life. These batteries are now in use in many parts of the country.

CALENDAR OF SOCIETIES.

Natural Science Association of Staten Island.

Jan. 9.—The building fund committee reported that the public appeal, heretofore adopted, had been printed and distributed to all members, to the press of the county, and to about two hundred prominent citizens in all parts of the island. Mr. Thos. Craig showed specimens of Staten Island pond-life under the microscope. Among the objects shown were *Amœba proteus* and *Protococcus viridis*. The latter organism is the cause of the green coating on the trees, stones and fences, which has attracted so much attention lately, especially in New York, where some persons have tried to connect it with the prevailing epidemic of influenza or "grip." Dr. Britton showed seeds of native orchids (*Corallorhiza odontorhiza and C. multiflora*) under the microscope, and explained their differences of appearance and structure. Mr. Arthur Hollick presented specimens of *Draba verna* in full bloom, collected at Tottenville, Dec. 30, at which date the fields in places where white with it. Skunk cabbages were in full bloom in abundance in many of the swamps at the same place. Mr. Hollick also showed fossil leaves in clay ironstone from the shore at Tottenville. The specimens were part of a recent rich find, resulting in adding many new species of the local fossil flora, which will be studied and reported upon at some time in the future.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

I wish to purchase Vol. 7 of the *American Chemical Journal*, either bound or unbound. State price. Address, Wm. L. Dudley, Vanderbilt University, Nashville, Tenn.

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmola patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes, etc., wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred. — James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.— D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write.— J. M. Keck, Chardon, Ohio.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

I want to correspond and exchange with a collector of beetles in Texas or Florida. — Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

A collection of fifty unclassified shells for the best offer in bird skins; also skins of California birds for those of birds of other localities. Address Th. E. Slevin, 2413 Sacramento St., San Francisco, Cal.

I have forty varieties of birds' eggs, side blown, first class, in sets, with full data, which I will exchange for books, scientific journals, shells, and curios. Write me, stating what you have to offer. — Dr. W. S. Strode, Bernadotte, Fulton County, Ill.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

GEOLOGICAL REPORTS.—Where would I be likely to find for sale the 5 "Annual Reports of the Geological Survey of New York," published in 1837–1841, and also the 4 vols. "Geology of New York," published in 1843, and both being issued by the State. Charles Fry, 54 Devonshire St., Boston, Mass.

WANTED.—A position in an Academy, Normal or High School, as teacher of the Natural Sciences and Modern Languages. Latin taught in addition if necessary. Address G., Box 441, Hanover, N.H.

STATISTICS OF LEPROSY IN THE UNITED STATES.—In view of the general impression that leprosy is spreading in this country, it is desirable, in the interest of the public health, to obtain accurate information on this point. The undersigned is engaged in collecting statistics of all cases of leprosy in the United States, and he would ask members of the profession to aid in this work by sending a report of any case or cases under their observation, or coming within their knowledge. Please give location, age, sex, and nationality of the patient, and the form of the disease,—tubercular or anæsthetic; also any facts bearing upon the question of contagion and heredity. Address Dr. Prince A. Morrow, 66 West 40th Street, New York.

WANTED.—The addresses of makers of small Dynamos suitable for a college laboratory. Address, T. S., Box 71, Gambier, Ohio.

WANTED.—To correspond with conchologists in America, especially in California, with a view to exchange. Many British land, fresh water, and marine duplicates; some foreign. Address Mrs. FALLOON, Long Ashton Vicarage, Bristol, England.

A YOUNG SCOTCHMAN desires an appointment in America. Three years in English Government Office. Good references. Address "Jack" care J. Lawson & Coy, 17 Princes St., Aberdeen, Scotland.

I WILL ASSIST in photographic or optical laboratory in return for experience and convenience of perfecting original appliances. Address E. C. Owen, care of Gibson & Simpson, 9½ Adelaide Street East, Toronto, Canada.

AN ANALYTICAL CHEMIST is open to an engagement in mining, metallurgy, calico printing, and bleaching, or as research chemist in alkali manufacture. Address "Alkali," care of SCIENCE.

LIGHTNING.—Concise descriptions of the effects of lightning discharges are desired. State whether the object struck was provided with a lightning rod, the character of the rod, and the way in which it was set up. Beginning at the top, describe briefly the effects. State whether there was any smoke or dust raised, and whether there was any odor. Any reports of recent and especially interesting discharges will be published in *Science*.—Science, 47 Lafayette Place, New York.

SCIENCE

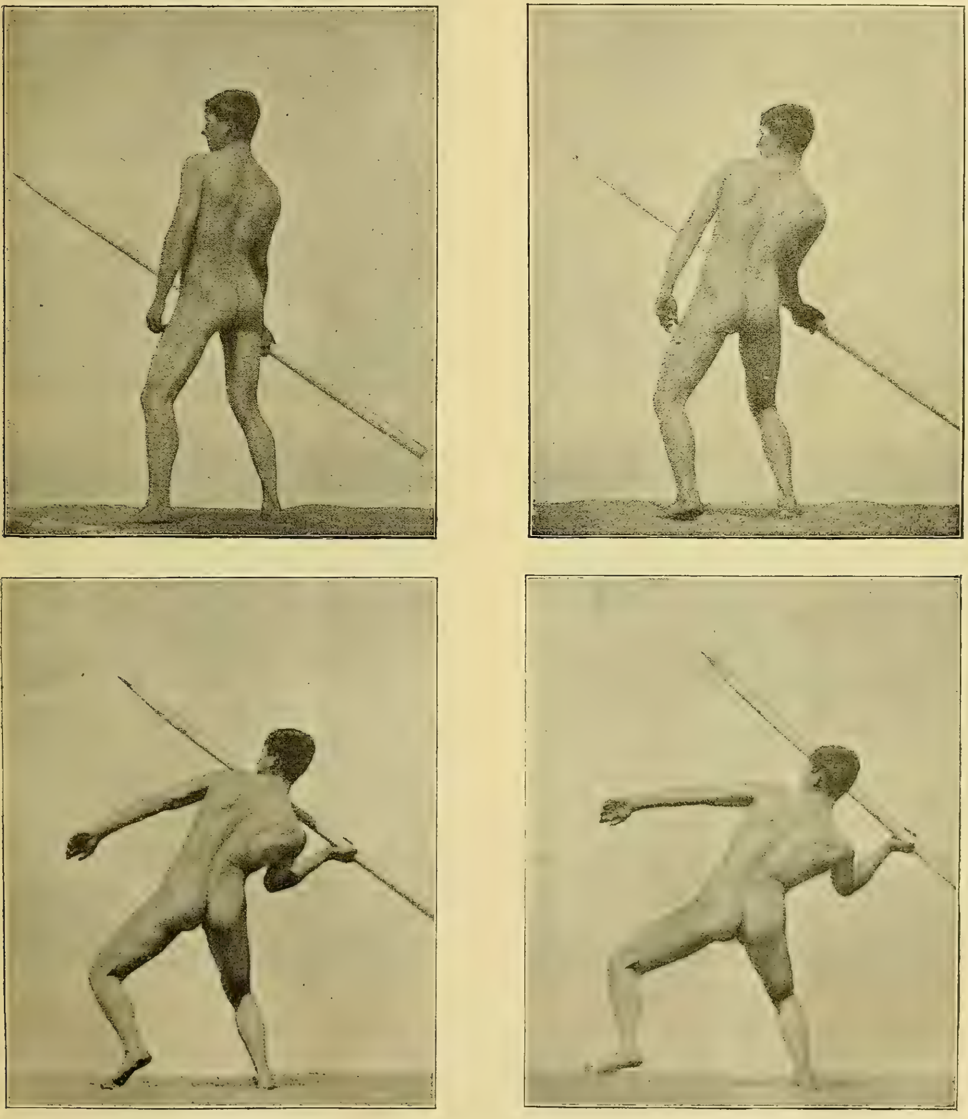
[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 366.

NEW YORK, FEBRUARY 7, 1890.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.



INSTANTANEOUS PHOTOGRAPHS OF AN ATHLETE THROWING A JAVELIN (see next page).

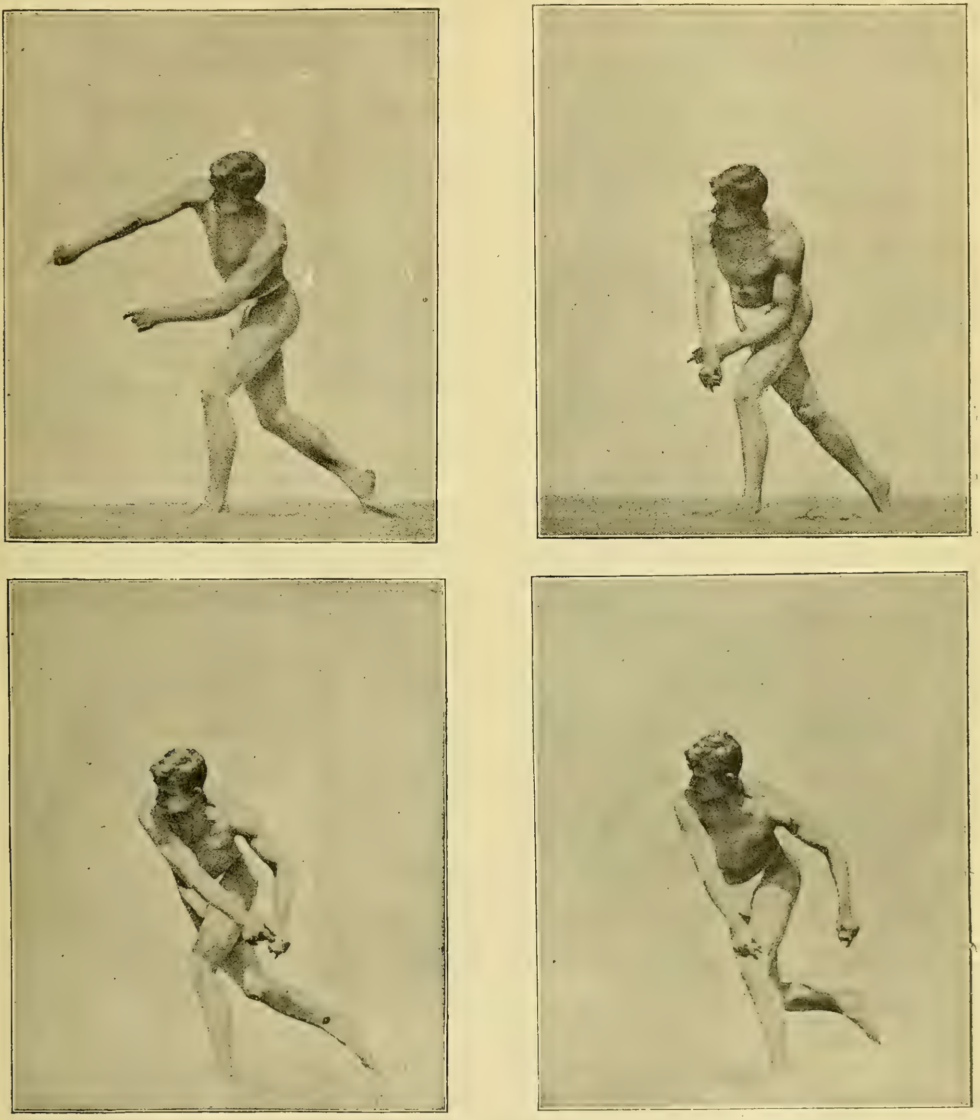
INSTANTANEOUS PHOTOGRAPHY.

IT is a psychological peculiarity of our eye to retain an impression for some time after its source has ceased to exist: thus, if a piece of glowing coal is quickly swung around in a dark room, the eye perceives a circle of light. This is a proof that the eye at a given moment does not see the glowing coal at the place where it happens to be, but that the impression of light of the previous position continues to prevail, thus giving us a composite picture consisting of separate and successive impressions. The same occurs in observing an animal in motion, when the impression we receive is composed of the momentary as well as the immediately preceding positions. It is only by means of photographic apparatus that any single and separate phase of motion can be seized and rendered visible to the eye. Thus it becomes apparent that photography enlarges the power of vision to an extent which is truly wonderful.

Of course, the sensitiveness of the photographic plate surpassing that of the human eye so many times, it was quite natural that the very first pictures made of men or animals in motion showed many new positions which the eye had never before been able to perceive, and artists as well as scientists at once began to make use of photography for the purpose of studying the phases of rapid animal motion. Prominent in this field of investigation is Mr. Ottomar Anschuetz of Lissa,

INSTANTANEOUS PHOTOGRAPHS OF AN ATHLETE THROWING A JAVELIN.

Prussia, who has taken thousands of pictures of flying birds, running horses, jumping men, etc., all admirable for their perfect "technique," and for the great artistic tact and scientific skill with which the moments of exposure had been chosen. In these pictures the characteristic positions peculiar to different motions are well presented. Many of them at first appear abso- walking man, as many views as possible in equal intervals o time, and he succeeded admirably in his undertaking. He was able to observe in this manner even the fastest motion, for instance, the hurdle-jump of a racing horse, which occupies only seventy-two one-hundredths of a second, and in this short time made twenty-four pictures of the different positions in



INSTANTANEOUS PHOTOGRAPHS OF AN ATHLETE THROWING A JAVELIN.

lutely unnatural, because the eye has never been able to observe them.

These pictures produced rich and important material for the study of motion, but Mr. Anschuetz succeeded in making his experiments more valuable by obtaining whole series of pictures giving the different phases of motion. He made it his object to get of one period of motion, for instance, of the step of a equal intervals. A dozen pictures showing the different phases of position assumed by an athlete in throwing a javelin, reproduced from instantaneous photographs taken by Mr. Anschuetz, are given on this and the preceding pages.

Mr. Anschuetz next constructed an apparatus which he called the electric tachyscope, in which he was financially assisted by the German Government. In this instrument the series o

pictures is put on a circular glass plate, which is rapidly turned round its axis; and, whenever a picture appears before the eye of the observer, it is lit up by an electric spark. By this means the natural motion of the object is reproduced with a degree of truth and accuracy that is absolutely bewildering. Looking thus at the representation of a man on a galloping horse, every single movement of horse and rider can be followed. Not only do the legs of the horse move according to the gait, but one sees the dust rise, the horse's mane and tail fly, and the nostrils extend. The rider is jerked in his saddle, he urges his horse, pulls the curb-chain, and moves back his leg to apply the spur, etc. Each series in this apparatus represents a bit of life — not a life-like picture, but life itself — with amazing naturalness and truth. One of these tachyscopes, and many notable examples of Mr. Anschuetz's work, have been brought to this country, and are now on exhibition at the showrooms of the United States Photographic Supply Company on Fourteenth Street, this city.

SOME FOOD SUBSTITUTES AND ADULTERANTS.[1]

MR. PRESIDENT, LADIES AND GENTLEMEN,—In his address before this society last year, our late president, Dr. J. H. Kidder, presented the subject of air as one of the "two necessities of life which," he said, "are absolute," and "which we cannot live without;" namely, "food (including water) and air." It is more especially to a certain class of foods, whose increasing consumption and sale have of late years attracted public notice, that I wish to call your attention this evening; namely, that of cheap and wholesome food substitutes, which are also frequently used as food adulterants.

Our bodies are like a furnace, and require fuel and air to sustain the heat of combustion by the constant renewal of fresh material and the elimination of the waste products. The form, whether solid or liquid, of animal or vegetable origin, in which we supply this fuel, depends largely on local circumstances, climate, education, etc.; and, as long as the food employed goes to furnish the proper amount of fuel material for the maintenance of the body temperature, life is sustained.

The extent of the consumption of any new food will evidently depend on how it fulfils this requirement as a fuel, and by its pleasing appearance, its palatability, its capacity to appease hunger, its wholesomeness, and its relative cheapness, attracts public attention. If the new food is a manufactured product, its cheapness will depend upon the possibility of its production on a large scale from relatively cheap materials.

From want of reliable information in regard to the materials employed in most new food products, there is a general feeling of uncertainty and insecurity on the subject. People, as a rule, imagine that any substance used as an adulterant of, or a substitute for, a food product is to be avoided as itself being injurious to health; and when they hear that a certain food is adulterated, or is a food substitute, there is immediately a prejudice excited against the article, which it takes time and familiarity to allay. A moment's reflection ought to show that it would be directly contrary to the food manufacturer's interest to add to, or substitute any thing for, a food product which would cause injurious symptoms, as in that case his means of gain would be cut off by the refusal of consumers to buy his product. It is true that the unscrupulous manufacturer or dealer does not hesitate to cheat his customer in the interest of his own pecuniary profit and gain, but he does not want to poison him. Where, through carelessness or ignorance, injurious substances, such as the arsenic, copper, aniline, and other metallic and organic poisonous salts sometimes used for artificial colors, are added to foods, their presence is promptly revealed by the dangerous symptoms which they call forth in the consumer. About a year ago the case of the Philadelphia bakers, who added chromate of lead to color some of their cakes, and thus caused the death of several persons, and serious illness in nearly every one who ate any of these products, will be recalled by many present.

[1] Annual address of the retiring president, Mr. Edgar Richards, delivered Jan. 23, 1890, before the Chemical Society of Washington.

The great majority of substances used for food adulterants or substitutes consist of cheap and harmless substances, which are not injurious to health, as the following list of those most commonly met with in the principal food products will show. This list has been compiled from the reports of the State boards of health, the returns of the British Inland Revenue Department, the reports of the British Local Government Board, and those of the Paris Municipal Laboratory.

TABLE I.

Food Products and their Chief Adulterants.

FOOD PRODUCT.	ADULTERANTS.
Milk	Water, removal of cream, addition of oleo-oil or lard to skimmed milk.
Butter	Water, salt, foreign fats, artificial coloring-matter.
Cheese	Lard, oleo-oil, cottonseed-oil.
Olive-oil[1]	Cottonseed and other vegetable oils.
Beer	Artificial glucose, malt and hop substitutes, sodium bicarbonate, salt, antiseptics.
Sirup	Artificial glucose.
Honey	Artificial glucose, cane-sugar.
Confectionery	Artificial glucose, starch, artificial essences, poisonous pigments, terra alba, gypsum.
Wines, liquors	Water, spirits, artificial coloring-matter, fictitious imitations, aromatic ethers, burnt sugar, antiseptics.
Vinegar	Water, other mineral or organic acid.
Flour, bread	Other meals, alum.
Baker's chemicals[1]	Starch, alum.
Spices[1]	Flour, starches of various kinds, turmeric.
Cocoa and chocolate	Sugar, starch, flour.
Coffee[1]	Chiccory, peas, beans, rye, corn, wheat, coloring-matter.
Tea	Exhausted tea-leaves, foreign leaves, tannin, indigo, Prussian blue, turmeric, gypsum, soapstone, sand.
Canned goods[1]	Metallic poisons.
Pickles	Salts of copper.

[1] For list of adulterated brands see Report of the Commissioner of Internal Revenue, 1889, pp. 181-184.

Water.

Ordinary potable water is not generally considered either externally or internally "injurious to health," yet it is probably the most common adulterant used. We find, indeed, in the Canadian "Adulteration Act," that "if water has been added" to milk, "it shall be deemed to have been adulterated in a manner injurious to health" (Section 15). The watering of milk is everywhere recognized as not only a fraud, but also a grave misdemeanor, if not actually a crime. This is the food on which the whole population under one year old is fed; and, where the mother cannot supply the proper nourishment for the child, she must depend for its bringing-up on cow's or other milk. It is self-evident that a pint of watered milk does not contain the same amount of nourishment as the same volume of whole milk, so that a child or invalid might be actually starved to death if compelled to rely on the former for its sole sustenance. The placing of watered and skimmed milk on the market should, in all large cities, call forth the active exertions of their health departments to supervise and as far as possible suppress their sale.

The skill of the milk adulterator has kept pace with the march of improvement, and to-day we find centrifugal machines costing over two hundred dollars placed on the market, designed solely to manufacture, from skimmed milk and oleo-oil and lard, an artificial cream or milk, depending on the amount of animal fat added, which, it is stated, can be used for all purposes in which the genuine article is employed. A description of such machines will be found in *Engineering* (vol. xliv. 1887, p. 478) and in the catalogues of the dealers.

O eomargarine.

Within the past few years two artificial food products made from what had theretofore been considered waste products of the large slaughter-houses have come prominently before the public, and established a legitimate place for themselves as perfectly wholesome articles of food. Oleomargarine and "refined" or "compound" lard are now found on sale in most cities of this country and Europe. Against the former there has been a large amount of legislation directed with a view of controlling its production and sale, and with the unexpected result of increasing both.

Whatever may have been the production of oleomargarine in this country before the National law went into effect, we have no reliable statistics; but since the 1st of November, 1886, we have the monthly statements of the manufacturers, duly attested under oath, of the quantity of oleomargarine made and removed from the factories, tax paid for domestic consumption or in bond for export, each day of the month. These statements also give the quantity and kind of materials employed in the manufacture, and the names and addresses of the parties to whom the oleomargarine is sold or consigned.

The following table shows the monthly quantity of oleomargarine produced in this country from Nov. 1, 1886, to Nov. 1, 1889:—

TABLE II.

Showing the Quantity of Oleomargarine produced, withdrawn Tax paid, for Export, and Lost or Destroyed in Manufactories, from Nov. 1, 1886, to Nov. 1, 1889.

Year.	Quantity Produced. Pounds.	Withdrawn Tax paid. Pounds.	Lost or Destroyed. Pounds.	Withdrawn for Export. Pounds.
On hand Nov. 1, 1886.	181,090			
From Nov. 1, 1886, to Oct. 31, 1887........	31,114,682	29,692,966	55,260	1,029,880
Highest, March, 1887.	3,568,254	3,512,138	12,472	96,499
Lowest, July, 1887 ...	1,208,638	1,170,136	1,191	33,240
From Nov. 1, 1887, to Oct. 31, 1888..........	35,530,146	33,655,423	6,442	1,937,907
Highest, March, 1888.	3,940,727	3,824,672	2,998	155,761
Lowest, July, 1888....	2,084,317	1,925,762	185	155,200
From Nov. 1, 1888, to Oct. 31, 1889.........	35,132,060	32,902,802	6,741	1,694,851
Highest, Dec., 1888...	4,181,317	4,025,336	10	109,385
Lowest, June, 1889....	1,575,362	1,514,658	—	58,579
On hand Oct. 31, 1889.	429,219			
Total for 3 years.....	101,786,888	96,251,191	68,443	4,662,638

During this period the number of factories has decreased from 37 to 21, notwithstanding which fact the production and sale have increased steadily. It is produced by expensive machinery in the large factories in such quantities that it can be sold nearly the whole year round at a less price than butter, although the high rate of tax paid by both the manufacturers and dealers, which is, of course, ultimately paid by the consumer, necessarily increases the market price. In the spring and early summer months the price of dairy butter is generally cheaper than oleomargarine, and consequently less of the latter is made and sold during that time. In July the production of oleomargarine reaches its lowest limits for the year, and obtains its highest in March.

The system followed by the Internal Revenue Bureau is such that each manufacturer's package can be traced from the time it leaves the factory till it reaches the hands of the retailer or consumer, or leaves the country.

The high rate of tax demanded from the manufacturers and dealers was undoubtedly intended to be nearly or quite prohibitory: when compared to those paid by other special tax-payers, rectifiers, brewers, etc., as shown in the following table, the amounts are from three to ten times as high:—

TABLE III.

Rate of Special Taxes per Annum.

	Oleomargarine.	Liquors.		Tobacco Manufactured.
		Distilled.	Malt.	
Manufacturer.........	$600 00	$200 00*	$100 00†	$6 00
Wholesale dealer.......	480 00	100 00	50 00	30 00‡
Retail dealer...........	48 00	25 00	20 00	2 40

* Rectifier of 500 barrels, or more, per annum.
† Annual manufacture, 500 barrels or more.
‡ Pedler of tobacco, first-class.

It is undoubtedly a fact that if the retailer's tax was as low as that for tobacco, the manufacturers of oleomargarine would pay the same to have at least one dealer to handle their goods in every village and town in this country. As it is, in the Chicago district, where there are seven factories, there were 974 retail dealers doing business in April, 1889, compared with 726 the April previous; in the Boston district, with its one factory, there were 460 retailers in April last year, and 405 at the corresponding time in 1888; in the Connecticut district, with four factories, there were 424 in 1889, and 384 the year previous; and in Michigan, with no factory, there were 290 and 267 respectively for the same periods. These four collection districts contain over one-half of the total number of retail dealers doing business at the close of the last special tax year (April 30, 1889). This would seem to indicate that where the public has been brought in unprejudiced contact with oleomargarine, as sold on its own merits, they have found it palatable and suitable to their wants.

I have been in retail stores in the lumber and mining regions of the upper peninsula of Michigan, in Boston, Chicago, and elsewhere, where as much as one-half to one ton of oleomargarine is sold per week, in quantities of less than ten pounds to any one purchaser at one time, put up in packages duly branded with the word "Oleomargarine," as required by the law and regulations. It may interest you to know that there was consigned to retail dealers, and presumably sold in Washington, between Jan. 1, 1889, and Dec. 1, 1889, 130,584 pounds of oleomargarine, as shown in the following table:—

TABLE IV.

Showing Monthly Shipments of Oleomargarine from Five Manufacturers Direct to Retail Dealers in Washington, D.C., from Jan. 1, 1889, to Dec. 1, 1889.

Month.	*Lbs. Oleomargarine.*
January	10,270
February	28,223
March	6,227
April	8,108
May	12,372
June	6,808
July	6,826
August	8,466
September	13,872
October	12,844
November	16,568
Total	130,584

The ingredients which enter into the manufacture of oleomargarine are (1) neutral or leaf lard, used in the proportion of from 25 to 60 per cent, made from the leaf fat of freshly slaughtered hogs; (2) oleo-oil, used in the proportion of from 20 to 50 per cent, made from the caul and suet fats of freshly slaughtered beeves; (3) some liquid vegetable oil, as cottonseed, sesame, peanut, used in the proportion of from 5 to 25 per cent, made by crushing the seeds and extracting the oil by pressure or solvents; (4) milk or cream, used in the proportion of from 10 to 20 per cent; (5) butter, used in the proportion of from 2 to 10 per cent, generally bought from the best creameries for its fine

flavor; (6) salt; and (7) annatto or other coloring-matter. Some factories employ no vegetable oils in their oleomargarine, preferring to use a larger proportion of "neutral" lard with a small amount of butter to obtain the desired butter consistency. In the higher grade of "creamery butterine" the proportions of oleo-oil are reduced, the vegetable oils are discarded, and butter is used to make up the charge for the churn.

The method of manufacture closely resembles that used in ordinary butter-making, except that the churn is steam-jacketed and the animal fats used are previously melted before being placed in it. From a personal inspection of some of the largest factories, I am convinced that the greatest cleanliness is observed throughout all the operations; that nothing but the freshest animal fats are used; that machinery is employed as much as possible, and large quantities worked at a time, to reduce the expense. The factories are as well arranged as the best creameries; and it is to the manufacturer's interest to produce a palatable and wholesome product, which is, however, not intended to compete with "gilt-edge" butter.

Oleo-Oil.

Owing to the construction by the attorney-general of Section 2 of the oleomargarine law, the internal revenue officers exercise no control over the production and sale of oleo-oil, although the commissioner has recommended that Congress amend the law in that regard. From inquiries that were made over a year ago by the collectors of internal revenue, there was found to have been produced during the year ended June 30, 1888, 69,623,795 pounds of oleo-oil in nine States. There was used in the manufacture of oleomargarine, as stated in the manufacturers' returns, 12,265,800 pounds during that period, and 30,146,595 pounds were exported, leaving 27,211,400 pounds used otherwise. As oleo-oil is sold at a much higher rate than tallow, it is presumable that this large quantity is used in some other food products, as emulsified cream and cheeses.

There is a special provision in the law in regard to the use of any unwholesome material or product in the manufacture of oleomargarine, but no sample has ever been submitted to the commissioner of internal revenue under it. From the testimony and investigations of the most prominent chemists, both here and in Europe, there is a consensus of opinion that oleomargarine, when made from fresh fats and in a cleanly manner, is a perfectly wholesome article of food.

Compound Lard.

In the manufacture of oleo-oil there is left behind on the filter-presses a hard white or slightly yellow fat, the beef or oleo-stearine. This for many years was sold to the candle and soap makers, but is now used in the extensive manufacture of "refined" or "compound" lard by being melted and mixed with some cottonseed-oil and a little leaf-lard until the mixture has attained the desired consistency.[1]

From the testimony given before the Congressional Lard Committee, "prime steam lard" is about as disgusting a mixture as can be imagined. The entrails and other viscera, head, feet, in fact every part of the animal which contains the faintest traces of fat, are dumped into the rendering-tanks, and live steam turned on until all the fat is thoroughly melted out. The liquid is then allowed to cool, the water containing a highly savored mass of impurities is run off, and the remaining fat is tierced or canned. If it smells too "loud," it is washed with hot water, allowed to cool, and then repacked.

The oleo-stearine and cottonseed-oil mixture is prepared from clean and wholesome materials, and does not suggest any such filthy practices as "prime steam lard." The manufacturers are generally abandoning the designation of "refined," and are now calling such mixtures "compound lards."

Cottonseed-oil.

The enormous and constantly increasing production of cottonseed-oil in this country is noteworthy as showing to what an extent it has come to be employed as an article of food, both here and abroad. The principal domestic consumption of the oil is in the manufacture of "compound lard." It is also used as a substitute for, and an adulterant of, olive-oil for cooking and table use, and in medicinal preparations. It is employed instead of the more expensive animal and vegetable oils in the mining regions for the miners' lamps. There are a hundred and twenty-five mills in operation, with a capital invested, in the South, estimated at $25,000,000. Twelve thousand hands, receiving $24,000, are employed per day. The amount of seed crushed last season was 875,000 tons,[1] yielding, on an average, 37½ gallons of crude oil per ton.

Some Queer Prejudices.

A large proportion of the articles suitable for food, and produced in all countries, is wasted annually because of people's prejudice against them. The old saws, "What is one man's meat is another man's poison," and "There is no accounting for taste," are trite, but warranted by the facts.

We do not object to eating a live oyster, but prefer all our other meats dead, and undergoing putrefaction to a slight extent, in order to get rid of the "toughness," as it is generally called, produced by the *rigor mortis*. Some people like to let the putrefaction proceed further until the meat is "gamy." The Texan cowboy eats goat's meat in preference to that of the cattle and sheep he is herding. Young puppies, rats, and bird's nests are considered delicacies by the Chinese. Frog's legs and snails are among the highest priced dishes served at Delmonico's. Except the bones and hide, every part of an animal slaughtered for food is eaten by most civilized nations,—the brain; tongue; blood in the shape of black pudding and sausages; the liver; heart; lungs; stomach as tripe; the pancreas, thyroid and sublingual glands, which are called sweetbreads, and considered a great delicacy; the feet in the way of jellies, and pickled; the intestines as sausage covering, etc. In the markets of Paris there is a steady demand for horse-flesh as food. The Arabs and other nomadic tribes prefer mare's or camel's to cow's milk. Many people would as soon eat a snake as an eel, yet the latter commands a higher price than most fish in many parts of the world. Lobsters, which are the scavengers of the sea, are eaten by people who would not touch pork. The Eskimo, who eats blubber and other solid fats, and the native of the tropics, who "butters" his bread with a liquid vegetable oil, have the same object in view; viz., to supply a concentrated form of fuel. The squirrel is considered a great delicacy in many parts of this country, but is not eaten in England. The vain efforts of Professor Riley some years ago to induce the starving people of Kansas to eat the food they had at their doors,—grasshoppers, sorghum, and millet seeds, and squirrels,—himself setting them the example, will be recalled by many present.

Cooking.

From experiments made by Jensen in the laboratory of the University of Tübingen, it appears that raw meat is much sooner digested than cooked meat. Cooking, as far as animal food is concerned, has the effect of making it more pleasing to the taste, but is unnecessary; whereas with certain vegetables, especially those composed principally of starch, as grain and potatoes, it is required to fit them for use. The proper preparation of food is one that has not received the attention it demands. A badly cooked meal is more apt to disorganize the system than to prove nutritious and beneficial. The general teaching of cookery in our schools, both public and private, to girls would undoubtedly result in much improvement in this regard.

Glucose.

In April, 1882, the commissioner of internal revenue addressed a letter to the president of the National Academy of Sciences, requesting "the appointment of a committee of the academy to examine as to the composition, nature, and properties of the article commonly known as 'glucose' or 'grape-sugar.'" In the report on this subject, made in January, 1884, the committee, consisting of Professors Barker, Brewer, Gibbs, Chandler, and

[1] My thanks are due to Messrs. Fairbanks & Co. of Chicago for a set of samples illustrating the manufacture of compound lard.

[1] This information was kindly furnished me by Mr. A. D. Fulton, editor of the Oil, Paint, and Drug Reporter, in a letter dated Dec. 28, 1889.

Remsen, from the results they had obtained, summed up briefly as follows:—

"1st, Starch-sugar as found in commerce is a mixture, in varying proportions, of two sugars, called dextrose and maltose, and of dextrine, or starch-gum. Dextrose was discovered in grapes by Lowitz in 1792, and was first prepared from starch by Kirchhoff in 1811. In 1819, Braconnot prepared it from woody fibre. Maltose was first recognized as a distinct sugar by Dubrunfaut, in 1847, in the product of the action of malt on starch. No dextrose is thus produced, according to O'Sullivan.

"2d, The process of making starch-sugar consists, first, in separating the starch from the corn by soaking, grinding, straining, and settling; and, second, in converting the starch into sugar by the action of dilute sulphuric acid, this acid being subsequently removed by the action of chalk. To make the solid, 'grape-sugar,' the conversion is carried further than to make the liquid, 'glucose.' After clarifying, the liquid is concentrated in vacuum-pans, and is decolorized with bone-black.

"3d, The starch-sugar industry in the United States gives employment to twenty-nine factories, having an estimated capital of five millions of dollars, consuming about forty thousand bushels of corn per day, and producing grape-sugar and glucose of the annual value of nearly ten millions of dollars. In Germany, in 1881–82, there were thirty-nine factories of this sort, consuming over seventy thousand tons of starch, and producing about forty thousand tons of starch-sugar."

Since this report of the National Academy was printed, the number of starch-sugar factories in the United States has decreased to twelve, with a capital invested estimated at from twelve to fifteen million dollars, consuming about fifty thousand bushels of corn per day, and having an annual production of 450,000,000 pounds, valued at $10,500,000.[1]

"4th, Starch-sugar is chiefly used in making table-sirup, in brewing beer as a substitute for malt, and in adulterating cane-sugar. It is also used to replace cane-sugar in confectionery, in canning fruits, in making fruit-jellies, and in cooking. Artificial honey is made with it; and so, also, is vinegar.

"5th, Starch-sugar represents one distinct class of sugars, as cane-sugar does the other; the former being obtained naturally from the grape, as the latter is from the cane and the beet. Starch-sugar, which is a term chemically synonymous with dextrose and glucose, when pure, has about two-thirds the sweetening power of cane-sugar. By the action of the dilute acids, both cane-sugar and starch yield dextrose. In the case of starch, however, dextrose constitutes the sole final product.

"6th, The commercial samples of starch-sugar obtained by the committee showed a fairly uniform composition on analysis. The liquid form, or 'glucose,' contains from 34.3 to 42.8 per cent of dextrose, from 0 to 19.3 per cent of maltose, from 29.8 to 45.3 per cent of dextrine, and from 14.2 to 22.6 per cent of water. The solid form, 'grape-sugar,' gave from 72 to 73.4 per cent of dextrose, from 0 to 3.6 per cent of maltose, from 4.2 to 9.1 per cent of dextrine, and from 14 to 17.6 per cent of water. Three specimens of especially prepared 'grape-sugar' contained 87.1, 93.2, and 99.4 per cent of dextrose respectively. The last of these was crystalline anhydrous dextrose.

"7th, Of mineral or inorganic constituents, the samples of starch-sugar examined contained only minute quantities. The total ash formed in the 'glucose' was only from 0.325 to 1.060 per cent, and in the 'grape-sugars' only from 0 335 to 0.750 per cent. No impurities, either organic or inorganic in character, other than those mentioned, were detected in any of the samples examined.

"8th, The elaborate experiments upon the fermentation of starch-sugar would seem to be final on the question of the healthfulness, not only of glucose itself, but also of the substances produced by the action of a ferment upon it. Large quantities of a concentrated extract from the fermentation, representing from one-third to one-half a pound of starch-sugar, were taken internally by the experimenter, and this repeatedly, without the slightest observable effect. This result, rigidly applied, holds of course only for those sugars which, like this, are made from the starch of Indian-corn or maize."

From the foregoing facts the committee reached the following conclusions: "First, that the manufacture of sugar from starch is a long-established industry, scientifically valuable and commercially important; second, that the processes which it employs at the present time are unobjectionable in their character, and leave the product uncontaminated; third, that the starch-sugar thus made and sent into commerce is of exceptional purity and uniformity of composition, and contains no injurious substances; and, fourth, that though having at best only about two-thirds the sweetening power of cane-sugar, yet starch-sugar is in no way inferior to cane-sugar in healthfulness, there being no evidence before the committee that maize-starch sugar, either in its normal condition or fermented, has any deleterious effect upon the system, even when taken in large quantities."[1]

Some Other Adulterants.

The use of flours and starches of various kinds—wheat, corn, rye, peas, beans, etc. — as food adulterants cannot be considered injurious to health. However much the public may be cheated in the purchase of such adulterated articles of food, as ground spices, coffee, etc., they are not poisoned by their consumption It is a question how much a purchaser is himself to blame, in his endeavor to secure a "bargain," when he demands so great a quantity of any given material at less than it can be purchased at wholesale in the market, that he compels the unscrupulous manufacturer to make a compound which has never more and generally less than the proportion of the genuine material represented by the price asked.

Many articles of food spoil in transportation; and, under the plea of preventing further fermentation, resort is had to antiseptics, such as salicylic acid, sulphite of soda, borax, etc. These deserve mention as being additions to foods of a class of substances used to cloak carelessness in manufacture and otherwise, and producing in many cases deleterious effects on the human economy. In France and Germany the use of such antiseptics as salicylic acid in food products is prohibited, although in the latter country such addition is tolerated when the food product is exported to countries where such use is not prohibited.

Legislation on Food Adulteration.

The adulteration of food, generally being aimed at the pocket and not at the health of the consumer, ought to be easily remedied, one would suppose, by legislation. On, however, turning to our different State laws on the subject, I am sorry to say that most of them are drawn up in a follow-the-leader style, under the popular but erroneous impression that any substance used as an adulterant of or a substitute for a food product is necessarily injurious to health, with the consequence that these laws are, with very few exceptions, merely dead letters.[2] New York and Massachusetts have laws nearly identical in wording, whose enforement is intrusted to their respective boards of health. In the former State the law has proved a failure, because in an action brought to obtain "an injunction against the sale of certain Ping Suey teas it was held by the court, in refusing to grant the same, that, although the teas in question had been clearly shown to be adulterated with gypsum, Prussian blue, sand, etc., it was likewise necessary to prove that the effect of these admixtures was such as to constitute a serious danger to public health"[3] In Massachusetts, however, the law has been enforced with vigor by the State Board of Health, and the yearly reports show a diminution in the percentage of adulteration of the samples submitted to analysis.

In this country the British Sale of Food and Drugs Act, 1875, with all its imperfections, has served as a model for our legislation; and until we have a general law on the subject, drawn up

[1] This information was kindly furnished me by the American Glucose Company of Buffalo, N.Y., in a recent letter, December, 1889, who also sent samples of liquid and solid glucose.

[1] Report on Glucose, prepared by the National Academy of Sciences, in response to a request made by the commissioner of internal revenue, Washington, 1884.

[2] For list of State laws on food adulteration see Report of the Commissioner of Internal Revenue, 1888, p. ccix.

[3] Battershall, Food Adulteration and its Detection, p. 8 (New York, 1887).

with clear definitions of adulteration, and adequate means for the enforcement, by the co-operation of State and National authorities, of its provisions in regard to this class of fraud, the food sophisticator will pursue the even tenor of his way undisturbed. The European Continental legislation on this subject is much superior to the English act.[1] Under Continental statutes, every dealer is held responsible for the quality of his merchandise, whether of foreign or domestic origin, and every food material must be sold under its true name; artificial products imitating a natural product must be properly labelled in a conspicuous and legible manner; all unwholesome foods are confiscated and destroyed without compensation to the owner; and adulterations generally are considered acts of fraud. Suitable police supervision and control are provided for the enforcement of these statutes; and, although these laws are somewhat of a paternal nature, they are much more effective than any we have.

The average American repudiates the idea of a paternal government supervision over his affairs, or any thing tainted with the idea. He realizes that he is a full-grown man and a sovereign, and that therefore he is perfectly competent to take care of himself; and no cheat or swindler can ever get the better of him. He may be willing to support, even to clamor for, a legislative measure to regulate the production or sale of a food product, provided it advances his particular business interests. He would, however, regard with apathy any general law that would guarantee to the public the liberty of purchasing pure food, with a reasonable certainty that they were not imposed upon in their purchases, if it was incumbent on him to take the necessary steps to execute its provisions by bringing samples for analysis, etc.

It may be, however, that some day he will reach the conclusion that his individual smartness, great as it may be, is not sufficient to wage successful warfare against the food sophisticator's combinations, which have made this country for years the choice dumping-ground of the frauds of Europe, Asia, and Africa. When this happens, we may hope that the proper laws will be passed to suppress the fraud, and that we, the chemists of the country, will have opened to us a new field of usefulness,— a field in which we ought to put forth our best efforts, with the constant aim to maintain the purity and wholesomeness of the food for suffering humanity.

[1] For copies of European laws on food adulteration see Reports of the Commissioner of Internal Revenue for 1888 and 1889; and for a summary of their eading features see Science, 1 9, xiv. p. 308.

THE ORIGIN OF HUMAN FACULTY.

IN a paper read before the Neurological Society, Dr. Romanes has presented in very convenient shape an outline of his recent work, "Mental Evolution in Man," which, being at once authoritative and brief, may be appropriately noticed in these columns. Taking for granted the truth of his first proposition, that no exception must be made in the case of the human mind to the law of continuous evolution,—a proposition fully discussed in the original work,—Dr. Romanes concentrates his energies upon tracing the probable causes and history of this transition from the intelligence of brute to that of man.

For this purpose it is found necessary to agree upon a working classification of mental products or ideas. The division adopted is that of simple ideas, which are simply the traces left in the mind by a sense-impression,—the seeing with the mind's eye, as it were; of compound, or, better, generic ideas, which are obtained by a fusion of several impressions, and so involve some amount of comparison; and, finally, of general ideas, which are named abstractions,—a symbolic mode of referring to a group of ideas. These may be more briefly referred to as percepts, recepts, and concepts. The first two are common to animals and men. A dog has a generic idea of man, and a simple idea of some particular man; but he cannot make the third step, and call the one by the word "man" and the other by the word "John." This is the distinction most usually insisted upon as dividing men from the most intelligent of animals, and not only involves a substitution of a symbol for an idea, but, to get this idea, requires the mind to look in upon itself and observe its own actions,— introspection or self-consciousness. While these concepts may at first be very simple, they may be subjected to mutual comparison, and the relations thus deduced again give rise to concepts, and thus a kind of algebra of recepts and their corresponding concepts be formed,—an algebra of the imagination, in which all the higher intellectual work is accomplished. Now, the difference between a mind capable of however limited a degree of conceptual ideation and one having only receptual ideation is usually agreed to be the possession of language by the first, and its absence in the other. We must therefore consider the mental powers involved in language. Language, considered broadly, is the faculty of making signs: this intelligent animals do. The dog barks to have the dcor opened, a parrot will give rise to sounds to express its wants, and so on. But there is a broad difference between this which is receptual sign-making, and the peculiarly human conceptual sign-making. The man can think about the name, which is to the animal merely an association of sound with thing. "The difference between naming a thing receptually by mere association, and naming a thing conceptually by intentional thought, is all the difference between knowing that thing and knowing that we know it." It is, then, the genesis of the self-conscious faculty that forms the special object of study,—the faculty that enables us to think of words as words, and of ideas as ideas. But we must remember that even in the human infant there is a stage of sign-making anterior to self-consciousness. There is first the indicative stage, in which the child, like the dog or parrot, makes intentionally significant signs or tones; there is then the denotative stage, in which the child uses names receptually by mere association, just as the talking birds do; upon this follows the connotative stage, in which a child will apply a name not alone to the object with which it was first learned, but also to objects with varying degrees of similarity to it, —will extend the meaning of "bow-wow" from the house terrier to other dogs, to pictures of dogs, to a person imitating the dog, etc. (parrots have been observed to possess the rudiments of this connotative stage); lastly there is the denominative stage, where the name is consciously bestowed as such (this occurs in the child between the second and third years, when the child arranges its names in statements). It is important to note that the first three stages occur in animals, but that they occur in a very much more perfect development in the child, before it reaches the distinctively human form of speech. The receptual intelligence of the child is greatly in advance of that of any animal; although this supremacy must not blind us to the fact that it is a difference of degree only, and not of kind. This preconceptual intelligence of a child is superior to that of a dog in the same sense as the dog is more intelligent than a bird. An intelligent chimpanzee, Dr. Romanes believes, would "follow a child through what would probably seem a surprising distance in the use of denotative names and receptually connotative words," if it had the power of articulation; and it would, too, under this condition, have been able to "answer us in the same way that a child answers us when first emerging from infancy." From here on, the child rapidly advances beyond the capacity of any animal, though it has still a long development to pass through before it reaches the truly human or self-conscious stage. A very large share of mental activity at this period is formed by the making of propositions which, to distinguish from the later propositions, may be called preconceptual propositions. If a child sees its sister crying, and its words for the person and the act are "Dit ki," this is a statement, but one made for the child by the "logic of events." It is not conceptual or introspective, but is of the "psychological kind that we might have expected a monkey to make, if a monkey had been able to pronounce denotative names as well as it can understand them." Up to this point we have been considering differences of degree only: the issue is thus narrowed down to the transition from the preconceptual to the conceptual stage.

Here we must note that even in the lower animals we find some of the conditions to the subsequent appearance of self-consciousness in the more gifted intelligence of man. The animal mind has a store of images to a certain extent independent of sensuous impressions. Animals dream, pine for absent friends, seem subject to hallucinations, etc. The brute, too, is able to "establish true analogies between its own subjective states and the corresponding states of other intelligences." The individual so far realizes its own individuality as to recognize that it is one of a kind, and thus has a rudimentary or nascent self-consciousness. This in the child is supplanted by a preconceptual self-consciousness, which is exhibited by all children after they have begun to talk, but before they begin to speak of themselves in the first person, or show that they realize their own personality. It is the recognition of self as an active and feeling agent, but involves no introspection. At this stage, then, the child has the characteristics just described as common to itself and the animal, but, in addition, has far better apparatus for sign-making, a better knowledge of others' states of mind, a better faculty of denotative utterance, and so on. Here the interval between denotation and denomination becomes so narrow that the step is easy. "The mere fact of attaching verbal signs to mental states has the effect of focusing attention upon those states; and, when attention is thus focused habitually, there is supplied the only further condition which is required to enable a mind, through its memory of previous states, to compare its past with its present, and so to reach that apprehension of continuity among its own states wherein the full introspective consciousness of self consists." Now, this step, though an important one, is not so important as to warrant our supposing it a step different in kind from the other steps of mental evolution, especially if we remember, that, even when self-consciousness appears, the human mind is in an infantile condition, and if we take into account the enormous difference in intelligence of a child and of a youth, where a difference in kind is out of the question.

We must add to this picture of individual development the parallel evidence of racial development. This evidence shows that the several distinctively human steps of thought were in ages past difficult or impossible. Of especial importance is the evidence of language. "The gradual evolution of articulate language has preserved for us a kind of paleontological record of the gradual evolution of conceptual thought, with the result of showing that in the life-history of the human species, as in the life-history of the individual child, this conceptual thought derived its origin from these preconceptual levels of ideation which have already been occupying our attention." In brief, then, Dr. Romanes concludes, that, on the basis of an exact psychological analysis, the differences between the intelligence of man and brute, though presenting marked contrasts, yet seem to be connected by intermediate stages, which should be regarded as differing in degree rather than in kind, and that this view is strengthened by considering the slow and painful steps of human intelligence, from its beginnings in savagery to its present lofty attainments, at first view so entirely separating, mentally, man from the rest of creation.

HEALTH MATTERS.

The Nutritive Value of Boiled Milk.

THAT the sterilization of milk, however important, is not without its disadvantages, has been shown by Randnitz and others. To determine the comparative assimilability of proteids and fats from boiled and non-boiled milk, Dr. Evsevy V. Vasilieff of St. Petersburg undertook a course of most careful experiments on six healthy young men, aged from eighteen to twenty-three years. Each experiment lasted six days, during three of which the men received raw milk, and during the other three boiled milk, the daily amount of the article in either case varying between 1,850 and 4,200 cubic centimetres. The following, according to the *Provincial Medical Journal*, are the conclusions deduced by the author from his very instructive researches:—

1. The assimilation of nitrogenous ingredients from boiled milk is invariably less than that from the raw article. In the case of raw milk the average percentage of non-assimilated nitrogen amounts only to 7.05, the maximum to 7.62, and the minimum to 6.42; while in the case of boiled milk the respective figures are 8.18, 8.79, 7.76.

2. The same holds true with regard to the assimilation of fats. When fat is ingested in a raw state, the average percentage of non-assimilated fatty acids is 3.89, the maximum 4.85, and the minimum 2.88. In the case of boiled milk, however, the figures rise to 6.01, 6.99, and 4.53 respectively.

3. Boiling seems to affect especially the assimilation of the fats of milk, since the percentage of fatty acids in relation to the total quantity of dried fæces in those fed on boiled milk is considerably larger than in those fed on non-boiled milk. In the former case, fatty acids constitute 19.03 per cent of the total amount of dry fæces; but in the latter, not more than 16.81. In other words, when a person ingests his milk boiled, every 100 grams of his dry fæces contain a surplus of fats amounting to 2.22 grams.

4. Therefore, as regards its nutritiousness, boiled milk represents a decidedly inferior dietetic article, compared with raw milk.

5. As far as proteids are concerned, the difference in their assimilation may find some explanation in Dr. I. Schmidt's researches, according to which, under the influence of boiling, cow's milk undergoes important chemical changes, nearly all the albumen and a part of the caseine being transformed into hemi-albumose. Schmidt's analysis proves that raw cow's milk contains 8.55 per cent of caseine, 8.4 of albumen, and 6.1 of hemi-albumose. Under the influence of ten minutes' boiling, the proportion of caseine sinks to 7.59 per cent, that of albumen to 0.7, while that of hemi-albumose rises to 23.4.

TRICHINÆ IN SWINE. — Professor E. L. Mark has recently published the results of the examination of 3,064 hogs raised in the vicinity of Boston, Mass. (*Report of Massachusetts State Board of Health*). The examination extended over the five years 1883 to 1888. The results show that 14.07 per cent of the males and 10.61 of the females were infected with trichinæ. Similar examinations of Western hogs have shown only from two to three per cent to be infected. Professor Mark reaches the conclusion that this difference is probably due to the character of the food given to those raised in the vicinity of Boston, and presumably in the vicinity of other large cities. Of the fifty-six raisers of the hogs examined by him, fifty-one fed city offal. The source of the infection he believes to be in the uncooked meat found in kitchen garbage. It would be interesting to know the condition, in this respect, of the large number of hogs fed upon this food in and about the other large cities, says the *Brooklyn Medical Journal*.

THE PSYCHOLOGY OF EPIDEMICS. — Every epidemic carries in its train curious exaggerations of many well-recognized characteristics, and these frequently call for appreciation and for treatment almost as much as the disease in which they originate. Perhaps one of the most striking of these mental perversities is to be found in the idea that the epidemic is to be treated by "common sense" or by nostra which have been largely advertised, or by specifics which are known to the laity mainly through their frequent mention in the daily press. Those suffering under this delusion feel that it is wholly unnecessary to seek skilled assistance, and they boldly dose themselves with remedies of whose power and properties they are absolutely ignorant. In Vienna, according to the *Lancet*, it has already been found necessary to forbid the sale of antipyrin, except under doctors' prescriptions, as no less than seventeen deaths were attributed to stoppage of the heart's action owing to overdoses. The freedom with which the prescription of this remedy has been assumed by the public has long since been viewed with anxiety by the medical profession, and frequent warnings have already fallen upon deaf ears.

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CONTENTS:

The warm weather of this winter has given rise to many theories as to its cause, in some of which the Gulf Stream has figured as an important factor. The Gulf Stream does change its position to a slight amount, but not in the arbitrary manner or to the great extent stated by some of the newspaper writers of late. The usually accepted position of the stream along our coast is that fixed by Professor Bache, based upon temperature observations made by various officers in the navy,—Davis, Lee, Sands, Bache, Craven, Maffitt, and others. The Gulf Stream probably has a vibratory motion, as evidenced by anchorages of the coast survey steamer "Blake" off Cape Hatteras, and off Rebecca Shoal, Florida. Anchored there on the northern edge of the stream, riding to the wind with a gentle current, the latter would suddenly become strong, and swing the vessel until she was stern to the wind, to remain but a short time; and then, the current becoming weaker, the wind would gain the ascendency. This was repeated a number of times Lieut. Pillsbury, U.S.N., who for five years was in command of the "Blake," believes that the daily volume of the stream varies but little, except as due to declination of the moon; that its track through the ocean is absolutely fixed by law; that its vibration is periodic, although the limit of the periodic change may vary to a trifling amount. Along the northern coast, however, it is not always on the surface, but is, from an unknown cause, overrun by other currents. The generally accepted belief, that a wind blowing across the current changes the position of its axis, is, Lieut. Pillsbury is convinced, erroneous. Every temporary wind, however, does transport water (chiefly by means of waves), and with it goes its heat or cold The fact of finding gulf-weed within a few miles of Nantucket lightship does not so much prove that the current is nearer our shores as it does that winds have prevailed in the direction from which it comes.

THE METHOD OF MULTIPLE WORKING HYPOTHESES.[1]

As methods of study constitute the leading theme of our session, I have chosen as a subject in measurable consonance the method of multiple working hypotheses in its application to investigation, instruction, and citizenship.

There are two fundamental classes of study. The one consists in attempting to follow by close imitation the processes of previous thinkers, or to acquire by memorizing the results of their investigations. It is merely secondary, imitative, or acquisitive study. The other class is primary or creative study. In it the effort is to think independently, or at least individually, in the endeavor to discover new truth, or to make new combinations of truth, or at least to develop an individualized aggregation of truth. The endeavor is to think for one's self, whether the thinking lies wholly in the fields of previous thought or not. It is not necessary to this habit of study that the subject-material should be new; but the process of thought and its results must be individual and independent, not the mere following of previous lines of thought ending in predetermined results. The demonstration of a problem in Euclid precisely as laid down is an illustration of the former; the demonstration of the same proposition by a method of one's own or in a manner distinctively individual is an illustration of the latter; both lying entirely within the realm of the known and the old.

Creative study, however, finds its largest application in those subjects in which, while much is known, more remains to be known. Such are the fields which we, as naturalists, cultivate; and we are gathered for the purpose of developing improved methods lying largely in the creative phase of study, though not wholly so.

Intellectual methods have taken three phases in the history of progress thus far. What may be the evolutions of the future it may not be prudent to forecast. Naturally the methods we now urge seem the highest attainable. These three methods may be designated, first, the method of the ruling theory; second, the method of the working hypothesis; and, third, the method of multiple working hypotheses.

In the earlier days of intellectual development the sphere of knowledge was limited, and was more nearly within the compass of a single individual; and those who assumed to be wise men, or aspired to be thought so, felt the need of knowing, or at least seeming to know, all that was known as a justification of their claims. So, also, there grew up an expectancy on the part of the multitude that the wise and the learned would explain whatever new thing presented itself. Thus pride and ambition on the one hand, and expectancy on the other, developed the putative wise man whose knowledge boxed the compass, and whose acumen found an explanation for every new puzzle which presented itself. This disposition has propagated itself, and has come down to our time as an intellectual predilection, though the compassing of the entire horizon of knowledge has long since been an abandoned affectation. As in the earlier days, so still, it is the habit of some to hastily conjure up an explanation for every new phenomenon that presents itself. Interpretation rushes to the forefront as the chief obligation pressing upon the putative wise man. Laudable as the effort at explanation is in itself, it is to be condemned when it runs before a serious inquiry into the phenomenon itself. A dominant disposition to find out what is, should precede and crowd aside the question, commendable at a later stage, "How came this so?" First full facts, then interpretations.

The habit of precipitate explanation leads rapidly on to the development of tentative theories. The explanation offered for a given phenomenon is naturally, under the impulse of self-consistency, offered for like phenomena as they present themselves, and there is soon developed a general theory explanatory of a large class of phenomena similar to the original one. This general theory may not be supported by any further considerations than those which were involved in the first hasty inspec-

[1] Paper read before the Society of Western Naturalists, by President T. C. Chamberlin, Oct. 25, 1889.

tion. For a time it is likely to be held in a tentative way with a measure of candor. With this tentative spirit and measurable candor, the mind satisfies its moral sense, and deceives itself with the thought that it is proceeding cautiously and impartially toward the goal of ultimate truth. It fails to recognize that no amount of provisional holding of a theory, so long as the view is limited and the investigation partial, justifies an ultimate conviction. It is not the slowness with which conclusions are arrived at that should give satisfaction to the moral sense, but the thoroughness, the completeness, the all-sidedness, the impartiality, of the investigation.

It is in this tentative stage that the affections enter with their blinding influence. Love was long since represented as blind, and what is true in the personal realm is measurably true in the intellectual realm. Important as the intellectual affections are as stimuli and as rewards, they are nevertheless dangerous factors, which menace the integrity of the intellectual processes. The moment one has offered an original explanation for a phenomenon which seems satisfactory, that moment affection for his intellectual child springs into existence; and as the explanation grows into a definite theory, his parental affections cluster about his intellectual offspring, and it grows more and more dear to him, so that, while he holds it seemingly tentative, it is still lovingly tentative, and not impartially tentative. So soon as this parental affection takes possession of the mind, there is a rapid passage to the adoption of the theory. There is an unconscious selection and magnifying of pheuomena that fall into harmony with the theory and support it, and an unconscious neglect of those that fail of coincidence. The mind lingers with pleasure upon the facts that fall happily into the embrace of the theory, and feels a natural coldness toward those that seem refractory. Instinctively there is a special searching-out of phenomena that support it, for the mind is led by its desires. There springs up, also, an unconscious pressing of the theory to make it fit the facts, and a pressing of the facts to make them fit the theory. When these biasing tendencies set in, the mind rapidly degenerates into the partiality of paternalism. The search for facts, the observation of phenomena and their interpretation, are all dominated by affection for the favored theory until it appears to its author or its advocate to have been overwhelmingly established. The theory then rapidly rises to the ruling position, and investgaton. observation, and interpretation are controlled and directed by it. From an unduly favored child, it readily becomes master, and leads its author whithersoever it will. The subsequent history of that mind in respect to that theme is but the progressive dominance of a ruling idea.

Briefly summed up, the evolution is this: a premature explanation passes into a tentative theory, then into an adopted theory, and then into a ruling theory.

When the last stage has been reached, unless the theory happens, perchance, to be the true one, all hope of the best results is gone. To be sure, truth may be brought forth by an investigator dominated by a false ruling idea. His very errors may indeed stimulate investigation on the part of others. But the condition is an unfortunate one. Dust and chaff are mingled with the grain in what should be a winnowing process.

As previously implied, the method of the ruling theory occupied a chief place during the infancy of investigation. It is an expression of the natural infantile tendencies of the mind, though in this case applied to its higher activities, for in the earlier stages of development the feelings are relatively greater than in later stages.

Unfortunately it did not wholly pass away with the infancy of investigation, but has lingered along in individual instances to the present day, and finds illustration in universally learned men and pseudo-scientists of our time.

The defects of the method are obvious, and its errors great. If I were to name the central psychological fault, I should say that it was the admission of intellectual affection to the place that should be dominated by impartial intellectual rectitude.

So long as intellectual interest dealt chiefly with the intangible, so long it was possible for this habit of thought to survive, and to maintain its dominance, because the phenomena themselves, being largely subjective, were plastic in the hands of the ruling idea; but so soon as investigation turned itself earnestly to an inquiry into natural phenomena, whose manifestations are tangible, whose properties are rigid, whose laws are rigorous, the defects of the method became manifest, and an effort at reformation ensued. The first great endeavor was repressive. The advocates of reform insisted that theorizing should be restrained, and efforts directed to the simple determination of facts. The effort was to make scientific study factitious instead of causal. Because theorizing in narrow lines had led to manifest evils, theorizing was to be condemned. The reformation urged was not the proper control and utilization of theoretical effort, but its suppression. We do not need to go backward more than twenty years to find ourselves in the midst of this attempted reformation. Its weakness lay in its narrowness and its restrictiveness. There is no nobler aspiration of the human intellect than desire to compass the cause of things. The disposition to find explanations and to develop theories is laudable in itself. It is only its ill use that is reprehensible. The vitality of study quickly disappears when the object sought is a mere collocation of dead unmeaning facts.

The inefficiency of this simply repressive reformation becoming apparent, improvement was sought in the method of the working hypothesis. This is affirmed to be *the* scientific method of the day, but to this I take exception. The working hypothesis differs from the ruling theory in that it is used as a means of determining facts, and has for its chief function the suggestion of lines of inquiry; the inquiry being made, not for the sake of the hypothesis, but for the sake of facts. Under the method of the ruling theory, the stimulus was directed to the finding of facts for the support of the theory. Under the working hypothesis, the facts are sought for the purpose of ultimate induction and demonstration, the hypothesis being but a means for the more ready development of facts and of their relations, and the arrangement and preservation of material for the final induction.

It will be observed that the distinction is not a sharp one, and that a working hypothesis may with the utmost ease degenerate into a ruling theory. Affection may as easily cling about an hypothesis as about a theory, and the demonstration of the one may become a ruling passion as much as of the other.

Conscientiously followed, the method of the working hypothesis is a marked improvement upon the method of the ruling theory; but it has its defects,—defects which are perhaps best expressed by the ease with which the hypothesis becomes a controlling idea. To guard against this, the method of multiple working hypotheses is urged. It differs from the former method in the multiple character of its genetic conceptions and of its tentative interpretations. It is directed against the radical defect of the two other methods; namely, the partiality of intellectual parentage. The effort is to bring up into view every rational explanation of new phenomena, and to devleop every tenable hypothesis respecting their cause and history. The investigator thus becomes the parent of a family of hypotheses; and, by his parental relation to all, he is forbidden to fasten his affections unduly upon any one. In the nature of the case, the danger that springs from affection is counteracted, and therein is a radical difference between this method and the two preceding. The investigator at the outset puts himself in cordial sympathy and in parental relations (of adoption, if not of authorship) with every hypothesis that is at all applicable to the case under investigation. Having thus neutralized the partialities of his emotional nature, he proceeds with a certain natural and enforced erectness of mental attitude to the investigation, knowing well that some of his intellectual children will die before maturity, yet feeling that several of them may survive the results of final ivestigation, since it is often the outcome of inquiry that several causes are found to be involved instead of a single one. In following a single hypothesis, the mind is presumably led to a single explanatory conception. But an adequate explanation often involves the co-ordination of

several agencies, which enter into the combined result in varying proportions. The true explanation is therefore necessarily complex. Such complex explanations of phenomena are specially encouraged by the method of multiple hypotheses, and constitute one of its chief merits. We are so prone to attribute a phenomenon to a single cause, that, when we find an agency present, we are liable to rest satisfied therewith, and fail to recognize that it is but one factor, and perchance a minor factor, in the accomplishment of the total result. Take for illustration the mooted question of the origin of the Great Lake basins. We have this, that, and the other hypothesis urged by different students as the cause of these great excavations; and all of these are urged with force and with fact, urged justly to a certain degree. It is practically demonstrable that these basins were river-valleys antecedent to the glacial incursion, and that they owe their origin in part to the pre-existence of those valleys and to the blocking-up of their outlets. And so this view of their origin is urged with a certain truthfulness. So, again, it is demonstrable that they were occupied by great lobes of ice, which excavated them to a marked degree, and therefore the theory of glacial excavation finds support in fact. I think it is furthermore demonstrable that the earth's crust beneath these basins was flexed downward, and that they owe a part of their origin to crust deformation. But to my judgment neither the one nor the other, nor the third, constitutes an adequate explanation of the phenomena. All these must be taken together, and possibly they must be supplemented by other agencies. The problem, therefore, is the determination not only of the participation, but of the measure and the extent, of each of these agencies in the production of the complex result. This is not likely to be accomplished by one whose working hypothesis is pre-glacial erosion, or glacial erosion, or crust deformation, but by one whose staff of working hypotheses embraces all of these and any other agency which can be rationally conceived to have taken part in the phenomena.

A special merit of the method is, that by its very nature it promotes thoroughness. The value of a working hypothesis lies largely in its suggestiveness of lines of inquiry that might otherwise be overlooked. Facts that are trivial in themselves are brought into significance by their bearings upon the hypothesis, and by their causal indications. As an illustration, it is only necessary to cite the phenomenal influence which the Darwinian hypothesis has exerted upon the investigations of the past two decades. But a single working hypothesis may lead investigation along a given line to the neglect of others equally important; and thus, while inquiry is promoted in certain quarters, the investigation lacks in completeness. But if all rational hypotheses relating to a subject are worked co-equally, thoroughness is the presumptive result, in the very nature of the case.

In the use of the multiple method, the re-action of one hypothesis upon another tends to amplify the recognized scope of each, and their mutual conflicts whet the discriminative edge of each. The analytic process, the development and demonstration of criteria, and the sharpening of discrimination, receive powerful impulse from the co-ordinate working of several hypotheses.

Fertility in processes is also the natural outcome of the method. Each hypothesis suggests its own criteria, its own means of proof, its own methods of developing the truth; and if a group of hypotheses encompass the subject on all sides, the total outcome of means and of methods is full and rich.

The use of the method leads to certain peculiar habits of mind which deserve passing notice, since as a factor of education its disciplinary value is one of importance. When faithfully pursued for a period of years, it develops a habit of thought analogous to the method itself, which may be designated a habit of parallel or complex thought. Instead of a simple succession of thoughts in linear order, the procedure is complex, and the mind appears to become possessed of the power of simultaneous vision from different standpoints. Phenomena appear to become capable of being viewed analytically and synthetically at once. It is not altogether unlike the study of a landscape, from which there comes into the mind myriads of lines of intelligence, which are received and co-ordinated simultaneously, producing a complex impression which is recorded and studied directly in its complexity. My description of this process is confessedly inadequate, and the affirmation of it as a fact would doubtless challenge dispute at the hands of psychologists of the old school; but I address myself to naturalists who I think can respond to its verity from their own experience.

The method has, however, its disadvantages. No good thing is without its drawbacks; and this very habit of mind, while an invaluable acquisition for purposes of investigation, introduces difficulties in expression. It is obvious, upon consideration, that this method of thought is impossible of verbal expression. We cannot put into words more than a single line of thought at the same time; and even in that the order of expression must be conformed to the idiosyncrasies of the language, and the rate must be relatively slow. When the habit of complex thought is not highly developed, there is usually a leading line to which others are subordinate, and the difficulty of expression does not rise to serious proportions; but when the method of simultaneous vision along different lines is developed so that the thoughts running in different channels are nearly equivalent, there is an obvious embarrassment in selection and a disinclination to make the attempt. Furthermore, the impossibility of expressing the mental operation in words leads to their disuse in the silent processes of thought, and hence words and thoughts lose that close association which they are accustomed to maintain with those whose silent as well as spoken thoughts run in linear verbal courses. There i therefore a certain predisposition on the part of the practitioner of this method to taciturnity.

We encounter an analogous difficulty in the use of the method with young students. It is far easier, and I think in general more interesting, for them to argue a theory or accept a simple interpretation than to recognize and evaluate the several factors which the true elucidation may require. To illustrate: it is more to their taste to be taught that the Great Lake basins were scooped out by glaciers than to be urged to conceive of three or more great agencies working successively or simultaneously, and to estimate how much was accomplished by each of these agencies. The complex and the quantitative do not fascinate the young student as they do the veteran investigator.

It has not been our custom to think of the method of working hypotheses as applicable to instruction or to the practical affairs of life. We have usually regarded it as but a method of science. But I believe its application to practical affairs has a value co-ordinate with the importance of the affairs themselves. I refer especially to those inquiries and inspections that precede the coming-out of an enterprise rather than to its actual execution. The methods that are superior in scientific investigation should likewise be superior in those investigations that are the necessary antecedents to an intelligent conduct of affairs. But I can dwell only briefly on this phase of the subject.

In education, as in investigation, it has been much the practice to work a theory. The search for instructional methods has often proceeded on the presumption that there is a definite patent process through which all students might be put and come out with results of maximum excellence; and hence pedagogical inquiry in the past has very largely concerned itself with the inquiry, "What is the best method?" rather than with the inqiry, "What are the special values of different methods, and what are their several advantageous applicabilities in the varied work of instruction?" The past doctrine has been largely the doctrine of pedagogical uniformitarianism. But the faculties and functions of the mind are almost, if not quite, as varied as the properties and functions of matter; and it is perhaps not less absurd to assume that any specific method of instructional procedure is more effective than all others, under any and all circumstances, than to asume that one principle of interpretation is equally applicable to all the phenomena

of nature. As there is an endless variety of mental processes and combinations and an indefinite number of orders of procedure, the advantage of different methods under different conditions is almost axiomatic. This being granted, there is presented to the teacher the problem of selection and of adaptation to meet the needs of any specific issue that may present itself. It is important, therefore, that the teacher shall have in mind a full array of possible conditions and states of mind which may be presented, in order that, when any one of these shall become an actual case, he may recognize it, and be ready for the emergency.

Just as the investigator armed with many working hypotheses is more likely to see the true nature and significance of phenomena when they present themselves, so the instructor equipped with a full panoply of hypotheses ready for application more readily recognizes the actuality of the situation, more accurately measures its significance, and more appropriately applies the methods which the case calls for.

The application of the method of multiple hypotheses to the varied affairs of life is almost as protean as the phases of that life itself, but certain general aspects may be taken as typical of the whole. What I have just said respecting the application of the method to instruction may apply, with a simple change of terms, to almost any other endeavor which we are called upon to undertake. We enter upon an enterprise in most cases without full knowledge of all the factors that will enter into it, or all of the possible phases which it may develop. It is therefore of the utmost importance to be prepared to rightly comprehend the nature, bearings, and influence of such unforeseen elements when they shall definitely present themselves as actualities. If our vision is narrowed by a preconceived theory as to what will happen, we are almost certain to misinterpret the facts and to misjudge the issue. If, on the other hand, we have in mind hypothetical forecasts of the various contingencies that may arise, we shall be the more likely to recognize the true facts when they do present themselves. Instead of being biased by the anticipation of a given phase, the mind is rendered open and alert by the anticipation of any one of many phases, and is free not only, but is predisposed, to recognize correctly the one which does appear. The method has a further good effect. The mind, having anticipated the possible phases which may arise, has prepared itself for action under any one that may come up, and it is therefore ready-armed, and is predisposed to act in the line appropriate to the event. It has not set itself rigidly in a fixed purpose, which it is predisposed to follow without regard to contingencies. It has not nailed down the helm and predetermined to run a specific course, whether rocks lie in the path or not; but, with the helm in hand, it is ready to veer the ship according as danger or advantage discovers itself.

It is true, there are often advantages in pursuing a fixed predetermined course without regard to obstacles or adverse conditions. Simple dogged resolution is sometimes the salvation of an enterprise; but, while glorious successes have been thus snatched from the very brink of disaster, overwhelming calamity has in other cases followed upon this course, when a reasonable regard for the unanticipated elements would have led to success. So there is to be set over against the great achievements that follow on dogged adherence great disasters which are equally its result.

The tendency of the mind, accustomed to work through multiple hypotheses, is to sway to one line of policy or another, according as the balance of evidence shall incline. This is the soul and essence of the method. It is in general the true method. Nevertheless there is a danger that this yielding to evidence may degenerate into unwarranted vacillation. It is not always possible for the mind to balance evidence with exact equipoise, and to determine, in the midst of the execution of an enterprise, what is the measure of probability on the one side or the other; and as difficulties present themselves, there is a danger of being biased by them and of swerving from the course that was really the true one. Certain limitations are therefore to be placed upon the application of the method, for it must be remembered that a poorer line of policy consistently adhered to may bring better results than a vacillation between better policies.

There is another and closely allied danger in the application of the method. In its highest development it presumes a mind supremely sensitive to every grain of evidence. Like a pair of delicately poised scales, every added particle on the one side or the other produces its effect in oscillation. But such a pair of scales may be altogether too sensitive to be of practical value in the rough affairs of life. The balances of the exact chemist are too delicate for the weighing-out of coarse commodities. Despatch may be more important than accuracy. So it is possible for the mind to be too much concerned with the nice balancings of evidence, and to oscillate too much and too long in the endeavor to reach exact results. It may be better, in the gross affairs of life, to be less precise and more prompt. Quick decisions, though they may contain a grain of error, are oftentimes better than precise decisions at the expense of time.

The method has a special beneficent application to our social and civic relations. Into these relations there enter, as great factors, our judgment of others, our discernment of the nature of their acts, and our interpretation of their motives and purposes. The method of multiple hypotheses, in its application here, stands in decided contrast to the method of the ruling theory or of the simple working hypothesis. The primitive habit is to interpret the acts of others on the basis of a theory. Childhood's unconscious theory is that the good are good, and the bad are bad. From the good the child expects nothing but good; from the bad, nothing but bad. To expect a good act from the bad, or a bad act from the good, is radically at variance with childhood's mental methods. Unfortunately in our social and civic affairs too many of our fellow-citizens have never outgrown the ruling theory of their childhood.

Many have advanced a step farther, and employ a method analogous to that of the working hypothesis. A certain presumption is made to attach to the acts of their fellow-beings, and that which they see is seen in the light of that presumption, and that which they construe is construed in the light of that presumption. They do not go to the lengths of childhood's method by assuming positively that the good are wholly good, and the bad wholly bad; but there is a strong presumption in their minds that he concerning whom they have an ill opinion will act from corresponding motives. It requires positive evidence to overthrow the influence of the working hypothesis.

The method of multiple hypotheses assumes broadly that the acts of a fellow-being may be diverse in their nature, their motives, their purposes, and hence in their whole moral character; that they may be good though the dominant character be bad; that they may be bad though the dominant character be good; that they may be partly good and partly bad, as is the fact in the greater number of the complex activities of a human being. Under the method of multiple hypotheses, it is the first effort of the mind to see truly what the act is, unbeclouded by the presumption that this or that has been done because it accords with our ruling theory or our working hypothesis. Assuming that acts of similar general aspect may readily take any one of several different phases, the mind is freer to see accurately what has actually been done. So, again, in our interpretations of motives and purposes, the method assumes that these may have been any one of many, and the first duty is to ascertain which of possible motives and purposes actually prompted this individual action. Going with this effort there is a predisposition to balance all evidence fairly, and to accept that interpretation to which the weight of evidence inclines, not that which simply fits our working hypothesis or our dominant theory. The outcome, therefore, is better and truer observation and juster and more righteous interpretation.

There is a third result of great importance. The imperfections of our knowledge are more likely to be detected, for there will be less confidence in its completeness in proportion as there is a broad comprehension of the possibilities of varied action, under similar circumstances and with similar appearances.

So, also, the imperfections of evidence as to the motives and purposes inspiring the action will become more discernible in proportion to the fulness of our conception of what the evidence should be to distinguish between action from the one or the other of possible motives. The necessary result will be a less disposition to reach conclusions upon imperfect grounds. So, also, there will be a less inclination to misapply evidence; for, several constructions being definitely in mind, the indices of the one motive are less liable to be mistaken for the indices of another.

The total outcome is greater care in ascertaining the facts, and greater discrimination and caution in drawing conclusions. I am confident, therefore, that the general application of this method to the affairs of social and civic life would go far to remove those misunderstandings, misjudgments, and misrepresentations which constitute so pervasive an evil in our social and our political atmospheres, the source of immeasurable suffering to the best and most sensitive souls. The misobservations, the misstatements, the misinterpretations, of life may cause less gross suffering than some other evils; but they, being more universal and more subtle, pain. The remedy lies, indeed, partly in charity, but more largely in correct intellectual habits, in a predominant, ever-present disposition to see things as they are, and to judge them in the full light of an unbiased weighing of evidence applied to all possible constructions, accompanied by a withholding of judgment when the evidence is insufficient to justify conclusions.

I believe that one of the greatest moral reforms that lies immediately before us consists in the general introduction into social and civic life of that habit of mental procedure which is known in investigation as the method of multiple working hypotheses.

AMONG THE PUBLISHERS.

Speaking of Professor Carl Lumholtz's "Among Cannibals," the *Athenæum* says that "the volume is not only agreeable reading throughout, but is full of curious information."

— In the *Jenness Miller Magazine* for February is a physical culture article by Miss Jenness. "The History of St. Valentine's Day," by Laura Giddings, suggests a new form of entertainment for modern society.

— In the *Electrical World* of Jan. 11 was an illustrated article descriptive of the new and handsomely equipped offices of that enterprising paper, which occupy the better part of a floor in the recently finished Times Building on Park Row, this city,—one of the finest office buildings in the world.

— The brother of President Harrison's private secretary, Mr. A. J. Halford, has written for the March number of the Philadelphia *Ladies' Home Journal* an article on "Mrs. Harrison's Daily Life in the White House," prepared with the consent and assistance of Mrs. Harrison.

— It is thought that the death of Mr. Frank Marshall will cause no delay in the publication of the eighth and final volume of the "Henry Irving Shakespeare." Mr. Marshall's arduous labors on this work were the indirect cause of his illness. The eighth volume, by the way, will contain "Hamlet."

— One of the gravest and most important problems that confront the American people relates to the hundreds of thousands of immigrants who pour into this country every year. In a timely book, soon to be published by the Scribners, Richmond M. Smith, professor of political economy in Columbia College, discusses the historical, statistical, economic, ethnic, and social aspects of this interesting question.

—"Laugh and Learn" is the title of a book of nursery lessons and nursery games, by Jennett Humphreys, with many illustrations. The union of simple instruction and amusement is happily carried out. The book will be published by Scribner & Welford.

— Under the title of "The Religious Aspect of Evolution," Dr. James McCosh's series of lectures delivered in 1887 at the Theological Seminary of the Diocese of Ohio and Kenyon College will be published by the Scribners. The chapter on "Final Cause" is entirely new.

— Professor Frederick L. Ritter of Vassar has revised and enlarged his popular history of "Music in America," and the new edition will be brought out soon by the Scribners. The author has continued to date the history of the leading musical organizations and of the opera in different cities, adding about a hundred pages to the book.

— Two new volumes of "The Uncollected Writings of Thomas De Quincey," with a preface and annotations by James Hogg, are announced by Scribner & Welford. The volumes contain many entertaining essays; "Shakespeare's Text," "How to Write English," "The Casuistry of Duelling," and "The Love-Charm," being a few of the titles.

—As a memorial of a distinguished administrator, and to further the cause of imperial federation, Mr. Stanley Lane-Poole has edited the papers of Sir George Bowen, and they will be published immediately in London and New York by Longmans, Green, & Co. In one of Sir George's earlier letters there is a pleasant glimpse of Washington society during Grant's administration.

— The "Truth Seeker Annual and Freethinkers' Almanac" for 1890 (28 Lafayette Place, New York) contains, among numerous other interesting articles, an account of the inauguration of the Bruno statue in Rome, by T. B. Wakeman; some investigations into the phenomena of Spiritualism, by E. M. Macdonald; and a history of the progress of free thought in the United States during 1889. The book is handsomely illustrated.

— Our readers will learn with interest that the Scribners will issue this month the third and fourth volumes of Henry Adams's "History of the United States." The first two volumes treated of Jefferson's first administration, — 1801 to 1805; the forthcoming two volumes relate to the great Democratic leader's second term of office, — 1805 to 1809. The new volumes are said to contain considerable new material bearing upon the Burr conspiracy and other events of the period.

— The January number of the *American Naturalist* is at hand. It contains, beside another instalment of E. L. Sturtevant's treatise on the "History of Garden Vegetables," an illustrated article by J. W. Fewkes, on the habit of certain sea-urchins of boring holes in the rocks to which they are attached, and a suggestive article by R. E. C. Stearns on "The Effects of Musical Sounds upon Animals." We note the fact that this number appears almost on time; and as the present publishers, the Messrs. Ferris Brothers, of Sixth and Arch Streets, Philadelphia, have been sending out the numbers at the rate of two a month since they assumed control, it is only fair to infer that the magazine will henceforth appear on its nominal date. There are still three numbers to be furnished of the year 1889; but these will be printed and sent out as rapidly as possible, and in the mean time the current issues for 1890 will proceed with regularity.

— The Publication Agency of the Johns Hopkins University, Baltimore, has just issued "The Beginnings of American Nationality," by President Small of Colby University, commencing the series for 1890 of "Studies in Historical and Political Science;" also "The Needs of Self-Supporting Women," by Miss Clare de Graffenried of the Department of Labor, Washington, D.C., being No. 1 (for 1890) of the "Notes Supplementary to the Studies in Historical and Political Science." It is proposed, also, to collect and publish, in a limited edition, the principal literary essays and studies of Professor Gildersleeve. They will make a volume of between three hundred and four hundred pages. The following is a list of the titles of the essays: 1. "Limits of Culture;" 2. "Classics and Colleges;" 3. "University Work in America;" 4. "Grammar and Aesthetics;" 5. "Legend of Venus; 6. "Xanthippe and Socrates;" 7. "Apollonius of Tyana;" 8. "Lucian;" 9. "The Emperor Julian;" 10. "Platen's Poems:" 11. "Maximilian, Emperor of Mexico;" 12. "Occasional Addresses."

— Of the contents of *The Chautauquan* for February we note "The Politics which Made and Unmade Rome," by President C. K. Adams, LL.D.; "The Politics of Mediæval Italy," by Professor Philip Van Ness Myers, A.M.; "The Archæological Club at Rome," by James A. Harrison, LL.D., Lit.D.; "Life in Mediæval Italy," by the Rev. Alfred J. Church, M.A.; "Economic Internationalism," by Richard T. Ely, Ph.D.; "Moral Teachings of Science," by Arabella B. Buckley; "The Works of the Waves," by Professor N. S. Shaler; "Traits of Human Nature," by J. M. Buckley, LL.D; "Modern English Politics and Society," by J. Ranken Towse; "How Sickness was prevented at Johnstown," by Dr. George Groff; "Trusts and How to Deal with Them," by George Gunton; and "Divorce in the United States," by Oliver Cornell.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

Physical Fields.

IT seems probable that the articles which have appeared in this journal on this subject — one by A. E. Dolbear on Dec. 27, and the other by N. W. Perry on Jan. 24 — are the most important that have been recently written as bearing especially upon present theories in meteorology. It is of the utmost consequence that in this complex science we lay a sure foundation of fact, and never be tempted to speculations unless supported in the main by observations. It is not my purpose, even if I were able, to discuss the questions at issue in these papers, but I wish to present what seems to me may prove a most important field for research, hoping that others may take up the matter and shed light upon the problem.

The "thermal field" is probably the easiest to comprehend. We may conceive a white-hot cannon-ball in space. It radiates its heat equally in all directions, and is rapidly cooled. We may measure the distance to which these radiations extend. If these radiations be intercepted by any body, it in turn will be heated, and send back its radiations to the ball; and these exchanges will continue till a thermal equilibrium be established. All orthodox theories in meteorology regard the sun as a hot ball in space; that its rays impinge upon the earth, passing through the atmosphere without heating it; that this heated earth sets up convection currents in the atmosphere; and, finally, that all our winds and storms are primarily induced by these convection currents. I believe the time is not far distant when this theory will appear puerile in the extreme, and it will be acknowledged that the actions produced in any locality through the direct heat agency of the sun must be greatest just at the time when there are *no* storms, and all of them combined will not account for a hundredth part of the energy developed.

The "electric field" is the one I wish to specially notice. Mr. Perry, speaking of electrification, says, "It is a condition which is dual in its character. The negative exists because of the existence of the positive, not because of propagation from one to another. . . . We must regard electricity as motion; electrification, one kind of stress which is capable of producing electrical vibrations; magnetism may be another." Granting the existence of such a dual condition, without at present going into the question of how it can be energized or brought about, I wish to inquire what may be told or inferred as to the action of individual electrified particles in either the positive or negative portion of such a dual condition, let us say, in the atmosphere.

Take, for example, the electric arc. As I understand it, particles of carbon are continuously carried from what is called

the positive pole to the negative, and the latter is built up at the expense of the former. I do not know that the velocity of these particles has even been estimated, but it must be exceedingly small as compared with that of electricty (186,000 miles per second). Suppose we have a positive and a negative electric field, or dual condition, in a dusty atmosphere: may we not say that the dust in the positive field, if sufficiently electrified, will have a tendency to pass toward the negative field? Or, if we consider that moisture particles take the place of dust, why may not these, positively electrified, have a tendency toward the negative field? We have an illustration on a large scale in the case of thunder-clouds which have been repeatedly seen to approach each other. Mr. Dolbear writes me that he has himself noted a most remarkable and sudden clearing of clouds after a thunder-storm. I have myself observed a line of blackness gradually advance in a clear sky, the line stretching from the south-east to the north-west. The demarcation between the clear sky and the black cloud was almost geometrical in its sharpness. No rain was felt till the edge of the cloud reached the zenith; and then rain fell in torrents, though there was blue sky almost directly overhead.

But there is a still more important consideration. The difficulty of changing the moisture contents of the air is universally recognized. The number of grains per cubic foot will remain absolutely constant for days at a time, no matter what may be the heat conditions of the earth, its winds, clouds, or any other changes in the meteorological elements. A sixteen-hours' steady rain has not been sufficient to saturate the air. Nothwithstanding these facts, we now know that accompanying a storm, and independent of the sun's heat, there are most extraordinary fluctuations in the moisture contents of the air. Frequently, over an area of 160,000 square miles, this moisture may be doubled, and immediately following the storm it may be diminished three-quarters of this; and this, too, absolutely independent of the wind, pressure, or temperature. I will give but one illustration. On Dec. 22, 1889, at 3.11 P.M., I observed 4.09 grains of moisture per cubic foot in the air, which was calm at the time. At 5.2 P.M., or 111 minutes later, there were only 1.04 grains per cubic foot. This was certainly the greatest diminution I ever observed, but several times I have observed it almost as great. Without going into the questions, which this discussion must raise, it seems to me that such extraordinary changes can be abundantly accounted for on the principles enunciated in this journal, and cannot be accounted for in any other way. What we need most of all are experimental determinations showing the possibility of such transfer in electric fields. Have we any help from the difficulty of running a Holtz machine in a damp room, from the gathering of dust and lint on electrified glass rods? Is it possible to electrify a mass of air so as to test any of these questions? Thus far I have hoped only to interest others more familiar with the subject than myself. I do not expect that I have added any thing to our knowledge; but as Professor Holden has said recently, regarding photographic magnitudes of stars, "any discussion of the question at this stage can but be advantageous," so it seems to me in this field of research we may well consider that any consideration of the questions involved must tend to bring out the best thoughts of many minds; and "in the multitude of counsellors there is wisdom."

H. A. HAZEN.

Northfield, Minn., Jan. 28.

IN my communication on physical fields published in *Science* of Dec. 27, what I was most desirous of pointing out was the character of the physical re-action of a field of a given sort upon a body in it. The explanation of the various steps was unessential, entirely so; and if my explanations were not the true explanations, the conclusions reached in the main thesis would not be vitiated.

Mr. N. W. Perry takes some exceptions to my terminology, which are proper enough if I have not used appropriate terms. I most heartily agree that in all departments of science the terms used should be explicit, definite, and not misleading; but it is unfortunate indeed that all through physics, to say nothing of other sciences, there is no general agreement as to the proper use of terms. Take, for instance, the term "heat." Some say "heat is vibratory atomic or molecular motion," others just as competent say "heat is a form of energy." Now, both cannot be right, unless a mode of motion is a form of energy. Again, note the long controversy lately had in England over the proper use of the words "mass" and "weight."

The significance of it is this: that, until there is a well-settled use of a word in a technical sense, one cannot be altogether blamed if he uses the word in a sense different from some other one. Now, Mr. Perry is certain that I do not use the word "stress" properly; that it "is not proper to say that a stress travels;" that Maxwell and others do not believe that electrification involves motion in any way; that potential conditions or energy are static, and that I have made a fundamental mistake in not discriminating between static and kinetic energy.

To all this I have to reply,

1st, Suppose an electrometer to be, say, one metre from a glass rod which I electrify with a piece of silk. If the electrometer gives any indication of electrification, the condition that incites it has travelled with a finite velocity. Whether it be called a stress, a strain, or any thing else, is immaterial; whether it is a condition of the ether or action at a distance in the sense the older philosophers thought, does not matter so much if it takes time to go from the glass rod to the electrometer. One may call it potential or kinetic energy if he chooses: a static condition will presently be reached, but not instantly. And the same is true of the effect produced by magnetizing a piece of iron.

Mr. Perry seems to say, that, if there was but one body in the universe, it could not have an electric field, even if it could be electrified. If that be his meaning, I must say that his conception of electrical re-actions is totally different from mine. As Tait has it, "every action between two bodies is a stress." The body and the ether about it are two bodies; and, if they can act at all upon each other, there will then be a field. Perhaps, however, Mr. Perry calls the ether matter, which has not been my habit, and against which I was not on my guard when I wrote the statement to which he objects. Until we have some evidence that ether is subject to the law of gravitation, it seems to me to be improper to speak of it as matter. If "every particle of matter attracts every other particle of matter," and if there is no evidence that ether is so attracted, it is not conducive to good terminology to call it matter.

2d, This term "stress" has not been long in use at all, and the adoption of it into electrical science I suppose to be due chiefly to Maxwell. I have therefore looked to see how he employed it, and I find the following in his treatise on "Electricity and Magnetism," Art. 866:—

"Now, we are unable to conceive of propagation in time, except either as the flight of a material substance through space, or as *the propagation of a condition of motion or stress* in a medium already existing in space." The Italics are mine, as I interpret them to mean precisely what I meant. Evidently Maxwell did conceive that stress could travel.

Again, in Art. 863 he says, "The emitted potential *flows* to the body;" and once more, "The potential as received by the attracted body is identical with, or equal to, the potential that arrives at it;" and once more, "The velocity of transmission of the potential is not like that of light, constant relative to the ether or to space, but rather like that of a projectile, constant relative to the velocity of the emitting particle at the instant of emission."

These quotations seem to me to justify me in the use of the word "stress" as a condition capable of translation from one point to another. It is not unlikely, though, that within the past few years, and since Maxwell's death, the term has become more precise; and that, if true, would justify calling attention to a departure from such use.

A. E. DOLBEAR.

College Hill, Mass., Feb. 2.

Pressure-Waves.

CAZENOVIA LAKE, or more properly "Owahgena," is about four miles long and half a mile wide, situated twelve hundred feet above sea-level. The outlet issues from one corner, and is a deep curved channel. Two hundred feet from the lake an artificial pond connects with the outlet. A dam at the neck of this pond rises to within four inches of the surface of the water. No ordinary waves reach this point, but it affords an unusually good opportunity for observing the long waves that are evidently caused by varying atmospheric pressure, apart from the frictional force that produces the common waves. When the water is perfectly smooth on each side of this dam, which is protected from wind-currents, it flows with such speed over the dam as to show a decided ripple. The flow is alternately in and out of the pond, which has no other opening, and it changes direction about every five minutes. The change of level is from three-quarters of an inch to an inch.

If the speed of this long low wave is the same as the small swells on the lake, ten minutes from crest to crest would indicate that the crests are about one mile apart, — a very long wave with an inch elevation. The phenomenon is regular for hours, and seems to depend very little upon the force of the wind, showing no connection with the wind's direction. If local storms prevail, the energy of this motion is increased very much in excess of the force of the wind felt on the lake.

The variation of atmospheric weight needed to produce this effect would probably be a little less than an ounce to the square foot, or an inch and a half on a water barometer. It suggests a low-tide rise and fall, with eight to ten minute intervals. It would be interesting to know if more skilled observers have given attention to water indications of air-pressure of this kind.

To-day there is ice on the lake two or three inches thick; the wind south, in strong gusts. At the south end, where the wind is offshore, and at a very sheltered point, I notice, at about eight-minute intervals, a rise of the water made evident by the cracking of the crust that connects the ice with the shore, showing that the long wave acts under the ice in the same way as when the lake is open. L. W. LEDYARD.

Cazenovia, N.Y., Feb. 2.

Influenza.

I LIVE on the Sioux Reservation, thirty-two miles from Fort Yates, the nearest white settlement. We have had a clear cold winter, west winds prevailing, few colds, and but little sickness except whooping-cough among children.

Over on the other side of the river, north of this about thirty or forty miles, is a Russian settlement. I have heard continually of late of their having influenza over there. I had no faith in the disease being an epidemic or contagious. A short time ago a few of our Indians went over there trading. We had no signs of the disease here. They returned, and in less than a week one of the families who went were all down with what I thought hard colds. I was called in to treat the cases. In three days, three more strong men were down; and now the whole Indian village is suffering with it, and I am just coming down with it myself. The patients have aching heads, and pain in the side and lungs, the whole body aching as if with ague. They are feverish, troubled with coughing and hoarseness, are restless, and have no appetites, but great thirst. Is it influenza? If so, influenza must be contagious. We have such cold weather, surely disease-germs would not survive; and our winds, being mostly west winds, could not bring disease-germs from the east. This may be of no use to science; but I am so isolated here, — being a missionary among the Indians, and the only white person here, — I thought it might have weight in some direction. M. C. COLLINS.

Fort Yates, N.Dak., Jan. 24.

Lightning Discharge.

IN response to invitation in the last number of *Science*, I send description of lightning discharge.

In the summer of 1883, when our present public high-school building was nearly completed, but before the lightning-rods were in place, a carved brownstone "finial" in the form of a double cross, weighing about a hundred pounds, which stood on one end of the roof of the building, was struck by lightning. No trace of the lightning was found on any part of the buliding below this "finial" stone, which was apparently blown to pieces as effectually as if an ounce of gunpowder had been enclosed in its centre, and fired by electricity. It was just before a thunder-shower, but not a drop of rain had fallen. The writer was within twenty rods of the building at the time, and helped pick up the fragments (all of which have been preserved), which were scattered over a space of thirty feet radius.

Was the cloud negative, and did the positive discharge go upward? JOSEPH HALL.

Hartford, Conn., Jan. 29.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Feb. 1. — C. Hart Merriam, General Results of a Biological Survey of the San Francisco Mountain Region in Arizona; B. E. Ferrow, Forest Influences on Water Supplies.

Boston Society of Natural History.

Feb. 5. — F. W. Putnam, Early Man in America; S. H. Scudder, Remarks on a Small Collection of Beetles from the Interglacial Clays of Scarboro', Ontario.

Exchanges

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Wanted—Books and journals, American or foreign, relating to Photography—exchange or purchase. C. W. Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St, Davenport, Iowa.

I wish to purchase Vol. 7 of the *American Chemical Journal*, either bound or unbound. State price. Address, Wm. L. Dudley, Vanderbilt University, Nashville, Tenn

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmola patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes etc., wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886.) for scientific books — those published in the *International Scientific Series* preferred.—James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.— D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write. — J. M. Keck, Chardon, Ohio.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A YOUNG MAN desires, about the 1st of July, a position as laboratory assistant, or as instructor in chemistry, physics, and lesser mathematics. References as to ability and character. 44 P.M.A. Address R. L. Porter, Penn. Mil. Acad., Chester, Pa.

PRACTICAL CHEMIST, with 10 years' experience in superintending manufacture of oil of vitrol, fertilizers, acetic acid, wood alcohol, etc., is open to an engagement. Bestre ferences. P. O. Box 43, Edgewater, Bergen Co., N. J.

AN M. S. GRADUATE of the University of Illinois is open for an engagement as teacher of the Natural Sciences, Biology a specialty, in an Academy, Institute, or High School. Three years' experience. Is a practical assayer and chemist. Good references. Address G. C., care SCIENCE.

WANTED.—A position in an Academy, Normal or High School, as teacher of the Natural Sciences and Modern Languages. Latin taught in addition if necessary. Address G., Box 441, Hanover, N.H.

A YOUNG SCOTCHMAN desires an appointment in America. Three years in English Government Office. Good references. Address "Jack" care J. Lawson & Coy, 17 Princes St., Aberdeen, Scotland.

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AN ANALYTICAL CHEMIST is open to an engagement in mining, metallurgy, calico-printing, and bleaching, or as research chemist in alkali manufacture. Address "Alkali," care of SCIENCE.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
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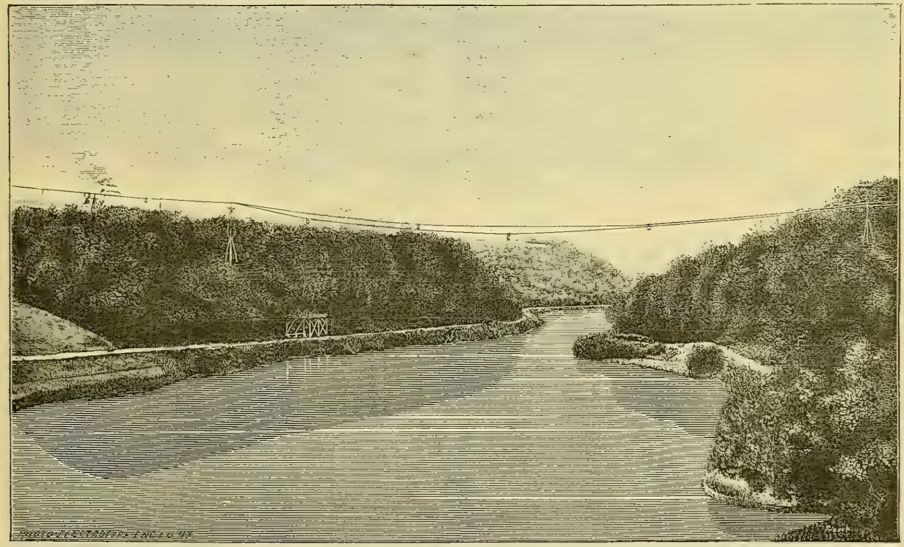
WIRE-ROPE TRAMWAYS.

WIRE-ROPE tramways, as a means of cheap transportation, are too well known to require any long dissertation on their advantages. As feeders to established systems of railroad or water communication, their low cost of construction through countries where, from the rugged contour of the surface, ordinary railroad or even wagon-road building would be scarcely practicable, except with long and costly détours, has always made them very attractive to the miner and quarryman, to whose use in this country they have been heretofore almost exclusively confined. The earliest tramways of this kind which were successfully introduced consisted of a single, moving, endless rope, from which the loads were suspended. In one system the buckets or carriers are attached to saddles, which ride on the rope, but can be separated from it. In another system the carriers are attached permanently to the rope. But in each of these systems one and the same rope both supports and moves the load.

This fact is really the reason that aerial transportation has hitherto not become general in the United States. Lines constructed with the single moving rope, while very efficient for certain purposes, are not available for general use as a means of transportation, because of their limited capacity for carrying individual loads, which in no case can exceed 300 pounds, and in practice have been much smaller. The original single-rope systems are the ones chiefly used hitherto in this country. In Europe, however, while these single-rope lines were also first in vogue, the double-rope system has of late years almost entirely supplanted them, and has established itself, as a general means of transportation, to an extent hardly yet dreamt of here.

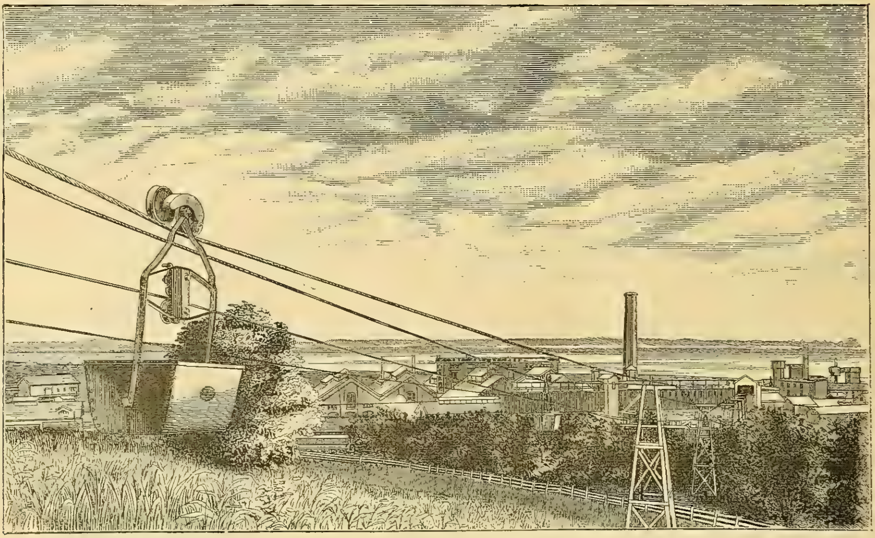
Railroad companies have adopted these lines as regular feeders to their main roads, and laws have been promulgated in different European countries regulating their construction and traffic, the same as for ordinary railroads. This extension of their application is due principally, if not entirely, to the perfection attained under the Bleichert system, some features of which are shown in the accompanying illustrations. While the individual loads to be carried by the single-rope lines should, for convenience and economy, preferably not exceed 150 pounds, and are, in fact, seldom over 100 pounds, the lines of this system are adaptable to individual loads up to 1,000 pounds each, and in special cases even heavier loads have been carried.



THE BLEICHERT WIRE-ROPE TRAMWAY, 1,000 FOOT SPAN, OVER THE WEINBACH VALLEY.

Single-rope systems of tramways, where the moving rope carries the load, must necessarily move slowly; otherwise there is great danger that the rope may jump out of the carrying-sheaves. These carrying-sheaves are very shallow, so as to permit the passage over them of the saddle or clip. The dropping of the rope from the supporting sheaves has always been a source of more or less trouble and expense in operating these lines. In this system this trouble never occurs, since the stationary carrying-cable has no tendency to leave the saddle

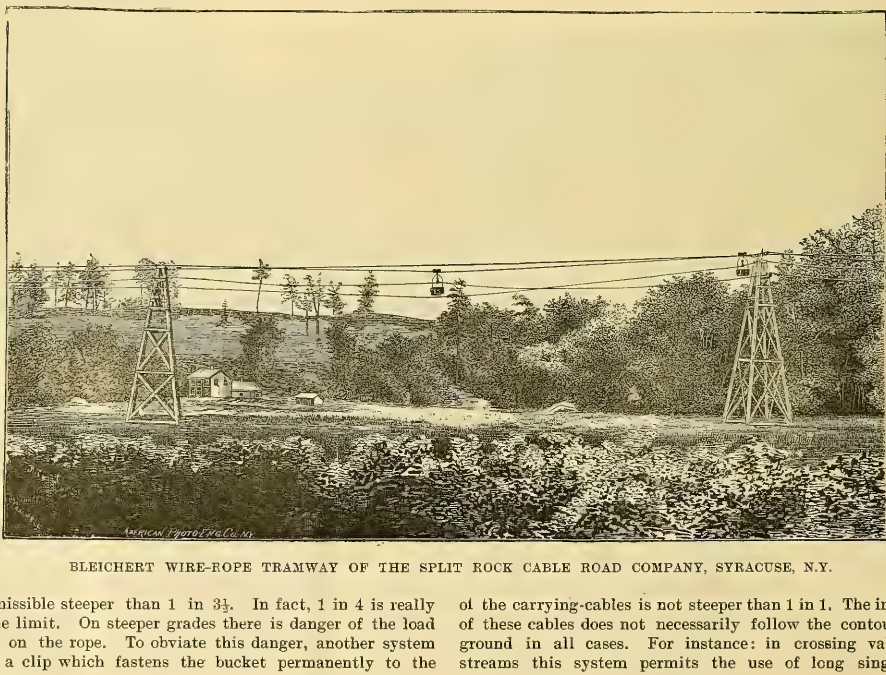
in which it is carried. This being the case, there is no difficulty in moving the cars of these lines at a speed of three or four miles an hour.



BLEICHERT WIRE-ROPE TRAMWAY OF THE SPLIT ROCK CABLE ROAD COMPANY, SYRACUSE, N.Y.

One of the advantages of these tramways over others consists in their capability of surmounting any grade.

In one system of single-rope tramways, no grades in the rope are permissible steeper than 1 in $3\frac{1}{2}$. In fact, 1 in 4 is really about the limit. On steeper grades there is danger of the load slipping on the rope. To obviate this danger, another system employs a clip which fastens the bucket permanently to the rope. While this corrects the danger of slipping, it gives rise to the objection that the buckets must be both loaded and unloaded while moving, since they cannot be stopped without stopping the whole line. In the system illustrated, both these objections are obviated. Any grade can easily be surmounted, provided the contour of the ground is such that the inclination of the carrying-cables is not steeper than 1 in 1. The inclination of these cables does not necessarily follow the contour of the ground in all cases. For instance: in crossing valleys and streams this system permits the use of long single spans,

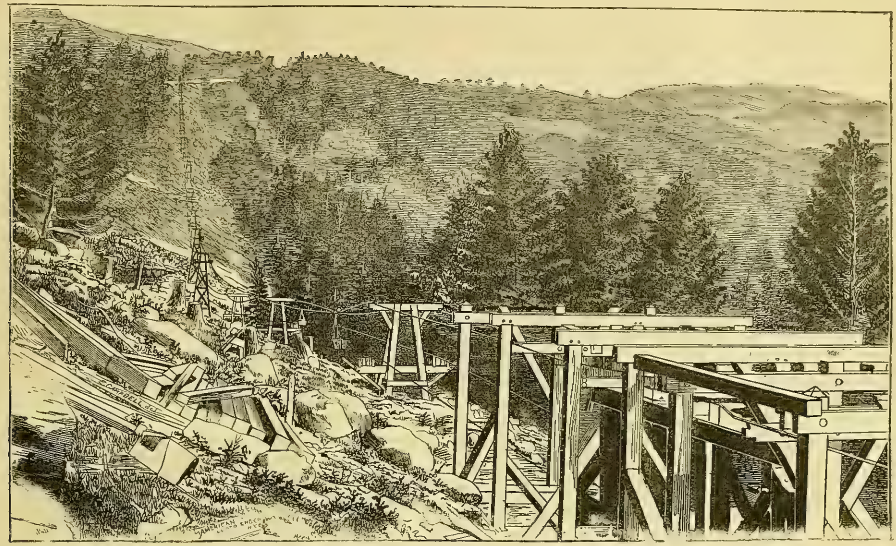


BLEICHERT WIRE-ROPE TRAMWAY OF THE SPLIT ROCK CABLE ROAD COMPANY, SYRACUSE, N.Y.

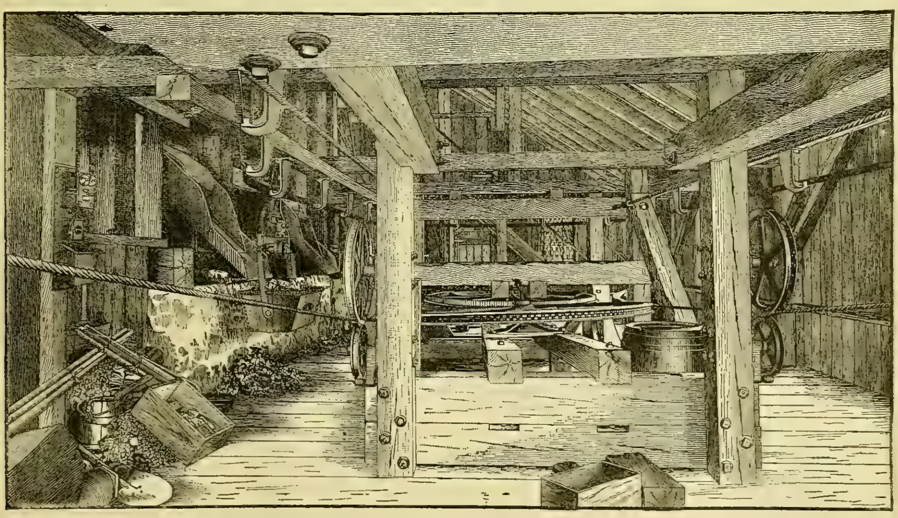
which, in the case of the single-rope tramways, would be impracticable. Again: a precipitous rise in the ground presents no insuperable difficulties, since the curves can usually be laid out so as to bring the inclination of the carrying-cables within the proper limits.

The other objection is obviated by the arrangement that when the car reaches either terminal, or any switch or turn-out on the line, it can be automatically disconnected, and run off to any point required for loading and discharging. This system also permits the introduction at any point on the line of movable or temporary switches or terminals, without the erection of special structures for their support.

The cost of both construction and maintenance is greatly increased for single-rope tramways by the use of spans longer than 100 feet, or the occurrence of very steep grades. Even if only one such span, or one such grade, is present in a whole line, it becomes necessary to make the entire double length of moving rope strong enough for the special strain due to that one spot, over which, in its endless travel, every part of the rope must pass; and this increase in the size of the rope affects the dimensions of the supports, sheaves, and other fixtures throughout the line, thus requiring a general increase of cost, nearly as great as if all the spans were equally long or all the grades equally heavy. The wear of the rope is also increased by reason



BLEICHERT WIRE-ROPE TRAMWAY AT GRANITE, MONTANA.



INTERIOR OF LOADING TERMINAL OF BLEICHERT WIRE-ROPE TRAMWAY AT GRANITE, MONTANA.

of its greater diameter and the more unfavorable conditions of the catenary curve, or sag, on long spans and steep grades; and these sources of increased cost of maintenance affect every part of the rope. In this system the carrying-cable, being stationary, can be locally graduated to the strains it has to bear. The cable for the empty cars does not, of course, require to be as strong as the cable for the loaded cars, and it is therefore made only strong enough for the work it has to perform. In like manner, if one or more long spans occur in the line, it is not necessary that the whole cable should be made strong enough to bear the extra strain at this one point: on the contrary, it is sufficient to so strengthen only the portions exposed to this extra strain, and this is easily practicable. On very long steep grades also, where the cable at the head of the incline must be able to bear not only the ordinary working strain due to the cars, but must also sustain the whole weight of the cable on the incline, this is effected by making the cable in sections of gradually diminishing area, thus effecting great economy in the total weight of the cable. A further advantage is, that the traction-rope used, instead of being loaded down by the cars, as in other systems, is itself carried and supported by them, thus lessening greatly the wear.

The ordinary spans used in the construction of these lines are from 150 to 200 feet, but there is no real objection to spans of 500 to 600 feet. Many lines built within the last few years have spans up to 1,500 feet. The illustration on the first page, taken from a photograph, represents one of these long spans. It is 1,000 feet in the clear, and forms part of a line nearly seven miles in length, built for the transportation of 250 tons of iron ore per day. This line has been in successful operation for many years.

There exists in nature hardly a difficulty or obstacle which would bar the introduction of this system of transportation: in fact, in many cases it is the only one that can be used. While this is eminently true where the contour of the ground is much broken up and long spans are necessary, this system possesses economical advantages even where there are few or no natural obstacles to the building of any kind of road. The service is regular; stoppages for repairs are rare; no interruptions due either to atmospheric influences or storms are liable to occur; the line being elevated, the service is entirely free from interference with surface traffic; wear and tear and expense of operating are relatively very low; terminals can be so arranged that the material transported can be delivered at the exact spot where it is needed, thus saving all expense of re-handling. This could not be done with a surface road, since, even if the cars could be brought close to the point at which the material is required, there would still be a further expense for unloading, irrespective of the cost of switching and hauling them.

This system of transportaton is controlled in this country by the Trenton Iron Company of Trenton, N.J.

THE SIGNIFICANCE OF THE DEGREE OF BACHELOR OF ARTS.

AT the conference of college presidents and professors in Philadelphia, Nov. 26, 1889, Professor E. H. Griffin read a letter from President Gilman, dated Oct. 17 (published in the February number of the *Johns Hopkins University Circulars*) as follows: —

"If I had been present, I should have asked leave to present to your consideration some thoughts respecting the baccalaureate degree; but as I cannot attend, on account of absence from the country, I have requested Professor E. H. Griffin to say a few words in my behalf.

"The points to which I should have directed attention are these: —

"1st, The American propensity to multiply academic titles so that the real significance of a degree is obscured.

"2d, The tendency to confer the baccalaureate degree in so many forms and phrases that its meaning cannot be discovered even from the name of the institution which confers it, but must often be worked out by a study of catalogues constructed in different orders of complexity.

"3d, The enumeration of the manifold forms of the baccalaureate degree now given in this country.

"4th, The historical significance of the bachelor's degree as marking attainment of the first grade in the fellowship of scholars, — a grade which may be attained in any faculty of a university, arts, medicine, theology, and law.

"5th, The value of a certificate the meaning of which is obvious at first sight, considered from the point of view of the holder of a diploma, and, second, from that of the public.

"6th, The importance of restoring, if possible, the baccalaureate degree to an honorable significance before it is altogether lost.

"7th, The importance of acknowledging that it is not essential that any one curriculum should be followed in order to attain the degree of bachelor of arts.

"8th, It is essential that the candidate who receives that degree should have received much instruction in (*a*) ancient and modern languages and literature, (*b*) in mathematics, (*c*) in the natural and physical sciences, and (*d*) in historical and moral sciences.

"9th, It is also essential that the candidate should pursue these studies in a public institution, under competent instructors, for a definite period, in a systematic way, subject to examination, the results of which are to be recorded, proclaimed, and certified to by a formal diploma." . . .

After reading the letter, Professor Griffin stated that there could be no doubt that the baccalaureate degree had lost something of the "honorable significance" of which President Gilman speaks. A recent writer in one of our magazines declares that "A. B. is as meaningless an abbreviation as exists." This, we are glad to know, continued Professor Griffin, is an exaggeration; but it is an exaggeration which contains an uncomfortable element of truth.

So far as it is true that the bachelor's degree has declined in dignity and value, the evil is a serious one. In view of its historical significance, the interests of learning and the credit of the fellowship of scholars require that this title, which marks the completion of a defined stage or period of training, should be kept in its original repute. It is a grave injustice that one who has gained the degree, at great expenditure of money, time, and labor, should find that others have gotten it upon so much easier terms that it becomes almost worthless as a guaranty of acquisition. The public have a right to assume that learned distinctions are bestowed in good faith, and upon some basis of common understanding, and ought not to be compelled to go back of academic titles to find out what they mean. Whether it be considered from the point of view of the public, or of the individual, or of the general interests of learning, few academic questions are of greater consequence than the proper significance, and most effective defence and maintenance, of the bachelor's degree.

The causes which have contributed to this loss of consideration are — some of them, at least — obvious.

As is well known, the institutions of higher learning first established in this country were modelled, not after the English universities, but after the English colleges. This was inevitable under the circumstances, and the American college has certainly shown itself well adapted to the conditions of our national life. As respects academic titles, however, the system has had its drawbacks. In Great Britain and Ireland there are eleven institutions conferring degrees; in the United States there are about four hundred, not counting colleges for women, of which there are perhaps one hundred exercising this prerogative. These institutions are, of course, of all grades of merit. Some of them are not greatly unlike the college in the Far West, of which Professor Bryce speaks in the "American Commonwealth," whose president had much to say about the views of his faculty, and what his faculty were going to do; the "faculty" consisting at the time, as it appeared, of that dignitary and his wife. A peculiar infelicity has attended our system as applied to honorary degrees, — as in theology and

law, — these being given by institutions which offer no instruction in these subjects. An eminent American composer is said to have declined the doctorate of music conferred by Yale, on the ground, that, as the university did not recognize this subject in its system of education, it was presumably incompetent to pronounce judgment about it. However uniform and thorough might be the standard of acquirement theoretically established by our colleges, their inordinate number, involving wide diversities of scholarly and teaching power, must prevent their certificates of graduation from bearing any thing like a uniform significance in respect to the amount and quality either of the instruction offered or of the proficiency attained.

So far as the bachelor's degree has suffered from this cause, there is probably no immediate remedy. The suggestion occasionally made, that the colleges of a State, or of a larger extent of territory, might, for certain purposes, affiliate themselves into a kind of university, and bestow degrees through a common board, is not likely to be received with favor. It is possible that something may be done toward the creation of a public sentiment unfavorable to the endowment and chartering of unnecessary institutions; but the main reliance must be upon such a gradual increase of resources and elevation of standards as shall diminish the evils which cannot be wholly removed. If an agreement of theory and practice could be reached among our most influential institutions in regard to the bachelor's degree, this would do more than any thing else to determine usage, and to fix the connotation of the title.

In looking over the reports of the commissioner of education, one is struck with the fertility of imagination and invention displayed in academic titles. The following enumeration of variations of the baccalaureate title is probably not exhaustive:—

Bachelor of arts, science, philosophy letters, laws, divinity, sacred theology, surgery, music, painting, pedagogics, English, English literature, Latin letters, agriculture, scientific agriculture, agricultural science, architecture, engineering, civil engineering, mining engineering, metallurgical engineering, mining metallurgy, chemical science, mechanic art, veterinary science, domestic art. The colleges for women add a new and pleasing element of variety from the fact that it seems to be supposed by some that the word "bachelor" is a designation of sex; and so we have licentiate, laureate, graduate, proficient, and, in more distinct antithesis to bachelor, maid.

The first criticism that one passes upon this list is that most of the titles indicate professional rather than liberal acquirements. The bachelor of science, of philosophy, of letters, may have pursued studies entitled to be called liberal; the same may be true of the bachelor of laws, divinity, music, of others in the list; but it is certain that the holders of most of these degrees have acquired a technical rather than a general training. Why, then, it may be asked, should they lay claim to the title to which usage has attached a different meaning? Is it historically just, or is it practically wise, to disregard the distinction between a technical and a liberal education by applying the baccalaureate title indifferently to both? Most of the colleges represented in the conference distinguish between the bachelor's degrees of arts, science, and philosophy, and the technical degrees, practical chemist, mining engineer, civil engineer, and the rest. It is important that those who hold to the old idea of a broad training in fundamental studies, precedent to specialization, should do this.

A question might arise as to what modifications of the baccalaureate title should be considered permissible under this principle. The degrees, bachelor of science, letters, and philosophy, are so well established that it is probably useless to make any objection to them; yet it is a fair question whether the subdivision is of any advantage. If these degrees do not certify to a course of study probably ranked as liberal, they ought not, according to this view, to be conferred; if they do, would not the simpler, more historical, more intelligible way be to comprise them all under the bachelor of arts? The contrast between the sciences and the humanities it may be well to recognize by retaining the bachelor of science; but bachelor of letters and bachelor of philosophy are of such indeterminate significance that it would be a relief to have them abandoned. Is it worth while to retain degrees whose significance no one can tell without knowing the institution which conferred them, or then without a careful consultation of the catalogue? It seemed to Professor Griffin that the baccalaureate degree would be greatly augmented in dignity if it were conferred only under the title "bachelor of arts," or, at most, with the variation "bachelor of science."

If the reduction of all the non-technical degrees to a single form, or to two forms, were to be accomplished, it would be necessary to reach a more definite understanding than at present exists as to what constitutes a liberal education. The proposition laid down by President Gilman, that "it is not essential that any one curriculum should be followed in order to attain the degree of bachelor of arts," would now be generally conceded. The rigidly exacted course of study which formerly prevailed in all our institutions is now admitted to be impracticable. The effort to adapt it to the demands of the new sciences, and the modern languages and literatures, made it so fragmentary and kaleidoscopic, so far impaired its disciplinary power, that some change was acknowledged to be inevitable. The only difference of opinion now is as to what subjects shall be insisted upon. The modifications of the bachelor's degree first named (bachelor of science, philosophy, letters) ordinarily indicate that one, at least, of the classical languages has not been pursued. The absence of this acquisition seems to render the bachelor of arts degree unsuitable; and, in default of a scientific specialty, one of the other titles is resorted to. If it were decided to abandon these, what could be done for the class of students for whom they were designed? This must, of course, depend on one's view of what is necessary to a liberal culture. Why not give to those who have studied no ancient language such certificates and titles as best describe their work, and, to those who have sufficiently pursued one, concede the full rank of bachelor of arts?

That a liberal education may be properly held to require a wider historical and moral horizon than the modern tongues alone can give, can hardly be disputed. An acquaintance, at first hand, with the manners and sentiments of a civilization remote from our own, one unmodified by Christianity, is so pre-eminently liberalizing, so quickens one's power of intellectual sympathy, so deepens one's sense of the unity of history, so enlarges the range and perspective of one's thoughts, that it may properly be made the differentia between a general and a special training. But are two ancient languages necessary for this? Is it even necessary that one of the classical languages should be pursued? Would not Semitic or Sanscrit studies, if these should happen to be unaccompanied by Greek or Latin, secure the same end? The main thing is to get a genuine hold upon a distant past.

The literary and æsthetic reasons for the study of the classical languages, that is, of Greek, which is the real issue in the case, it is not necessary to belittle the force of. But how few candidates for the degree of bachelor of arts ever acquire any refinement or delicacy of Greek scholarship! How few teachers — happily there are signal and distinguished exceptions to this remark — teach Greek otherwise than as a grammatical drill, or, at the best, a philological discipline! Was ever the Hellenic spirit and form better reproduced than by Keats, who could not read Greek at all?

It is not, in Professor Griffin's opinion, easy to justify the insistence upon both Greek and Latin as essential to a liberal education. We may be in danger of displaying in behalf of Greek studies something of the same excessive deference to traditionary habits and standards which worked so powerfully against their reception in the fifteenth century. It is undeniable that the majority of men in two, at least, of the so-called learned professions,— law and medicine,— in editorial work and in politics, are not, in the academic sense, liberally educated men. Is not this due in part to the fact that we have been too rigid at certain points, making our education seem remote from life and pedantic? If it should seem wise to bestow the bachelor of arts degree without Greek, we could simplify our

nomenclature by dispensing with the degrees of bachelor of letters and of philosophy; we could carry to full graduation some who now pursue partial courses of study; we could obviate criticisms, which proceed not always from so-called "practical" men, but often from persons abundantly qualified to form an opinion, — graduates, not rarely, of our own institutions.

"But while this additional freedom may wisely be conceded," the speaker went on to say, "it is of the last importance that we insist upon those fundamental subjects which any rational theory of a liberal education must include. President Gilman enumerates these as follows: 'It is essential that the candidate who receives that degree should have received much instruction in (*a*) ancient and modern languages and literature, (*b*) in mathematics, (*c*) in the natural and physical sciences, (*d*) in historical and moral sciences.' I need not stop to show why these four classes of subjects are essential: we are not likely to disagree about that. Experience has shown, what one's knowledge of human nature would lead one to expect, that young men, left wholly to themselves, will not apportion their time equitably between these different interests.

"Professor West of Princeton took the trouble, three or four years ago, to summarize the choices of elective studies made by members of a recent class at one of our leading colleges. A more careful administration of the system probably prevents, at the present time, such extreme abuse of liberty; yet these facts are instructive as an illustration of a danger against which we need to guard. The first man in standing omitted two of the classes of subjects named by President Gilman, taking no course in mathematics or in science. The second omitted nearly three, taking no course in mathematics, in science (except botany), in philosophy, history, or political science. The third took no science and no philosophy. The fourth took no course in philosophy, history, political science, classics, modern languages. How can we consider a man liberally educated who has studied, during his collegiate residence, no modern language, no ancient language, no logic, psychology, or ethics, no history, no political or social science? Omissions of like significance occur in the case of each of the ten highest men, while the men at the bottom of the class show a marked inclination to the easiest subjects. We cannot plead the example of the German universities, for we have no such preliminary training as the German gymnasia afford. It is obvious that unrestricted liberty of election cannot be permitted. No degradation of the baccalaureate degree is comparable to that which would come from the general adoption of such a system in our colleges. The degree has at present an approximate uniformity of meaning. This would speedily and totally disappear."

The suggestions which Professor Griffin offered, on the basis of President Gilman's paper, are these:—

1. Diminish the evils growing out of the number of our colleges, and the inferiority of some of them, through an agreement among the strongest and best, which would have the force of an authoritative example.

2. Distinguish sharply between the technical and the baccalaureate degrees, reducing the latter to one, or, at most, two forms.

3. Relax the requirement in regard to Greek, accepting one ancient language as sufficient for the bachelor of arts degree.

4. Allow no elections on the part of students that will prevent a suitable distribution of attention between the four great groups of subjects which have been named.

HEALTH MATTERS.

The Rôle of Potable Waters in the Etiology of Typhoid-Fever.

THERE has long been a consensus of medical opinion as to the *rôle* of drinking-water in the causation of typhoid, and facts to prove an etiological relation are accumulating every year. According to the *Boston Medical and Surgical Journal*, Vaillard has made a communication to the Société Médicale des Hôpitaux, in which he furnishes new bacteriological proofs.

1. In March, 1889, there broke out in the regiment of cavalry quartered at Melun an epidemic of typhoid-fever, but only one squadron was affected. This squadron made use of the water of a particular well which had been contaminated in some unknown way. Repeated examinations of samples of this water revealed the presence of the *bacillus typhosus*.

2. At Cherbourg there was an epidemic of enteric-fever, affecting particularly a military company. The water-supply of this part of the city had been contaminated by typhoid dejections in a manner easily explicable, and samples of this water showed the *bacillus typhosus* in abundance.

3. Similar facts were noted with regard to epidemics which prevailed last year and the year before at Miranda, at Bourg-en-Bresse, and at Chatellerault.

M. Vaillard's method of identifying the typhoid bacillus seems to have been in accordance with the most approved data of bacteriological science.

At the same meeting, Chantemesse stated some facts of interest respecting the influence of Seine water on the prevalence of typhoid epidemics. It was remarkable, that whenever, from accident happening to the reservoirs or mains of the other water sources, the water of the Seine was distributed to the various departments and drank by the inhabitants or the soldiery, an epidemic of typhoid appeared.

This statement was corroborated by M. Schneider at a meeting of the Société de Médecine Publique, Dec. 27, 1889, who also showed, by facts that had come under his own observation as military surgeon, that the use of Seine water for drinking had repeatedly been followed by epidemics of enteric-fever. Such an epidemic has recently prevailed in the barracks of Paris, owing to the temporary shutting-off of the water of the Vanne, which seems to be of exceptional purity.

The Grippe and Cholera.

Fears having been expressed as to a possible connection between influenza and cholera epidemics, Dr. Smolenski publishes, in the Russian *Official Messenger*, an elaborate report upon the subject. He points out that the suspicion is not new, and that in 1837 it was discussed by Gluge ("Die Influenza"), and refuted. In fact, influenza or *grippe* epidemics have been known in Europe since 1173, that is, for more than seven hundred years; while the first cholera epidemic appeared in Europe in 1823, but did not spread that time farther than Astrakhan. Six years later it broke out in Orenburg; next year, in Caucasia and Astrakhan again, whence it spread over Russia, and in 1831 reached western Europe. As a rule, influenza spreads very rapidly; and at St. Petersburg in 1782, says *Nature*, no fewer than forty thousand persons fell ill of it on the same day (Jan. 14). In 1833 its progress was also very rapid, and within a few days it appeared at places so far apart as Moscow, Odessa, Alexandria, and Paris; while cholera epidemics are usually slow in their migrations from one place to another. Moreover, influenza is chiefly a winter epidemic, while cholera prefers the spring and the summer.

Dr. Smolenski has further tabulated all influenza and cholera epidemics which have broken out in the course of this century in Europe; and he comes to the following results: influenza broke out in 1816 in Iceland; 1827, in Russia and Siberia; 1830–33, in Europe generally; 1836–37, in Europe; 1838, in Iceland; 1841–48 and 1850–51, in Europe; 1853, in the Faroe Islands; 1854–55 and 1857–58, in Europe; 1856, in Iceland and the Faroe Islands; 1862, Holland and Spain; 1863–64, France and Switzerland; 1866, France and Great Britain; 1867, France, Germany, and Belgium; 1868, Turkey; and 1874–75, western Europe. As to the cholera epidemics during the same period, they were, 1823, Astrakhan and Caucasia (from Persia); 1829, Orenburg (from Turkestan); 1830, Russia (from Persia); 1831–37, various parts of Europe. The next epidemic appeared in 1846 in Transcaucasia (coming from Persia); in 1847 it spread over Siberia and Russia, and in 1848 it was in Europe; in 1849–52 it was followed by feeble outbreaks all over Europe. The third cholera

epidemic came from Persia again in 1852, and it resulted in a severe outbreak during the years 1853–55 in Europe, followed by feebler outbreaks till 1861. The fourth cholera epidemic came through the Mediterranean ports in 1865, and lasted in Europe till 1868, with feebler epidemics in 1869–74. The latest invasion of cholera was in 1884, when it came again through the Mediterranean ports. As to the cholera epidemic which now begins to die out in Persia and Mesopotamia, it certainly is a danger; the more so, as, out of the five epidemics of cholera which have visited Europe, three have come from Persia.

BURIAL REFORM IN ENGLAND.—After a period of incubation which has been spent in educating public opinion in the matter of the hygienic iniquity of the present system of interment, the group of sanitary philanthropists, with the Duke of Westminster at their head, who have taken up the ungrateful task of bringing the necessary reforms to pass, have at last decided to approach the government with the object of having their contentions indorsed by the Legislature. How far the general public will consent to allow their cherished usages in this respect to be interfered with, we are unable to guess, but the object in view will certainly commend itself to those who have a thought beyond the morrow. What is required, says the *Medical Press and Circular* of Jan. 1, 1890, is the prohibition of leaden and other solidly constructed coffins, the effect of which is to indefinitely retard complete decomposition, and so prolong the period during which the dead are not only æsthetically objectionable, but are an indisputable source of danger to the living, wicker-work or *papier-maché* receptacles alone being used. This is, after all, no very startling innovation, and is not open to the sentimental and theological objections which some persons entertain to the more radical plan of cremation. It is merely a sanitary precaution of an elementary kind; and, whatever the immediate fate of the movement may be, it must sooner or later impose itself. The effect of legislative interference would simply be to hasten and generalize the practice among those who have too much to do in this world to find time to decide upon the material of which their coffin is to be made. We are rather inclined to agree with Sir Spencer Wells in his suggestion that in future only properly cremated remains should be admitted to funeral honors in Westminster Abbey and other national mausoleums. Not only would there result a valuable economy of space, but the very deleterious odor of decomposing sanctity which pervades many sacred edifices would be done away with.

ACTION OF THE LIVER ON POISONS. — Dr. Roger points out that the liver modifies the toxic effects of several poisons, as has already been noted by Schiff, Hegar, Jacques, and Lautenbach. He has performed certain experiments, as we learn from the *Provincial Medical Journal*, which demonstrate clearly its modifying action with regard to nicotine, atropine, quinine, and strychnine; also certain putrid and intestinal poisons, peptones, and some salts, particularly ammoniacal salts. On the other hand, the liver exercises no influence over other substances, such as digitaline, some salts (potash and soda), glycerine, etc. The liver, therefore, like the kidney, possesses an elective action. To control these results, it is necessary that the poison should be absorbed very slowly. In the case of a diseased liver (cirrhosis, fatty degeneration, etc.), in which the parenchyma no longer contains glycogen, the liver does not act on poisons, but it suffices to administer substances capable of forming glycogen, to see the hepatic gland again competent to transform poisons. The action of the healthy liver is continually exerted against toxic substances in the system; it is still more marked in those infectious diseases in which decided toxic effects are produced. Some clinical facts go to prove that many morbid symptoms are due to insufficiency of the liver in regard to poisons.

DOES SALTING MEAT DESTROY BACTERIA? — Professor J. Forster of Amsterdam has published an account of some investigations made in his laboratory by himself and De Freytag, having for their object the determination of the effect of the common process of salting or pickling meat on various forms of bacteria. It was found, as stated in the *British Medical Journal*, that cholera bacilli were soon destroyed under the influence of abundance of salt, usually in a few hours, but that typhoid bacilli, pyogenic staphylococci, the streptococci of erysipelas, and the bacilli of porcine infectious diseases, frequently retained their vitality for several weeks, or even months, in spite of the presence of abundance of salt. The same was also true of the bacilli of tubercle. In some cases these bacilli were found alive after being two months in pickle, their vitality being proved by their capacity for infecting new cultures. Portions of the viscera of a tuberculous animal, preserved for a considerable time in salt, were found capable of causing tuberculosis in a healthy animal when introduced into its peritoneal cavity. Experiments on the spleen of an animal which had died of malignant anthrax showed that salt possessed the power of destroying the bacilli of this disease in about eighteen hours. These, as well as cholera bacilli, were found to require seven and one-half per cent of salt to destroy them. From these facts it would appear that salting or pickling has but little destructive effect on many of the more common forms of bacilli liable to be found in diseased meat.

THE ELECTRICAL PHENOMENA OF THE HUMAN HEART. — A special meeting of the Berlin Physiological Society was called by Professor Dubois-Reymond on Dec. 27, 1889, in order to see a demonstration by Dr. Augustus Waller on man and uninjured animals of the electro-motive action accompanying the beat of the heart. Besides the ordinary members of the society, the leading physicists of Berlin were invited, and Professors Helmholtz and Kundt witnessed the experiments. Dr. Waller, says the *British Medical Journal* of Jan. 11, employed the capillary electrometer magnified 1,250 times, and thrown on a ground-glass screen in one of the lecture-rooms of the Physiological Institute, and demonstrated the electro-motive action of the heart on a horse and on a dog. The horse stood in a courtyard near the lecture-room. Electrodes were attached to his extremities by firm bands, and the wires from the electrodes were passed through the window to the electrometer in the preparation-room adjoining the lecture-room. The dog stood in the lecture-room. In the library of the institute, Professor Dubois-Reymond allowed the demonstration to be made on himself, so that the pulsations might be seen directly through the microscope by all the members present.

THE HEALTH OF LONDON IN 1889. — Remarkable as has been the continual decline of the death-rate in England and Wales in recent years, the decrease of the rate of mortality in London, with its aggregate population of more than four millions, with constantly increasing density, is still more remarkable, says the *Lancet* of Jan. 4, 1890. The registrar-general, in his last annual summary, reported that the death-rate registration in London in 1888 was 18.5 per 1,000, being "far the lowest death-rate as yet recorded in London," the next lowest being 19.8, 19.9, and 19.6 in the three immediately preceding years, 1885, 1886, 1887, previous to which the London death-rate had never fallen below 20 per 1,000. The death-rate in 1889, moreover, again fell, and was considerably below the low rate in 1888. The registrar-general's return for the fifty-second week of 1889 affords the means of calculating that the mean annual death-rate in London in the fifty-two weeks of last year did not exceed 17.5 per 1,000, which was 1 per 1,000 below the rate in 1888.

FLOODS AND THEIR RESULTS FROM A SANITARY STANDPOINT.— We learn from the *Medical Record* that arrangements have been made to hold a tri-State sanitary convention at Wheeling, W. Va., Feb 27 and 28, 1890. Representatives will be present with papers and addresses from Pennsylvania, West Virginia, and Ohio. The object of the convention is to consider the question of floods and their results from a sanitary standpoint, and the best methods of managing the sanitary interests of a given community after such a calamity. Owing to the mutual relations held by these three States with reference to large rivers, and the numerous towns in each one of these States that are annually affected by floods and their results, it has

been thought wise to hold a convention for studying how best to manage the sanitary interests of cities and towns so affected. Every person interested directly or indirectly in this important subject is earnestly requested to be present and assist in discussing the papers, and add whatever information he can to the solution of these practical and most important questions, affecting as they do the health and lives of thousands of citizens of these three great commonwealths annually.

Cholera and Europe. — The epidemic of cholera which has for so many months been raging in the valleys of the Tigris and Euphrates and the interior of Mesopotamia has also made considerable inroads into Persia. Reports of the epidemic having crossed the western boundary of Persia have been heard from time to time; but it has now been announced to the Faculty of Medicine of Paris, that there has been an alarming increase of the disease in central Persia and on the Turko-Persian frontier, and that the inhabitants are fleeing toward the north. All those who can afford the journey are trying to reach the Russian ports on the Caspian. Remembering that this is the route into Europe which the cholera has so frequently taken, the announcement, says *The Medical and Surgical Reporter*, must be regarded as one of great gravity.

MENTAL SCIENCE.

The Rapidity of Mental Processes in Insanity. — The fact that the change in the mode of responding to the stimuli of the environment, characteristic of a disturbed mental equilibrium, will reveal itself in things important and trivial, has often been emphasized and illustrated. In this respect a comparison of the time required for performing simple mental operations in the insane with similar times in normal individuals is interesting, especially if we take account of the nature of the disease. The chief point in such an investigation is to secure a fair comparison, — a desideratum which former studies have not sufficiently taken into account. The most recent contribution to this field comes from a lady (Marie Walitzky, *Revue Philosophique*, December, 1889), and furnishes interesting results, based upon a sound method. She has chosen for her subjects men of good education—physicians, military officers, bankers, etc.—suffering from mental disease, and compared the times they require for executing certain mental processes with the times required for the performance of the very same processes, tested by the same apparatus, under the same conditions, by healthy physicians and other intelligent persons. The subjects were three persons suffering from paralytic dementia,—a case of remission after intense maniacal excitement; a case of general paralysis (in the initial stage of excitability); and another case observed at two different stages (in the period of remission, and in a state of maniacal agitation). Experiments were also made upon another patient whose disease is not altogether clear, and who was in a condition very nearly normal. The preliminary stages of practice were overcome; though times differing largely from the average always occurred, and had to be rejected. The processes studied were (1) the simple re-action time (with each hand) to a sound; (2) a choice of re-action, re-acting with the one hand to a loud sound, and with the other to a low one; (3) the re-action to a spoken word; (4) the ordinary association of one word with another; (5) the addition of one number to another. The associations were further distinguished as external, e.g., *flour-hour*, *mouth-nose*, in which the link was not logical, but rather accidental; internal or logical associations, such as *table-round*, *house-dwelling*; and assocations fixed by habit, such as *pater-noster*, *Adam-Eve*. Of course, these distinctions are neither absolute nor always easy to apply, and the same association may take place differently in different persons. Each average for each subject is founded upon about a hundred and fifty observations. The most important conclusions are the following: in the three cases of paralytic dementia the simple re-action time is lengthened, .225, .388, and .364 of a second; while in the average of five healthy individuals this average was .188 of a second; while in the other cases, mainly conditions of remission, no essential difference exists, the average time being .201 of a second. The difference in the time of re-action to a weak and to a strong stimulus is about the same in sane and insane, except in the two most pronounced cases of paralytic dementia, where the additional time needed to re-act to a slight stimulus is one-tenth of a second or more. The choice time is (and a similar relation holds of the other times) often three or four times as long in the paralytic dementia as in sanity, but approaches, though it is far from reaching, the normal in the states of remission: dementia, .816 of a second; remission, .629 of a second; normal, .364 of a second. The re-action to words is markedly longer than the normal only in the severest case of dementia, .864 of a second; normal, .285 of a second. The association time is most lengthened in a state of remission approaching melancholy, 1.377 seconds; in the state of remission, as in paralytic dementia, it approaches the normal, .898 of a second (normal, .680 of a second). In mania this time is shortened, .263 of a second. In those cases in which the patient was observed in two different stages of the disease, the same result is confirmed: the association time diminishes, and the choice time increases, as the maniacal agitation becomes more pronounced. The observations respecting the nature of the association are too limited to be separately discussed. These results suggest to the authoress the view, that, granting a reduction in association time to be dependent upon the faculty of unconsciously reproducing the associations fixed in the memory, the automatic function of the mind is increased in the initial stages of mental impairment, and that, parallel with this increase of mental automatism, the activity of the will decreases, its processes being slower. As the intellectual powers fade, the automatic functions also become slow, and finally even the perception of the simplest impressions is slackened. In the period of remission, even at its best, the mental powers do not fully recover: the automatism of the brain becomes normal, but the recovery of the will is incomplete.

A Curious Mental Trait.—A correspondent of the German Anthropological Society tells of his meeting a farmer by the name of Löwendorf, who had a peculiar habit of writing "Austug" for "August," his Christian name. Some years later he was inspecting a school, and heard a little girl read "leneb" for "leben," "naled" for "nadel," and the like. Upon inquiring, he found that her name was Löwendorf, and that she was a daughter of his former friend the farmer, now dead. This defect was noticeable in the speech and writing of both father and daughter. It appeared in the father as the result of a fall that occurred some time before the birth of his daughter.

NOTES AND NEWS.

We regret to announce the death of Gustave-Adolphe Hirn, the eminent physicist. He died at Colmar on Jan. 14, in his seventy-fifth year.

— A new kind of butter is now being made in Germany from cocoanut-milk. The Calcutta correspondent of the London *Times* says that the cocoanuts required for this industry are imported in large numbers from India, chiefly Bombay, and that the trade seems likely to attain still greater importance.

— Special attention was called by the United States Hydrographic Office to the unusually early southward movement of ice. Already (Feb. 1) thirty-six reports have been received of ice sighted since Jan. 5, and the positions and dates indicate that the ice season is one of the earliest on record,— nearly a month earlier than usual. This is undoubtedly due in large part to the prevalence of severe northerly gales east of Labrador, coincident with the heavy westerly gales of December and January along the transatlantic route. Masters of vessels should keep well clear of the Grand Banks for a few months, till there is less danger from icebergs and field-ice.

— Professor S. P. Langley, in a paper on the "Temperature of the Moon," in the December *Journal of Science*, states, that, of

the numerous conclusions to be drawn from this research, the most important one is that the mean temperature of the sunlit lunar soil is much lower than has been supposed, and is probably not greatly above zero Centigrade. In a postscript Professor Langley says, "I would ask to be allowed here to state that the very considerable expense for the special means and reduction of the preceding series of lunar researches was borne by one of the most generous and disinterested friends that science has had in this country,— the late William Thaw of Pittsburgh. By his own wish, no mention of his name was made in previous publications in connection with the results so greatly indebted to his aid. His recent death seems to remove the restriction imposed by such a rare disinterestedness.

— The proceedings of the International Marine Conference came to an end Dec. 31, 1889, and a final act has been issued showing for each division of the programme, and in the order of the divisions, the resolutions adopted. The delegations of the twenty-eight nations represented will now make their reports to their home governments, but none of the rules adopted will go into effect until approved and enforced by appropriate legislation. Relative to the great question of course-indicating sound-signals in foggy or thick weather, it was decided, after mature deliberation, that it is inexpedient to adopt any one of the various systems proposed. The various other questions before the conference, such as lights, sound-signals, distress-signals, regulations regarding the seaworthiness, draught, and designation of vessels, the saving of life and property from shipwreck, qualifications for officers and seamen, steamer-lanes, etc., were considered thoroughly, and the conclusions arrived at must command general attention and respect. It is of interest to note here that the carrying of white range-lights by steamers is favored, although not made obligatory; and steamer-lanes for transatlantic navigation are not adopted, although the various companies are urged to adopt regular routes for vessels of their own lines. The increased attention given to such subjects as the removal of dangerous derelicts and the use of oil to prevent heavy seas from breaking on board is of especial interest to the United States Hydrographic Office, in view of the efforts made to circulate information on these subjects by the "Pilot Chart."

— The International Horticultural Exhibition to be held in Berlin under royal and imperial auspices, from April 25 to May 5, will be characterized by two special features,— an exhibition of horticultural architecture, and one of horticultural models, apparatus, etc. It is requested that all exhibits or announcements of such should be promptly sent to the general secretary of the Society for the Promotion of Horticulture, Professor Dr. L. Wittmack, Invalidenstrasse 42, Berlin N., from whom all further information may be obtained. The exhibition will be held in the Royal Agricultural Exhibition Building, on the Lehrt Railway. The general organizer of the scientific department is Professor Dr. Pringsheim, and the following gentlemen have undertaken the management of special branches: for the geography of plants, Professor Dr. Ascherson; for physiology, Professor Dr. Frank; for seeds, Herr P. Hennings; for morphology, anatomy, and the history of development, Professor Dr. Kny; for fungi, Professor Dr. Magnus; for soils, Professor Dr. Orth; for history, literature, and miscellaneous, Dr. Schumann; for officinal and technical objects, Dr. Tschirch. The minister for agriculture, Dr. Freiherr v. Lucius-Balhausen, will be the honorary president of the exhibition. The city of Berlin has granted the sum of 15,000 marks towards its expenses, and a guaranty fund of 80,000 marks has been raised.

—The marine meteorological service in the Spanish West Indies was organized about a year ago, and was in active operation during the last hurricane season, as already stated on the "Pilot Chart." Its importance to the West Indies, Mexico, and the United States, as well as to the commerce of every nation navigating the Bay of North America, is so great that it is gratifying to learn that its establishment has been definitely approved by a recent royal order issued through the minister of marine, Madrid. It is in charge of a commander in the navy, assisted by two lieutenants, with headquarters in Havana, at the Comandancia General del Apostadero, and a number of secondary reporting stations at points along the coasts of Cuba and Porto Rico. Capt. Luis García y Carbonell, who has organized the service, has been designated as its director. The United States Hydrographic Office has already, upon several occasions, acknowledged valuable assistance from Capt. Carbonell, and it regards the establishment of this weather service upon a permanent and effective basis as of the greatest importance to the interests of commerce.

— The month of January was remarkable for the tempestuous weather that prevailed almost uninterruptedly over the transatlantic steamship routes. Storms succeeded each other in rapid succession, the majority of them having developed inland, and moved east-north-east, on very similar paths, from Nova Scotia and across southern Newfoundland. The most notable storm of the month was probably the one that developed in the St. Lawrence valley, and moved out to sea across the Straits of Belle Isle early on the 3d, when it was central about latitude 52° north, longitude 48° west. It then moved nearly due east, rapidly increasing in intensity, until reaching the 20th meridian, when it curved to the north-eastward, and was central on the 5th about latitude 55° north, longitude 17° west, and disappeared north of Scotland. The barometric pressure in this storm was remarkably low, the lowest corrected reading reported being 27.93, at 4 P.M., Jan. 4, about latitude 53° north, longitude 23° west. This was reported to the United States Hydrographic Office by Capt. Johnson, of the British steamship "Connemara," who further states that the storm was accompanied by winds of hurricane force, with terrific squalls, occasional hail, and mountainous seas.

— The January number of the *Kew Bulletin* contained an able and most interesting report, by Dr. Francis Oliver, on the so-called weather-plant. This plant is *Abrus precatorius*, Linn., a well-known tropical weed. Mr. Joseph F. Nowack claims to have discovered that its leaves have "the peculiar property of indicating by their position various changes in nature about forty-eight hours before the said changes occur." Numerous observations with hundreds of such plants have convinced him that "any given position of the leaves corresponds always to a certain condition of the weather forty-eight hours afterwards." Some time ago he devised an apparatus for the purpose of putting his supposed discovery to practical use. It consists of a "transparent vessel containing the weather-plant, closed on all sides, protected against injurious external influences, and adapted to be internally ventilated and maintained at a temperature of at least 18° Reaumur, these being the conditions under which, in temperate climates, Nowack's weather-plant answers the purpose of a weather-indicator." Last year Mr. Nowack was anxious that his apparatus should be scientifically tested at Kew, but it would not have been easy for any member of the staff of the Royal Gardens to find time for the necessary observations. The task was undertaken by Dr. Francis Oliver, who now presents the results of his investigation. The following, as we learn from *Nature*, is a summary of the conclusions at which he has arrived: "I contend that all the movements exhibited by the leaves of *Abrus precatorius* depend on causes not so far to seek as those suggested by Mr. Nowack. The ordinary movements of the leaflets, of rising and falling, are called forth in the main by changes in the intensity of the light. In a humid atmosphere they are more sluggish than in a relatively dry one. In other words, when the conditions are favorable for transpiration, the movements are most active. The position for snow and hail is connected intimately, in the cases that have come under my observation, with a spotting or biting (by insects) of the leaflets, and is not due to any other external factor. The position for fog and mist, and for electricity in the air, is probably due to the disturbance caused by varying light, the rhythmical movements of the leaflets being temporarily overthrown. The position indicating thunder and lightning I take to be pathological from its tendency to recur on the same leaves. Daily movements of the rachis constitute a periodic function in this as in many other plants with pinnate leaves. The regularity of these oscillations is considerably influenced by both light and temperature."

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CONTENTS:

THE PALEONTOLOGICAL EVIDENCE FOR THE TRANSMISSION OF ACQUIRED CHARACTERS.[1]

MUCH of the evidence brought forward in France and Germany in support of the transmission of acquired characters, which has been so ably criticised in Weismann's recent essays, is of a very different order from that forming the main position of the so-called Neo-Lamarckians in America. It is true that most American zoölogists, somewhat upon Semper's lines, have supported the theory of the direct action of environment, always assuming, however, the question of transmission. But Cope, the able if somewhat extreme advocate of these views, with Hyatt, Ryder, Brooks, Dall, and others, holding that "the survival of the fittest" is now amply demonstrated, submit that, in our present need of an explanation of the origin of the fittest, the principle of selection is inadequate, and have brought forward and discussed the evidence for the inherited modifications produced by re-actions in the organism itself; in other words, the indirect action of environment. The supposed arguments from pathology and mutilations have not been considered at all: these would involve the immediate inheritance of characters impressed upon the organism and not springing from internal re-actions, and thus differ, both in the element of time and in their essential principle, from the above. As the selection principle is allowed all that Darwin claimed for it in his later writings, this school stands for Lamarckism *plus* — not *versus* — Darwinism, as Lankester has recently put it. There is naturally a diversity of opinion as to how far each of these principles is operative, not that they conflict.

The following views are adopted from those held by Cope and others, so far as they conform to my own observations and apply to the class of variations which come within the range of paleontological evidence. In the life of the individual, adaptation is increased by local and general metatrophic changes, of necessity correlated, which take place most rapidly in the regions of least perfect adaptation, since here the re-actions are greatest. The main trend of variation is determined by the slow transmission, not of the full increase of adaptation, but of the disposition to adaptive atrophy or hypertrophy at certain points. The variations thus transmitted are accumulated by the selection of the individuals in which they are most marked, and by the extinction of inadaptive varieties or species. Selection is thus of the *ensemble* of new and modified characters. Finally, there is sufficient paleontological and morphological evidence that acquired characters, in the above limited sense, are transmitted.

In the present state of discussion, every thing turns upon the last proposition. While we freely admit that transmission has been generally assumed, a mass of direct evidence for this assumption has nevertheless been accumulating, chiefly in the field of paleontology. This has evidently not reached Professor Weismann, for no one could show a fairer controversial spirit, when he states repeatedly, "Not a single fact hitherto brought forward can be accepted as proof of the assumption." It is, of course, possible for a number of writers to fall together into a false line of reasoning from certain facts. It must, however, be pointed out that we are now deciding between two alternatives only; viz., pure selection, and selection *plus* transmission.

The distinctive feature of our rich paleontological evidence is that it covers the entire pedigree of variations: we are present not only at, but before birth, so to speak. Among many examples, I shall select here only a single illustration from the mammalian series, — the evolution of the molar teeth associated with the peculiar evolution of the feet in the horses. The feet, starting with plantigrade bear-like forms, present a continuous series of re-adjustments of the twenty-six original elements to digitigradism which furnish proof sufficient to the Lamarckian. But, as selectionists would explain this complex development and reduction by panmixia and the selection of favorable fortuitous correlations of elements already present, the teeth render us more direct service in this discussion, since they furnish not only the most intricate correlations and re-adjustments, but the complete history of the addition of a number of entirely new elements, — the rise of useful structures from their minute embryonic, apparently useless, condition, the most vulnerable point in the pure selection theory. Here are opportunities we have never enjoyed before in the study of the variation problem.

The first undoubted ancestor of the horse is *Hyracotherium*. Let us look back into the early history of its multicuspid upper molars, every step of which is now known. Upon the probability that mammalian teeth were developed from the reptilian type, Cope predicted in 1871 that the first accessory cusps would be found on the anterior and posterior slopes of a single cone; i.e., at the points of interference of an isognathous series in closing the jaws. Much later I showed that precisely this condition is filled in the unique molars of the Upper Triassic *Dromotherium*. These, with the main cusp, form the three elements of the tritubercular crown. Passing by several well-known stages, we reach one in which the heel of the lower molars intersects, and, by wearing, produces depressions in the transverse ridges of the upper molars. At these points are developed the intermediate tubercles which play so important a *rôle* in the history of the ungulate molars. So, without a doubt, every one of the five main component cusps superadded to the original cones is first prophesied by a point of extreme wear, replaced by a minute tubercle, and grows into a cusp. The most worn teeth, i.e., the first true molars, are those in which these processes take place most rapidly. We compare hundreds of specimens of related

[1] This article is an informal reply to the position taken by Professor Weismann in his essays upon heredity. I have borrowed freely from the materials of Cope, Ryder, and others, without thinking it necessary to give acknowledgment in each case. [Reprinted from Nature.]

species. Everywhere we find the same variations at the same stages, differing only in size, never in position. We extend the comparison to a widely separate phylum, and find the same pattern in a similar process of evolution. Excepting in two or three side-lines, the teeth of all the *Mammalia* have passed through closely parallel early stages of evolution, enabling us to formulate a law: The new main elements of the crown make their appearance at the first points of contact and chief points of wear of the teeth in preceding periods. Whatever may be true of spontaneous variations in other parts of the organism, these new cusps arise in the perfectly definite lines of growth. Now, upon the hypothesis that the modifications induced in the organism by use and disuse have no directive influence upon variations, all these instances of sequence must be considered coincidences. If there is no causal relationship, what other meaning can this sequence have? Even if useful new adjustments of elements already existing may arise independently of use, why should the origin of new elements conform to this law? Granting the possibility that the struggle for existence is so intense that a minute new cusp will be selected if it happens to arise at the right point, where are the non-selected new elements, the experimental failures of nature? We do not find them. Paleontology has, indeed, nothing to say upon individual selection, but chapters upon unsuccessful species and genera. Here is a practical confirmation of many of the most forcible theoretical objections which have been urged against the selection theory.

Now, after observing these principles operating in the teeth, look at the question enlarged by the evolution of parallel species of the horse series in America and Europe, and add to the development of the teeth what is observed in progress in the feet. Here is the problem of correlation in a stronger form even than that presented by Spencer and Romanes. To vary the mode of statement, what must be assumed in the strict application of the selection theory? (*a*) That variations in the lower molars correlated with coincident variations of reversed patterns in the upper molars, these with metamorphoses in the premolars and pocketing of the incisor enamel; (*b*) all new elements and forms, at first so minute as to be barely visible, immediately selected and accumulated; (*c*) in the same individuals, favorable variations in the proportions of the digits, involving re-adjustments in the entire limbs and skeleton, all coincident with those in the teeth; (*d*) finally, all the above new variations, correlations, and re-adjustments not found in the hereditary germ-plasm of one period, but arising fortuitously by the union of different strains, observed to occur simultaneously and to be selected at the same rate in the species of the Rocky Mountains, the Thames valley, and Switzerland. These assumptions, if any thing, are understated. Any one of them seems to introduce the element of the inconstant; whereas in the marvellous parallelism, even to minute teeth-markings and osteological characters, in all the widely distributed forms between *Hyracotherium* and *Equus*, the most striking feature is the constant. Viewed as a whole, this evolution is one of uniform and uninterrupted progression, taking place simultaneously in all the details of structure over great areas. So nearly does race adaptation seem to conform to the laws of progressive adaptation in the individual, that, endowing the teeth with the power of immediate re-active growth like that of the skeleton, we can conceive the transformation of a single individual from the eocene five-toed bunodont into the modern horse.

The special application of the Lamarckian theory to the evolution of the teeth is not without its difficulties, some of which have been pointed out to me by Mr. E. B. Poulton. To the objection that the teeth are formed before piercing the gum, and the wear produces a loss of tissue, it may be replied that it is not the growth, but the re-action which produces it, which is supposed to be transmitted. Again, this is said to prove too much. Why is the growth of these cusps not continuous? This may be met in several ways: first, in the organism itself these re-actions are least in the best adapted structures, a proposition which is more readily demonstrated in the feet than in the teeth (moreover, since the resulting growth never exceeds the uses of the individual, there is a natural limit to its transmission); second, the growth of the molars is limited by the nutritive supply (we observe one tooth or part growing at the expense of another); third, in some phyla we do observe growth which appears to lead to inadaptation, and is followed by extinction. In one instance we observe the recession of one cusp taking place *pari passu* with the development of the one opposed to it. These and many more general objections may be removed later; but they are of such force, that, even granting our own premises, we cannot now claim to offer a perfectly satisfactory explanation of all the facts.

The evidence in this field for, is still much stronger than that against, this theory. To sum up: the new variations in the skeleton and teeth of the fossil series are observed to have a definite direction; in seeking an explanation of this direction, we observe that it universally conforms to the re-actions produced in the individual by the laws of growth; we infer that these re-actions are transmitted. If the individual is the mere pendant of a chain (Galton), or upshoot from the continuous root of ancestral plasm (Weismann), we are left at present with no explanation of this well-observed definite direction. But how can this transmission take place? If, from the evident necessity of a working theory of heredity, the *onus probandi* falls upon the Lamarckian,— if it be demonstrated that this transmission does not take place,— then we are driven to the necessity of postulating some as yet unknown factor in evolution to explain these purposive or directive laws in variation, for, in this field at least, the old view of the random introduction and selection of new characters must be abandoned, not only upon theoretical grounds, but upon actual observation.

Reading between the lines of Weismann's deeply interesting essays, it is evident that he himself is coming to this conclusion.

HENRY FAIRFIELD OSBORN.

AMERICAN ARCHIVES IN SEVILLE.[1]

IF I could meet the historical students of the Johns Hopkins University or the members of the Maryland Historical Society, I am quite sure, that with the aid of a few photographs which I can find here, and with the aid of a few books to which, as a hurried traveller, I cannot here find access, their interest would be quickly excited in an account of the celebrated collection of papers pertaining to early American history which I have just visited for the second time. I am not so sure that by means of a letter I can convey the same impression; nevertheless I will try.

The Alcazar, which is to be compared with, if it does not equal, the Alhambra as a Moorish palace; the Giralda, a magnificent bell-tower, noble in size, proportions, and details, and famous as an observatory in the days of Moorish supremacy; and the Cathedral, which contains a few of the most celebrated works of Murillo,—form a group of buildings which has given renown to Seville, and has drawn the admiring gaze of architects and poets and historians from every part of the civilized world.

Under the shadow of these world-famous monuments are two edifices which, in comparison with the three greater structures, hardly arrest the notice of the sight-seeker, though they are buildings which would be noteworthy for their age and dignity in any American city. One of these contains the Columbian Library, founded by Fernando Columbus, son of the great discoverer; and the other contains original papers which pertain to the Spanish discoveries in the New World. It is of the second of these remarkable and world-famous collections that I now propose to write.

Casa Lonja is the name of the building in which are kept "The Archives of the Indias," the title by which Spain has designated from the earliest days until now the papers pertaining to her American discoveries and possessions. For a long period the authorities of this country refused to accept the name "America," and "only yielded to the majority," as a Spanish writer informs us, "when resistance was useless."

[1] Letter from President D. C. Gilman, in the Baltimore Sun of Dec. 31, 1889, written from Seville, Spain, under date of Dec. 12.

The Lonja was built nearly three hundred years ago, as a sort of merchants' exchange; and there is a trace of its original purpose in the apartments now occupied by the Chamber of Commerce. It is a massive, simple, quadrangular building, the sides of which may be two hundred feet long, and it encloses a beautiful court, in which stands a statue of Christopher Columbus. The stone of which it is partly built is of a dull-brown hue, but in other respects I was reminded of the Peabody Institute in Baltimore. There are two lofty stories, the upper one being devoted to the archives. Ascending a stately marble staircase, and passing the outer offices of the registers or secretaries, we entered a long gallery, which extends completely around three sides of the building, and must, therefore, be almost six hundred feet in length. It is not interrupted by partitions, is lofty, light, free from dust, and in excellent order.

Around the walls are cases open to the eye, in which are thousands upon thousands of packages containing original letters and reports from every part of the globe. Each package is carefully tied up, and it bears a conspicuous label, stating the district to which the papers belong and the dates to which they relate. They are separated in fourteen principal departments, corresponding with the fourteen *audiencias* into which the exterior possessions of Spain have been divided. Not yet placed upon the shelves, but stacked in the centre of the gallery, were a multitude of packages lately received from Havana.

To the casual visitor all this is impressive because of its voluminous extent. If he has any antiquarian taste, his appetite is whetted to know what these packages contain, and whether there are any papers of historical interest that have still escaped the keen eye of historical scholars. But the curiosity of the passing visitor is gratified, as it is in the British Museum, and as it is in the Lenox Library of New York, by the display under glass of some of the most interesting autographs and documents belonging to the collection. Here are papers bearing the signatures of Ferdinand and Isabella, Philip le Bel, Joanna or Crazy Jane, Charles V., and Philip II.; but to me the papers sent to these sovereigns from the New World by the great navigators and conquerors were of far more interest than royal autographs. Hanging upon the walls were portraits of many famous discoverers, doubtless authentic likenesses, though not original pictures. We seemed to be brought into the presence of these great men as we looked upon their faces and saw the lines which their pens had traced.

The newspapers of this week are filled with the splendid achievements of Stanley, whose arrival at Zanzibar is just reported, and with expressions of pity for Emin Bey, who has met with such an accident after escaping the dangers of the Mahdi, imprisonment, sickness, battle, and fatigue. These stories of the exploration of Africa are a fresh commentary on the privations and perils encountered when America was "the dark continent." In parallel columns we are reading of the exile of Dom Pedro II. and of the substitution of a republican for a monarchical government in the great territory of Brazil, last of all the countries in Spanish America to renounce the authority of a king. How obvious it is that the "archives" of to-day are books and newspapers. The telegraph in a moment reports from the lands beyond the seas events which three or four hundred years ago would not have been made known for months and years.

Here, for example, is one of the first letters which attracted our attention, from Fernando Cortez to Charles V., dated May 15, 1522, and complaining that he has had no answer to the despatches he had sent during the three years he has been in New Spain. He announces that he has discovered the South Sea, the coast of which is inhabited, and that he has begun to build ships. He begs the King to listen to the messengers whom he sends, assuring him that this business is far more important than all that pertains to the rest of the Indies. Contrast this delay in the exchange of correspondence with the telegrams which have been passed within the last week between Stanley and the King of the Belgians and the Emperor of Germany.

Another letter which interested me particularly was that of Juan Ponce de Leon, dated Feb. 10, 1521, announcing the discovery of *la isla florida*, and expressing his intention to go again and find out whether this is really an island or a part of the mainland of Velasquez.

Here was a letter from Francisco Pizarro, dated at Cuzco in 1535, in the handwriting of a secretary, who attaches the signature of the conqueror. Pizarro makes his mark on the right and left of the signature, as Spaniards now are wonted to subscribe a flourish or dash of the pen to their signatures.

I paused with special attention before the portrait of Fr. Bartol. de las Casas, in his clerical garb, and read his letter to Charles V., explaining to the Emperor, that, in addition to saving many souls, he might obtain the best income in the world from the rich lands beyond the seas if he would only adopt the measures which Las Casas proposed.

Here, too, we saw an autograph of Amerigo Vespucci, another of Bernal Diaz, one of Magellan, one of Balboa, one of Velasquez. There was also displayed in one of the cases the treaty (June 5, 1494) between Ferdinand and Isabella and the King of Portugal with regard to their respective possessions in the seas. We were also shown the bull of May 3, 1493, delivered by Pope Alexander VI.

The autograph of Christopher Columbus is not here to be seen. In the Columbian Library, near by, are some of his books, with annotations in his own handwriting, — books that have often been mentioned by the travellers who have seen them. Before leaving Baltimore, I read with great interest the account of this library given by Mr. S. Teackle Wallis in his recollections of Spain, and I will not attempt to redescribe that which he described so well. Indeed, his books ought to be reprinted, and made accessible to a new generation of readers, for they are just as good now as when they were written. Can copies be found in the New Mercantile Library or in the Hopkins Historical Rooms? If not, let some one give his copies, to be made accessible to the public.

The consul of the United States, Mr. Caldwell, introduced us to the chief of the archives, Ilmo. Sr. D. Carlos Jimenez-Placer; and this distinguished gentleman accompanied us through the halls and answered all our inquiries in the most obliging way; and, although our knowledge of Spanish was not much better than his knowledge of English, we were able through an intelligent interpreter to obtain a great deal of information.

It appears that the collection of these historical papers at Seville is due to one of the most enlightened of the modern kings of Spain, Charles III., who in 1781 issued a decree establishing in the Casa Lonja *el real archivo de Indias*. Most of the Spanish archives are still at Samancas, north of Madrid, including, doubtless, many of those which have been so serviceable to Mr. S. R. Gardiner in the preparation of his admirable history of England in the reigns of James I. and Charles I., to Froude and other recent historians.

I asked the head of the archives, Sig. D. Jimenez-Placer, whether a young man from the Johns Hopkins University, properly accredited and having a definite historical purpose, might be allowed to prosecute his inquiries in the Indian archives. He replied that such authority could only be given in Madrid, and that application should be made to the ministry of foreign affairs, properly, of course, through the American minister. In the two visits which I made to the archives I saw no signs of an investigator. I also asked for an authentic account of the archives, printed in Spanish or any other language; but I could learn of nothing more satisfactory than that which is given in the local histories and guides to Seville.

In one of the book-stores I found a copy of the "Cartas de Indias," published at Madrid in 1877 by the minister of Fomento, — a magnificent quarto volume, containing facsimiles of two letters of Columbus, and of many other imporant papers, illustrated with notes and essays. I looked upon the book with the envious eye of a librarian and the economical eye of a college president; but whether I shall buy it for the university or not, to-morrow will decide.

BOOK-REVIEWS.

De la Suggestion et du Somnambulisme dans leurs Rapports avec la Jurisprudence et la Médecine Legàle. Par JULES LIEGOIS. Paris. 8°.

PROFESSOR LIEGOIS has in this volume presented a work destined to take an authoritative place in the modern study of hypnotism. He approaches the subject from an aspect not yet worthily represented. He is a professor in the law faculty at Nancy, and, together with Bernheim, Beaunis, and Liebault, has contributed to the position and the fame of the school of Nancy. In the present volume he brings together the result of some five years' study and observation. Though interested primarily in the legal aspects of hypnotism, and entitling the volume according to this interest, the author takes a very wide view of the subject; so that, in addition to its special purpose, the volume forms a serviceable manual of the views of the Nancy school of hypnotism.

We have first an historical survey of the phenomena beginning with Mesmer, in which special attention is paid to those who first presented the importance of suggestion as an explanation of the phenomena, and thus in some sense were predecessors of the school of Nancy. Following upon this is a chapter describing the methods of hypnotization and the various kinds and degrees of the effects produced. We come then to the real core of the subject, suggestion and its many variations. The author forcibly defends, and illustrates with an abundance of examples and *pièces justicatives*, the point of view of the school of Nancy, holding that suggestion, conscious or unconscious, is the clew to the explanation of all the phenomena, and assigning to the physical manipulations, etc., the *rôle* of re-enforcements of suggestion. The main body of the work is devoted to the description of all those phenomena of hypnotism likely to be concerned in criminal abuses, for which this state of automatism and unconsciousness offers facilities; and, as almost the entire range of phenomena can be so abused, the result is a rather large work.

The first class of crimes noticed are those against the person hypnotized. To make this possible, it is necessary that the subject shall be entirely insensible, and again, that, upon awakening, the subject retain no memory of what has been done. The former is conclusively shown by the many tests of pricking with pins; applying electrical shocks, irritating substances, etc., employed to show the genuineness of the phenomena; and, in addition, by the many cases in which this insensibility is utilized for performing surgical operations. A very complete account of these is given, showing how easily and how variedly this power may be abused, and no clew remain of the perpetrator of the crime The forgetting of what has happened in hypnosis is the normal case in all but the lightest stages, and, especially if re-enforced by a direct suggestion that no trace shall remain in the memory, becomes a most serious factor in the legal aspects of hypnotism. The normal life of the individual is broken into by these hypnotic states, until at length we have almost a dual personality; the normal self knowing nothing of the hypnotic *ego*, and the latter forming successive though not continuous experiences of its own.

A second important class of crimes is inherent in the susceptibility of the subject. The automatism of the hypnotic state, placing the subject so largely at the mercy of the operator, opens out possibilities of abuse limited only by the variety of suggestions. The subject's signature may be obtained to documents of great money value; he may be induced to declare himself the perpetrator of a crime really committed by another; he may be made to accuse an innocent third party of a crime, and perhaps declare himself a witness of the fact; he may be made to commit a theft, a forgery, while hypnotized; and so on. These complications are made the more probable and the more perplexing by the existence of post-hypnotic and of retro-active hallucinations. It has been shown that almost any suggestion acted out by the subject while hypnotized may also be performed while in his normal waking condition, in obedience to a suggestion given a shorter or longer time previously in the hypnosis. Here, then, would be a person committing a crime with a full consciousness of his surroundings, perhaps accepting the responsibility of his actions, and yet really the tool of another, irresistibly guided by a hidden hand. To show that these cases are more than fictitious, Professor Liegois devised several experiments in which subjects were made to shoot a designated individual with a paper pistol, offer him a drink of water which was believed by the subject to be poison, and the like. The retro-active hallucinations take place when the subject accepts the suggestion that a certain event has formed a part of his experience; that he has done or seen a certain thing, while in fact, though the event may be a real one, he has had no part in it. The easily impressed subject absorbs the pseudo-event into his mental possessions, may perhaps add corroborating details of his own, fixing the time, place, and circumstances. Every imaginable variety of falsification of testimony is thus made possible. This susceptibility has been observed, too, in the ordinary waking state without any hypnotization whatever, though usually only with persons subject to hypnotization. The state would then be similar to that slightly morbid condition in which fact and fiction are intermingled and an imaginative person believes his own fabrications, except that the latter are impressed upon him from without. Children are particularly liable to this weakness. The case of the boy Moritz, in the famous Tisza-Eslar affair, accusing his own father of a heinous crime, is doubtless to be accounted for in this way; and Professor Liegois cites several cases in which, in less enlightened ages, persons have been tortured and executed on the strength of evidence very probably the result of suggestion upon a susceptible temperament.

Having thus outlined the field of criminal suggestion, the author reviews a few cases of actual legal proceedings in which he feels confident that hypnotism has played a part. In some trials an abnormal condition was suspected, in others not. They are mostly, however, of no recent date, and will not command the interest attendant upon cases now occurring, in which the possibilities of hypnotism are fully understood. It is to the discussion of the methods of placing the responsibility in cases that may arise, that Professor Liegois devotes the final chapters of his volume. In the cases where the subject is the victim of a crime, it will usually be known whether he or she has been accustomed to be hypnotized, and by whom; in other words, the case would present the same difficulties as the detection of guilt in an assault in which the victim is rendered helpless by physical means. In cases in which the hypnotized subject commits a crime, the hypnotizer alone is responsible; and the proof of acting while in an irresponsible condition will clear the alleged criminal, as in a plea of insanity. If the crime is committed post-hypnotically, the proof would be more difficult, though in both cases it would have to be shown that the defendant can be hypnotized to a degree of forgetting all that happens in the hypnotic state. The right of a court to hypnotize a person in order to ascertain what has occurred in a former hypnosis (but which remains totally forgotten in the normal state) the author seems to regard as a dangerous precedent. The main point, however, is to discover the author of a suggestion, when the latter has taken the precaution to suggest to his subject complete amnesia of himself, and a full acceptance of the deed as his or her own. This difficulty Professor Liegois thinks he has solved by a series of ingenious tests. It is quite true, that, under the conditions described, the subject will be unable to name the author of a suggestion; but if, for example, she be told that as soon as the author of the suggestion enters the room she will go to sleep or do any designated act, she will do as desired, and thus reveal the real criminal. No matter how carefully the hypnotizer may have trained his subject, the possibilities of indirectly inducing the subject to reveal the hypnotizer are so many and various that some means of detection must be available. The subject, then, while irresponsive to a direct question or appeal, will respond to a suggestion indirectly giving the desired information, provided this does not conflict with a contrary suggestion previously imposed; and the safeguard of society lies in the endless possibilities of these indirect suggestions.

Such, then, are the main points in the legal aspects of hypnotism. It will readily be understood that much of their interest

attaches to the details which the original alone can supply. To guide the reader most directly to the points of greatest interest, the author prints an exhaustive summary at the opening of each chapter. In all respects the work shows most careful preparation, and deserves the place it will doubtless find upon the shelves of all following the interesting developments of the science of hypnotism.

AMONG THE PUBLISHERS.

NUMBERS 20 and 21 of the *Modern Science Essayist* (Boston, J. H. West) contain respectively "Primitive Man," by Z. Sidney Sampson, and "The Growth of the Marriage Relation," by C. Staniland Wake.

— The Worthington Company have recently published Swinburne's "Study of Ben Jonson."

— Rand, McNally, & Co. announce for next week an unabridged edition of the journal of Marie Bashkirtseff.

— The Welch, Fracker Company have nearly ready "In Western Levant," also a new edition of "On the Wing Through Europe," two volumes of travel sketches by Francis C. Sessions, president of the Ohio Archæological and Historical Society.

— Henry Holt & Co. will publish shortly the third and concluding volume of Fyffe's "History of Modern Europe." The new volume treats of the years 1848–78, and covers the period of European politics which led up to the Franco-Prussian war.

— D. Lothrop Company have just published "The Catholic Man," a study of the character that is developed by the many phases of our modern life, by Mrs. Lawrence Turnbull; also "Stories of New France," episodes of Canadian history, written by Miss A. M. Machar and Thomas G. Marquis.

— G. P. Putnam's Sons have ready in the Questions of the Day Series "Railway Secrecy and Trusts," by John M. Bonham; and a new edition in paper covers of Edward Bellamy's "Six to One," first published in 1878.

— The result of Prang's national flower campaign is 70 per cent of all votes for golden-rod; 16 per cent of all votes for Mayflower; 14 per cent scattering for daisy, mountain laurel, dandelion, sunflower, and others.

— Mr. Walter J. Clutterbuck, one of the authors of "Three in Norway," has written an account of a voyage in the waters between Iceland, Greenland, and Spitzbergen, a region hitherto neglected. "The Skipper in Arctic Seas" will be published here at once by Longmans, Green, & Co.

— D. Appleton & Co. publish this week a little book by Dr. F. H. Rankin, on "Hygiene for Childhood," giving suggestions for the care of children after the period of infancy to the completion of puberty; and a volume entitled "Evolution of Man and Christianity," by the Rev. Howard McQueary.

— The J. B. Lippincott Company have published "The Conquest of Mexico," in the new library edition of Prescott's works; a revised edition of Dr. Agnew's work on "The Principles and Practice of Surgery;" an elementary work on plane and spherical trigonometry, by Professor E. S. Crawley of the University of Pennsylvania; and a guide to Philadelphia and its surroundings.

— Macmillan & Co. have nearly ready Sir Charles Dilke's "Problems of Greater Britain," which English critics rank in importance with Bryce's "American Commonwealth." It is one of the most exhaustive accounts yet attempted of the British Empire, and written by a statesman of the first rank. It gives but passing attention to the United States, and chiefly for purposes of comparison with Canada; but about one-half of the first volume deals with North America, and the whole subject has interest for every American.

— It is announced by Messrs. Charles Scribner's Sons that they have acquired from Mr. Henry M. Stanley all the American rights for his personal narrative of the expedition for the relief of Emin Pacha. Prior to the appearance of the complete work, *Scribner's Magazine* will publish an article upon his last journey by Mr. Stanley. Readers may have noticed that Mr. Herbert Ward, who was one of Stanley's officers, makes no mention of the expedition in the article recounting his experiences upon the Kongo, which appears in *Scribner's* for February, the fact being that Mr. Stanley has reserved the sole right to describe this most remarkable of all his African undertakings.

— Ginn & Co. announce to be published in April "The Best Elizabethan Plays," edited with an introduction by William R. Thayer. The selection comprises "The Jew of Malta," by Marlowe; "The Alchemist," by Ben Jonson; "Philaster," by Beaumont and Fletcher; "The Two Noble Kinsmen," by Fletcher and Shakspeare; and "The Duchess of Malfy," by Webster. It thus furnishes not only the best specimen of the dramatic works of each of the five Elizabethan poets who rank next to Shakspeare, but also a general view of the development of the English drama from its rise in Marlowe to its last strong expression in Webster. This volume appeals to the general reader who wishes to get, in small compass, the best products of the Elizabethan drama (exclusive of Shakspeare), and also to the students in academies or colleges who are studying this most important period of English literature. It is a work equally well adapted to the library and to the classroom.

— Funk & Wagnalls of New York announce the following books now in preparation and soon to be ready: "Wendell Phillips, the Agitator," by Carlos Martyn, to which we have referred already; "The Economics of Prohibition," by Rev. J. C. Fernald, which is an attempt to apply the principles of political economy to the subject of the liquor traffic, showing the advantage that national prohibition would secure; and "A Cyclopedia of Temperance and Prohibition," which is to be a large work, treating every relevant topic, from the most elementary to the most advanced phase of the liquor question. It will give many brief sketches of eminent temperance workers; the latest action of the various religious denominations; the liquor status of all countries of the world; the different temperance organizations; the political parties; facts and figures relating to all kinds of intoxicants, all branches of the liquor traffic, and all kinds of attempted remedies.

— The Appalachian Mountain Club of Boston has happily utilized an opportunity afforded it by the completion of the topographical survey of Massachusetts by the United States Geological Survey in compiling a contoured map of the region about Boston from parts or the whole of half a dozen sheets of the survey. The map is in the shape of a rectangle, about thirty by twenty miles, with Boston at the right centre, extending west beyond Concord, and including the Blue Hills on the south, and Marblehead on the north, — a land area of about five hundred square miles. The presence of the harbor, with its varied islands and broken outline, renders the effect of the map a specially pleasing one. For the study of the topography and geology of the district, as well as for walks, rides, and drives, and for all the special purposes of the club, the map is invaluable. The scale is a mile to an inch, and the details of reproduction precisely those of the survey. The idea may well be copied by our other large cities; and the club is certainly to be congratulated upon its promptitude, since some of the sheets included in the map have not yet been issued by the survey.

—A praiseworthy movement is about to be set on foot by *The Ladies' Home Journal* of Philadelphia. It proposes to give to any young girl of sixteen years or over, who will send to it between now and Jan. 1, 1891, the largest number of yearly subscribers to the journal, a complete education at Vassar College, or any other American college she may select. The education offered includes every branch of study, with every expense paid, the journal agreeing to educate the girl irrespective of the time required or the expense involved. To this is also pinned a second offer, which guarantees to any girl of ixteen or over, who will secure a thousand yearly subscribers before Jan. 1, a full term of one year at Vassar or any other preferred college, with all expenses paid, thus making it possible for any number of young girls to receive free educations at the best colleges.

— The old-fashioned *Home Journal* has abandoned the unwieldy "blanket sheet," and appeared last week in the more convenient size of the modern eight-page paper; but there is no change in the tone and general style of the paper, which was established by George P. Morris and N. P. Willis nearly fifty years ago.

— A symposium on "Constructive Freethought" was begun in the New York *Truth Seeker* of Feb. 8, and will be continued through the two succeeding numbers. Among the contributors are R. G. Ingersoll, T. B. Wakeman, R. B. Westbrook (president of the American Secular Union), Parker Pillsbury, and many others.

— The next volume of the series of "Historic Towns," edited by Mr. E. H. Freeman and Mr. Hunt, will be "Winchester," by Mr. G. W. Kitchin, the Dean of Winchester, who declares that the place teems with picturesque tradition and anecdote, and thinks it the most historic of English cities. The book will be published immediately by the Longmans.

— Among the principal articles in *Belford's Magazine* for February are one by Adele M. Garrigues on the University of Michigan, one by W. A. Phillips on "The New English Invasion," and one by John McGovern on the new auditorium in Chicago. "The State and the Citizen" and "The Case of Brazil" are treated editorially.

— The remarkable weeping spruce, *Picea Breweriana*, which was discovered in the Siskiyou Mountains in 1884, is figured in *Garden and Forest* for the past week, and Professor Goodale gives an interesting study of heather in North America. Garden art in public parks is treated editorially, and there is the usual variety of matter prepared by experts in different branches of horticulture.

— On Jan. 1, 1890, was issued the first number of a monthly magazine of popular natural history for Scotland. It is intended to make it a chronicle of the work done by the different natural history societies in Scotland; and reports of their meetings, excursions, etc., as well as the more important papers read before them, will receive special attention. All communications regarding it should be addressed to the editors, care of the publisher, Mr. W. B. Robinson, 194 Sauchiehall Street and 105 New City Road, Glasgow, Scotland.

— Marion Harland has taken up the work of restoring the ruined monument marking the burial-place of Mary, the mother of Washington. The publishers of *The Home-Maker*, of which Marion Harland is the editor, offer, as their contribution to the good cause, seventy-five cents out of every annual subscription of two dollars to the magazine sent in during the next six months. Every such subscription must be accompanied by the words, "for Mary Washington monument."

— D. Lothrop Company have just ready "Eggs: Facts and Fancies about Them," a book brimful of information about eggs, though not a cook-book, compiled by Miss Anna Barrows

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Supposed Aboriginal Fish-Weirs in Naaman's Creek, near Claymont, Del.

INCORRECT and exaggerated accounts of the aboriginal remains discovered in Naaman's Creek, near its mouth, having appeared in various scientific and other journals, by which the public have been led to believe that remains of a people akin to the lake-dwellers of Europe were found in alluvial deposits at the place referred to, let me here state that the pile-dwelling theory is all bosh, and any such statements were made without my knowledge or consent. My friend, Professor Haynes of Boston, when he wrote his article on the prehistoric archæology of North America for the "Narrative and Critical History of North America," unfortunately copied the atrociously garbled version of my letter published in the *American Antiquarian* of November, 1887, from which the false impressions referred to have arisen. In the letter which I sent to the editor of the *Antiquarian*, I never made use of the term "river-dwelling sites," nor did I suggest that the wooden stakes "once supported shelters of early man that were erected a few feet above the water." I distinctly stated that I coincided with the fisherman in his suggestion about the spot having been a fishing-place of the Indians; and luckily this portion of my account has been published correctly, as by reference to p. 364 of that magazine, for November, 1887, will more fully appear.

When I heard that Professor Haynes was preparing an account of my work carried on for the Peabody Museum, Harvard University, I wrote him a letter, calling attention to the fact that I deemed the wooden piles or stakes to be fish-weirs, enclosing him at the same time a typical collection from three spots in the creek's bed that had been found fruitful, and for the sake of convenience designated, at Professor Putnam's suggestion, stations A, B, and C, so that each implement dredged up (by hand) could be located on my note-book and working plan. For some inexplicable reason, Professor Haynes seems to have been more impressed with the *American Antiquarian's* version of the affair than my own statements, adopting as his own my suggestions of the fish-weir theory, which but re-echoes that of the fisherman who discovered the wooden stake-ends. I also requested in this letter that the proof-sheets relating to my work for the Peabody Museum be forwarded for correction; but in Professor Haynes's reply to me he states, that as the publishers wanted his manuscript immediately, a portion of it being already in press, this would be impossible. I make these remarks with no intention of attacking the statements of Professor Haynes, for whom I have the most sincere regard. I simply desire to show that he has been misled by following the *American Antiquarian's* version of the find, and suggest that I should have been consulted as to the correctness of the details given, especially in so important a work as the "Narrative and Critical History of America." Any one who will take the trouble to read p. 364 of the *American Antiquarian* will also see not only the errors that I have already corrected, but others still more ridiculous, where, after my return from France, I am quoted as again having visited "the flats in the cave at Naaman's Creek." What connection there is between a cave and the mud flats around the mouth of Naaman's Creek, I am at a loss to understand. It is evident that such statements as these are the result of either gross carelessness on the part of the editor of the *American Antiquarian*, or else may be referred to his printer.

My object in stating in my letter to the *Antiquarian* that during my visit to Europe I saw wooden specimens in archæological collections from the Swiss lake-dwellings was because the dressing of these pile structures with stone implements recalled those I had remarked upon the ends of wooden posts or stakes in the bed of Naaman's Creek, near its mouth (not "on the Delaware marshes," as erroneously set forth in the *American Antiquarian*). This reference to a similarity of the stone axe dressings on the wooden piles used by the lake-dwellers of Europe to those of the wooden stake-ends found in alluvial deposits at Naaman's Creek, in my opinion, has occasioned all those glowing accounts which have lately been published by enthusiastic collectors, and journalists, in regard to "Remains of an Indian City at the Mouth of Naaman's Creek," "Lake Dwellings and Villages in America," "Indian Huts in the Naaman's Creek Marshes," etc.,—most glorious accounts, indeed, in which "Keller's Lake Dwellers of Europe" has been largely drawn upon, and even added to. Let me now make another attempt to give a correct version of the work carried on at Naaman's Creek for the Peabody Museum, loath as I am to spoil the romantic ideas that have emanated from certain enthusiasts in regard to them. I shall simply here repeat a copy of my letter sent to the *American Antiquarian* several years ago (Oct. 20, 1887), allowing the readers of *Science*, and others interested in the subject, to compare this correct statement with the incorrect version already referred to.

"In 1870 a fisherman living in the village of Marcus Hook, Pennsylvania, gave me some spear and arrow heads chipped from a dense argillite, as well as other rude implements of a prehistoric people which he had found on the edge of some extensive mud flats that border Naaman's Creek, a small tributary of the Delaware River. The finder stated that while cat-fishing among the reeds and spatter docks he had noticed here and there the ends of logs or stakes protruding from the mud; that they seemed to be placed in rows (to use his own words, 'they stuck out just above the mud, were as rotten as punk, and he could see no reason why they'd been placed there by white folks; more than likely the Indians in old times usem 'em to hitch their canoes to when spearing fish, and that was the reason the darts, axes, and such like, were found around there'). A visit to the place made a few days afterward, in company with this simple-minded old fisherman, disclosed the ends of much decayed ends of stakes, or wooden structures, protruding here and there above the mud, just as he had stated, confirming what I had before heard in regard to the wooden structures from a pot-hunter, or professional reed-bird gunner, who encountered them while poling his skiff off the marsh into the creek after the water had fallen somewhat on the ebb tide. At that time (1870) I coincided in the fisherman's views about the spot having been a fishing-place of the Indians, as the finds of argillite implements seemed only to exist in the neighborhood of the wooden structures or stake-ends. More mature deliberation, based upon hand-dredging and excavation, made since my first visit (1870), only serves to confirm my opinion that they were fish-weirs.

"Professional duties did not permit me at this time (1870) to give the matter serious attention, and it was not until my return from France in 1880, whither I had gone to pursue studies at the Ecole des Beaux Arts and Ecole d'Anthropologie, that I again visited the spot on the edge of the mud flat at Naaman's Creek (the north-east side of the mud flat referred to forms a part of the banks of the creek, near its mouth), where the finds had been made. While abroad I studied, in spare moments, many archæological collections, especially those from the Swiss lakes, and visited various prehistoric stations of Switzerland. The rude dressings of the pile-ends were in some cases evidently made with sharp stone implements, recalling the cuts I had seen on the wooden stake-ends in northern Delaware. Since 1880 I have quietly examined the spot, excavating the few wooden ends that remained, preserving several that did not fall to pieces. Careful notes were made of the dredgings and excavations. These operations were carried on at low tide. The work was conducted principally by myself, aided at times by interested friends. The results, so far (1877), seem to indicate that the ends of piles embedded in the mud, judging from the implements and other *débris* scattered around them, had once served as supports to structures intended for fish-weirs, these in all probability projecting a few feet above the water, and were no doubt interlaced with wattles, or vines, to more readily bar the passage of

fish from the creek into the river. The upper portion of these wooden structures has entirely disappeared in the long lapse of time that has ensued since they were placed there. The edge of the flats on which the stakes stood[1] was covered with about two and a half to three feet of water on the flood tide. At slack water it forms a low mud-bank slanting toward the creek. Three different stations[2] were located, probably all that exist, in the bed of the creek referred to. This opinion is based upon careful examinations, made within the past four years, of nearly every inch of ground in the neighborhood of the wooden stake-ends, by dredging in sections between certain points marked upon the creek's bank. The implements found in one of the stations are generally made of argillite, with a few of quartz and quartzite. Some were very rude in character, and not unlike the palæoliths found by Dr. C. C. Abbott in the Trenton gravels.[3] Objects of stone and pottery rather better in finish than those at station A have been found at the two other stations, B and C."

The remainder of my letter of November, 1887, is correct: the other portions must be read subject to the changes that this repetition may suggest, which have been copied from a duplicate letter made by me before sending it (in October, 1889) [1887? —ED.] to the journal referred to, for publication.

A unique collection from the supposed aboriginal fish-weir sites is now at the Peabody Museum, Harvard University, where any one interested in the subject may examine them. Most of the objects presented were collected by myself and friends, whose names are attached to their specimens. Work was abandoned on the locality two years ago, careful hand-dredging having exhausted the relic-beds. Last summer the steam-dredge used in deepening the creek's bed, so that sloops might approach the brick-yard standing on its bank, uprooted the various stations, A, B, and C, completely obliterating them. A few specimens of interest were, however, secured by some of the workmen in the brick-manufactory and myself. Some of these specimens have been presented to the Peabody Museum, with letters from the donors in regard to them.

[1] These had the alluvium excavated from around them, and were photographed in place, before removal.

[2] The term "station" was adopted at Professor Putnam's suggestion, because certain spots in the creek's bed, several feet apart, were found to yield implements.

[3] It may be well to remark, that, since this letter has been published in the *American Antiquarian*, implements of like kind have been found in the bowlder clay at the brick-yard alongside of Naaman's Creek mouth. The implements that were brought up by the hand-dredge at station A may therefore have been washed out of the brick and bowlder clay desosits, and scattered among the alluvial deposits in which the wooden stakes were found.

I hope this letter, giving a brief *résumé* of the finds at Naaman's Creek mouth, will cause all absurd romance in regard to pile-dwellers on the Delaware to cease. If they ever did exist, I have certainly failed to find any traces of such a people, and never upheld any such nonsensical theories. HILBORNE T. CRESSON.

Philadelphia, Feb. 6.

Oscillations of Lakes (Seiches).

THE ten-minute wave that Mr. Ledyard reports on Cazenovia Lake, N.Y., in *Science* of Feb. 7, is apparently an oscillation of the same kind as those known in Switzerland by the name of *seiches*. They have been minutely studied for Lake Geneva by Professor Forel of Morges, Switzerland, who has written many reports on his observations for the *Archives des Sciences*, about 1877–80. He regards them as wave-like oscillations, commonly uninodal, of the whole body of water in the lake, produced by external disturbance, such as an earthquake, or a change of atmospheric pressure like that occurring in thunder-storms or wind gusts. He finds that the full period of oscillation for the uninodal wave is $2l \div \sqrt{gh}$, in which l is the length of the lake, and h the depth; that is, the velocity of the wave is proportional to the square root of the depth. Sometimes the *seiche* is transverse, or from side to side, instead of longitudinal or from end to end. In Lake Geneva the longitudinal *seiche* has a full period of 73 minutes, which, for the length of 73.2 kilometres, indicates a mean depth of 114 metres. The transverse *seiche* oscillates in 10 minutes and 17 seconds, where the breadth of the lake is 13.8 kilometres, indicating a mean depth of 205 metres. These depths agree well with the results of soundings. Similar phenomena have been described for other Swiss lakes.

Very little has been said about *seiches* in this country. Professor John LeConte has called attention to the probability of their occurrence in Lake Tahoe, and predicted their periods by Forel's formula as 18 and 13 minutes (*Overland Monthly*, 1883). *Science* (May 7, 1886, p. 412) has a note on the *seiches* of Lake Ontario, as observed by Rhodes at Oswego, N.Y., indicating a period of about an hour. The lakes of central New York, near Mr. Ledyard, afford the best possible opportunity for examination in this regard. A simple self-recording apparatus to determine the oscillations of water-level could be driven by an ordinary clock; and a month's record from the end and the middle side of a lake would probably suffice to determine its *seiches* with fair accuracy. W. M. DAVIS.

Harvard College, Feb. 10.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Feb. 4. — Washington Matthews, Gentes of the Navajos; John G. Bourke, Gentes of the Apaches.

Biological Society, Washington.

Feb. 8 — Frank Baker, An Undescribed Muscle from the Infraclavicular Region of Man; C. D. Walcott, A New Genus and Species of Ostracod Crustacean from the Lower Cambrian; Cooper Curtice, The Moultings of the Cattle Tick; Lester F. Ward, The Flowers that bloom in the Winter-Time.

American Academy of Arts and Sciences, Boston.

Feb. 12. — Henry W. Williams, On Reconstruction of Languages.

Engineers' Club, St. Louis.

Feb. 5.—Mr. George W. Dudley read a paper on "Tests of Water-Works Engines." He explained the meaning and origin of the term "duty." He explained in detail the precautions necessary to be taken in making duty tests, in order that the results might be of value. He submitted reports in detail of two tests of compound condensing duplex direct-acting pumping-engines,—one of 3,000,000 gallons capacity per twenty-four hours, giving a duty of about 62,500,000 foot-pounds per hundred pounds of coal; the other of 5,000,000 gallons capacity, giving a duty of about 75,000,000. In the discussion, Mr. Bryan called attention to a simple rule for comparing the efficiency of pumping-engines with ordinary steam-engines, the evaporation in pounds of water per horse-power per hour being equivalent to the constant 1,980, divided by the duty expressed in millions of foot-pounds, based upon ten to one evaporation. He called attention to remarkable results that were being guaranteed by makers of compound and triple-expansion condensing-engines now being built for electic-light purposes.

Professor Johnson stated, that, if due allowance were made for engine friction, he thought the results would not be so unfavorable to pumping-engines as shown by Mr. Bryan. Professor Gale stated that pumping-engines were subject to certain losses, due to friction, for which they were given no credit. This being allowed for, the efficiency would be increased. He also showed that the cost of high-duty engines was an important item, as the increased interest and depreciation accounts might overbalance the saving. He also showed that pumping-engines were usually put in of greater capacity than required, so that they were operated under a disadvantage. Mr. Holman called attention to the relative importance of duty as compared with other items of expense in pumping water. In St. Louis the coal bill was less than half of the total cost, the items of labor and repairs being of almost equal importance. He also expressed great doubt as to the reliability of the tests of the old Cornish pumping-engines, which were usually held up as standards.

The secretary then read for Mr. J. H. Kinealy a paper entitled "Some Mathematics on Ventilation." The author tested the commonly accepted rules of practice by mathematical deduction, with the result of showing the practice to be well founded. In the discussion Professor Gale stated that the intention of the author was to investigate what difference, if any, must be made in the provision for ventilation between a room occupied only temporarily and the same room occupied continuously.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn

I wish to exchange or purchase well-fixed or hardened vertebrate embryos for sectioning. Desire specially reptilian embryos, but will be glad to secure any material that I do not possess. Thomas G. Lee, M.D., Histological Laboratory, Yale University, New Haven, Conn.

Wanted—Books and journals, American or n relating to Photography—exchange or purchase. C. W. Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

I wish to purchase Vol. 7 of the *American Chemical Journal*, either bound or unbound. State price. Address, Wm. L. Dudley, Vanderbilt University, Nashville, Tenn

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmola patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes.etc.,wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred.—James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.—D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write.— J. M. Keck, Chardon, Ohio.

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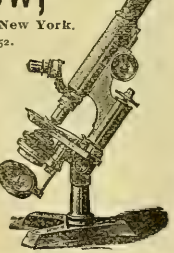

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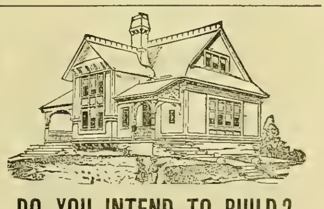

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THE steam-engine shown in the accompanying illustrations is of a novel and ingenious design. The aim of the builders has been to produce a valveless compound engine, and that they have succeeded admirably in designing and building such a machine is admitted by all whose experience with steam-engines enables them to judge.

through the cylinder casting, it is evident that the omission of the valves has not led to troublesome complications in other directions.

In the illustrations, Fig. 1 is a vertical longitudinal section through the engine, Fig. 2 is a vertical cross-section through the same, Fig. 3 is a horizontal cross-section through the live-steam ports, and Fig. 4 is a horizontal cross-section through the expansion parts.

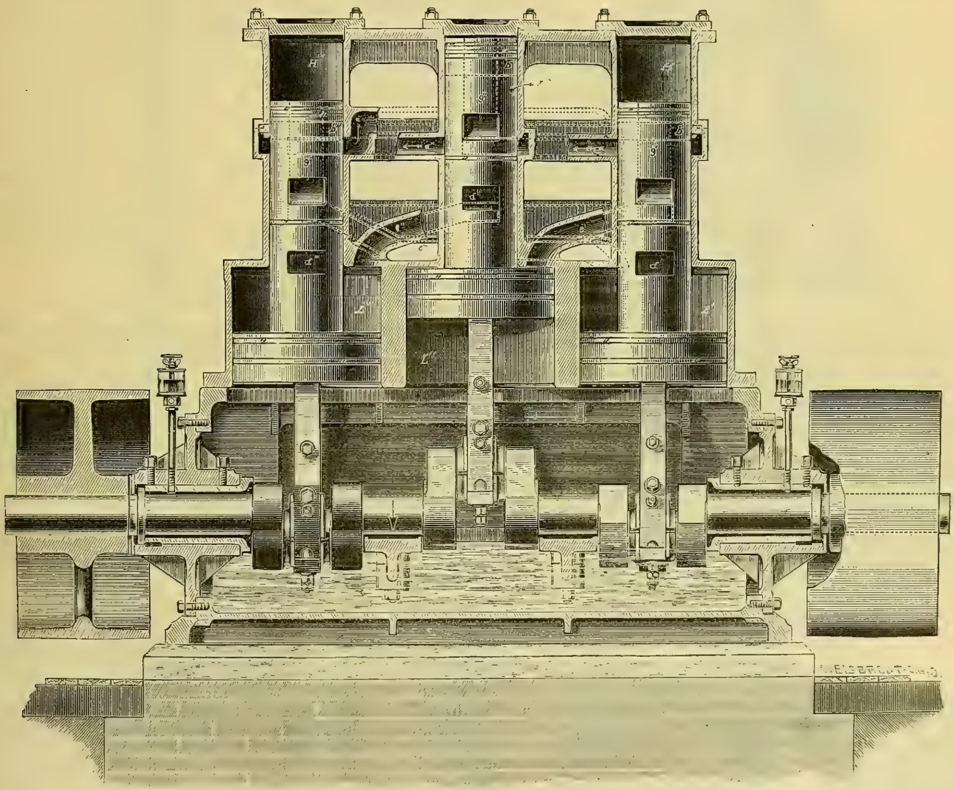

FIG. 1.—TRIUMPH COMPOUND VALVELESS STEAM-ENGINE.

The engine shown, which is built by the Triumph Compound Engine Company of Cincinnati, has three high and three low pressure cylinders, each with single-acting pistons. Each high-pressure piston controls the steam-supply to its own cylinder and that of one of the low-pressure cylinders. The exhaust is also controlled in the same manner; so that the high-pressure pistons do double duty, acting as pistons and as valves. As the latter office is performed by means of passages through the piston-heads and

H' H'' H''' are high-pressure and L' L'' L''' are low-pressure cylinders, and the pistons acting in each will be referred to by the same letters. The pistons are connected directly to the shaft by connecting-rods without the intervention of piston-rods; and the cranks are set at an angle of 120 degrees with each other, in which position all the moving parts are perfectly balanced.

Pistons H'' and L'' are shown on the upper centre, pistons H' and L' being 120 degrees in advance, and pistons H''' and L''' 120

degrees in the rear. In this position, live steam is admitted from the main steam-pipe a (Fig. 3), thence through ports b', pipe a', and port g'', to cylinder H''; and at the same instant steam which has

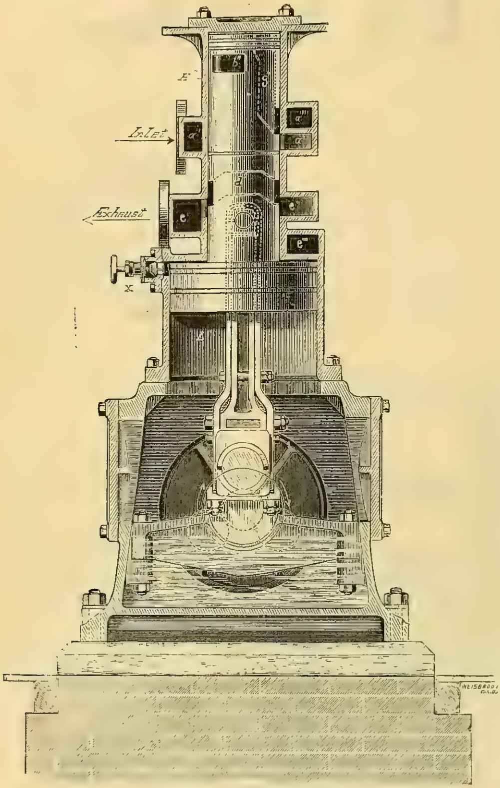

FIG. 2.

been partly expanded in cylinder H passes down through port g' (Figs. 1 and 3) and pipe e', to cylinder L'', thus admitting live and low-pressure steam on one set of pistons at the same moment. Under the action of the steam, pistons H'' and L'' move downward, live steam being admitted until the upper edge of port g'' (Fig. 1) passes the lower edge of pipe a', at which point it is cut off, and expands in this cylinder until the lower edge of port g'' passes the upper edge of pipe e'', at which point it passes to cylinder L'''. At the same moment live steam passes from a through port b' (Fig. 3), pipe a'', and port g''' (Figs. 1 and 3), to cylinder H'''. At this point also, piston H', moving upward, closes the connection between cylinders H' and L'', and the steam expands in L'' for the remainder of the stroke. As piston L'' reaches the lower centre, port d' (Fig. 1) comes opposite pipe e', and the exhaust steam passes through this connection into pipe e (Fig. 4), which communicates with the atmosphere or condenser. When piston H' reaches the upper centre, live steam passes from a (Fig. 3) through port b''', pipe a''', and port g', to cylinder H', and the partly expanded steam passes from cylinder H''' down through port g''' (Fig. 1) and pipe e''' to cylinder L'. Cylinder L''' exhausts through pipe e'' and port d'' into e, and cylinder L' through pipe e''' and port d''' into e.

The valve X (Fig. 2) is merely a live-steam connection with the low-pressure cylinders for heating up and starting. Thus, with the exception of the cut-off, each set of pistons controls the steam in the cylinder next preceding, in the order of rotation, and, when acting as a valve, is at or near its maximum speed; while the pistons in the preceding cylinders are at or near their slowest speed. This simple expedient controls the steam in this engine in a manner unexcelled by any valve device.

All lubrication is automatic, consisting of a sight-feed lubricator on the steam-pipe, a drop-sight-feed cup on each end-bearing of the shaft, and a mixture of oil and water in the crank-case, perfectly lubricating all parts within. The cylinders are cast in one piece, and bored at the same time on a tool especially designed for the purpose, by which means they are made absolutely parallel, and the danger of leaky joints is avoided. The bearings for the shaft are bored out after being bolted in place, insuring perfect alignment; and all wearing surfaces are exceptionally large, so that internal friction is reduced to a minimum. The only adjustments consist of two keys in the connecting-rods, which take up all the wear in both boxes. The pressure being always downwards, these adjustments are seldom necessary; and the engine, it is claimed, will run indefinitely without stoppage, and with but little attendance.

THE TENSILE STRENGTH OF SHEET ZINC.

So little has been published about the strength of zinc, that any contribution to this question must be welcome. The most careful tests which Professor Martens made on some zinc sheets supplied by the Schlesische Actien-Gesellschaft für Bergbau und Zinkhüttenbetrieb at Lipine, in Silesia, on behalf of these works, hence, deserve all the more attention. These tests, according to *Engineering* of Jan. 31, were carried out at the Royal Technical Testing Station at Berlin, of the mechanical department of which Professor Martens is chief, and are described in the official reports of that institution, 1889, IV.

The reputation of zinc as a structural material is not particularly good, and these tests do not tend to show that the metal deserves a better name for constancy and reliability of its mechanical properties. A great many tests had to be made to arrive at fair averages. The test samples were five sheets, supplied by the Silesia mills of the above works, two specimens from foreign works; and finally eleven sheets rolled before Professor Martens

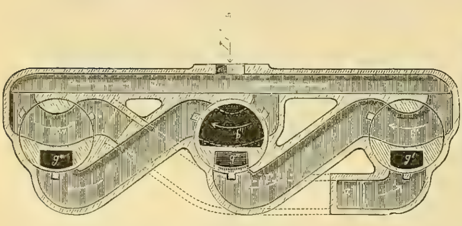

FIG. 3.

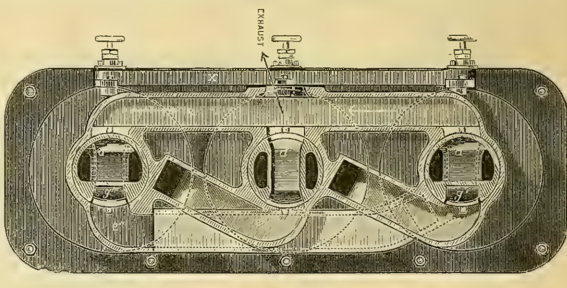

FIG. 4.

out of bar plates of 1 foot width. Three of these latter were rolled out to two, three, and four times their length, to thicknesses of 6.1, 5.4, and 3.1 millimetres: the other eight were rolled in bundles, first in one direction, then at right angles to 1 per cent of lead and .02 of one per cent of iron; the two foreign plates showed traces of antimony; no other metals were observed.

The first series of tests was made with a horizontal Rudeloff

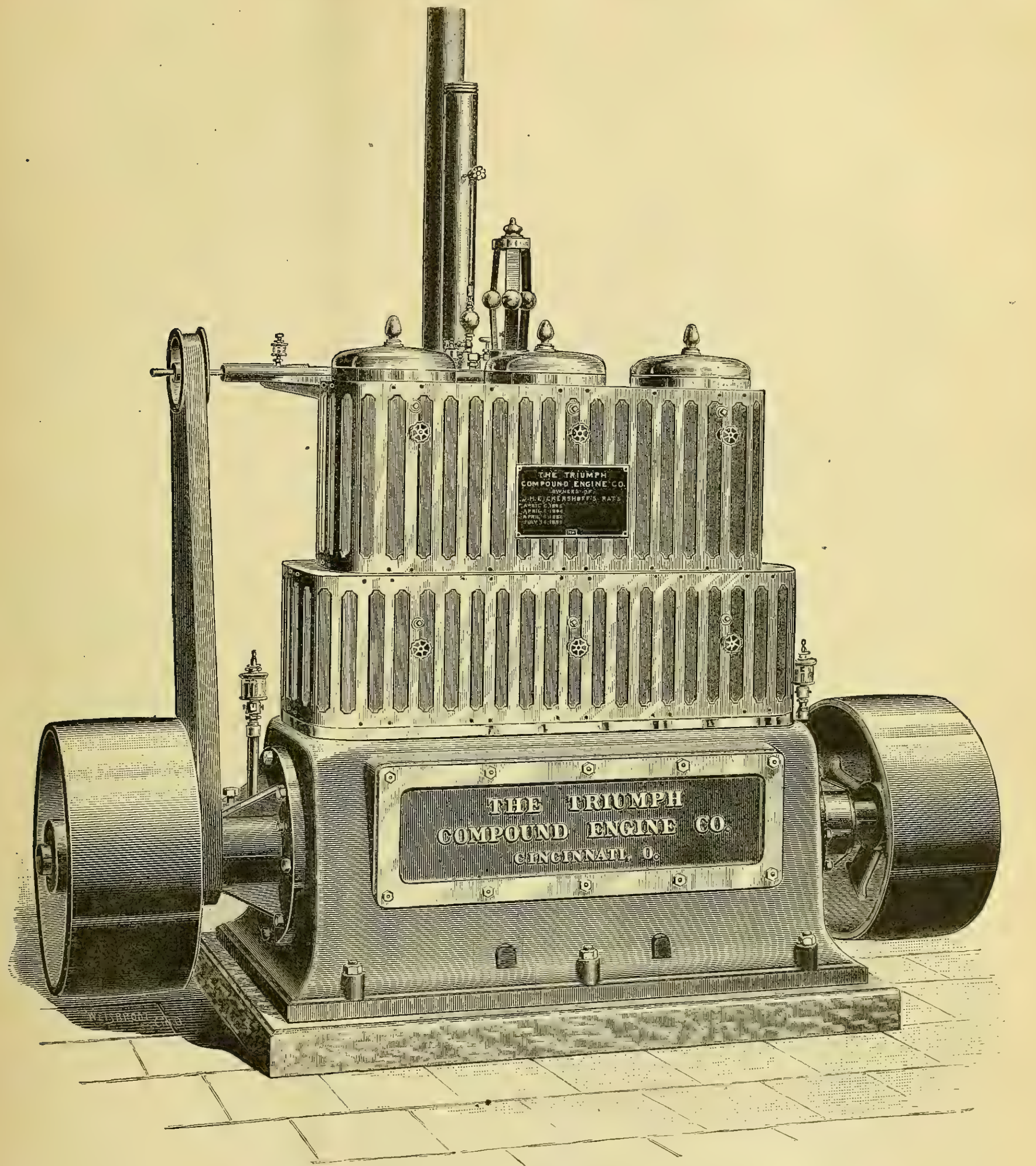

FIG. 5.—TRIUMPH COMPOUND VALVELESS STEAM-ENGINE.

this direction, test-pieces being cut out each time when the length had increased by 500 millimetres. The final plate varied in length from 1,210 to 4,710 millimetres, and in thickness from 1.1 millimetres to .6 of a millimetre. The chemical analyses of the various plates agreed very closely: they all contained about testing-machine with scale-pan, screw, and nut-feed; the prismatic test-pieces, 20 millimetres (.8 of an inch) in width, being fixed in caps, and tightened there by means of wedges. The pieces frequently broke close to this clamp; and it was found that the length of the wedge, and the distribution of the pressure, were

of considerable importance. The wedges should press out the mouth of the clamp slightly, but more and more towards the back. Direct application of the loads proved quite unsuited, as zinc is highly influenced by the rapidity of the changes. Professor Martens, therefore, resorted to a testing-machine of his own design, three different modifications of which were employed. As indicators for these apparatus, a circular vessel filled with mercury was employed, from the side of which a vertical tube branched off. The cover of this vessel was formed by a strong central plate supporting a weight surrounded by a ring of german-silver. The strain imparted to the test-piece was partly taken up by the weight, the mercury column effecting the balance. This arrangement, which resembles others employed for similar purposes, did not answer; it was, moreover, not self-recording. The mercury-tube was therefore replaced by a horizontal cylinder with a piston-rod ended in another piston moving in a second cylinder with a slide-valve, which was actuated by an electric device comprising electro-magnets and relays. The common piston-rod carried a pointer recording on a paper drum. A third device, also electrical, but worked by gravity instead of water-pressure, was employed for the highest loads up to 50,000 kilograms. These three arrangements labored under the disadvantage that the cover of the mercury vessel retained an amount of mobility sufficient to affect the accuracy of exact measurements. Professor Martens hence returned to an often-employed arrangement, utilizing the elasticity of a spring of an elastic steel rod. The idea is, that the variations of the rod are marked directly (and without being magnified by multiplying levers or other devices whose accuracy Mr. Martens altogether questions) by means of a little conical diamond point on glass plates of the size for microscopic slides, fixed on a platform moved by means of a micrometer-screw and adjusting-spring, in a direction at right angles to that of the axis of the rod. Two of the resulting curves would occupy a space of not more than a square millimetre. The plates were examined and measured in a large Zeiss microscope provided with micrometers for both object and ocular glasses In this form, the recording device has been constructed by Mr. Boehme. It is, however, intended to leave the platform at rest, and to register the movements in the direction of both the abscissæ and the ordinate.

The chief objects of the tests were to ascertain the elasticities at ordinary temperatures and at 80°, 120°, 150°, 170°, and 200° C. (between 176° and 392° F.), and to ascertain the influences of different modes of rolling and of time-effects The latter are striking. One can hardly speak of the elasticity of rolled zinc, as even under very small strains the permanent expansion varies with each change of load. There was always a noticeable after-stretching. When cold, the breaking strength was 23 per cent larger, the breaking extension 22 per cent smaller, and the "fulness degree" (i.e., the ratio of the area comprised by the curve to the rectangle formed by the greatest extension multiplied by the greatest force) neither larger nor smaller, in a direction at right angles to the rolling, than in that of the rolling. The two samples supplied by other works showed, however, opposite characteristics, and one test-piece particularly deviated in a manner probably to be accounted for by some peculiar treatment during manufacture, the chemical composition seeming to afford no explanation. Rising temperatures modified the results. The breaking strength increased considerably in thinner sheets; that is, in such as have undergone greater and more continued pressure in the rolls. It rose from 11 kilograms per square millimetre for 6-millimetre plates, to 19 kilograms for plates .48 of a millimetre thick. The English equivalents of these values are 17.5 and 30 tons per square inch respectively for plates of .24 and .019 of an inch in thickness. The breaking extension decreases first, and increases rapidly afterwards. For the temperature tests, the pieces were heated in a linseed-oil bath. The results confirm the well-known and important fact, first established by Silvester and Hobson of Sheffield, that zinc should be worked, rolled, stamped, turned, etc., at 300° F., and that any higher temperature should carefully be avoided. On the whole, the tests demonstrate clearly that ordinarily tensile strength tests are not alone sufficient, and should be combined with folding and bending tests.

METEOROLOGICAL OBSERVATIONS ON PIKE'S PEAK.

SINCE the Boyden fund of the Harvard College Observatory was established for the purpose of obtaining astronomical observations at some station of great elevation above the level of the sea, an inquiry into the meteorological character of such stations seemed desirable before undertaking the proposed work. It was known that a long series of meteorological observations at the highest station ever permanently occupied for such a purpose had been made by the United States Signal Service on the summit of Pike's Peak, in Colorado. It was accordingly proposed to the chief signal officer of the United States Army, Gen. A. W. Greely, that these observations should be printed at the expense of the Boyden fund, in the "Annals of Harvard College Observatory;" and his courteous co-operation has enabled this plan to be carried out, as shown in Vol. XXII. of the "Annals" of the observatory, just published.

The summit of Pike's Peak, Colorado, is situated in latitude 38° 50′ north, longitude 105° 2′ west, and has a height of 14,134 feet above sea-level, as determined by spirit-level from Colorado Springs. It is the highest meteorological station in the world; Leh, Ladakh, being 11,503 feet, and the Sonnblick, Austria, 10,154 feet. The station on the summit of Pike's Peak was established in October, 1873, and the first telegraphic report sent on Nov. 6 of that year. The telegraph line was frequently interrupted, and for long periods, until November, 1882, when it was virtually abandoned, owing to the great cost and the difficulty of its maintenance. Observations, however, were continued until September, 1888.

During the first few weeks the observations were more or less interrupted, and it has been deemed best to commence the publication from Jan. 1, 1874, at which date the station was in complete working order.

Pike's Peak rises very abruptly from the eastward, being about 8,000 feet above Colorado Springs, which is within ten miles or so from the summit. The open plain extending to the eastward affords unusual advantages for noting such cloud and storm phenomena as originate or move to the eastward of the mountain; and even the peaks to the westward are enough lower to permit observation of storm and cloud conditions below the level of the observer on Pike's Peak.

Perhaps the most notable fact resulting from a cursory examination of the meteorological elements is the remarkable resemblance between the recurring annual phases of atmospheric pressure and the temperature of the air. The curves of these elements not only are alike in having a single bend, but the maximum phase of both occurs in July, and the minimum in January. Not only are these elements coincident in their extreme phases, but the annual march is the same; so that the two curves are not only parallel, but almost coincident. When examined mathematically, it will be seen that not only are the plus and minus changes from month to month the same for both elements, but they bear a close, definite, and apparently dependent relation to each other, the mean monthly pressure rising or falling about .016 of an inch for each change of one degree Fahrenheit in the monthly mean temperature.

A similar relation between the mean monthly pressure and mean temperature obtains on the summit of Mount Washington, New Hampshire (elevation 6,279 feet above the level of the sea); but the barometer and temperature curves for the year at this last-named station are not as regular as on the summit of Pike's Peak. On Mount Washington, while the extremes of monthly mean temperature fall likewise in January and July, yet the maximum monthly pressure shows a tendency to prolong itself into August, and the minimum pressure to continue throughout January, February, and March. The relation on Mount Washington of monthly changes of pressure to like changes of mean temperature differs slightly from that of Pike's Peak, being about .012 of an inch rise or fall for each degree Fahrenheit.

The actual atmospheric pressure at Rocky Mountain stations above 4,000 feet elevation attains its minimum in January and its maximum in July or August; and the barometric phases

are of the same sign, with reference to the annual mean, as the temperature phases at such stations. This phase of barometric pressure, which is the reverse of that in the parts of the United States of low elevation, results from the lower average temperature of the winter months contracting the great body of air, so that much of it is brought below the summit of the mountain, while in summer reverse conditions obtain.

The mean temperature of Pike's Peak is 19.3°, with a range in the annual mean temperature of 4°, dependent on the mean of 17.9° for 1880 and 21.9° for 1879. The highest temperature observed was 64°, July 19, 1879; and the lowest, — 39°, Dec. 21, 1887. As might be expected, the range at Mount Washington is considerably greater. The mean temperature at this latter station is 26.1°, with a range in the annual mean temperature of 4.5°, — from 23.5° for 1875, to 28° for 1878. On Mount Washington the highest temperature recorded was 74°, Aug. 9, 1872; and the lowest, — 50°, Jan. 22, 1885.

The daily range of temperature on the summit of Pike's Peak, as determined from ten years' observations with self-registering instruments, shows that the maximum range occurs in July and September (14.3° and 14.2° respectively), with the minimum of 11.6° in December. The greatest range likewise occurs at adjacent stations on lower level in the summer or early fall, as shown by ten years' record at Denver, Col., with the greatest ranges (27.9°) in September and (27.2°) in July; and at West Las Animas, Col., — record of five years, — (32.7°) in October. At Denver the minimum range occurs in February (23.5°), and at West Las Animas in May (29.5°).

It thus appears that the mean daily range on the summit of Pike's Peak is only about one-half of that which obtains on the low plateau country to the eastward. The mean daily range at Mount Washington differs materially from that of Pike's Peak, it having its maximum (18°) in January, whence it decreases quite regularly to July (10.6°), and then rises gradually to the winter maximum. The mean range — from ten years' observations — on Mount Washington is 13.8°, being only slightly less than that at Portland, Me. (15.4°), and at Burlington, Vt. (16.5°).

The precipitation of Pike's Peak exhibits peculiarities in its distribution throughout the year, the amount rising from a primary minimum in February to a secondary maximum in April. A very decided secondary minimum occurs in June, followed immediately in July by the primary maximum. The amount of precipitation in the summer (35 per cent) is substantially the same as that in the spring (33 per cent), the remainder being very equally distributed throughout the autumnal and winter months. The June minimum appears very remarkable, but its authenticity seems assured in view of the fact that at Colorado Springs, at the base of the mountain, and at Denver, nearly 80 miles to the northward, similar rainfall conditions obtain. At Denver the May rainfall is 18 per cent; the June rainfall, 9.5 per cent; July, 11; against 15, 12, and 24 per cent respectively at Colorado Springs, and 13, 6, and 15 per cent on Pike's Peak.

The mean wind-velocity throughout the year is graphically represented by a curve with one bend or inflection; the decrease in velocity being, as a rule, very gradual, from 26.6 miles in January, to 12.5 in July and 12.3 in August. The curve of the mean wind-velocity is substantially opposite in its phase to the curve of the mean temperature; that is to say, the highest mean monthly velocity occurs with the lowest mean monthly temperature, and the least mean velocity with the highest mean temperature. It is interesting to note that the same general rule holds true as bearing on the relations between the mean hourly temperature of the day and the mean wind-velocity. The average hourly velocity of the wind for the entire period decreases gradually from a mean of 23.2 miles per hour between 2, 3, and 4 A.M., to 17.5 miles between 11 A.M. and 12 noon. It is also noted that the minimum hourly wind-velocity for every month in the year occurs between 11 A.M. and 12 noon; but the distribution of the hours of maximum mean wind-velocity is somewhat irregular throughout the different months of the year, varying from between midnight and 1 A.M. to the hours of 4 and 5 A.M. Doubtless, were means of hourly temperatures available, it would appear that the highest temperature occurs quite regularly at noon, while the lowest temperature occurs more irregularly between midnight and sunrise. In July the maximum hourly velocity is 15.5 miles against a minimum of 9; but in January the range of the mean hourly velocities is very materially reduced, the range being from 28 from midnight to 1 A.M., to 25.4 from 11 A.M. to 12 noon.

Unfortunately, the direction of the wind was not automatically recorded, but the prevailing directions are obvious from the observations made thrice each day. It appears from these observations that 31 per cent of the wind comes from the south-west, 20 per cent from the west, 21 from the north-west, 10 from the north, 8 from the north-east, and 5 from the south; while 2 per cent pertains in each case to the east, south-east, and calms. The direction of the wind changes but slightly through the different months of the year; the records showing that the maximum per cent comes from the south-west from March to October inclusive, but during the winter months the direction changes slightly, and the winds from the west prevail from November to February inclusive, with the north-west winds and the south-west winds of slightly less frequency by 1 or 2 per cent.

On Mount Washington, however, from nine years' observations, 54 per cent of the wind comes from the north-west, 12 per cent from the west, and 8 per cent each from the south-west and north.

The observations for two years at Colorado Springs, at the base of the mountain, show, as might be expected, very different wind conditions. From the situation of this station, it might be inferred that the winds would blow from the north or north-west, or from the south and south-east, which is the case; the order of frequency being as follows: north, 27 per cent; south-east, 22 per cent; north-west, 15 per cent; south, 10 per cent. The influence of topographical features upon the wind is also clearly shown by the direction at Denver, where 28 per cent of the wind comes from the south, and 14 per cent from the north.

Severe and prolonged wind-storms are unusual on Pike's Peak, and the days are comparatively infrequent when the mean hourly velocity equals or exceeds fifty miles per hour. The most remarkable wind-storms were those of Sept. 28–29, 1878, when the mean velocity for twenty-four hours was 71 miles, and Dec. 25, 1883, when the mean velocity was 70 miles per hour. The highest extreme velocity recorded at Pike's Peak was comparatively low, being 112 miles, May 11, 1881.

Velocities exceeding these have been frequently noticed at exposed points on the Pacific and Atlantic coasts. Mount Washington not only has higher winds than the summit of Pike's Peak for short periods, but also for days or months. On Feb. 27, 1886, the mean hourly velocity on the summit of Mount Washington was 111 miles for the entire day, and in January, 1878, the extraordinary velocity of 186 miles per hour was recorded. The maximum monthly movement at Pike's Peak was 28,691, in January, 1887; at Mount Washington, 36,515 miles for January, 1885, a mean hourly velocity throughout the month of 49 miles, followed closely by a mean of 48 miles for February, 1883.

The mean annual cloudiness on Pike's Peak is 40 per cent, ranging from 33 per cent in November, to 74 per cent in July. The tendency is to an excess of cloudiness during the late spring and the late summer, with the least amounts from September to January inclusive. On Mount Washington the cloudiness is much greater, averaging 57 per cent for the year. The range at this latter station is also higher, varying from 52 per cent in September, to 61 per cent in March. The distribution throughout the year on Mount Washington appears to be accidental, with possibly a slight tendency to less cloudiness during the months of high temperature.

Pike's Peak is celebrated for its electrical storms. Many

interesting details of these are given in the observer's journals. The storms only occur when the air is moist; the most favorable condition is during the time a light, soft snow is falling. When the hands are held up, sparks emanate from the tips of the fingers. At such times, with considerable wind, the anemometer-cups look like a circle of fire. Each flake of snow, as it alights on a mule's or burro's back, gives a spark like a fire-bug. The station was once struck by lightning. The electricity came down the anemometer-rod, following along the wire running to the battery. Every place the wire crossed a nail, the head of the nail was fused, and the wire melted at the same point.

In addition to the regular meteorological observations on the summit of Pike's Peak which appear in the "Annals," other special observations have been made.

HEALTH MATTERS.

Contagious Pneumonia.

Dr. F. Mosler, in a paper read before the Greifswald Medical Society, gives details of a series of cases of acute pneumonia in a family where there seemed every reason for believing that contagion was the cause of the spread of the disease. The patients, says the *Lancet* of Jan. 25, 1890, were all attacked during the last fortnight of January, 1889; the first to fall ill being the father, who died on Jan. 22, the fifth day of his illness. On this day his wife was attacked, and she too succumbed on the fifth day of the disease. While she was ill, her son, who constantly visited his parents during their illness, himself was attacked on the 26th. He was thirty years of age, strong and temperate, but succumbed on the twelfth day of the attack. Further, his sister, who had come from Arendsee, near Stralsund, to be with her sick parents, and who staid in their house from Jan. 22 to Jan. 26, was attacked at Arendsee on Jan. 29, and was admitted into the Greifswald Hospital. She alone recovered.

Dr. Mosler points out that the parents' house was dry, the two rooms they inhabited were well ventilated and clean, and that there had been no illnesses in the house within the past five years. He thinks the father must have acquired his pneumonia outside, and that the disease was communicated in turn to the members of his family by contagion through the sputa. In the case of the son, a *post-mortem* examination showed that the form of pneumonia was not the typical one: it was more lobular, was accompanied by a hemorrhagic pleurisy and by swelling of the spleen. Moreover, an examination by Professor Grawitz of some of the fluid withdrawn from the lung of the daughter during the height of the disease resulted in the discovery of bacilli resembling those of rabbit septicæmia, but neither the pneumono-bacillus of Friedländer nor the pneumono-coccus of Fränkel was found. In the case of the son, the blood from the heart yielded a similar micro-organism. Dr. Mosler thinks that such facts, as well as the peculiarities of the morbid anatomy of the latter case, suggest the occurrence of a special form of pulmonary inflammation, owning a cause different from that of the ordinary form. He sees in such cases a reason for believing that many varieties of poison may give rise to pneumonia. But the main lesson from the cases is that of contagiousness, and the need for the careful disposal and disinfection of the sputa, which he believes to have been the infective medium in these cases. He refers to recent contributions of Finkler and Cantani on infectivity of pneumonia, the latter recording some striking instances where the disease was more of the lobular than the lobar type.

Mouth-Breathing and the Teeth. — Dr. Scanes Spicer read a paper at the last meeting of the Odontological Society of London, upon "Nasal Obstruction and Mouth-Breathing as Factors in the Etiology of Disorders of the Teeth." In the course of his remarks, as we learn from the *Lancet* of Jan. 8, he said he had been struck with the frequency with which carious teeth were associated with obstruction of the pharynx and enlarged tonsils; so much so, that he had made it a routine practice to examine the teeth in all cases of nasal obstruction, and he believed that there existed a relation between them; and he further is of opinion that there is a generic relation between some cases of vaulted arch, narrow jaws, and irregular teeth, and nasal obstruction. Normally we should breathe through the nose, so as to warm and filter the air respired. All animals, savage races, and young infants do so; but a large number of adults of civilized nations breathe through the mouth, because they have some obstruction of the nasal passages, — erectile tumors, permanent catarrhal affections, polypi, post-nasal adenoid growths, etc. Mouth-breathing, he said, as a predisposing cause of caries of the teeth, came into action in various ways. The teeth were exposed to a current of air of a much lower temperature than that of the body, which would tend to cause inflammation of the periosteum and pulp of a tooth; the cold, dry air produced congestion of the mucous membrane, with a secretion of stringy acid mucus; and the rapid evaporation of water which takes place when the mouth is constantly open inspissated this mucus, which so formed a fertile soil for the development of micro-organisms. Again: when sleeping with the mouth open, the tongue falls back, and the parotid secretion finds its way directly through the pharynx instead of bathing and washing the teeth. With reference to the so-called V-shaped maxilla, Dr. Spicer thought that many cases might be traced to mouth-breathing, the muscles of the cheek pressing unduly upon the soft alveoli when the mouth is open.

Scratching the Back for Intermittent Fever.—Dr. Alois Fénykövy communicates to a Vienna medical journal an account of some observations made on the treatment of intermittent fever by means of friction of the back along the spine. Many years ago, as stated in the *Lancet*, while at Nisch with his regiment, there occurred so many cases of intermittent fever that the stock of quinine was becoming exhausted, and, in order that the patients might not be entirely without some sort of treatment, it was ordered that they should be rubbed twice a day along the spine with simple ointment. The day after this order had been given it appeared that the usual attack had not come on. Accordingly since that time Dr. Fénykövy has very frequently employed this treatment, and usually with marked success. Indeed, he says that three-fourths of his cases have done very well without any quinine at all.

NOTES AND NEWS.

The English Royal Meteorological Society have arranged to hold at 25 Great George Street, Westminster, on March 18 to 21 next, an exhibition of instruments and photographs illustrating the application of photography to meteorology.

— Herr Trautweiler thinks that a railway should go to the top of the Jungfrau, and in the *Schweizerische Bauzeitung* gives a brief account of his scheme. The railway would go from the valley below to the summit, and would be almost entirely under ground. There would be several intermediate stations, from which convenient, well-arranged tunnels would lead to points on the mountain whence the best views are to be had. If stormy weather came on, the passengers could withdraw into the shelter of those tunnels. The railway would be lighted by electricity.

— The Thomson-Houston Electric Company of Boston are building several large electric motors, or electric locomotives, for a street-railway company in that city. Each locomotive will be powerful enough to draw a train of cars.

— The Russian Government, it is stated, has announced its intention to begin operations soon on the great railway across Siberia. Work will begin at Vladivostok and at the present eastern terminus of the Russian railway system at the same time. The total length of the line is to be 4,375 miles.

— The Jull snow-excavator, illustrated and described in these columns some months ago, received several severe tests during the recent snow blockades on Western railroads. On Feb. 3 it opened up a blockade on a road between Pendleton, Ore., and

Walla Walla, Wash., where the snow was from ten to fifteen feet deep, and solidly compacted by rain and thaws. The track was cleared in a few hours.

— In the current number of the *Journal of the Anthropological Institute* there is a valuable paper, by Dr. Arthur Thomson, on the Veddahs of Ceylon. Discussing the affinities of the Veddahs, he says there appears to be little doubt, that, if they be not of the same stock as the so-called aborigines of southern India, they at least present very strong points of resemblance as regards stature, proportions of limbs, cranial capacity, and form of skull. The similarities of hair and color between these races, according to *Nature*, have often been remarked; so that, on the whole, if physical features alone be taken into account, Dr. Thomson thinks the affinities of the Veddahs with the hill tribes of the Nilgherries and the natives of the Coromandel coast and the country near Cape Comorin, are fairly well proved.

— According to the *Perseveranza* of Milan, quoted in the current number of the English *Board of Trade Journal*, important sponge-banks have lately been discovered close to the island of Lampedusa, on the southern coast of Sicily. These deposits of sponges extend for over a surface of from fifteen to eighteen marine leagues, and are situated about an equal distance from the south-eastern extremity of the island. The smallest depth above these banks is twenty ells; the greatest depth is from thirty to thirty-one ells. At the lesser depths rock is met with, on which the sponge grows; at greater depths a sandy soil is found. All varieties of sponge are discovered here, including those which are in the greatest commercial request, and they are easy to obtain. Greek and Italian vessels have already (January) proceeded to Lampedusa to take advantage of this discovery.

— One of the most interesting applications of the electric light yet made is to the passage of the Suez Canal at night-time. This great waterway, which is so important to all European nations, and particularly to England, ran the risk of being choked by the continued development of the traffic through it in the years 1882 to 1885. At the end of this period, however, the Canal Company determined to light the channel at night-time, so that the passage could be made without danger, and hoped in this way to sensibly diminish the traffic on the canal during the day, and to render the state of affairs less annoying to ship-owners, until the enlargements now in progress could be completed. The company accordingly installed a complete system of beacons along the banks of the canal, supplemented by luminous buoys burning Pintsch gas on the water, and in this way the channel was clearly marked out. It was soon seen, however, that this alone would be insufficient to insure safety in night passages, and it was therefore decided, says *Engineering* of Jan. 31, that every vessel moving along the canal at night must itself be supplied with arrangements for working a set of electric lamps on board. Rules were accordingly drawn up, which provide that these lamps shall be four in number, one of which is to be a powerful light at the bow, inside of a projector lamp capable of throwing the beam to a distance of not less than 4,000 feet in front of the vessel. The other lights are placed, one at the stern, and one on each side of the boat. The first vessel to make the passage under these regulations was the Peninsular and Oriental steamship "Carthage," in 1886; the transit lasting eighteen hours; but, with the improvements recently effected, the time has now been reduced to sixteen hours for large vessels. The Mangin projector is that principally employed, both war-vessels and vessels belonging to the great mail companies being fitted with this apparatus. Smaller companies usually employ a portable apparatus, which they find ready for hire on their entering the canal, and which they unship again on reaching Port Said or Suez. These sets of apparatus include the projector, a dynamo, and a motor, and certain firms make a specialty of the business of hiring them out. The great companies generally employ a similar apparatus, but are themselves the owners of the plant. The night traffic on the canal has increased very rapidly since it was started. Thus in 1887 there were, in all, 371 night transits made; but in 1889 this number had increased to 2,454 out of a total of 3,420, or upwards of 71 per cent of the vessels passing through the canal; and four-fifths of the total tonnage used the electric light to assist them. At the same time the average duration of the passage has been reduced upwards of 40 per cent. Putting these facts into another shape, it appears that the effect of the electric light as applied at Suez has been the same as if the canal had been increased from 22 metres, its present width at the bottom, to 32 metres,—an operation which would cost at least $20,000,000.

— The National Home-Reading Union, London, Eng., has been formed for the purpose of developing a taste for recreative and instructive reading among all classes of the community, and directing home study to definite ends, so as on the one hand to check the spread of pernicious literature among the young, and on the other to remedy the waste of energy and lack of purpose so often found among those who have time and opportunity for a considerable amount of reading. Its objects are (1) to draw up and publish courses of reading adapted to the tastes and requirements of different classes of readers, especially (*a*) young people, (*b*) artisans, (*c*) general readers; (2) to publish for each class of readers a cheap monthly magazine, giving introductions to the prescribed books, answers to questions, and other helps (the readers will be organized, as far as possible, into local circles under suitable leaders, certificates will be issued to those who have completed regular courses of study, and such further assistance as experience shows to be practicable will be rendered); (3) to organize summer assemblies at convenient centres, when lectures will be delivered by experienced teachers, social gatherings held, and excursions arranged. The first reading season commenced on Oct. 1 last, and the union now numbers 5,500 members. It publishes a monthly journal in three sections, printed at the University Press, Cambridge, Eng.: (*a*) "The General Reader's Magazine," which contains chapters on literature (English and general), nature (organic and inorganic), history (English and general), and political science; (*b*) "The Artisan's Section" of the monthly journal; (*c*) "The Young People's Section" of the monthly journal. These all give directions for the reading and study of the prescribed books, abstracts of these books in most cases, and questions on them to be answered after reading. The union bids fair to be a great elevating and civilizing agency, and its very rapid extension and success have already outstepped the most sanguine expectations of its promoters.

— The subject of spelling-reform is occupying a great deal of attention in France. M. Mich. Bréal wrote a very exhaustive article on it in a recent number of the *Revue des Deux-Mondes*, and M. T. Carré has a reply to it in the January number of the *Revue Pédagogique*. After discussing the merits and demerits of the proposals of the thoroughgoing phonetic school, which he characterizes as too sweeping, he passes on to spelling on an etymological basis, and points out the hopeless contradictions of the present system viewed from the point of etymology: *imbécile* with one, and *imbécillité* with two *l*'s; *chariot* and *charrue*, *charrette; philosophie* and *fantôme*, *fantaisie*, etc., parallel examples of which can be found, and have often been pointed out, by the English spelling-reformers. He then enumerates the reforms which he considers moderate and within the bounds of practicability: 1. To bring the spelling of the conjugated forms of the verbs in *eler* and *eter* under one and the same rule, and to cease writing *je chancelle* by the side of *je modèle*. 2. To do away with useless exceptions, as in the seven nouns in *ou* that take *x* instead of *s* in the plural. 3. To suppress useless double vowels and consonants; to write *honeur* as well as *honorer; abatre*, *acabler*, *apeler*, *aporter*, *atraper*, where only one consonant is pronounced; but to continue to write *appétence*, *acclamer*, *annuité*, *innovation*, *immortalité*, etc., where the double consonant is heard. He gives on this point an experience he had at the inspection of a girls' school. He had expressed his surprise to the head mistress at finding some of the eldest pupils copy out from a dictionary lists of words commencing with *ab* and *ac*. "These pupils," replied the head mistress, "have an examination to pass. They must know how to spell *académie* and *accabler*. *apercevoir* and *apparaître*, *alimenter* and *allaiter*, *agrandir* and *aggraver*, etc. If I trust to their getting up the spelling of such

words from the haphazard way in which they occur in dictation and reading lessons, they will never learn them all, and those they do learn must be pointed out to them specially at a great loss of time during these lessons. I thought this plan of exercises better. I own it to be unintelligent, yea, absurd; but it answers its purpose.'' The inspector confesses that at this reply he was gravelled. 4. To suppress as much as possible all exceptions, and bring them under general rules. We should soon get accustomed to *châteaus*, *chevaus*, *cieus*, in which words the *x* is due to a grammatical error. Why write *ails* in botany, and *aulx* in cookery? Why not write *des livres hébreus* as we write *des habits bleus?* Why not give the birthright to *agenda*, *exeat*, *errata*, *quatuor*, and write them with an *s* in the plural? We write *porte-plume* because a holder holds only one pen, but *porte-cigares* because it holds more than one cigar. This is hair-splitting. On this principle, are we to write *des villageois en casquette*, or *en casquettes; du sirop de groseille*, or *de groseilles; des oiseaux qui voltigent de fleur en fleur*, or *de fleurs en fleurs?* 5. In the case of compounds that are of constant use, to suppress the hyphen: to write *porteplume*, *portemonnaie*, as well as *porte faix*, *portefeuille*. On the five preceding points, as well as on the following, M. Carré is at one with M. Bréal. 6. To simplify the rules of the past participle. At present we write, *la maison que j'ai vu construire*, and *la maison que j'ai vue tomber;* but the syntax is the same in both cases. The real object of *vu* is the infinitive with which it forms one phrase, one idea. In the second case, as in the first, it is not *the house that I have seen*, it is *la maison qui tombait:* what I saw is *the house that fell*, *the falling house*.

— The bound volumes added to the library, Kansas Historical Society, Topeka, Kan., in the past year, numbered 1,269; unbound volumes and pamphlets, 2,248; volumes of newspapers and periodicals, 1,053; single newspapers and newspaper cuttings containing special historical matter, 5,707; maps, atlases, etc., 53; manuscripts, 219; pictures and other works of art, 367; scrip, currency, and coin, 8; war and other relics, 224; miscellaneous contributions, 99. The library accessions during the past year have somewhat exceeded in number the average of former years. They have been of the same general character. The purchases have been chiefly confined to works more or less directly pertaining to Kansas. The additions to the number of volumes of newspapers and periodicals exceed that of any year except one since the organization of this society. This year's experience has brought additional proof of the great value of this department. There are now 9,034 volumes of this class. Of these, 6,613 volumes are files of Kansas newspapers. These represent every county and considerable town in the State. These files are consulted by the people of all classes,—by teachers, students, and local historians and writers; for information as to the early settlements, the organization of societies, churches, and schools; for the proceedings of political conventions and all public gatherings; for the records of public men; and for official and legal notices. In these days historical writers seek for original information as to the early beginnings and the every-day progress of the social life of the people; and they have come to learn that it is in the columns of the daily and weekly newspaper that this information has been most fully recorded, and that nowhere else is exact data to be found. Teachers and students in our educational institutions are more and more learning that the study of the history and development of their own State and locality are worthy of their attention. No little of the correspondence of the secretary is employed in giving information sought by students, teachers, and other inquirers for such local information.

— In one of the lectures delivered at Aberdeen. in January, under the Gifford bequest, Dr. E. B. Tylor, says *Nature*, offered a most interesting suggestion as to the meaning of a well-known but puzzling Assyrian sculptured group. This group consists of two four-winged figures, with bodies of men and heads of eagles, standing opposite a tree-like formation, which is easily recognized as a collection of date-palms, or a conventionalized representation of a palm-grove. Each of the two figures carries in the left hand a bucket or basket; in the right, a body which each seems to be presenting to the palm-tree. What is this body? It is usually described as a fir-cone; but some have regarded it as a bunch of grapes, others as a pine-apple. Dr. Tylor suggests that it should be connected with the most obvious point of interest for which the date-palm has been famous among naturalists since antiquity; namely, its need of artificial fertilization in order to produce a crop of edible dates. This process in its simplest form consists in shaking the pollen from the inflorescence of the male date-palm over the inflorescence of the female. The practice is mentioned by Theophrastus and Pliny, and in modern times in such works as Shaw's ''Travels in Barbary.'' Dr. Tylor exhibited a drawing of the male palm inflorescence, and said it was hardly necessary to point out the resemblance to the object in the hand of the winged figure of the Assyrian sculpture. As the cultivator of the palm-tree has to ascend the tree in order to perform the process of fertilization, he of course takes with him a supply of fresh flowers in a basket. Dr. Tylor's theory, therefore, is that the objects carried by the winged genii of the Assyrians are the male inflorescence of the date-palm in one hand, the basket with a fresh supply of inflorescence in the other, and that the function the genii are depicted in the sculptures as discharging is that of fertilizing the palm-groves of the country, —a function which must have been held to denote their great beneficence, since it showed them fulfilling the great duty of providing the Assyrians with bread.

— The following, published in *Nature* of Jan. 30, is translated from a notice published by the authorities of the Madrid Observatory: ''D. Ernesto Caballero, professor of physics, and director of the electric-lighting manufactory in Pontevedra, writes to this observatory, giving details of a remarkable meteorological phenomenon which appeared at 9.15 P.M. on Jan. 2. In a sky serene and clear, there appeared suddenly a globe or ball of fire of the apparent size of an orange, which, after falling (it is not possible to well indicate how or from whence) upon the conducting wires stretched across the city, entered the manufactory (referred to) by a skylight or window, struck the apparatus for distributing the light, from which (after raising the armature of a magnetic current closer) it struck the dynamo at work. In the presence of the alarmed engineer and workmen present, it rebounded twice from the dynamo to the conductor, and from the conductor to the dynamo, then fell, and burst with a sharp and clear detonation into a multitude of fragments, without producing any harm or leaving any trace of its mysterious existence. In various parts of the city the lights swiftly oscillated and were extinguished for some seconds; and that the darkness was not general and long-continued, was owing to the admirable self-possession of the employees, who almost instantly established the order of things, so suddenly and strangely interrupted by this mysterious meteor, of whose action and presence there only remained traces on the melted (or soldered) edges of the thick copper plates belonging to the armature of the circuit-closer. Outside the building, and at the moment of falling upon the conducting wires, it was seen by (among others) the professor of natural history, Señor Garcéran; and, from various effects observed on the wires during the following day, there were undoubted manifestations (in no other way explicable) of its electrical origin.''

— An interesting paper is contributed by Professor Carnelley to the *Philosophical Magazine* for January, in which he attempts to express the periodic law of the chemical elements by means of an algebraic formula. For reasons which are given in detail in the memoir, an expression of the form $A = c\ (m + \sqrt{v})$ is adopted, where A represents the atomic weight of the element, c a constant, m a member of a series in arithmetical progression, depending upon the horizontal series in the periodic table to which the element belongs, and v the maximum valency or the number of the vertical group of which the element is a member. From a number of approximations, as we learn from *Nature* of Jan. 30, Professor Carnelley finds that m is best represented by the value 0 in the lithium-beryllium-boron, etc., horizontal row; by $2\frac{1}{2}$ in the sodium series; 5 in the potassium series; and $8\frac{1}{2}$,

12, $15\frac{1}{2}$, 19, $22\frac{1}{2}$, etc., in the subsequent rows. Thus m is a member of an arithmetical series of which the common difference is $2\frac{1}{2}$ for the first three members, and $3\frac{1}{2}$ for all the rest. On calculating the values of the constant c from the equation $c = \frac{A}{m + \sqrt{v}}$ for 55 of the elements, the numbers are all found to lie between 6.0 and 7.2, with a mean value of 6.6. In by far the majority of cases the value is much closer to the mean 6 6 than is represented by the two extreme limits: thus in 35 cases the values lie between 6.45 and 6.75. If the number 6.6, therefore, is adopted as the value of c, and the atomic weights of the elements are then calculated from the formula $A = 6\ 6\ (m + \sqrt{v})$, the calculated atomic weights thus obtained approximate much more closely to the experimental atomic weights than do the numbers derived from an application of the atomic heat approximation of Dulong and Petit. The number 6.6 at once strikes one as being remarkably near to the celebrated 6.4 of Dulong and Petit, and Professor Carnelley draws the conclusion that there must be a connection between the two. This assumption appears to be supported by the following interesting facts. If we assume c to represent the atomic heat, then atomic weight = atomic heat $\times$ $(m + \sqrt{v})$ = atomic weight $\times$ specific heat $\times (m + \sqrt{v})$; or specific heat = $\frac{1}{m + \sqrt{v}}$. On calculating the specific heats of the elements from this equation, they are found to agree remarkably well with the experimental values, except in those cases in which the observed specific heat is known to be abnormal. Again, Bettone has shown that the hardness of the elements is inversely proportional to their specific volumes. If this be so, hardness = $\frac{\text{specific gravity}}{6.6\ (m + \sqrt{v})}$; and, on calculating the hardness from this formula, the numbers are again found to agree very closely with the hardness experimentally determined by Bettone. That the periodic law may therefore be approximately expressed by a formula of the type $A = c\ (m + \sqrt{v})$ appears very probable, and that the number 6.6 is a very close approximation to the value of c appears also to be established. Moreover, the fact that m in the even series represents a whole number, while in the odd series it represents a whole number and a half, corresponds to the well-known difference in chemical properties between the members of these series; and the assumption that the common difference between the first three values of m is only $2\frac{1}{2}$, while between all the rest it is $3\frac{1}{2}$, is borne out by Mendeleeff's statement that the elements of the lithium and sodium rows are more or less exceptional in their nature, and not strictly comparable with the subsequent series.

—The demand for fibre-machinery, so extensive of late years in Mexico, is likely to be increased under more favorable fiscal circumstances by the development on a large scale of the sisal hemp industry of the Bahamas. Last year Sir Ambrose Shea, governor of these islands, which are a natural continuation of Florida, wrote to the *London Times* a powerful appeal that British capitalists should undertake the cultivation in the Bahamas of this rival to manila hemp. The demand for the latter long ago outstripped the supply; and, to make good the deficiency, fibre has been sought for in all parts of the world. The most successful substitute of all, we learn from *Engineering* of Jan. 31, has been sisal, a wild hemp-plant indigenous to Central America and the West Indies. Thanks to the prompt enterprise of Americans, the trade soon began to flourish in Yucatan, where large tracts of waste lands are covered with sisal hemp. Experience, however, soon revealed that only carefully selected plants, properly cultivated, could produce fibre that would stand the tests applied to good manila. It was found, moreover, that the plant was stronger and more fibrous in the Bahamas than in Mexico; and the result was, that in order to render these islands the counterpart of the Manilas in prosperity, if possible, the authorities decided to grant an export bounty of £4 13s. 4d. per ton on all sisal hemp grown in the Bahamas. The effect of this encouragement has been to draw English capital to the islands, where arrangments are now being made to plant ten thousand acres with this useful plant. Sisal is like an aloe in appearance, and has leaves about six feet long. It grows wild on the poorest soils, sprouting freely from a sucker, and in three years the leaves are ready for plucking. For nearly twenty years it continues to furnish, season after season, crops of these leaves, which are gathered by coolies, placed in fibre-machines, and are baled ready for export within a few hours of being plucked. Excessive drought or rain having no effect on the plant, and no attention beyond pruning being needed after the first year or two, the crop is inexpensive to manage, and practically permanent for twenty years, when the old plants are replaced by young ones. If the energetic encouragement of the governor, and the liberal bounty granted, cause the cultivation of the plant to be conducted on a large scale, a fresh lease of prosperity will be conferred upon the Bahamas, and the machinery trade, as well as the fibre one, will benefit by the new West Indian industry.

— From a desire to verify his own researches as to the causes of failing nutrition in aged organisms, Mr. C. A. Stevens offers three cash prizes of \$175, \$125, and \$100 for the best three comparative demonstrations, by means of microscopical slides, of the blood capillaries in young and in aged tissues, canine or human. By young tissues (canine) are meant tissues from animals between the ages of one and three years. By aged tissues (canine) are meant tissues from animals not less than twelve years of age. By young tissues (human) are meant tissues from subjects between the ages of ten and twenty years. By aged tissues (human) are meant tissues from subjects not less than sixty-five years of age. While a preference will be given to demonstrations from human tissues, it will be possible for work in canine tissues to take the first, and indeed all, of the prizes. But of two slides equally well done in all respects, one canine, the other human, the latter will be given the preference. Canine tissues should be from large animals. Twelve slides from young and twelve from aged tissues must be submitted by each competitor, together with a full description of the subjects, methods pursued, and every detail and circumstance which is likely to throw light upon, or account for, any peculiarity. The slides are for comparison as to the condition of capillary circulation, the young with the old, and should be in numbered pairs, or groups from the same kind of tissue. The term "tissue" is used in a general sense; e.g., pulmonary tissue, hepatic tissue, renal tissue, osseous tissue, muscular tissue, nerve tissue, alimentary tissue, etc. No particular schedule of methods for injection or staining will be insisted upon, and no more definite directions or explanations will be given. The slides, carefully packed and boxed, together with descriptive manuscript, can be sent by mail. It is stipulated that the demonstrations which receive the prizes shall become the property of Mr. Stevens, for publication. All others will be returned, if desired. No pseudonymes required. Accompany slides, in every case, with (real) name and address. Unless of known reputation as a biologist, a reference is respectfully solicited. Reservation: no award will be made unless work of at least ordinary merit is submitted. This offer is made on the first day of January, 1890, and will remain open until the twentieth day of August, 1890. Slides and manuscript will be examined and receipted for as soon as received. The prizes will be adjudged on the first day of October, 1890. These nominal prizes are offered less in expectation of results from the money as an agent than in the hope that the offer may furnish a *point d'appui* for really needed work. Besides professional observers and students, there are in the United States a large number of amateur microscopists of acute vision and undoubted talent, who are at present playing with microscopes as with toys, merely to see the curious or pretty things. The time has come to concentrate observation upon the one proper object of biology; viz., the renovation and prolongation of human life. Mr. Stevens's address is Norway Lake, Me.

— Herbert Ward, the African explorer, in collaboration with D. D. Bidwell, begins in the *New York Ledger* of March 1 a series of articles descriptive of a canoe journey of twenty-five hundred miles on the Upper Kongo.

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BOOK-REVIEWS.

Proceedings of the Society for Psychical Research. Part XV. London, Soc. Psych. Research. 8°.

THIS number of the "Proceedings," though dated December, 1889, has just come to hand. Its contents are very varied, and the titles of the contributions illusively attractive. We may select as the most interesting pages of the number the brief preliminary report on the census of hallucinations, and Mr. Barkworth's paper on "Duplex Personality." The census of hallucinations relates to the answers received to the following query: "Have you ever, when believing yourself to be completely awake, had a vivid impression of seeing or being touched by a living being or inanimate object, or of hearing a voice, which impression, so far as you could discover, was not due to an external physical cause?" In England 2,928 answers have been received (1,633 women and 1,293 men); and of these, 363, or 12.4 per cent, have answered "yes." Of the 363, more than two-thirds (251) are women. The nature of the impression was visual in 205 cases, auditory in 115 cases, and tactile in 24 cases. Further subdivisions are made, and several interesting points suggested, which will doubtless be fully considered in the complete report. For this, 50,000 answers are desired, and the inquiry is going on in France, Germany, and the United States. In France, up to last October, 633 answers were received (366 from men and 161 from women), of which 106 answer "yes," the percentage of affirmative answers being again much larger among women than among men (31 per cent and 16 per cent). Professor Sidgwick explains the purposes of the census from a point of view certainly not that of those answering the queries, and places as the very last of his remarks a caution, that should have been printed in red ink and large capital letters on all pages of the blanks; namely, to record separately all those who give, or are asked to give, a reply because something is known or suspected of their having had an hallucination. Without this precaution most strenuously observed, the result can have little value in fixing the prevalence of hallucinations. Mr. Barkworth's essay deals very ably and interestingly with those subconscious automatic phenomena whose vital importance in the intellectual life has been so clearly shown, and not least by the phenomena of hypnotism. The tracing of the relation of these degrees of consciousness to various strata of personality, and to those bizarre disintegrations of self presented by morbid psychology, forms the main purpose of the essay.

To deal first with the supplement, we find an account of the recent congress of experimental psychology, and especially of the proceedings of the section on hypnotism, by Dr. A. T. Myers, and several reviews of recent hypnotic literature by Mr. F. W. H. Myers and Mr. Leaf, those by the former being rather controversial in character. To deal fairly and yet critically with the main papers of the number is no easy task. It is all too evident, that instead of profiting by our increased knowledge of the possibilities of deception, and the many side-lights of psychic phenomena which this society, either directly or through its antagonists, has aided and encouraged, the experiments seem to be conducted with fewer and fewer precautions, and speculations indulged in more and more freely. This is not the place or the occasion for the detailed review of the experiments on thought-transferrence offered by Professor and Mrs. Sidgwick and Mr. Smith, and those of M. Richet on clairvoyance, necessary to show how much weaker the evidence collected will be when clearly and logically stated. The possibilities of those who guess the numbers drawn from a lotto-bag getting a glimpse of what was going on does certainly not seem to have been excluded by the experiments (as related); and nothing can be more suggestive than the small number of correct answers when Mr. Smith is in the next room, compared with the successes when in the same room. Professor Richet's jubilant tone is not consistent with the facts he has to tell. To sit up all night with a nervous subject holding an envelope containing a playing-card in her hand, and taking an hour or more to guess the card enclosed, is certainly a marvellous devotion to science. But a little more method and caution, and enclosing the cards between sheets of metal instead of in envelopes, would probably be more to the purpose than this devotion. We are told nothing of the history of the cards from the time they were bought until placed in the envelope; and so significant a fact as that court-cards were guessed rightly so large a proportion of times is recorded as a peculiarity of the clairvoyance; and over M. Richet's calculation of the chances in the matter one loses all patience. There are also a collection of notes of *séances* with D. D. Home, by Mr. Crookes, for which there seems no sufficient *raison d'être*, and the longest article of the number, by Mr. Myers, on apparitions occurring more than a year after death. It is difficult to take Mr. Myers seriously in this contribution. One always admires the patience in analyzing and describing these many cases of apparitions, but ends by suspecting that Mr. Myers's detailed knowledge of the mental habits of ghosts must be telepathically obtained.

Absolute Measurements in Electricity and Magnetism. By ANDREW GRAY. 2d ed. London and New York, Macmillan. 16°. $1.25.

THE first edition of this work was published in 1884. It consisted mainly of papers which had previously been contributed to the columns of *Nature* by Professor Gray, together with such alterations and additions as he deemed advisable to make in order to render the book more generally useful. While it made no pretensions to being a complete or exhaustive treatise on the subject, it gave, as far as its limits admitted, a clear account of the present system of absolute units of electrical and magnetic measurements, as well as of some methods and instruments by which the system may be applied in theory and in practice.

Something over a year ago the first volume of a more comprehensive treatise on the subject, by the same author and publishers, made its appearance, which, together with the second volume now in preparation, it was intended would supersede the original small work, then out of print. But Professor Gray found that a demand still existed for the original work, or for one similar to it; and the present edition, amplified and brought down to date, is the result. In it are incorporated a few parts of the larger work, which add much to its value.

Among the many additions to the present work may be mentioned a fuller account of the determination of the horizontal component of the earth's magnetic field; a description of Sir William Thomson's standard electrical instruments; a more complete treatment of the graduation of instruments; an extension of the theory of alternating machines, including Dr. Hopkinson's theory of the working of alternators in series and in parallel, and additional information regarding the measurements of activity, etc., in the circuits of alternators; and a chapter on the theory of dimensions of physical quantities. In the last-named chapter the author takes the view that the dimensions of the electric and magnetic inductive capacities should be left undetermined, and regarded as so related as to render the dimensions of every physical quantity the same in the electro-static as in the electromagnetic system of units.

A Handbook of Florida. Part I. Atlantic Coast. By C. L. NORTON. New York, Longmans. 16°. 50 cents.

WE are so accustomed in this country to the most trashy kind of guide-books, that it is positively refreshing to find in this first part of what is to be a guide-book of the whole of Florida a book containing the very information a traveller needs, told in plain, straightforward English. Why the majority of American guide-books are so worthless is not so plain, unless it is that there is, or has been, but little demand for any, not to say the best. But it is certain that the plan of setting the ordinary reportorial talent at work in "writing up" our places of interest does not result in any very intelligible descriptions. Mr. Norton's book is a model, and can be commended to those interested, and to those likely to inflict guide-books of another stripe upon the travelling community. The whole work is not published as yet, but the other parts are promised to be ready soon.

AMONG THE PUBLISHERS.

AT this time, when the works of Jean François Millet are being much discussed, readers will be interested in the announcement of two articles upon Millet, his companions and friends. The May *Scribner* will contain the first of these articles upon the artist's life at Barbizon. The author, Mr. T. H. Bartlett, who has been long a resident of Barbizon and an admirer and student of Millet's work, has incorporated many unpublished letters of Millet, and has furnished a great wealth of new material for illustrating the articles abundantly.

—The following extract is taken from a letter written from Cairo, Egypt, recently received from Mr. Henry M. Stanley, about his forthcoming book: "I believe the work will be in two volumes, from 450 to 500 pages each. God knows there is matter enough, but I would wish to deal very lightly with the whole from Zanzibar to Yambuya, that the book might be of as high interest as the main theme. . . . I have six note-books filled with matter extremely interesting. Three long chapters are already written. I have a number of most interesting photographs of scenery, sketches of incidents, scenery, etc., and maps will be a prominent feature. I hope it will be ready in May."

—The ninth part of the current series of Edwards's "Butterflies of North America" (Boston, Houghton, Mifflin, & Co.) is fully up to the average standard. The first plate is given up to species of *Argynnis*, the females of two Western species being for the first time figured; while the early stages of our common Eastern *A. aphrodite* are admirably illustrated, every stage of the caterpillar having a colored figure. Only the earliest stage is given by Scudder. Edwards makes the interesting statement that protection is sought at pupation by constructing a tent,—a feature not before observed in this genus. The second plate illustrates the Southern *Satyrus pegala*, but only the butterfly; and the third, *Erebia Epipsodea* of the Rocky Mountains. Heretofore our knowledge of the transformations of any species of this genus, abundant in parts of Europe, has been most meagre, but here we are treated to a plate full of exquisite details, leaving nothing to be desired; and this when the insect had to be obtained from points thousands of miles away, and sent five hundred miles again to the artist. We are equally amazed at the enterprise and the success of the author. The chrysalis was found to pupate in an inclined position, head upward, in a clump of grass whose blades were fastened by a few threads, forming a rude kind of cocoon. The spines of the cremaster are without hooks. Illustrations of the transformations of other satyrids are promised in the present volume; and Mr. Edwards hopes to show that this group should be placed at the bottom, and not at the top, of the butterflies, — not an easy task when he has to ignore the fundamental structure of the final stage. This excellent iconography, which has appeared at intervals ever since 1868, surpasses in the excellence of its illustrations any heretofore attempted or now publishing; and it is strange indeed that the entomologists of Europe have not been spurred by its excellence to some sort of rivalry in illustrating the histories of their native species. They have nothing which can in any way approach it, and yet the cost of work of this class is far cheaper in Europe than with us. Mr. Edwards's enterprise should be well sustained.

— According to a circular lately issued by the Geological Survey of Arkansas, we learn that an act of the Legislature directs that the reports of the State Geological Survey, with the exception of certain specified copies, shall be sold by the secretary of state at the cost of printing and binding. The reports thus far issued, and their prices, are as follows: "Annual Report for 1888, Vol. I., Geology of Western Central Arkansas," by mail, one dollar; "Vol. II. South-west Arkansas," one dollar; "Vol. III. Coal," seventy-five cents. They may be had by addressing Hon. B. B. Chism, secretary of state, Little Rock, Ark. Reports are being prepared, and will be issued as soon as possible, on the following topics: 1. Kaolins, clays, and clay shales; 2. Complete report on the coal of the State; 3. Manganese; 4. Marbles and limestones; 5. Novaculites; 6. Crystalline rocks; 7. Washington County; 8. Crowley's Ridge; 9. Miscellaneous reports.

— Mention has been made from time to time of the topographical map of Massachusetts, the plan of joint work by the State and the United States Geological Survey, the Greylock map issued by the Appalachian Mountain Club, and the general map of the State of recent date, all having been described in our columns. There is now to be added a "map of the country about Boston," again issued by the Appalachian Club, a very welcome addition to our local cartographic material. It is printed from the stones that will be used in the final issue of the map for the State, the scale being 1: 62,500, with brown contours every twenty feet. We are glad to note that it comes from the lithographic establishment of George S. Harris & Sons of Philadelphia; and from this it may be inferred that the number of houses capable of doing this sort of work in our country is increasing, and that the

deserved monopoly that prevailed some years ago in map-engraving can no longer be so described. The map is a handsome piece of work, and will serve as an excellent basis for scientific work about Boston and Cambridge. It can be obtained of W. B. Clark & Co., Washington Street, Boston, sales-agents for the Appalachian publications.

— James J. Chapman, Washington, will publish March 25 the second volume of Gen. V. Derrécagaix's work on "Modern War," translated by Lieut C. W. Foster, U.S.A. This volume will treat of the grand tactics, illustrating tactics of the march, manœuvre marches, combats, battles (important modern combats and battles given in illustration), pursuits, and retreats.

— Little, Brown, & Co. have in preparation "Myths and Folk-Lore," by Jeremiah Curtin; the fifth and final volume of Palfrey's "History of New England," from the author's manuscript by his son, with full index to the complete work; "The Way Out of Agnosticism, or, The Philosophy of Free Religion," by Frances Ellingwood Abbot, author of "Scientific Theism;" and "The Influence of Sea Power in History," by Capt. A. T. Mahan, U.S.N., an important historical work, showing the great power and influence developed by naval forces.

— Professor John Henry Comstock begins in the *New York Ledger* of March 1 a series of six articles on the study of insects, in which he describes not only those insects which are useful to the farmer, but also those which destroy entire fields of grain, cotton, and rice, and ravage orchards, gardens, and vineyards. He demonstrates how it was scientifically determined that an average annual loss of $30,000,000 has been occasioned in the South by the cotton-worm alone; and that an average loss per year of nearly $2,400,000 has been brought about in the apple-crop of Illinois by the ravages of the codling-moth. The series is illustrated.

— "American Whist Illustrated," by "G. W. P.," has just been published by Houghton, Mifflin, & Co. It is needless to say that this is a book for whist-lovers. The dedication to "The players of whist who study the game" seems to hint that no scoffers need expect even a nod of recognition if they were to be so bold as to intrude themselves upon the sacred band of whist lovers who will doubtless peruse the pages of "American Whist Illustrated." That many will read is sure from the fact that many have carried away and read the dozen and more editions of "American Whist" and "Whist Universal," from a union of which the present volume is the result.

— Lippincott's series of school readers are likely to attract attention. "The Third Reading-Book," by Eben H. Davis, has just been issued. The book introduces its users to the writings of the most popular authors of juvenile literature, many of the leading publishers having granted the use of copyright matter. The well-drawn pictures for language exercises are a novel feature.

— E. & F. N. Spon have issued an "Engineers' Diary and Reference Book, for Engineers, Machinists, Contractors, and Users of Steam." It is a neatly bound volume of 150 quarto pages, alternate leaves being left blank and ruled for writing. Among its contents are many reference-tables of weights, measures, money, and wages; coal and iron trade statistics; recent legal decisions interesting to engineers; an index of recent technical literature; recent papers presented to Parliament relating to canals and railways, mining, explosives and fires, shipping, sanitation, etc.; reports of the Board of Trade and mercantile marine; and a list of engineering and allied societies. Though the book is prepared with special reference to the needs of engineers in Great Britain, it contains much that will interest those on this side of the water.

— In *Babyhood* for February is described a recently discovered means of relieving whooping-cough, which is purely mechanical, and seems worthy of trial by mothers and intelligent attendants. Another medical article which will interest parents is that on "A Diet Disease," by Dr. James H. Young, in which the results of the injudicious feeding of infants are brought out. Color-blindness, and the means of detecting and treating the defect, form the subject of an article by Dr. C. H. May.

— Messrs. E. & F. N. Spon announce a second edition, revised, of "Naturalistic Photography," for students of the art, by P. H. Emerson; "Mechanical Graphics," a second course in mechanical drawing, with preface by Professor Perry, arranged for use in technical, and science and art schools, and colleges, by George Halliday; and a second edition of "Aid Book to Engineering Enterprise," by Ewing Matheson.

— The following are the contents of No. 6 of the fourth volume of "Studies from the Biological Laboratory," issued by the Johns Hopkins University, Baltimore: "On the Morphology of the Compound Eyes of Arthropods," by S. Watase; "On the Anatomy and Histology of Cymbuliopsis Calceola," by J. I. Peck; "On the Amphibian Blastopore," by T. H. Morgan; and "On a New Actinia, Hoplophoria Coralligens," by Henry V. Wilson.

— Messrs. D. Appleton & Co. have just issued a book entitled "Exercises in Wood-Working, with a Short Treatise on Wood," by Ivin Sickels. These exercises were prepared originally for students of the College of the City of New York, as long ago as 1883. From time to time they were modified as the author gained in experience, and now they are published, that those who are interested in manual training may have the benefit of this course that for five years has proved itself satisfactory. But it is not to be supposed that this is solely a treatise on the handling of wood-working tools: the structure of wood is described, and a very large amount of space is given to the methods of seasoning wood, to the age of trees and their decay, to the measure and value of wood, and to the diseases and insect enemies of wood.

— Three volumes in the Romance of Science Series have recently been published by the Society for promoting Christian Knowledge, whose agents in New York are Messrs. E. & J. B. Young & Co. The smallest of these is "The Story of a Tinder-Box," by Charles Meymott Tidy. Mr. Tidy originally told this story in a course of three lectures to young people at the London Institution during the Christmas holidays of 1888–89. They are profusely illustrated by experiments that are sure to be suggestive to teachers in this country. "Time and Tide" is the title given by Sir Robert S. Hall to his number of the series, which contains the substance of two lectures before the London Institution. That this is a subject extremely difficult to handle without mathematics, goes without saying; but it can be said that the illustrious author acquits himself with due honor. The people of not so many years ago believed that our moon was a new creation each month; but, while this extreme view can no longer be held, there are many happenings to our moon that will in time relieve it from an everlasting service upon the earth. Of these happenings the author tells, and he likewise tells of the interesting discoveries that have been made of the doings of the satellites of other planets. "The Diseases of Plants," by H Marshall Ward, the third of the number to which we referred, is not on so popular a subject as the other two, and naturally refers especially to conditions as they are in England. But, since plant-diseases are only too glad to migrate, it may well be that the instruction of this book may not be profitless here.

— Cassell & Co. will publish shortly "Star Land," a series of talks on astronomy with young people, by Robert S. Ball.

— Sir William Thomson of Glasgow University, the great European authority on electricity, has an article in the February number of *The North American Review* on "Electric Lighting and Public Safety," showing the methods adopted in Europe to guard against the dangers of electric lighting. Mr. T. A. Edison's article on this subject appeared in the November number of the *Review*, and Mr. George Westinghouse's in the December number. Among other brilliant contributions in the February number are "The Gladstone-Blaine Controversy," by Hon. R. Q. Mills; "Italy and the Pope," by Gail Hamilton; "The Doctrine of State Rights," by the late Jefferson Davis; "A New View of Shelley," by "Ouida;" "Newspapers Here and Abroad," by E. L. Godkin; "British Capital and American Industries," by Erastus Wiman; "The American Bishop of To-day," by the

Rev. J. H. Ward; "Final Words on Divorce," by Margaret Lee and the Rev. P. S. Moxom, D.D.

— The special topic in the annual report of the United States commissioner of education for the year 1887–88 is manual and industrial training. The commissioner, Mr. Dawson, is not a partisan in favor of or against the system, but presents the views and arguments of leading educators on both sides. He also gives some account of the history of manual training both in this country and in Europe, and then furnishes an outline of the courses of manual exercise that have been adopted in various places, with the comments of teachers and observers on their effect. This account of manual training occupies a hundred pages of the report, and contains a good deal that will be interesting to students of the subject. Another topic to which considerable attention is given is the training of teachers in normal schools and elsewhere, and there is also some account of the recently established teachers' reading circles. Brief abstracts of the various State reports are also given, with the usual variety of statistical matter.

— The prize offered by Mrs. John Armstrong Chanler ("Amélie Rives"), through the American Economic Association, for the best essay on the subject of child-labor, has been awarded to Mr. William F. Willoughby and Miss M. C. de Graffenreid, both of Washington, D.C. The prize was equally divided between the two contestants, their essays being of equal merit. Mr. Willoughby is a native of Alexandria, Va. He was graduated at the Washington High School, received the degree of A.B. in June, 1888, at the Johns Hopkins University, where he was awarded an "Honorary Scholarship" for three successive years, and is now a resident of Washington, D.C. Miss M. C. de Graffenreid comes of an old Southern family, she herself being a native of Georgia. She holds a position in the Department of Labor, and had a large share in the compilation of the "Fourth Annual Report of the Commissioner of Labor," on the subject of working-women, having interviewed personally eighteen thousand workingmen in different parts of the country. A paper written by her on "The Needs of Self-Supporting Women" has recently been published as a supplementary note to "Johns Hopkins University Studies in Historical and Political Science."

— Among the new publications of the J. B. Lippincott Company are: "Works of William H. Prescott," a new library edition, edited by J. Foster Kirk, illustrated with portraits and maps. Through his long association with Prescott, to whom he acted as assistant in the preparation of the original edition, Mr. Kirk was enabled to incorporate in the revised work all the material collected by this celebrated historian. He has verified doubtful references, corrected typographical errors, and occasionally appended a note when statements appeared to need authentication. "Elements of Plane and Spherical Trigonometry," by Edwin S. Crawley, assistant professor of mathematics in the University of Pennsylvania. In the preface it is stated that "the aim of the author in this treatise has been to present to the student, in as concise a form as is consistent with clearness, that portion of the subject of trigonometry which is generally given in a college course. The first part of the subject is presented in much detail, each point being emphasized as far as possible by means of numerous examples and illustrations. Farther on, the student is thrown more upon his own resources, with the object of developing in him the power of making intelligent use of the materials furnished by the previous part of the course. An appendix is added in which is collected, in a manner convenient for reference, a list of such formulæ as the student will find most useful in his subsequent work in mathematics." "International Atlas of Rare Skin Diseases," edited by Malcolm Morris, London; P. G. Unna, Hamburg; H. Leloir, Lille; and L. A. Duhring, Philadelphia. This work, a periodical publication consisting of two or more parts per year, will contain the most recent and rare cases of skin-diseases that have come under the observation of the leading dermatologists of the world, thus presenting to the practitioner the most reliable information on the subject. The illustrations are chromo-lithographs. The text is rendered in English, French, and German. "The Principles and Practice of Surgery" (second edition, thoroughly revised, with additions), a treatise on surgical diseases and injuries, by D. Hayes Agnew, professor of surgery in the medical department of the University of Pennsylvania. The order of subjects has been somewhat changed from that followed in the earlier work, and much new material has been added. Certain chapters have been transposed, others have been partly rewritten, and all have been carefully revised and illustrated. The author has embodied in the present treatise whatever by observation and experience appeared to him worthy of professional confidence, and hence it represents the most approved knowledge of the day as embraced in the science and art of surgery. His teachings as well as his practice are characterized by a humane conservatism, and show a higher regard for the welfare of the patient than for a reputation for brilliant and heroic operations. A safe practitioner, he is notably a prudent counsellor. "Foods for the Fat," a treatise on corpulency, and a dietary for its cure, by Nathaniel Edward Davies, member of the Royal College of Surgeons, England, author of "Aids to Long Life," "Medical Maxims," "Nursery Hints," etc. "Conversation on Mines between a Father and Son," to which are added questions and answers to assist candidates to obtain certificates for the management of collieries, a lecture on the atmosphere and explosive gases, table of calculations, rules of measurements, etc., by William Hopton, being a reprint from the eighth English edition. This plain and unpretentious little book has had a remarkable history. Its author determined in 1864 to issue the work chiefly as a handbook for the use of operatives and laborers in coal-mines. It filled exactly a want of the times, and from the very outset the work has had a marked success. Its language is so clear and plain that no man of ordinary native intelligence can fail to understand it. The following subjects are clearly and intelligibly explained: how mines generate gases; how the weather on the surface of the earth affects the workings of a mine; the power of explosions, and how to diminish it, etc.

— Two Americans contribute to the February *New Review*, — Mr. James and Miss Harriet W. Preston; Mr. Hamilton Aide discusses the "Deterioration of English Society;" and there is a paper on recent plays and books by Mr. L. F. Austin, Henry Irving's private secretary. Mr. Parnell is the subject of a trenchant but courteous character-study in the same number.

—"The Federal Constitution of Germany," by Edmund J. James (Philadelphia, University of Pennsylvania), a little monograph of forty-three pages, contains a translation of the text of the Federal Constitution of Germany, now for the first time made accessible to English readers. The work is of special value as showing how very different some federal governments are from others, and how accidental are some of the features of our own system which we have been accustomed to regard as essential. Alexander Hamilton argued a century ago that such a government as that of the present German Empire could not hold together, and yet there is no doubt that it is one of the strongest federal unions in existence. The constitution reveals it as a union which acts directly upon the states, and not upon the citizens of the states, like our own. It is well worth the study of American citizens. The next number in the series of publications on political economy and public law will contain the text of the Federal Constitution of Switzerland.

— John Ericsson, the great engineer, in a confidential letter written March 23, 1866, said, "The great importance of what I call the subaquatic system of naval warfare strongly presented itself to my mind in 1826; yet I have not during this long interval communicated my ideas to a single person, excepting Emperor Napoleon III. What I knew twelve years ago, he knows, with regard to the general result of my labors, but the details remain a secret with me. The 'Monitor' of 1856 was the *visible* part of my system, and its grand features were excluded from its published drawings and descriptions." Among Ericsson's papers were found, after his death, a series of autograph pencil-drawings, showing these concealed features of his "Monitor" system as originally conceived. They represent the ideas of subaquatic attack first presented in the "Destroyer" in 1878,

after being withheld from the public gaze by their author for half a century. These rude sketches will for the first time be made public, in facsimile, in *Scribner's* for March.

— Kirk Munroe, who has spent many winters among the Florida Seminoles, in his article for the March *Scribner*, describes the immense turban which is the universal masculine head-dress and distinguishing badge of that tribe.

— Professor William James of Harvard, in his article on hypnotism, entitled "The Hidden Self," in the March *Scribner*, says, "I know a non-hysterical woman who, in her trances, knows facts which altogether transcend her possible normal consciousness,— facts about the lives of people whom she never saw or heard of before. I am well aware of all the liabilities to which this statement exposes me, and I make it deliberately, having practically no doubt whatever of its truth. My own impression is that the trance condition is an immensely complex and fluctuating thing, into the understanding of which we have hardly begun to penetrate, and concerning which any very sweeping generalization is sure to be premature. A comparative study of trances and subconscious states is meanwhile of the most urgent importance for the comprehension of our nature."

— Horace Baker, who studied the subject carefully in Australia, will describe "The Blackfellow and his Boomerang" in the March *Scribner's*. "This curious and unique weapon," he says, "about which so much has been written and so little is really known, is a curved piece of wood, slightly convex on one side, and nearly flat on the other. It is cut from a natural bend or root of a tree, the hardest and heaviest wood being always selected, and its curve follows the grain of the wood. Thus it will vary from a slight curve to nearly a right angle, no two ever being the same shape. It is about three-eighths of an inch thick, and from two to three inches wide, tapering toward the ends, which are either round or pointed. The edge is sharpened all around, and the length varies from fifteen inches to three and a half feet."

— The March number of *The Chautauquan* presents among other subjects the following: "The Politics of Mediæval Italy," by Professor Philip Van Ness Myers; "The Archæological Club at Rome," by James A Harrison; "Roman Morals," by Principal James Donaldson; "Life in Mediæval Italy," by the Rev. Alfred J. Church; "Torquato Tasso," by Arlo Bates; "Traits of Human Nature," by the Rev. J. M. Buckley; "The Nationalization of Industry in Europe," by Franklin H. Giddings; "The Problems in the Physics of Photography," by Professor Edward L. Nichols; "Moral Teachings of Science," by Arabella B. Buckley; "English Politics and Society," by J. Ranken Towse; "Karl Marx," by Professor Charles J. Little; "Trusts, and How to deal with Them," by George Gunton; "Pan-American Congress," by the Hon. W. P. Frye; "The Woman Question in Germany," by Frau J. Kettler; "Common Sense as to Christian Science," by H. M. Dexter.

— Messrs. Ginn & Co. announce to be published in April, "Elements of Structural and Systematic Botany," for high schools and elementary college courses, by Douglas Houghton Campbell, Ph.D., professor of botany in the Indiana University. It is designed to serve as both a laboratory guide and an outline of the classification of the vegetable kingdom, based upon the results of the most recent and reliable authorities. To this end a number of typical plants have been carefully selected, and these studied in detail, with full directions for gathering or growing the specimens as well as for the study of their structure. This work is supplemented by a brief diagnosis of the group to which each plant belongs, with such descriptions or figures of related forms as will enable the student to recognize the common forms likely to be met with, as well as the relationships of the different groups of plants. Since the place to begin is the beginning, and the elements of botany do not consist in the "analysis" of a certain number of flowering plants, the lower plants are considered first, and at some length, as a preparation for the study of the more difficult structure of the ferns and flowering plants. This feature is especially commended to the attention of teachers as an aid in their work, as well as an incentive to the study of these important forms, some knowledge of which is indispensable to an intelligent comprehension of any scientific classification of the plant kingdom.

— The Cassell Publishing Company, New York, announce three editions of the "Journal of Marie Bashkirtseff." The one they first issued at two dollars has been reduced to one dollar and a half; there is another in plainer binding at one dollar, and a third in paper at fifty cents. These editions are printed from the same plates; and the two former have the portrait and illustrations as in the original two-dollar edition, while the latter has the portrait only. Nothing has been "suppressed" in this translation of Mlle. Bashkirtseff's journal. Mrs. Serrano simply left out such parts as were uninteresting or trivial. The same firm also announce a new story by Judge Tourgee, under the title "Pactolus Prime." While dealing with a new phase of the race problem, the author slashes right and left at the pet follies of the time, and touches a good many people's self-complacency, who perhaps have little thought of being hit.

— P. Blakiston, Son, & Co., Philadelphia, will publish next week a new German-English medical dictionary, by Frederick Treeves, F.R.C.S., and Mr. Hugo Lang; "A Manual of the Practice of Medicine," by Frederick Taylor, M.D.; and a text-book on obstetrics, by Dr. F. Winckel (Munich), translated by Professor Edgar F. Smith of the University of New York.

— Last week's issue of *Garden and Forest* contains an interesting view of the entrance to Père-la-Chaise, the famous Parisian cemetery, and an illustration of a remarkable specimen of the beautiful blue orchid, *Vanda cœrulea;* Mr. William Watson of the Royal Gardens at Kew writes of cape heaths; and the duty of Congress to our public forests is discussed editorially. Among the contributors to this number are Professor Budd of Iowa, Herr Max Leichtlin, Charles A. Dana, and Mrs. Schuyler Van Rensselaer.

— The following new publications are announced by the J. B. Lippincott Co.: "A Text-Book of Assaying," for the use of students, mine managers, assayers, etc., by J. J. Beringer, lecturer to the Mining Association of, and public analyst for, the county of Cornwall; and S. C. Beringer,— a work that has been prepared to meet the existing want of a practical "handy-book" for the assayer. Aside from a description of those substances which have a commercial value, the work contains short accounts of the rarer elements, since they are frequently met with, and occasionally affect the accuracy of an assay. Under the more important methods, the results of a series of experiments showing the effect of varying conditions on the accuracy of an assay are given. This record will be of great value to students who, learning any particular process, cannot do better than repeat such a series of experiments. "Manual of Mythology in Relation to Greek Art," by Maxime Collignon, translated and enlarged by Jane E. Harrison, author of "Manual of Ancient Sculpture." The subject of this work is not mythology in general, but strictly mythology as seen in art. Literature is cited, but only in so far as it throws light upon the conceptions of art. All questions dealing with the origins of myths and their literary variations are of necessity set aside. A brief summary is first given of the general principles that govern the formation of types in art; and the development of the type of each god or goddess, genius or hero, is historically considered. The book is intended, in fact, to supplement, not to supersede, existing handbooks. "Manual of Ancient Sculpture," by Pierre Paris, formerly member of the Ecole Française at Athens; edited and augmented by Jane E. Harrison, author of "Introductory Studies in Greek Art," etc. "Crime: Its Nature, Causes, Treatment, and Prevention," by Sanford M. Green, author of "Green's Practice," etc. Of books in press, the firm announces "Stanley's Emin Pasha Expedition," by A. J. Wauters, with maps, thirty-four portraits, and illustrations; "Medical Diagnosis," a guide to the knowledge and discrimination of disease, by J. M. Da Costa, M.D.; "A Text-Book of Clinical Diagnosis: The Chemical, Microscopical, and Bacteriological Evidence of Disease," translated from the second edition, by James Cagney, with additions by William Stirling, professor of physiology, Owens College, Manchester; "Lippin-

cott's New Series of Readers," by Eben H. Davis, superintendent of schools, Chelsea, Mass. (complete in four books; the third and fourth readers in press); "How to Remember History," a method of memorizing dates, with a summary of the most important events of the sixteenth, seventeenth, eighteenth, and nineteenth centuries, for the use of schools and private students, by Virginia Conser Shaffer; "A System of Oral Surgery" (fifth edition, thoroughly revised, with important additions), being a treatise on the diseases and surgery of the mouth, jaws, face, teeth, and associate parts, by James E. Garretson, surgeon in charge of the Philadelphia Hospital of Oral Surgery, dean of the Philadelphia Dental College, etc.; "Chambers's Encyclopædia," Vol. V. (new edition), edited and published under the auspices of W. & R. Chambers, Edinburgh, and J. B. Lippincott Company, Philadelphia, to be completed in ten volumes; "Recollections," by George W. Childs; and "Historic Note-Book," by the Rev. E. Cobham Brewer, Trinity College, Cambridge, author of "The Reader's Hand-Book," "Dictionary of Phrase and Fable," etc.

LETTERS TO THE EDITOR.

Mock Sun.

THE train leaving Albany for Boston, in surmounting the hills east of the Hudson River, affords the traveller very beautiful views of the wide valley, the river, and a picturesque sky-line formed by the bold and broken Helderbergs. On the evening of the 9th this view was enhanced in beauty by a superb sunset, having seemingly the double glory of two suns twenty degrees apart. It was not easy to determine the actual sun, so brilliant were both reality and counterfeit; but the mock sun, like many pretenders, overdid the thing a little, and assumed very gorgeous rainbow effects, that are not seen very near the royal original. It was north of the actual sunset.

The pretender was not, however, the often seen "sun-dog," which is ordinarily a scrap of rainbow color, but it had a luminous centre of golden refulgence, that was worthy of the orb of day; and, when seen by shutting off the sun with a shade, it made a centre of a brilliant sunset, really holding a court of its own.

This most attractive phenomenon, with varying changes, all wonderful, lasted for nearly half an hour, affording, in connection with the remarkable views, a very unusual unison of terrestrial and celestial beauty. The change of our point of view was five or six miles as the train sped on; but the thin clouds upon which the colors were so lavishly embroidered were very far away, not showing perceptible change in position relative to the sun with that movement of the observer.

The same phenomena were simultaneously observed at Cazenovia, one hundred and ten miles due west, but there the sun's rival was seen south of the great luminary.

The next day was clear and fine at Cazenovia, but snowing at Boston, indicating that the frost crystals that masqueraded

as celestial bodies were moving as storm-centres drift, eastward.

Would it not be of interest to learn from correspondents how far the gay deceiver was seen? It was so exceptionally striking, that no person favorably situated could have failed to observe it, and no one could but be impressed by the beauty of the unusual event.
L. W. Ledyard.

Cazenovia, N.Y., Feb. 18.

The Fiske Range-Finder.

With reference to the note of Lieut. Casey in your issue of Jan. 31, 1890, calling attention to an apparent hiatus in the theory of my range-finder, permit me to say that Lieut. Casey is entirely correct in all his statements and deductions, but that the instrument does in reality make an automatic correction which has not yet been publicly described. There are a number of ways of accomplishing it; but it does not seem advisable to describe any of them yet, in view of patent applications now pending.
Bradley A. Fiske, U.S.N.

Norfolk, Va., Feb. 12.

Answers.

49. Influenza.—In reply to the query in *Science* of Jan. 17, "Has epidemic influenza been known to cross the equatorial line?" I beg to append the following: The epidemic of 1836-37, which originated probably in Russia, "also spread to the southern hemisphere, and prevailed at Sydney and the Cape of Good Hope at the same time that it visited the north of Europe" (*Cyclopædia of Medicine*, Von Ziemssen, ii. p. 522).
Harvey B. Bashore.

West Fairview, Penn., Feb. 17.

INDUSTRIAL NOTES.

Improvements in Electric Motors.

In *Science* of Dec. 13, the Crocker-Wheeler electric motor, as applied to pumps and fans, was illustrated and described. The accompanying engravings show the improved motor as now manufactured by the Crocker-Wheeler Company, and also an improved starting-switch and device for adjusting the speed and power.

The improved motors contain all the features which, during several years' experience in the manufacture and operation of a large number of successful motors, have been found to increase their strength, economical use of current, general appearance, and their convenience for starting, stopping, and regulating. The construction has been improved to permit the use of wire on the armature two sizes larger than has been possible before, therefore making the winding much less liable to breakage, and enabling it to carry more current without heating. The $\frac{1}{4}$-horse-power motor is made to run at a practically steady speed, even with the most sudden and heavy changes of load. The base is made extra heavy, with the centre of gravity low, to add to the steadiness and solidity of the machine. The bearings are made of the best babbitt metal, the same as on large steam-engines and other first-class machinery, this being a new feature in small motors.

The efficiency of these machines, or the amount of power that they will furnish from the consumption of a given amount of electricity, has been materially increased. The direction of rotation is made reversible by simply changing the brush-holders, and considerable advance is made in the finish of the machine, the best workmanship being bestowed upon every part.

With the adjusting-switch in the position shown in Fig. 2, these motors run at full speed (1,900 revolutions per minute), and in the position shown in Fig. 3 they run at about half speed. The windings are so proportioned that in either case the proper current flows through, and runs the motors at the respective speeds with high efficiency.

The new "K" winding on these machines takes the place of the lamp frequently used on the top of other motors to vary the speed. It is a radical improvement in this respect, saving the current usually wasted on the lamp, and giving a means of instantly changing the motor's speed by turning the knob

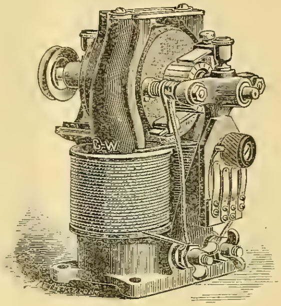
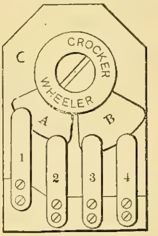
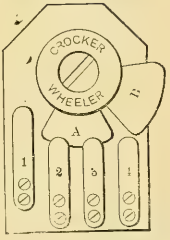


FIG. 1.

without the use of resistance-boxes or the trouble of unscrewing and removing a lamp. The starting-switch is shown in Fig. 4.

The arrangement is adapted to running fans, pumps, and all kinds of machinery that are not subject to extreme variations, and is superior for these purposes on account of the facilities it





FIGS. 2 AND 3.

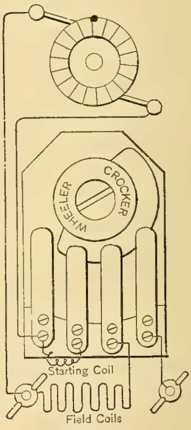


FIG. 4.

offers of changing the speed. For work which is variable and sometimes thrown off entirely, as in the case of buff-wheels, lathes, etc., the constant speed motors are preferable, because they maintain steady speed at all times.

The Springfield Industrial Drawing-Kit and Drawing-Model Support.

Every draughtsman finds a drawing-board, a T-square, and one or more triangles as essential to his work as are the scale of inches and the compasses, and every pupil in mechanical drawing requires a similar outfit. The Springfield industrial drawing kit, shown in the illustrations, is intended for use in grammar and high schools, the family, the office, and the shop.

The set (Fig. 1) consists of a board about ten by twelve inches,

to which a pad of drawing-paper is fastened, and a wooden T-square and triangles of suitable size. The draughtsman or architect fastens the piece of paper on which he is working to his drawing-board by means of thumb-tacks; but this method has proved both expensive and annoying in the primary grades of schools, so the scheme of the pad has been devised. This pad is slightly glued to the board at each corner, and the sheets com-

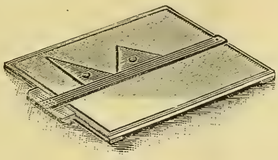


FIG. 1.

posing it are torn off one by one as fast as they are used. The pads are sold separately from the boards, and can be renewed as often as circumstances require. The T-square is a substantial instrument, having a blade fourteen inches long. The head is adapted for use with the pad, as well as the single sheet, being unusually thick, so as to allow it to have a hold on the board when the pad is of full thickness. The two triangles, commonly

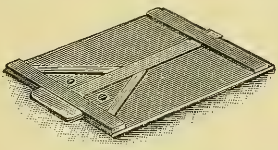


FIG. 2.

called the 45° and 60° triangles, include the standard angles, 90°, 45°, 60°, and 30°.

As a convenience in keeping the several pieces of the set together, the back of the board is provided with grooved cleats, and the cross-cleats at the two ends of the board are slotted to receive the tongue of the T-square, as shown in Fig. 2.

A few sample boards were placed in the schools of Springfield, Mass., by way of experiment, three years ago, and since that time their use has spread to such cities as Providence, R.I.; Hartford, Conn.; Harrisburg, Penn.; Cambridge, Chelsea, Quincy, Brookline, Mass.; Pawtucket, R.I.; and various other places; while the demand is constantly increasing.

A kit of larger size, called the No. 2 kit, double the size of the other, and without pads, is also made, intended for the use of advanced pupils and draughtsmen.

In connection with these instruments, the manufacturers, the Milton Bradley Company of Springfield, Mass., have just put on the market a support for models used in drawing (Fig. 3). It is so made that it may be attached to the ordinary school-desk, and removed at pleasure. Now that form-study has become a legitimate branch of every well-devised school course, there is a necessity that the pupils' desks shall be properly equipped for

FIG. 3.

the pursuit of this study, which is equally urgent with the demand that they shall be supplied with conveniences for writing. The support for drawing-models shown in the illustration can be readily adjusted, and easily removed from the desk at pleasure. The wooden table on which the models rest, within easy reach of the pupil sitting at the desk, is supported by a wooden rod, which passes through a hole in the top of the desk, and also through the shelf underneath. A metallic cam attached to the top of the desk, at the corner opposite the ink-well, holds the rod and the table at any desired height. The table can quickly be removed from the rod, and may be placed in the desk, or collected with those from the other desks, and kept in a suitable cupboard when not in use. The rod is then dropped to the level of the desk-top, so that nothing is seen above the desk.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Feb. 15.—Gardiner G. Hubbard, An Account of Stanley's Discoveries in Africa; C. D. Walcott, A Study in Structural Geology.

Appalachian Mountain Club, Boston.

Feb. 14.—F. H. Chapin, Climbs in the Cañon of the Rio Mancos, Col.: A Visit to the Homes of the Cliff-Dwellers.

Boston Society of Natural History.

Feb. 19.—Samuel Garman, Some Recent Discoveries in Caves; W. O. Crosby, A Large Granite Bowlder in Madison, N.H., and The Occurrence of Decomposed Granite in Blandford, Mass.

Publications received at Editor's Office, Jan. 27–Feb. 15.

ASTRONOMICAL Observatory of Harvard College, Annals of the. Vol. XXI. Part I. Observations of the New England Meteorological Society in the Year 1888. Cambridge, W. H. Wheeler, pr. 105 p. 4°.

——Same. Vol. XXII. Meteorological Observations made on the Summit of Pike's Peak, Colorado. . . January, 1874, to June, 1888. Cambridge, John Wilson & Son. 475 p. 4°.

BALL, R. S. Time and Tide, A Romance of the Moon. London, Society for promoting Christian Knowledge; New York, E. & J. B. Young & Co. 192 p. 16°. $1.

BRAY, H. T. The Evolution of a Life; or, From the Bondage of Superstition to the Freedom of Reason. Chicago, Holt Publ. Co. 436 p. 12°. $2.

CLUTTERBUCK, W. J. The Skipper in Arctic Seas. London and New York, Longmans, Green, & Co. 271 p. 12°. $2.25.

CRAWLEY, E. S Elements of Plane and Spherical Trigonometry. Philadelphia, Lippincott. 159 p. 12°. $1.

DAVIS, E. H. The Third Reading-Book. Philadelphia, Lippincott. 336 p. 12°. 56 cents.

GOODWIN, W. W. Syntax of the Moods and Tenses of the Greek Verb. Boston, Ginn. 464 p. 8°. $2.15.

HALL, I. F. The Riverside Manual for Teachers. (Riverside Literature Series, extra No.) Boston and New York, Houghton, Mifflin, & Co. 16°. 15 cents.

NORTON, C. L. A Handbook of Florida. Part I. The Atlantic Coast. New York, Longmans, Green, & Co. 240 p. 16°. 50 cents.

PHYSICAL TRAINING Conference, a Full Report of the Papers and Discussions of the, held in Boston in November, 1889. Ed. by Isabel C. Barrows. Boston, G. H. Ellis. 135 p. 8°.

SALOMONS, D. Electric Light Installations and the Management of Accumulators. New ed. London, Whittaker & Co.; New York, Van Nostrand. 334 p. 12°. $1.50.

SCHENCK, F. S. The Ten Commandments in the Nineteenth Century. New York and London, Funk & Wagnalls. 139 p. 12°.

SICKELS, I. Exercises in Wood-Working, with a Short Treatise on Wood. New York, Appleton. 158 p. 8°.

THURSTON, R. H. A Handbook of Engine and Boiler Trials, and of the Indicator and Prony Brake. New York, Wiley. 514 p. 8°. $5.

TIDY, C. M. The Story of a Tinder-Box. London, Society for promoting Christian Knowledge; New York, E. & J. B. Young & Co. 105 p. 16°. 80 cents.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Corresp ndence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn

I wish to exchange or purchase well-fixed or hardened vertebrate embryos for sectioning. Desire specially reptilian embryos, but will be glad to secure any material that I do not possess. Thomas G. Lee, M.D., Histological Laboratory, Yale University, New Haven, Conn.

Wanted—Books and journals, American or foreign, relating to Photography—exchange or purchase. C. W. Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St, Davenport, Iowa.

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*. *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmola patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes, etc., wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred.—James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.—D. E. Willard, Albion Academy, Albion, Wis.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

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WANTED—Hall's works on Palæontology, and other works giving plates which show fossils of the Niagara Epoch. Address M. D. Sullivan, St. Ignatius College, Chicago, Ill.

WANTED—Set of Encyclopædia Britannica, Scribner's edition, at a discount. R. T. Robinson, 50 Pemberton St., North Cambridge, Mass.

IS THERE any device at present in use for grooming horses by electric power? Is there any power machine for cutting heavy cloth in clothing manufactories, carpet houses, etc.? Any reader having information on these points would confer a favor by addressing Mills, care of SCIENCE.

WANTED.—In the Peekskill Military Academy for Sept., 1890, an instructor in chemistry, physics and mathematics. Address, with full particulars, J. N. Tilden, Peekskill, N. Y.

A YOUNG MAN desires, about the 1st of July, a position as laboratory assistant, or as instructor in chemistry, physics, and lesser mathematics. References as to ability and character. 44 P.M.A. Address R. L. Porter, Penn. Mil. Acad., Chester, Pa.

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WANTED.—To correspond with conchologists in America, especially in California, with a view to exchange. Many British land, fresh water, and marine duplicates; some foreign. Address Mrs. FALLOON, Long Ashton Vicarage, Bristol, England.

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SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 369.

NEW YORK, FEBRUARY 28, 1890.

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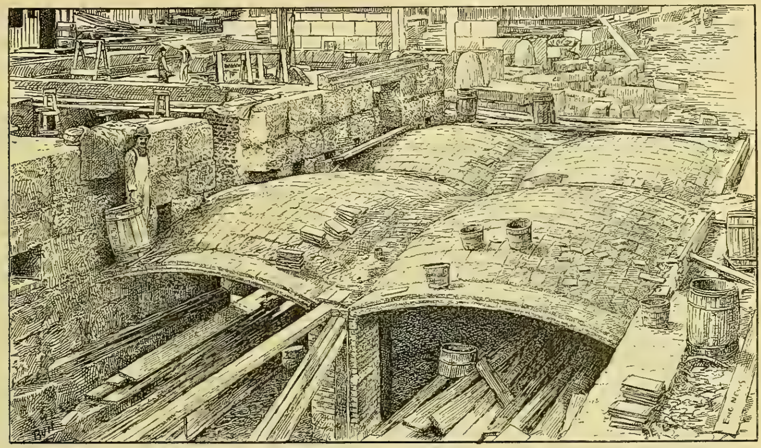
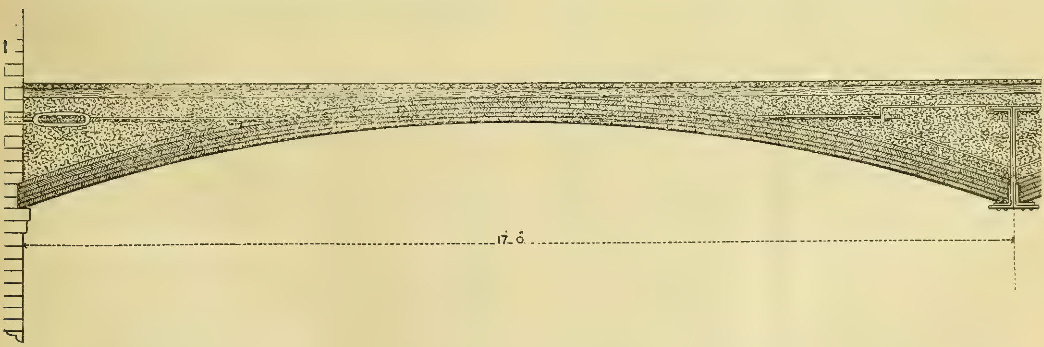
A NEW SYSTEM OF FIRE-PROOF FLOOR-CONSTRUCTION.

THE Guastavino Fire-proof Construction Company of this city is now introducing a new system of fire-proof floor-construction, which has many features of superiority to the ordinary system, and is especially valuable in that it reduces the cost of a fire-proof floor by nearly one-third.



TILE ARCHES IN NEW PUBLIC LIBRARY BUILDING, BOSTON.

The general features of the construction, as described in the *Engineering News*, are the use, to form the arches, of a hard, well-burnt clay tile, about one inch thick, six inches wide, and twelve inches long, laid flat, with the several courses breaking joints. A very light centring is used, and the first layer of tiles is laid with a quick-setting mortar, composed principally of plaster-of-Paris. The other layers are laid in a mortar composed chiefly of Portland cement. Its exact composition is a secret; but it adheres so closely to the tile, and is so firm and solid when it has fully hardened, that its strength is about equal to that of the tile itself, and the whole arch is practically a monolithic mass, showing no tendency to separate at the joints more than at any other point.



A NEW SYSTEM OF FIRE-PROOF FLOOR-CONSTRUCTION, ARION CLUB BUILDING.

These tile arches are built in spans of five feet and upward, and either as plain cylindrical arches or as dome arches, as shown in the perspective view. The weight of the tiles is about one hundred pounds per cubic foot: hence an arch built of three layers of tile, which may be used for spans as great as twelve feet, will weigh about thirty-five to forty pounds per square foot, or but little more than half the weight of the brick

arches as ordinarily constructed. The principal saving, however, is in the reduced number of beams used, owing to the considerably greater span which may be made with the tile arch. The prices for the work vary, of course, with the span and number of courses, and also with the location and size of the building under contract.

The system is by no means an experimental one, as a large number of buildings have already been erected with it, and many others are in process of construction. Among notable buildings in and near New York City, employing this method, are the Mount Sinai Hospital, the Young Women's Christian Association building, the Plaza Hotel, and the two new Edison Electric Illuminating Company's buildings. The new Public Library building at Boston is also being built by the system, and some of the domed arches under construction are shown in the accompanying engraving, made from a photograph. The other engraving shows the arches in the Arion Club building at Fifty-ninth Street and Park Avenue. In the Arion Club building the arches are seventeen feet span. In the Young Women's Christian Association building there are some arches of twenty-nine feet span. The company is now erecting a building at Fifty-seventh Street and Eleventh Avenue in this city, which will have an arch of forty feet span for the roof.

With these tile arches, some very fine architectural effects are possible. Where it is desired to leave the soffit of the arch exposed, a special flanged tile can be used which shows no joints when laid. Where desired, also, enamelled tiles can be used for the soffit, of such color as the architect may desire.

The great points of excellence claimed for this type of construction, however, are cheapness and great strength. In the construction of the Boston Public Library building, a heavy iron column fell from a derrick, and went end first through one of these arches. The arch, however, was not shattered by the blow, but remained solid and unharmed except for the hole broken out where the column went through. This system of construction has been in use in Spain for a number of years, and some notable buildings have been erected by it. One which should interest factory-builders in this country is a one thousand loom silk-mill at Barcelona, 371 feet by 330 feet in size. The weaving-room occupies the whole of one floor, and its arched ceiling is supported by 336 iron columns.

WAR-BALLOONS.

IT has hitherto been generally believed that the Montgolfier or hot-air balloon cannot be used in tropical climates. If this were true, ballooning for war purposes would of course be impossible in places where coal-gas could not be obtained. We learn from the London *Times* that Mr. Percival Spencer, who has been making a series of interesting balloon experiments in Central India, has succeeded in showing that the theory is without foundation. At Secunderabad, in presence of the garrison and a crowd of European and native spectators, he lately made an ascent in his patent asbestos balloon. The inflation was effected by the burning of methylated spirit inside the balloon, which was held in place by twenty-five soldiers of the Bedford regiment until the word to let go was given. After rising to a considerable height, the aeronaut descended by means of his parachute. The spot where the ascent was made is over two thousand feet above the level of the sea, and the achievement was all the more remarkable because of the sultry climate and the great rarity of the air.

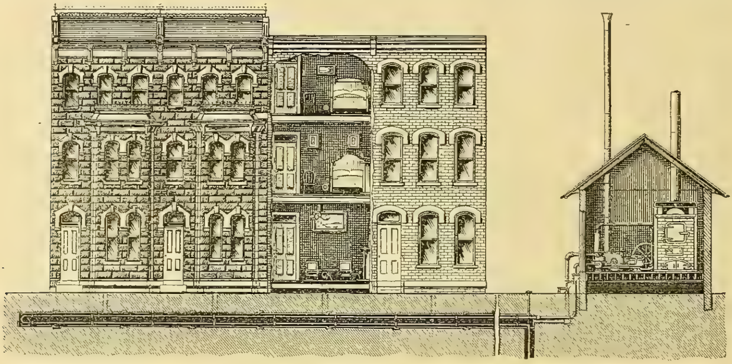
HEAT AND VENTILATION.

To every man, woman, and child in this country this is an important and interesting subject. Science has made more progress in almost every other direction than in this, and naturally all improvements in heating and ventilating are carefully examined. The Hon. Hugh O'Brien, ex-mayor of Boston, at a public meeting and in addressing the mayors of New England, said, "In my judgment, there cannot be found in the city of Boston one single public building which could be considered as properly ventilated, and I would strongly recommend a fair and careful consideration of the Timby system of ventilating."

This Timby system is now attracting universal attention, especially in New England, and we are gratified to be able to present to our readers the plan given herewith, showing the manner in which this system is introduced. It is applied here as a street system, pure heated air being introduced into all the houses on a line of street from a centrally located plant, precisely as gas and water are introduced. Pure fresh air is received through a pipe at an elevation above the surrounding houses, and this air is driven by a fan through a conduit, and over pipes filled with hot water, at such a pressure as admits of its being distributed into all the apartments of any house on the line. This heat being regulated by a register in the various rooms, the temperature can be secured as desired. Not only can this be accomplished, but, when so desired, the air can be cooled; so that in Southern climes, or during heated terms, each house on the route can be made perfectly comfortable. So much for the street or city system.

When required for a single building, say a schoolhouse, church, or hospital, the plant can be placed in the basement, and the fresh air brought from above, driven in the same manner into all the rooms, heated or cooled as desired. When necessary, a disinfectant can be used, and a block of houses, a street, or city thoroughly fumigated in a few minutes. The adoption of the Timby system for our schoolhouses will insure to every scholar the amount of fresh air changed as required, which at present is the crying want of our educational system.

With the great progress in cooking by gas, it is not unreasonable to suppose that eventually the demand for fuel for use in

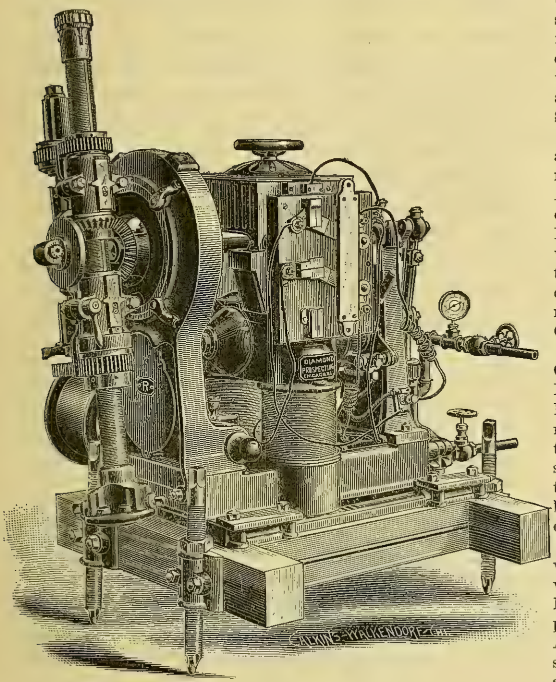


THE TIMBY SYSTEM OF HEATING AND VENTILATING.

our dwelling-houses will be entirely done away with. Already, within a few months past, companies have been formed, for the purpose of introducing this important and necessary invention, in Washington, D.C., Boston, Mass., and Portland, Me ; and others are in process of organization in Providence, R.I., New York City, and Hartford, Conn. Parties wishing information on the subject can address the secretary of the New England Heating and Ventilating Company, 85 Water Street, Boston, Mass.

AN ELECTRICAL DIAMOND-DRILL.

THE electric motor is rapidly winning an important place for itself in mining operations. Already there are electric coal-cutting machines, electric hoists, electric mine locomotives, and electric drills, some of which have been described and illustrated in these columns. One of the latest devices in this line, the Sullivan electric diamond-drill, operated by a Thomson-Houston motor, is shown in the accompanying illustration. In the form shown, the drill is intended mainly for prospecting, though of course it is equally well adapted to underground work. One of the difficulties heretofore encountered in using diamond-drills in underground work, as well as in prospecting where the ground is rough or mountainous, has been that of getting power to operate the machine. By the use of electric power, however, this difficulty is entirely overcome. The dynamo may be located at any convenient point, and the current transmitted to the drill by insulated wire in the usual manner.



AN ELECTRICAL DIAMOND-DRILL.

This machine is compact, occupies but little space, and may be operated by any intelligent workman. It will drill a hole to a depth of three hundred feet, and in any direction, the drill being fed forward by a friction feeding device at a speed proportioned to the hardness of the material operated upon. The machine is manufactured by the Diamond Prospecting Company of Chicago.

THE ELECTRIC-LIGHT CONVENTION.

THE eleventh convention of the National Electric-Light Association was held at Kansas City, Mo., on Feb. 11 to 14, the sessions being held in the Coates Opera House. When the convention was called to order by the president, E. R. Weeks, there were about one hundred and fifty members and guests present, the attendance increasing to three hundred before the convention ended. After an address of welcome by the mayor of Kansas City, President Weeks briefly reviewed the growth of the association, and outlined the programme arranged by the executive committee. The rest of the session was taken up by routine business.

On the 12th the committee on the abolition of duty on copper presented its report, and recommended that all members place themselves in communication with their respective members of Congress, with the view of securing the removal of the duty on copper. The committee on standardizing potentials on electric street-railways and that on harmonizing insurance and electrical interests presented reports, which were full of interest, and evoked considerable discussion. The papers read at this session were one on central-station construction, by C. J. H. Woodbury, and one on the history and theory of the steam-engine, by F. E. Sickel.

On Thursday the 13th, after the reading of communications and action thereon, George E. Palmer read a paper on the economic generation of steam, written by George H. Babcock. After this and the papers of the previous session had been discussed and commented on by the members, a paper entitled "A Recent Edison Central Station and the Results thus far obtained" was read by C. J. Field. This paper brought out a long and interesting discussion. T. Carpenter Smith followed with a paper on a universal system of central-station accounts. At the afternoon session the following papers were read and discussed: "The Cost of the Products of Central Stations," by A. J. DeCamp; "Nine Years with the Arc-Lamp," by M. D. Laws; "Arc-Light Carbons," by E. F. Peck; "How our Paths may be Paths of Peace," by H. W. Pope; and "Safety and Safety Devices in Electrical Installations," by Professor Elihu Thomson. The report of the committee on data was then received, and a resolution adopted petitioning Congress to authorize and direct the superintendent of the census to collect certain data in relation to the electrical industry in addition to that already provided for by law, and asking for a special appropriation of fifty thousand dollars to carry on the work.

On Friday, the last day of the convention, the following papers were read and discussed: "Electricity as applied to Street-Railways," by F. J. Sprague; "Prodigality in Economy," by C. C. Haskins; "Line Insulation from the Standpoint of Practical Experience," by C. A. Harber; and "How to locate Grounds on Arc-Light Circuits," by J. E. Lockwood. At the afternoon session, after an exhibition of and address upon the phonograph and graphophone, by E. H. Johnson, committees were appointed on the revise of the by-laws and constitution of the association, on underground conduits and conductors, and on the relations between parent companies and sub-companies.

The officers for the ensuing year are as follows: president, M. J. Perry of Providence, R.I.; first vice-president, E. A. Maher, Albany, N.Y.; second vice-president, C. L. Edgar, Boston; executive committee, C. R. Huntly (Buffalo, N.Y.), chairman, E. R. Weeks (Kansas City), James E. English (New Haven, Conn.), J. J. Burleigh (Camden, N.J.), M. D. Law (Philadelphia), M. J. Francisco (Rutland, Vt.), A. F. Mason (Boston), J. A. Seely (New York), H. K. Thurber (New York). The semi-annual meeting next August will be held at Cape May, N.J.

During the four days of the convention there was an extensive collection of electric apparatus on exhibition in Casino Hall, near the headquarters of the association. The hall was brilliantly illuminated by both arc and incandescent lights, and the attendance was good. Electric motors of various sizes were exhibited by the Sprague, the Crocker-Wheeler, and the C. & C. motor companies of this city, the Elektron Company of Brooklyn, the Detroit Motor Company of Detroit, the Baxter Company of Bal-

timore, the Eddy Company of Windsor, Conn., the Jenney Company of Indianapolis, and the Rockford Electric Company. Wires for electrical uses were shown by the New York Insulated Wire Company, the Edison Machine Company, the Electrical Supply Company of Chicago, the India-Rubber and Gutta-Percha Company and the Bishop Gutta-Percha Company, the Ansonia Brass and Copper Company, and the Okonite Company. There was also a fine display of Grimshaw wire. Carbons were exhibited by the Standard and the National carbon companies of Cleveland, conduits for inside electric wiring were shown by the Interior Conduit and Insulation Company of this city, and an interesting exhibit of the new Edison-Lalande batteries was made by the Edison Manufacturing Company of Newark. The elements of this new battery are zinc, a caustic-potash solution, and oxide of copper, the latter being made up in the form of a plate and clamped in a copper frame. The zinc plates are suspended from a binding-post resting on the cover and hanging on either side of the oxide plate. The caustic potash is furnished in shape of sticks, two sticks accompanying each cell. These sticks are placed on either side of the zinc, and the cell is filled with water within an inch of the top, a thin layer of oil being then poured over the top of the water in order to prevent formation of creeping salts. The internal resistance of the cell is only .025 of an ohm. The electro-motive force on open circuit is about one volt, .8 of a volt on light closed-circuit work, and about .7 of a volt on heavy closed-circuit work.

THE FISHERIES OF NEW ZEALAND.

THE colony of New Zealand is now celebrating its jubilee — the jubilee of its separation from the parent colony of New South Wales — by a series of demonstrations at Auckland, its chief northern town, and by an intercolonial exhibition at Dunedin, the southern metropolis. The latter town is barely forty-two years old, its first settlers having landed from Scotland in March, 1848. It is therefore all the more remarkable to find it now holding an exhibition which, alike by its size, excellence of character, and the illustrative nature of its exhibits, is attracting attention throughout Australasia and Polynesia.

The island colony has hitherto developed only two of her natural sources of wealth; namely, her mines and her agriculture (including pastoral resources under this head). Both, but especially the former, are still capable of great extension and improvement. The third great source to which we desire to draw attention at present is that of her fisheries. These are still almost totally undeveloped, but in time to come they will certainly occupy a very important position. In the Dunedin exhibition there is a very fine display of the mineral, agricultural, and pastoral wealth of the colony, while the fisheries are almost unrepresented. There are no doubt many hundreds of individuals dependent on the industry for their daily bread; but, while the amount of capital invested in agriculture and mines amounts to millions of dollars, that engaged in the fisheries can only be counted by thousands. The promoters of the exhibition obtained almost no response from those occupied in the fishing industry, few of them being able, or finding it to their advantage, to figure as exhibiters. As population increases and means of transit are improved, this state of affairs gives promise of being altered.

A glance at a map of Australasia shows, that while Australia has a great area of land as compared to her coast-line, New Zealand, on the other hand, reverses these conditions. Her coast-line extends to about 5,300 miles, and is indented by numerous deep bays, fiords, and estuaries. At all seasons of the year the seas round her coasts literally swarm with fish, most of them of excellent quality, and many very suitable for canning or curing. In past days New Zealand was noted for her whale and seal fisheries, and American vessels reaped a very considerable share of the maritime harvest; but indiscriminate fishing has nearly exterminated these animals in the local waters, and the enterprise now rarely proves remunerative.

Hitherto very little organized effort has been put forth to develop the fishing industry; but very recently the freezing of fish for the Melbourne and Sydney markets, and the sending over of fresh fish in ice, are both being tried with great promise of success. The appliances in use are still very primitive, small open boats with seine fishing-nets being used in most parts. Only in a few localities are there trawlers or well-boats. Therefore the fishing is limited to inshore work, and is largely conditioned by the weather. Very little is known of the ocean-currents and of their variations of temperature; yet, from what little has hitherto been learned of the distribution of the various species of fish, the latter seems to depend to a considerable extent upon the former. Still less is known as to the development and life-history of the fish themselves. When it is remembered that important questions of this nature have only of very late years received attention from the scientific men and the governments of the oldest and wealthiest countries, it is not to be wondered at if the government of one of the youngest communities of the world has not yet found time or means to do any thing in this direction. The Marine Department has done a little, by way of commencement, in obtaining regular records from the lighthouse-keepers round the coast; but as none of these men are trained observers, and many of them are totally ignorant of the subject, the results, except in a few instances, have not been satisfactory.

The trade returns of the colony give no information as to the value of the fish taken for home consumption, but the export and import returns show that the local supply is still barely equal to the demand. During the six years ending 1885, the colony imported fish (dried, pickled, salted, potted, and preserved) to the value of £252,000, on which the government levied £31,887 as duty. During the same period the export only reached £3,031. In 1888 the imports were as follows: dried, pickled, and salted fish, to the value of £6,006, chiefly from Great Britain; and potted and preserved fish, to the value of £22,361, from Great Britain and the west coast of the United States. On these two items the government realized a duty of £6,062. The value of fish exported during 1888 was £7,450. This is exclusive of the oyster-fishery returns. The export of these mollusks in 1888 was valued at £11,927. These figures show that the outside trade in fish is still in its infancy, and is capable of immense extension. The number of species of marine fish already described as occurring in the coastal waters of New Zealand is close on two hundred; and of this number, over thirty are used as food, and appear in the markets. Many are locally called by names familiar to the settlers who emigrated from Britain, as, for example, cod, haddock, perch, etc.; and the general facies of the fishes of New Zealand is similar to that of the northern hemisphere. More than one-half of the described species are peculiar to the New Zealand seas, but a large percentage, including many pelagic forms, are common to Australasian waters.

One of the most valuable and abundant food-fishes of the colony is the hapuka or groper (*Oligorus gigas*), which is taken with bait all round the coast in from twenty to fifty fathoms. It is a big heavy fish, sometimes nearly six feet long, and varying in weight from forty to one hundred and twenty pounds. Its flesh is very solid and rather coarse, but admirably adapted for curing.

The kahawai (*Arripis salar*) is another abundant fish, especially in the northern portion of the colony. It appears to be migratory, swarming in the warmer seas during the summer months, but avoiding the cold southerly current which washes the southern and south-eastern coasts of the South Island. It is a handsome fish, somewhat resembling a small salmon in appearance, and running from two to seven pounds in weight. It is a capital fish for sport, and takes the fly or spoon-bait readily. The Maoris used to catch it by a bit of pawa-shell (*Haliotis iris*), the bright iridescent hues of which, when drawn rapidly through the water, gave the appearance of a fish swimming quickly. The writer has caught it in the Bay of Islands with such a bait, towing behind a yacht which was scudding along in a half-gale at twelve knots an hour. The

kahawai appears very commonly in the markets, but its flesh is rather dry.

The snapper (*Pagrus unicolor*) is also very abundant, and is one of the best edible fishes in these seas. It is taken up to thirty inches in length, and, though commonly from five to ten pounds, is not infrequently twenty-five pounds in weight. It may be taken by bait, and is a grand fish for sport, but it is commonly caught in seine-nets, in which enormous hauls, weighing several tons, are sometimes taken. Two species of *Latris*, known respectively as trumpeter and moki, are common round the coast. The first is always taken by bait, and the latter only by seine-nets or trawls. They are deep and compressed in form, and range up to twenty or thirty pounds in weight, though often brought to market when only weighing two or three pounds. They are two of the best curing fishes in the colony.

The fish most valued for its gastronomic qualities is the frost-fish (*Lepidopus caudatus*), which is very similar to if not identical with an Atlantic species. Indeed, it is one of the most remarkable features of the fish fauna of the south temperate zone that it resembles in general features that of the north temperate zone, from which it is separated by a totally dissimilar tropical fauna. The frost-fish is a long, narrow, silvery fish, which is apparently never taken either in nets or by bait, but gets stranded on sandy beaches, especially after cold frosty nights: hence its popular name. Numerous theories have been advanced as to the cause of its coming ashore, but no satisfactory explanation has yet been given. Numerous papers on the subject are to be found in the volumes of the "New Zealand Institute Transactions" and in the *New Zealand Journal of Science*, but the subject has not been cleared up. The fish commands a ready sale at a high price, — often as much as half a crown per pound,—and hence is never cured.

Another important pelagic species is the voracious barracouta (*Thyrsites atun*), which appears in enormous shoals about October, and remains on the coast for seven or eight months. It is a common South-East Australian and Tasmanian fish. It is a long narrow fish, bluish-white in color, usually from thirty to thirty-six inches in length, and weighing five or six pounds. It flashes through the water like a knife, and, though it takes bait readily, is not a pleasant creature to hook, as its formidable teeth will cut through any line. Sometimes when half a dozen lines are out from a boat for cod, a barracouta will seize one of the hooks, and, dashing off at a great pace, will in half a minute kink all the lines into an almost inextricable tangle. The usual mode of capture is very simple and interesting. The writer sat on the cliffs at Otago Heads on a summer's morning, watching the fishermen in the still water down below filling their boats. The bait used consists of a piece of red-cedar wood with a bent nail driven through it near one end. This is fastened to a couple of feet of stout cord, which again is attached to the end of a short strong rod. As soon as a shoal is observed to be passing, the oars are unshipped, and each of the two men in the boat, seizing his rod, begins to whisk it round and round in the water. The fish dash at the bait, and are rapidly jerked into the boat, several being often caught in the space of a minute. In perhaps two or three minutes the shoal is past, and the boat is again pulled about till another shoal is met with. The flesh of the barracouta is firm and white. It is especially palatable when smoked, and in this state is exported to a considerable extent to New South Wales and Victoria.

The only true cod (*Gadus Australis*) found in New Zealand waters is called locally the haddock, and is not common. The red cod (*Lotella bacchus*), on the other hand, is extremely abundant, and is also an excellent fish for curing. Its usual weight is from four to five pounds, though it is taken up to ten pounds. Another equally good fish is the representative of the northern fish of the same name,—the ling (*Genypterus blacodes*). This is very common in the southern part of the colony. The so-called rock-cod or blue cod (*Percis colias*), which belongs to a totally different family of fishes from the *Gadidae*, is abundant in all rocky parts of the coast.

The gray mullet (*Mugil perusii*) is met with in enormous quantities in the northern part of the colony, and especially in tidal estuaries. It is the richest of all New Zealand fishes, and is now being extensively canned as well as cured for export in the Auckland and Kaipara harbors. According to Sir James Hector, the Maoris frequently catch this fish on still moonlight nights by paddling their canoes close to the banks of the streams. The fish are startled by the beat of the paddle, and, leaping up, fall into the canoe. The fishermen take them in large seine-nets, as many as two thousand fish at a time having been recorded; and, as each fish weighs from one to four pounds, it sometimes happens that the nets tear with the weight of the haul. The sea mullet (*Agonostoma forsteri*), which is very abundant round the coasts, is a much smaller fish, and not so rich in quality. It is usually caught in all the harbors by persons fishing from the jetties. This fish is sometimes called the herring in popular parlance, but a fish (*Chanos salmoneus*) more closely resembling the true herring is taken occasionally by the trawlers; and, when this mode of fishing is more commonly resorted to, it will no doubt be a common fish in the market.

The true pilchard or sardine (*Clupea sagax*) occurs in enormous quantities round the coasts. Its capture and curing are made a specialty in Queen Charlotte and Pelorus Sounds, and the cured fish is known in the colony as the Pictou herring. An anchovy (*Engraulis encrasicholus*, var. *Antipodum*) has also been taken in the Thames estuary, but not yet in any quantity.

Other fishes common in the local markets are horse mackerel or scad (*Trachurus trachurus*); trevally (*Caranx georgianus*); king-fish (*Seriola lalandii*); John Dory (*Zeus faber*); mackerel (*Scomber australasicus*); gurnard (*Trigla kumu*), called by the local name of "Jack Stuart" in the southern part of the colony; gar-fish (*Hemiramphus intermedius*); butter-fish (*Coridodax pullus*), which is commonly called kelp-fish because usually found among the seaweed fringing inshore rocks and reefs; and the skate (*Raja nasuta*).

A very fine flounder (*Rhombosolea monopus*) is common in all the shallow estuaries, bays, and coastal lagoons. It is the fish most commonly sold in the markets the whole year round, and is certainly very good eating. A sole (*Peltorhamphus novæ-zealandiæ*) and a sole-like flounder (*Rhombosolea leporina*), commonly known as "yellow-belly," are also frequently caught.

Reference has been made in previous numbers of *Science* to the great success which has attended acclimatization efforts in the fresh waters of the colony. Most of the rivers and lakes now teem with trout of several kinds, including the beautiful American brook-trout (*Salmo fontinalis*). Salmon (*S. salar*), perch, tench, and cat-fish are increasing in various parts. Already the various acclimatization societies raise a considerable amount of revenue from licenses, and sales of fish and ova, and no doubt every year the value of the inland fishery will increase. The great experiment, that of the complete acclimatization of the salmon, has not yet been accomplished, but breeding-fish are now to be found in several ponds, so that the supply of ova is assured.

Outside of fishes proper, there are only two species which attract much notice on account of their economic importance: these are crayfish and oysters. The former (*Palinurus*) occurs on all the rocky parts of the coast in great numbers, and is usually taken in a baited ring-net. It is the only representative of the European lobster in these seas. There are no large edible crabs, like those of the northern hemisphere. Shrimps (*Crangon*) and prawns (*Palæmon*, etc.) are hardly ever taken for food, though common enough in places. Oysters are of two kinds, — small rock oysters, which are found all round the coasts; and the mud oyster, of which the most valuable fisheries occur in Stewart Island. The latter kind are very large in size, and fine in quality, and make a formidable mouthful. The quantity dredged has increased so much of late years, that, if not looked after, the beds will soon be exhausted. The export only dates from 1879, when £12 was the declared value. The value has steadily increased each year, standing at £12,000 for 1888. The consumption in the colony must have been very

large, and the low retail price—threepence per dozen—shows how great the take has been.

It is clear, from the mere enumeration of the species named here, that there is great variety in the fish fauna of these islands; and, when the testimony of observers in all parts of the colony as to their immense numbers is taken into account, it is certain that from her fisheries New Zealand will yet reap an immense harvest.

BOOK-REVIEWS.

A Popular Treatise on the Winds: Comprising the General Motions of the Atmosphere, Monsoons, Cyclones, Tornadoes, Waterspouts, Hail-Storms, etc. By WILLIAM FERREL, M.A., Ph.D. New York, Wiley. 8°.

THOSE of us who, about to reach the twoscore prime of middle age, nevertheless feel a little hurt at the respect shown for our advanced years by a younger generation who call us old, may take comfort on realizing that the science of meteorology has been made over again by a man whose labors upon it began only when he had reached our measure of life. William Ferrel was born in 1817, a farmer's boy in Pennsylvania. He grew up in Virginia, dividing his time between the field and the rough country schoolhouse. A love for mathematics then led him into teaching, and afterwards to our Nautical Almanac Office. In 1856, at the age of thirty-nine, Maury's facts made him so dissatisfied with Maury's impossible theory of the winds, that, at the solicitation of a friend, he wrote an outline of what seemed to him a truer conception of the general circulation of the atmosphere; and with this essay the new school of mathematical meteorology began. A few years ago the appearance of Ferrel's "Recent Advances in Meteorology" gave occasion to state the outline of his theory,[1] in comparison with others generally in vogue. Another volume now allows another reference to this attractive subject.

This "Popular Treatise on the Winds" embodies the substance of a series of forty lectures delivered by Ferrel before a class of army officers of the Signal Service in February and March, 1886. It is now much expanded by deliberate statement of the fundamental principles of atmospheric rest and motion, and is illustrated by abundant citation of pertinent observations and records. The book is too serious, too severely argumentative, for general reading; but it will for a long time have no equal in our language as a volume to which teacher and student may make safe reference in the search for the solution of difficulties. The plan of the book may be judged by a brief review of its contents. It opens with preliminary chapters on the constitution and nature of the atmosphere, and on the motions of bodies relative to the earth's surface; the latter being a subject which Ferrel has made his own, and without which no safe step can be taken in the discussion of atmospheric movements. The third chapter discusses the theoretical circulation of an atmosphere lying on a rotating globe, and heated around the equator, deducing therefrom certain critical consequences, and confronting them with the facts as ascertained by observation. He must indeed be wanting in the scientific turn of mind who does not find mental entertainment in the logical order of investigation here traced out, quite apart from its bearing on the special science to which the book is devoted. Next follow a chapter on the climatic influences of the general circulation of the winds, in the production of wet and dry zones and of wet and dry mountain slopes, and in the determination of equable and variable temperatures on the west and east sides of continents, and another chapter on the monsoons, littoral breezes, and mountain and valley winds, by which the general terrestrial circulation is more or less broken up. Thus the first half of the book is occupied. The second half discusses those great travelling whirls known as cyclones, and the more local tornadoes and thunder-storms, on all of which the impress of Ferrel's methods is most clearly marked.

Through all this there runs a single theme. Some fact of occurrence calls for explanation. A fit explanation is devised, strictly in accord with a full knowledge of physical law, and its consequences are then deduced as minutely as may be. These are matched with the facts, and the validity of the theory is measured by the degree of correspondence then detected. No one can read such a work as this without feeling a distinct intellectual gain from the keen vigor of its methods.

There is one feature in Ferrel's theory of the atmospheric circulation that does not seem to be generally appreciated. We may perhaps best approach it through its misapprehension by certain commentators. Professor Supan, editor of *Petermann's Mitteilungen*, whose extended reviews give us the best means of keeping abreast with the advance of geography in all its branches, referred four years ago to Ferrel's theory in a notice of Sprung's

FIG. 1.

"Lehrbuch der Meteorologie." He said in effect that the distribution of atmospheric pressure was the control, not the result, of atmospheric motion; and that, as there is low pressure at the poles and high pressure at the tropics, the hypothetical return current from poles to equator cannot exist, for it would have to move against the barometric gradients.[1] The same question is asked by M. Léon Teisserenc de Bort, one of the specialists of the Bureau Central Météorologique de France. In an essay on the general circulation of the atmosphere,[2] this author says, "Mr. Ferrel does not explain the cause of the gradient that is directed toward the equator, and that is necessary for the return current from pole to equator, which he places at a middle altitude in the atmosphere. This gradient is the more difficult to explain, inasmuch as the pressure at sea-level decreases towards the pole, and as a similar decrease must exist aloft to determine the flow of the

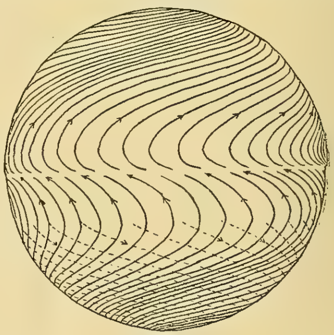


FIG. 2.

upper current from the equator." These criticisms appear reasonable enough at first sight, but this is because they fail to apprehend one of the essential points in Ferrel's theory. The case may be stated in brief as follows:—

Given a uniform distribution of temperature in the atmosphere, its imaginary isobaric surfaces will stand level, essentially equidistant. Given two adjacent regions, one maintained at a higher temperature than the other, the isobaric surfaces can no longer be level or parallel. A convectional interchanging motion will be established, as a consequence of which there will come to be a slight excess of pressure in the colder region. The isobaric surfaces, not parallel, but diverging from the region of cold and compressed air to the region of warm and expanded

[1] Science, iv. 1887.

[1] Petermann's Mitteilungen, Lit. Bericht., 1886.

[2] Ann. Bur. Centr. Mét., 1885, part. iv. Mét. Générale.

air, are no longer level: they are deformed into slanting positions, and the slant or gradient is directed toward the warm region in the lower atmosphere, and toward the cold region in the upper atmosphere. Thus far every one is willing to go: and, if it be desired to try the experiment on a class of intelligent scholars, some live interest in the question may be aroused by asking how far they are individually ready to assert that this simple abstract theory is applicable to the case of the earth; the warm region being the equator, where the mean annual pressure must therefore be low, and the cold region being either pole, where the pressure must be correspondingly high. No more salutory lesson can be given in the danger of the purely deductive method in the hands of others than the masters of a subject, for the high pressure that is confidently expected at the poles does not exist. The pressure there is lower than at the equator. The contradiction of theoretical deduction by well-ascertained fact is of the flattest kind, and the scholar may fairly be excused if for a time he loses faith in a theory that has led him into so blundering an expectation. But when he looks further, and finds that there is a belt of lower pressure at the equator than at the tropics, and that this belt migrates with the seasonal shifts of the heat equator, and that the continents unload their share of atmosphere somewhat in their summer season, it becomes apparent that the theory must be wrong chiefly by omission; and it may be readily shown that the omitted consideration is the effect of the earth's rotation. There are very few men in the world who have for themselves avoided this omission; and of these few, Professor Ferrel is the only one who has given the complete theory the full consideration that it deserves.

The fact that the interchanging convectional circulation of the atmosphere between the equator and the poles takes place upon an earth that rotates on its axis, requires the development of great eastward spiral polar whirls, and the centrifugal force of these whirls greatly deforms the simple arrangement of the isobaric surfaces that would be produced by differences of temperature alone; so greatly, indeed, that the theoretical high pressure of the poles is reversed to actual low pressure. In consequence of this, the gradients of nearly all the atmosphere are directed polewards, the only gradients that lead to the equator being in the lower atmosphere within the tropics, where we have the trade-winds. This may appear more clearly in Fig. 1, which represents a vertical meridional section of the atmosphere, greatly magnified vertically, from pole across the equator to pole; the meridian line being, for simplicity, straightened out from its true semicircular curve. The pressures at the surface are known by observation, being, on the average, about 29.9 at the equator, 30.1 a little outside of the tropics, and perhaps 29.0 at the poles. Remembering that the successive isobaric surfaces diverge from the cold polar regions towards the warm equatorial belt, a number of higher and higher surfaces may be drawn in section, and the prevailing poleward slope of the gradient is then made apparent.

Now, the question asked by Supan and Teisserenc de Bort is practically this: "How does the air, which flows toward the poles on the steep gradient of the upper current, manage to return to the equator against the poleward gradients of the lower levels?" This is as if they asked, "How does the ocean stand thirteen miles higher (i.e., farther from the earth's centre) at the equator than at the poles, instead of at once rushing tumultuously poleward?"

The low pressure at the poles is the indirect product of the initial meridional convectional circulation between poles and equator, and the deformation of the simple convectional gradients thus introduced can never go so far as to stop the convectional motion by preventing the return of the lower current to the equator. The great velocity and consequent great centrifugal force attained by the upper current, as it swings around the pole on the steep upper gradients, enable it to run obliquely against the weaker lower gradients as soon as it encounters them in the descending portion of its convectional circuit. That is the essence of the whole affair, though it may be stated in different ways, from words to formulæ. Perhaps a simpler way of putting it is this. The difficulty comes from thinking that the lower isobaric surfaces slope toward the pole. But it must be remembered that slopes and levels are determined by the local direction of gravity, not by distance from the earth's centre; that the local direction of gravity is determined by the local value of the centrifugal force arising from axial rotation, and the velocity of axial rotation depends on whether the body that is under discussion goes around the axis once in twenty-four hours, as we do who live on the earth's surface, or in a decidedly less time, as the eastward winds do. If the earth had no rotation, its present level surfaces would be called poleward slopes. The winds which move eastward must regard the sea-level as an equatorward slope; and the fast winds of the great eastward whirls around the poles must regard even the lower gradients of the atmosphere as slopes directed toward the equator, and not toward the pole. It is only the lower winds, whose velocity is weakened by surface friction, that have the same opinion of the lower gradients as we have, and obey them by moving obliquely toward the pole. This is not a matter that needs mathematical statement for its demonstration. The rational conception of the process, on which the validity of any mathematical treatment must be based, is sufficient to demonstrate that the isobaric surfaces, whose arrangement is determined simply by differences of temperature, cannot agree in position with those which are, as it were, deformed by the introduction of the deflective forces that arise from the earth's rotation; and to demonstrate, further, that the deformation thus introduced can never go so far as absolutely to stop, although it may greatly retard, the meridional or convectional components of motion, on whose persistence all the other motions depend. The reader of the "Popular Treatise on the Winds" can come to no other conclusion than that the essential nature of the circulation of the winds is such as is here outlined; and the doubts raised by Supan and others will then not be regarded as objections to Ferrel's theory.

The actual circulation of the winds over continents and oceans is greatly complicated by seasonal and topographic influences, as well as by the presence of numerous cyclonic storms, marching in continuous procession around either pole. But the ideal planetary circulation is relatively simple; and, as the graphic illustration of its course is seldom given in more than highly diagrammatic forms, we venture to introduce here a more carefully drawn view of it, the upper winds being exhibited in the northern hemisphere, and the hypothetical return current of middle elevation being drawn on the southern, while the surface winds are in dotted lines beneath. There is much that is hypothetical in this; but it is as a whole well borne out by actual observation. One of the questions that is still open is the latitude at which the upper poleward overflow from the equator has a directly poleward motion. The latitude certainly varies with the altitude, but it does not appear to be more than ten degrees north or south of the equator: for on a poleward gradient, and with a right-hand deflection, both of which are undoubted, the upper overflow cannot long maintain the westward component of motion that it possesses above the equator; and, as a matter of fact, the oblique pole-eastward motion of the overflow has often been observed in the drifting of clouds and in the wind on mountain-tops in the so-called "anti-trade."

The reader must not imagine that all of Professor Ferrel's book is occupied with theoretical discussions. The citation of appropriate facts is plentiful and well selected; quotations are made at length from various sources; and although the winds are, by the title of the work, its main theme, one needs but small acquaintance with meteorology to know that nearly all of the science may be fairly presented under this heading. It is most natural that a course in meteorology should begin and end with a discussion of the circulation of the winds; for pretty much every thing meteorological is, like the deformation of the polar gradients, more or less closely a sequence of the motion of the atmosphere. When the educational value of the study of meteorology is more widely appreciated, as it must be when more of our teachers are familiar with such works as this one of Ferrel's, it may come to be true, as an eminent Scottish meteorologist some twenty years ago imagined it was already at that time, that "in the schools of the United States of America,

meteorological observations and the keeping of meteorological registers form a part of the common education of the people."

W. M. D.

NOTES AND NEWS.

AT the Franklin Institute, Philadelphia, Monday evening, Feb. 17, Mr. George F. Kunz of New York lectured on precious stones, showing lantern illustrations of the Paris Exposition.

— The next meeting of the American Branch of the Society for Psychical Research will be held at the rooms of the Boston Society of Natural History, corner of Berkeley and Boylston Streets on Tuesday, March 4, at 8 P.M. Professor William James will preside. An abridgment of papers by Mr. Frank Podmore and Mr. F. W. H. Myers, on "Phantasms of the Dead," will be read by the secretary. No admittance except by ticket.

— The New York Mineralogical Club made an excursion on Feb. 22 to Philadelphia, to visit one of the principal mineral localities and some important collections. Leaving by the 8 A.M. express, they reached Broad Street Station at 10.10. Here the party was met by representatives of the Mineralogical Section of the Philadelphia Academy. Thence, under the guidance of Mr. Theodore D. Rand, they went by rail to the Soapstone Quarry, on the Schuylkill, crossing exposures in the vicinity of the quarry, of most of the rocks of Philadelphia. Returning to Broad Street between 1 and 2 P.M., they visited the Academy of Natural Sciences during the afternoon, and the celebrated cabinet of Mr. Clarence S. Bement. The return to New York was by the train leaving Broad Street at 8 30 P.M.

— In the "Third Annual Report of the Henry Draper Memorial," attention is called to the fact that the K line in the spectrum of ζ Ursæ Majoris occasionally appears double. The spectrum of this star has been photographed at the Harvard College Observatory on seventy nights, and a careful study of the results has been made by Miss A. C. Maury, a niece of Dr. Draper. The K line is clearly seen to be double in the photographs taken on March 29, 1887, on May 17, 1889, and on Aug. 27 and 28, 1889. An examination of all the plates leads to the belief that the line is double at intervals of fifty-two days, beginning March 27, 1887, and that for several days before and after these dates it presents a hazy appearance. The doubling of the line was predicted for Oct. 18, 1889, but only partially verified. The star was, however, low, and only three prisms could be used, while the usual number was four. The only satisfactory explanation of this phenomenon as yet proposed is that the brighter component of this star is itself a double star, having components nearly equal in brightness, and too close to have been separated as yet visually; also that the time of revolution of the system is one hundred and four days. When one component is approaching the earth, all the lines in its spectrum will be moved toward the blue end, while all the lines in the spectrum of the other component will be moved by an equal amount in the opposite direction if their masses are equal. Each line will thus be separated into two. The predicted doubling of the lines of ζ Ursæ Majoris on Dec. 8 was confirmed on that day by each of three photographs. Two more stars have been found showing a similar periodicity.

— The *Engineer* of Jan. 31 contains a leading article on color-blind engine-drivers, and it is interesting to note what the leading technical journal has to say on the subject: "We do not say that no accident was ever brought about by the inability of a driver to distinguish between a green light and a red one, but we can say that nothing of such an accident is to be met with in the Board of Trade Reports." Our contemporary is of opinion that the testing of the sight of locomotive men should be made under working conditions, i.e., with actual signal lights.

— We learn from *Nature* of Feb. 6 that a paper on mortality from snake-bite in the district of Ratnagherry was read before the Bombay Natural History Society by Mr. Vidal, of the Bombay Civil Service. Many of the deaths in that district are, he says, due to a small and insignificant-looking snake, called "foorsa" by the natives. It is a viper rarely more than a foot long, and is so sluggish that it does not move out of the way till trodden on. Thus it is much more dangerous than the stronger and fiercer cobra.

— A new and very simple method of synthesizing indigo has been discovered by Dr. Flimm of Darmstadt (*Ber. deut. chem. Ges.*, No. 1, 1890, p. 57). In studying the action of caustic alkalies upon the monobromine derivative of acetanilide, $C_6H_5.NH.CO.CH_2Br$, a solid melting at 131.5°, it was found, that, when this substance was fused with caustic potash, a product was obtained which at once gave an indigo-blue color on the addition of water, and quite a considerable quantity of a blue solid resembling indigo separated out. The best mode of carrying out the operation, according to *Nature*, is described by Dr. Flimm as follows: "The monobromacetanilide is carefully mixed with dry caustic potash in a mortar, and the mixture introduced into a retort and heated rapidly until a homogeneous reddish-brown melt is obtained. This is subsequently dissolved in water, and a little ammonia or ammonium-chloride solution added, when the liquid immediately becomes colored green, which color rapidly changes into a dark blue; and in a short time the blue coloring-matter is for the most part deposited upon the bottom of the vessel in which the operation is performed. The fused mass may also conveniently be dissolved in dilute hydrochloric acid, and a little ferric chloride added, when the formation of indigo takes place immediately. The collected blue coloring-matter may be readily obtained pure by washing first with dilute hydrochloric acid, and afterwards with alcohol." That this blue substance was really common indigo was proved by the fact that it yielded several of the most characteristic reactions of indigotin, such as solubility in aniline, paraffine, and chloroform; its sublimation; and the formation of sulphonic acids, which gave similar changes of color with nitric acid to those of indigotin. The final proof was afforded by its reduction to indigo white, and re-oxidation to indigo blue by exposure to air. Moreover, the absorption spectrum of the coloring-matter was found to be identical with the well-known absorption spectrum of indigo: hence there can be no doubt that indigo is really formed by this very simple process

— A recent telegram from Tashkent, says *Nature*, announced that Col. Pevtsoff and M. Roborovsky had discovered a convenient pass to the north-western part of Thibet, from Nia, and had amounted to the great tableland. The plateau has there an altitude of 12,000 feet above the sea, and the country round is desolate and uninhabited, while towards the south the plateau is well watered and wooded. The Tashkent telegram is so expressed that it might be supposed to mean that two separate passes had been discoverd by the two explorers. But the news received from the expedition at St. Petersburg on Dec. 26, and dated Oct. 27, shows that both explorers proposed to leave the oasis of Keria (100 miles to the east of Khotan) on the next day, for Nia (65 miles farther east), and there to search for a passage across the border-ridge which received from Prjevalsky the name of the "Russian Ridge." This immense snow-clad chain separates the deserts of eastern Turkestan from the trapezoidal space, the interior of which is quite unknown yet, and which is bordered by the "Russian Ridge" and the Altyn-tagh, in the north-west; the ridges of Tsaidam and those named by Prjevalsky "Columbus" and "Marco-Polo," in the north-east; the highlands (explored by Prjevalsky in 1879–80) at the sources of the Blue River, in the south-east; and a long, yet unnamed ridge, which seems to be a prolongation of the Tan-la, in the south-west. The pass leading to that plateau from Nia, and now discovered by the Russian expedition, is situated some 80 miles to the east of the well-known pass across the Kuen-lun Mountains, which leads from southern Khotan to Lake Yashi-kul. M. Roborovsky's intention is evidently next to move up the Tchertchen River, and to endeavor to reach the ridges "Moscow" and "Lake Unfreezing" (11,700 feet high), which were visited by Prjevalsky from the east during his last journey. Having succeeded in finding a pass to Thibet in the south of Nia, Col. Pevtsoff proposes, as soon as the spring comes, to proceed himself by this pass to the tableland, while M. Roborovsky probably will be despatched

to explore the same border-ridge farther east, in the south of Tchertchen.

—The Western Union Telegraph Company has lately put in operation in Chicago a new plant of dynamo-machines to take the place of the gravity-batteries which have been used in the business of the company. The plant consists of eighteen dynamos of the Edison pattern, arranged in three gangs of six each. Two gangs are in constant use, the third held as reserve. Each gang is driven, independently, by a Sprague motor, power being furnished from the central station of the Edison Light and Power Company. The current for the Western Union lines radiating from Chicago has been furnished heretofore by gravity-batteries, aggregating something over thirty thousand cells, at a cost of about one dollar and twenty-five cents per annum for each cell. The reduction in cost of maintenance of storage space, and the improvement in efficiency, are very great. The Chicago office is the only telegraph station in this country where the gravity-battery has been entirely superseded by dynamo-machines, and marks a new departure in telegraphy. The plant and its connnections embrace many features and applications novel and interesting. The plans, designs, and calculations were worked out by Mr. L. L. Summers, one of the electricians of the Western Union Company, and under whose direct supervision the changes have been made, and whose success establishes his reputation as a competent scientific electrician.

—The first shipment of Java cinchona-bark in commercial quantities was made on Sept. 28, 1869, when fourteen packages, weighing altogether nine hundred pounds, left the island for Holland. The consignment was in the hands of the Netherlands Trading Company, and that organization called in two professors to give an opinion on the trial shipment. Their report was very favorable, says *Indische Merkur*, and the bulk of the shipment was sold privately to manufacturers and dealers. Five of the purchasers afterwards also gave their opinions of the bark; but all agree, that, owing to its immaturity and insufficient alkaloid contents, the cinchona was unfit for manufacturing purposes, although it would answer admirably for druggists' use. In 1870 the Java exports amounted to 41 bales and 28 cases, and on Oct. 20 of that year the first public auction of 876 kilos took place in Amsterdam. Up to 1883, one or two public sales were held every year. Last year there were ten, and for 1890 the same number is announced again. The first private planter to commence cinchona-growing in Java was Mr. K. F. Holle, in 1866; but not until about eight years later, when the first consignments of the rich Ledger barks had been shipped to Europe and realized enormously high prices, did private planters commence to pay special attention to the article. At first the intention of the shippers appears to have been to send all the Java bark for sale to London, where a market already existed for the article; but the Netherlands Trading Company determined to create a centre in Amsterdam, and the importance which that market has now acquired demonstrates the wisdom of their decision. In 1878, when it had been shown beyond doubt that the most valuable cinchona alkaloids were found principally in the outer bark layers, the then director of the Java Government plantations, Mr. Moens, decided to adopt the system of scraping the older Ledger trees; but after some seasons the scraping was found to be injurious to the trees, and since 1886 this method of harvesting has been abandoned in the government plantations, although it is still followed by a few private planters. At first all barks were cut to the uniform size of twenty centimetres (about eight inches), and brought to market in quills, all bark which could not be harvested in this manner being crushed to a coarse powder. The trade in the beginning offered considerable opposition to the sale of this powdered bark, as it was believed to facilitate sophistication, and also on the alleged ground that the powdered bark lost some of its alkaloidal richness by keeping. At present, however, the system of crushing bark has become universal in Java, and at the Amsterdam auctions nearly all the manufacturing barks are now offered in that condition, and the pharmaceutical barks in quills. Since 1874 it has been customary, according to the *Oil, Paint, and Drug Reporter*, to sort the Java quill bark into two classes, according to length.

—Possibly no food-product was more extensively shown at the Paris Exhibition than olives and olive-oil. In the French official catalogue 606 exhibiters of olive-oil are specially named, besides numerous collective exhibits, and many others which are included under the general term "comestible" or edible oils: 448 of these exhibiters are from Portugal, 128 from California, and only 12 from France. One French exhibit, however, is made by 67 associated producers. The Mediterranean has from time immemorial been the seat of the olive-culture, and, according to the *Journal of the Society of Arts*, Spain has about 3,000,000 acres under olives; Italy, 2,250,000; and France, about 330,000. Tunis has over 4,000,000 trees, Algeria 3,000,000, Nice 1,000,000, where olive-oil forms four-fifths of the agricultural produce, and Syria several million. The number of trees in other countries is unknown. Tuscany first exported olive-oil: hence its old name, "Florence oil." Forty-five distinct species of the olive-tree have been described, and in countries where it is indigenous the tree sometimes reaches a height of sixty feet, with a trunk circumference of twelve feet. Besides the difference in the nature of the wood, foliage, and habit of growth, there are large olives and small olives, pointed, oval, round, and curved fruit, and of all colors, ranging from white to black and from green to red. The flavor of the fruit is mild, sharp, or bitter, and according to the variety there is obtained sweet-oil, light-colored and of exquisite flavor, up to dark green, thick, and of a bitter taste, strong and very unpleasant to the taste.

—For the last forty years attention has been paid to the production of smokeless explosives, and in no country with more marked success than in England; and this is due mainly to the initiative and energy of Sir Frederic Abel. He is to-day looked up to, says *Engineering*, as a great authority on the subject of explosives; and it is not surprising, then, to find that the mere announcement that he was to give a "Friday evening" discourse brought to the theatre of the Royal Institution, London, not only a large number of those who have its *entrée*, but also knots of gentlemen from abroad who were eager to hear the very latest about smokeless explosives, and the probable effect of their introduction into naval and military warfare. Sir Fredric Abel spoke of the early efforts made in Germany in France to produce smokeless explosives, and dwelt with emphasis upon the superior intrinsic qualities of gun-cotton, pointing out at the same time that its application as a safe and reliable propulsive agent for military and naval use is still attended by many serious difficulties, — difficulties which will be ultimately overcome, and probably in the immediate future. Reference was made to melinite and other French explosives. Despite the secrecy with which their composition is kept, it is pretty certain that the chief element is picric acid; and, as this body is exceedingly unstable, it is probable that but little more will be heard about these much-vaunted destructive explosives. The most successful of contemporary experimenters with high explosives is Mr. Nobel, the inventor of dynamite and other efficient blasting-agents. He appears to have derived from nitro-glycerine and nitro-cotton a material which, when treated with camphor, compares very favorably with gun-cotton as to its ballistic properties, its stability, and uniformity, besides being almost absolutely smokeless. This powder has been tried in small arms in Italy, and reports are current that Mr. Krupp is carrying on experiments with it in guns of various caliber. Sir Frederic Abel corrected an impression that seemed to be spreading; viz., that the new powder would be not only smokeless, but also noiseless. It was shown that there is hardly any noticeable difference between the explosive violence of the new and the black powder. If any thing, the report of the former is sharper and more ringing, as well as of shorter duration. The absence of smoke in the battles of the future will call into requisition military qualities that up to the present have lain dormant.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

RECENT STUDIES IN HYPNOTISM.[1]

Hypnotization against the Will of the Subject.

WHILE it has been generally admitted that subjects who have been frequently hypnotized lose the power of resisting the customary manipulations of the operator, or, in other words, that the natural suggestion of going to sleep at the sight of the operator and his proceedings is stronger than the auto-suggestion not to yield (just as we may fall asleep, in spite of all effort, at a lecture or social gathering), yet great stress has been laid upon the original consent of the subject to submit to the operation, as well as upon a considerable power of resistance by sheer determination. Dr. Herrero, a Spanish writer on the subject, has recently announced a means of hypnotizing any body and every body, *nolens volens*.

A great number of those classed as non-hypnotizable will succumb, says this authority, if the process be maintained for a sufficient length of time. As this is very trying to the operator, a device may be resorted to by which the subject is forced to gaze continuously at a bright object, the operator re-enforcing the suggestion to sleep. If, however, the subject resist the proceedings, one may bind him, and force him to assume the position necessary for hypnotization. But this drastic process may be dispensed with; for in those cases in which it is necessary, for therapeutic or correctional purposes, to hypnotize a person, Dr. Herrero has another method. It is based upon the discovery that in light chloroformization there is a stage in which the subject obeys suggestions as readily as in hypnotism. This period may at first be brief, but may be prolonged by care and practice. While in this "chloroformic somnambulism," the suggestion is given that in future no such agency will be necessary to hypnotize the subject, in some the suggestion is made gradually that they will resist less and less; and so on. While this disposes of those unconsciously resisting hypnotization, does it apply to those opposing it voluntarily? Here is a case in point. A patient showed a morbid fear of hypnotism, regarding it as a satanic art, and absolutely refusing to be hypnotized. It had been attempted over and over again, but in vain. Chloroformization was proposed, to which she consented. The first day it required fifteen grams to bring on the susceptible period, then thirteen, and so on until the patient went to sleep by merely staring at the doctor's fingers, and became a good hypnotic subject. By this means, then, it is proposed to induce a state by the action of drugs from which the transition is easy and certain to ordinary hypnotism. It seems probable that there will be much discussion and experimentation in this novel mode of extending the powers of hypnotism.

[1] Mainly from current numbers of the Revue de l'Hypnotisme.

Auto-Hypnotism.

By this is meant the power to put one's self to sleep. We do this every night, and persons differ very markedly in the ease and rapidity with which they fall asleep both at night and at other times. Dr. Coste de Lagrave has developed this power to a considerable extent, making himself at once operator and subject in an hypnotic experiment. The best time to experiment is just after awakening. One then attempts to go to sleep again for a short time only. One may wake and go to sleep again three or even five times in an hour. The sleep is light, may be accompanied by dreams, and the sleeper be sub-consciously aware of his condition. When the sleep is still lighter, and self-consciousness is largely present, the auto-hypnotic state has appeared. Dreams may occur, though the dreamer is perfectly conscious that he is dreaming, and may even attempt to direct these dreams. This amounts to auto-suggestion. To enter this state, the author lies down, closes his eyes, tries to sleep, keeping his thoughts fixed on the desired auto-suggestion. Here are a few instances of his success. As the result of a dysentery contracted in Tonkin, he could not walk a mile without extreme fatigue. One evening he gave himself the suggestion not to become tired, and the following day he was able to take a long walk. He suggests good appetite, and suggests away dyspepsia and cold feet, even under the most trying circumstances, such as in the open air on a cold day, and finds that his feet are really warm to the touch. Hallucinations are thus excited. He writes, talks interestingly, all by auto-suggestion. But the process is not without its disadvantages. Fatigue, depression, and sometimes severe headache, are the results. Like all phases of hypnotism, it has its uses and abuses. While this power is thus unusually developed in the cases cited, it undoubtedly exists to a lesser degree in many; and it would not be difficult to find in the habits of all a close analogy to what is here termed "auto-suggestion."

Retro-active Hallucinations.

This name has been given by Dr. Bernheim to hallucinations suggested back into the experience of the hypnotized subject. He is told that so many days or weeks ago he was a witness of such and such an act. The suggestion is accepted, perhaps additional details are added, and the fictitious event is embodied with the ordinary experiences of life. The case to be here noted is interesting, on account of influencing several at once, some without direct personal suggestion, and on account of being accepted by a person who happened to be sleeping normally. In one of the wards of the hospital, Dr. Bernheim hypnotized eleven patients while one was sleeping normally. He tells one of his subjects, "You see No. 3 seated on a chair. Yesterday he came back intoxicated, sang and shouted through

the halls, struck the keeper, making his nose bleed. You were there." The illusion soon developed; and the subject repeated the whole story, adding that a nurse came with a basin of water to wash off the blood. A neighboring subject was then aroused, and asked what happened yesterday to No. 3. After some hesitation, he repeated the story. And so on with all the others, including one who was sleeping naturally. No. 3 himself admitted that he struck the keeper, but he did not begin the quarrel. None of these patients had ever assisted at such an experiment before. The experiment may not succeed at all times and with all subjects; but it shows, that, when the sleeper has his attention fixed upon the person who is speaking, he hears and accepts every thing. On awakening, he does not recall this of his own accord; but, as soon as a hint is given, he recalls it all, and accepts it as a reality. As a practical outcome of the observation, Dr. Bernheim gives the warning not to tell secrets in the presence of a sleeper.

Statistics of Cures by Hypnotism.

The methods and purposes of the clinic for the treatment of diseases by hypnotism, founded at Amsterdam by Drs. van Reuterghem and van Eeden, have been noticed before in these columns (*Science*, May 24, 1889). On the occasion of completing the first two years of their experience, they have put together an account of the kind and number of diseases treated, and the amount of success achieved; and these statistics, being comparatively extensive and carefully collected, have good claims to general consideration. There were treated, in all, 414 patients (219 men and 195 women). Of these, only 15 (less than 4 per cent) could not be hypnotized; 217 (53 per cent) entered a light stage of sleep; 135 (32 per cent) entered a deeper stage; and 47 (11 per cent) entered the somnambulic stage, characteristic of the best hypnotic subjects. The ages of the patients were distributed as follows: from 1 to 10 years, 9; from 11 to 20 years, 46; from 21 to 40 years, 203; from 41 to 60 years, 131; from 61 to 80 years, 25. There were 361 of the 414 afflicted with various kinds of nervous troubles, 168 were classed as general neuropathic disorders, 68 as neuralgias and pains, 60 as mental diseases, 40 as hysterical affections, and 29 as organic affections. In general, the effects of the treatment are indicated by the following figures: no effect in 71 cases (20 per cent), a slight or passing improvement in 92 cases (26 per cent), a distinct and permanent improvement in 98 cases (27 per cent), and a cure in 100 cases (28 per cent). The disproportion in the number of nervous and non-nervous cases makes a fair comparison of the results in the two classes impossible. Among the nervous diseases, those classed as neuropathic show a very favorable result, 33 per cent being cured, and 26 per cent permanently benefited. Hysterical and neuralgic affections show nearly as high a percentage, though the absolute numbers are here much smaller. Diseases classed as organic naturally show the very minimum of success in treatment. We have thus no announcement of hypnotism as a panacea curing all diseases, but a fair proportion of success and failure distributed among various disorders in a way that accords with our knowledge of the nature of such diseases. It is only by such impartial and scientifically collected results that the movement can make progress.

AMONG THE PUBLISHERS.

LAST week's issue of *Garden and Forest* contains an excellent illustration of the famous Waverly Oaks, near Boston, and a figure of *Gladiolus turicensis*, one of the noteworthy additions to garden-plants last year. Mr. Charles Eliot writes instructively of the coast of Maine; and among other contributors to the number are Professor J. B. Smith, Professor W. A. Buckhout, Professor E. S. Goff, Professor J. T. Rothrock, Dr. Udo Dammer, John Thorpe, and Mrs. Schuyler Van Rensselaer.

— The March number of the *New England Magazine* will contain many portraits. In the article on the "Supreme Court of the United States" there will be given likenesses of more than a dozen of the great justices. In an article on "Chautauqua" will be found portraits of Bishop Vincent and Mr Lewis Miller. "A Successful Woman's Club," "A Strange Dinner-Party," and "An Old New England Country Gentleman," are other illustrated articles in this number.

— To meet the demand for a much greater variety and number of illustrations in the *American Architect*, Messrs. Ticknor & Co. have arranged to more than double the extent of that department, and to add many new features. To give their subscribers a greater amount of illustration, it is necessary to increase the subscription price, but only to those who desire the increased illustration. They therefore continue their regular and imperial editions, but have issued, in addition, an enlarged and more expensive edition, called "the international edition." The international includes all that the imperial contains (that is, the equivalent of 384 pages of photo-lithographic illustration of all sorts, also 40 gelatine and 12 heliochrome plates, and the extra photogravure plate for the year), and adds (A) a large amount of foreign work, received regularly from England, France, and Germany. The apportionment of this new matter is not yet finally settled, but it will amount approximately to over 200 pages of photo-lithographs, and probably 150 gelatine plates, besides a large number of genuine copperplate etchings. To give still further value to this edition, there will be from time to time (B) additional colored prints and (C) real photogravures,—genuine copperplate prints, such as are issued by Messrs. Goupil in Paris by that name. But the feature perhaps the most interesting to the American profession will consist (D) in publishing in this international edition, as far as subscribers will aid, competitive designs submitted in limited, and in some cases in public, competitions. To do this — to provide a journal containing approximately 1,000 page illustrations (besides nearly as many smaller cuts in the text) and (E) an attendant increase in the text of four pages weekly, 200 pages per annum — has required a considerable increase in the subscription price, and it cannot be placed at less than $25 per annum. At the same time, to place it within reach of many to whom so large a single payment might be an inconvenience, quarterly payments at a slightly increased rate may be made when preferred. No subscriptions will be received, however, for less than the full calendar year, as the plans involve contracts in at least three foreign countries, made upon a permanent basis by the year. There has just been issued in the *American Architect* a photogravure from Mr. Axel H. Haig's famous etching, "At the Fountain of St. George." This is commonly called "St. George at Lubeck;" but Mr. Haig writes, "The subject is not to be found at Lubeck at all or in any North German town. The work is a composition, partially founded on a scene in an old Bavarian town, but, being so very much an invention, I cannot give a locality to it."

—"The danger of an ignorant person in seizing an electric wire carrying a strong current is as great as that to which a person ignorant of the ways of snakes would be subjected if he undertook to take the place of the skilled observer . . . accustomed to put his arm into a tall jar containing rattlesnakes and take them out." This extract will show the general drift of an article on "Dangers from Electricity," by John Trowbridge, which appears in the *Atlantic* for March. There is a paper by Charles Worcester Clark on "Woman Suffrage, Pro and Con;" George Parsons Lathrop shows us "The Value of the Corner;" and there is a paper called "Loitering through the Paris Exposition," which tells, among many other things, of all the concerts given at the cafés of the exposition by the various nationalities,— Gypsies, Javanese, Hungarians, and many more. Dr. Holmes is particularly amusing in "Over the Teacups," and seems to wish that people would write less poetry. He closes with some odd verses on the rage for scribbling.

LETTERS TO THE EDITOR.

Physical Fields.

I THINK Professor Dolbear misunderstands the motive of my communication relative to physical fields, that appeared in *Science* Jan. 24. It was not so much what I conceived to be misuse of the term "stress," that I wished to call attention

to, but rather what I believed to be a misconception of the nature of certain phenomena which such misuse seemed to imply. Let me see if I can maintain my ground.

If two bodies connected by an elastic medium retain their relative positions, the two may be transported or caused to move in any or all possible ways, and still with all speeds; yet the condition of stress under which this elastic connecting medium exists is not changed at all. If a force be exerted upon one of these bodies, tending to change its position relative to the other, the stress of the elastic connecting medium will be changed; and I do not think it necessary to conceive of a rate of propagation of this modified stress from the one object to the other, for, if the second body were not attached to the first in some way, the force applied to the first could produce no stress whatever in the medium connecting the two. A push on one becomes a pull on the other, but there could be no push on the one without there being an exactly equal and opposite effect upon the other. Has any propagation taken place in this case?

If, again, we have a system of bodies, all of which are connected with each other by elastic strings or by a pervading elastic medium, any movement of one of these bodies necessarily involves a change of stress between all of them. A push on one means a pull of exactly equal amount on others. There can be no push without a resistance, and this resistance is a

Publications received at Editor's Office, Feb. 17-22.

KANSAS Academy of Science, Transactions of the Twentieth and Twenty-first Annual Meetings of the, 1887-88. Vol. XI. Topeka, State. 127 p. 8°.

U. S. COAST AND GEODETIC SURVEY. Chart showing Annual Change of the Magnetic Declination for the Epoch January, 1890. Washington, Government. Scale 1: 10,000,000.

——Chart showing Magnetic Meridians of the United States for January, 1890. Washington, Government. Scale 1: 10,000,000.

——Isogonic Chart for the Epoch 1890. Alaska and Adjacent Regions. Washington, Government. Scale 1: 13,700,000.

——Isogonic Chart of the United States for the Epoch 1890. Washington, Government. Scale 1: 7,000,000.

WARD, H. M. Diseases of Plants. London, Society for promoting Christian Knowledge; New York, E. & J. B. Young & Co. 196 p. 16°. $1.

WAUTERS, A. J. Stanley's Emin Pasha Expedition. Philadelphia, Lippincott. 378 p. 12°. $2.

WEDDERBURN, A. J. A Popular Treatise on the Extent and Character of Food Adulterations. (U. S. Dept. Agric., Bulletin No. 25.) Washington, Government. 61 p. 8°.

WHIST, American, Illustrated. By G. W. P. Boston and New York, Houghton, Mifflin, & Co. 367 p. 16°. $1.75.

quality of the elastic medium given to it by the mere presence of the other body. We have seen, in the case of the two bodies connected by an elastic string, that the stress is due to the relative positions of the two bodies. They were brought into their position by motion; but, so soon as this motion was overcome by the elastic resistance of the string, the force applied became potential, not kinetic.

Now, supposing one of these bodies to remain stationary while the other is moved farther away, the stress between the two is increased. The push on the one has increased the pull on the other, yet there has been no motion of the latter. The only motion there was in the system was that imparted to the former; and the motion was away from the latter, not towards it. A new static condition has been induced upon both of them, but can it be said to have been propagated from one to the other? I do not think it can.

Now, these two bodies thus connected may be moved from one place to another, yet, so long as they maintain their same relative positions, the stress or tension of the elastic between them will not vary. So, if a form of stress between two bodies in space may be conceived to be entirely independent of the presence of any other bodies in space, a relative motion of these two bodies between themselves involves a change of stress without propagation; and, again, if these two be relatively still, they may move relatively to all other bodies without changing their stress or altering their static condition with regard to stress; yet in one sense (and I conceive in this sense alone) is the stress properly said to be propagated.

Professor Dolbear says, "One may call it potential or kinetic energy if he chooses: a static condition will presently be reached, but not instantly."

Right here, I suppose, lies the gist of the whole thing. The point I wished to make was that Professor Dolbear did not distinguish between the condition of the medium in the two states of motion and rest. A potential condition involves motion only in so far as motion was necessary to bring it into being. It may in one sense be considered as stored-up motion, as it is capable of giving out again an equivalent quantity o motion, but it is not motion itself. He implies, and I agree with him, that motion precedes the potential condition. Now, this motion, or energy if you choose, may be of any known kind (not necessarily electrical, but may be); and when, by reason of the work done, we have produced a condition of matter of a certain kind, — when all the work has been done, — we have a conditon that is called electrification.

What I have been contending for is that the magnetic field and the fields of electrification and gravity are those fields when they are established (before that, in the interval during which they are being established, the fields are kinetic, not potential); that in the case of electrification the movement necessary or involved in its establishment is not the electric field, but is the electric current which can be propagated, and the condition of stress produced by that motion is the electric field.

It is possible, however, that I have not fully understood him. Perhaps he means something like this: imagine, for instance, a row of material points numbered from 1 to 10 spread out in a row, and connected by elastic thread. If 1 and 10 are stationary, and the intermediate numbers are strung along the string, the tension upon the string is uniform throughout its length. If, now, No. 1 be moved a little farther from No. 2 than originally, the tension on the string between the two would be greater than before. This would cause a slight movement of No. 2; and so on to No. 10, which we have imagined stationary. Would it take *time* for the pull on No. 1 to become apparent on No. 10? It would with all material elastics, because of their viscosity and inertia; but, if we use as our elastic the luminiferous ether, I maintain that it would not, for one of the main features assigned to it is absolute and perfect elasticity. If No. 1 were pushed nearer to No 2, the lessening tension would exist at No. 10 at the same instant, because another property of the ether is absolute incompressibility.

Taking this latter characteristic of the ether, — incompressibility, — if we had a long pole (say, a thousand miles long), if we should cause one molecule of that pole to change its position, would not every other molecule, even those a thousand miles away, be caused to move also? and would there be any time lost in their responding? Or, to put it in another way, if we should premise that the farthermost molecule should not move, would it be possible in any way to move the nearer molecules? I contend that it would not, and that if one moved, all must move.

He says, "Mr. Perry seems to say, that, if there was but one body in the universe, it could not have an electric field, even if it could be electrified." That is not my statement, nor is it my idea. My idea is, that in the case of static fields, under which head I would include electrification, magnetism, and gravity, two exactly equal and opposite conditions are inevitable. I cannot conceive of there being a push without there being a corresponding and equivalent pull, without the destruction of equilibrium; and, if the equilibrium be destroyed, we have motion which may be in any direction whatever. This is what I conceive to be the difference between the two kinds of fields. As before stated, I do not believe a pull can exist without a corresponding push and yet maintain equilibrium. If the one exceeds the other, there will be motion towards the greater, — there will be more positive than negative electricity; there will be more north-seeking magnetism than south-seeking magnetism, or *vice versa;* and by the same token one may exist without the other. By the same course of reasoning, if a stress can be propagated (as I use the term "stress"), there is implied an existence of one form (the positive) before the existence of the other (the negative), as the element of time is involved. Faraday distinctly states that there cannot be an absolute charge of matter. I stated my belief that a stress could not exist unless there were two particles. I should also have added that there must be a connecting medium between those two particles. If this be so, then it is clear without reasoning, that, if either one of the particles or the connecting medium be wanting, the conditions for stress are wanting, and it cannot exist. A material body having two points and a connecting medium between the two is therefore capable of either magnetism or electrification. If one of the points be wanting, and energy be applied to the other, this energy, instead of being stored up by the tension of the elastic medium, and producing stress as before, — which would be capable of giving out again an equivalent amount of energy or motion, which stress might constitute electrification or magnetism,—produces no stress, but motion at once, which may be heat, light, or the electric current, or give rise to these.

Again: if there were but a single body in space, its physical field would, I think, be confined within itself, and not radiate outward indefinitely. Let us imagine space to consist of an elastic jelly: then all particles of matter in space are connected with each other by elastic bonds. One particle cannot be moved from its position without setting up stresses in space between itself and all the other particles. But it is evident that the algebraic sum of all the stresses is zero. If the stress be wholly positive on one body or particle, the stresses on all the other particles will be negative and exactly equal in amount, whether there be a million or only one other particle. If there be but one other particle or body, all of the negative stress — electricity, if you choose — will be upon it, or perhaps rather in the medium joining the two. Now, since the stress lies wholly between these two (they are in no way connected with any other particles, or, in other words, they are the only two particles in space), they may be moved in any way, providing their positions relatively to each other remain the same, without altering the stress of the surrounding medium. Since they do move, there is kinetic energy; but this movement does not alter their relations to other particles, because there are no other particles: hence no additional stresses are set up. Their movement does not convert the potential energy stored up between them into kinetic energy, although a movement of one relative to the other would do so; and the resulting kinetic

energy would represent the difference between the initial and final potential states of the system.

He quotes Tait as saying, "Every action between two bodies is a stress," and says that "the body and the ether about it are two bodies, and, if they can act at all upon each other, there will then be a field." But you will recollect that he makes this statement in controversion of mine, that, if there were but "a single mathematical point in space, there could be no stress." I said nothing at all about there being such a thing as ether in this connection, though I see the necessity of including it, and also the force of his argument; but I do not think Tait meant to consider the ether as a body in the sense in which Professor Dolbear here uses it. As I understand it, Faraday, Maxwell, Thomson, and I assume Tait also, believe the dielectric to be the active agent, and the conductor the passive agent, in all the phenomena which we are considering. The dielectric, whatever it may be, — the ether, if you will, — is really the seat of the strains which terminate in the two bodies connected. I think Tait used the term in the sense that I have indicated.

"Perhaps, however, Mr. Perry calls the ether matter, which has not been my habit, and against which I was not on my guard when I wrote the statement to which he objects. Until we have some evidence that ether is subject to the law of gravitation, it seems to me to be improper to speak of it as matter. If every particle of matter attracts every other particle of matter, and if there is no evidence that ether is so attracted, it is not conducive to good terminology to call it matter."

Let us see what authority we have for considering ether as matter. I believe the weight of opinion is either that the ether is a form of matter or that matter is a form of ether. Sir William Thomson believes that matter is nothing but ether; that it is composed of it. We know this all-pervading medium as ether when it is unorganized. When it is organized into vortex rings, we have the atom and molecule, hence gross matter, as it is usually distinguished. I am of the opinion that Sir William Thomson's theory of matter is the most popular one at present. In 1838 M. Pouillet found that the heat-energy transmitted from the sun to the earth would, if none were absorbed by our atmosphere, raise 1.76 grams of water 1° C. in 1 minute on each square centimetre of the earth normally exposed to the rays of the sun. This is equivalent to 83.5 foot-pounds of energy per second. This figure Sir William Thomson used in determining the probable density of the ether.

Herschel estimated the stress (elasticity?) of the ether at 17×10^9 pounds per square inch. S. Tolver Preston estimates the probable inferior limit of the tension of the ether at 500 tons per square inch, which is much smaller than Herschel's estimate. Young remarks, "The luminiferous ether pervading all space is not only highly elastic, but absolutely solid." I do not understand the meaning attaching to "solid" here, but it is evidently an attribute of matter. Sir William Thomson, calculating upon the data above referred to, finds the weight of a cubic foot of ether to be $\frac{5}{8} \times 10^{-20}$ pounds. Bellini makes it $\frac{1}{2} \times 10^{-13}$ pounds. M. Herwitz, another investigator, arbitrarily assumes a cubic foot of ether to weigh 10^{-18} pounds.

De Volson Wood treats the ether as if it conformed to the kinetic theory of gases, which, with other assumptions, is equivalent to considering it as gaseous in its nature, and at once compels him to consider it as molecular. He says, "The electro-magnetic theory of light suggested by Maxwell (?), as well as the views of Newton, Thomson, Herschel, Preston, and others, are all in keeping with the molecular hypothesis."

Professor Rood succeeded in producing a vacuum of $\frac{1}{390,000,000}$ of an atmosphere. Professor De Volson Wood states, that, even at this great rarity of the atmosphere, the quantity of matter in a cubic foot of air "would be some 200 million million times the quantity in a cubic foot of ether," and says, that, admitting that the ether is subject to attraction according to the Newtonian law and of compression according to the law of Mariotte, in order to make the density vary sensibly with the distance, the attraction of the central body must be something like a million times as great as that of the sun, or have a diameter a million times as large; but, there being no such known body, he concludes that the density and tension of the ether may be considered uniform throughout space; and he says that the weight of a given volume of it would vary as the force of gravity, and places the weight of a cubic foot of ether at the surface of the sun at 57×10^{-24} pounds, and estimates the pressure on a square foot of the sun of a column of infinite height at 13×10^{-14} pounds.

Thus we see, that, while no two of these investigators agree in their results, they all agree in ascribing to the ether all the properties of matter, including that of gravity, and I therefore think it no violation of the proprieties to speak of it as though it were matter.

In regard to the definition of the word "stress," Professor Dolbear quotes Maxwell as follows: "Now, we are unable to conceive of propagation in time except either as the flight of a material substance through space or the propagation of a condition of motion or stress in a medium already existing in space," and says, "Evidently Maxwell did conceive that stress could travel." I freely admit that a "condition of stress" may travel, in the sense that a body between the particles of which there exists a stress may travel; and it seems to me that is what Maxwell means. If he meant what Professor Dolbear thinks he does, why does he says a "condition of stress"? Why not simply "stress"?

I think Maxwell was probably the first to use the term "stress," but it was in relation to phenomena described by Faraday. In regard to this, Maxwell himself says (vol. i. p. 153), "The distribution of stress considered in this chapter is precisely that to which Faraday was led in his investigation of induction through dielectrics." Further, he says, "This is an exact account of the conclusions to which we have been conducted by our mathematical investigation. At every point of the medium there is a state of stress such that there is tension along the lines of force, and pressure in all directions at right angles to these lines." "The expression 'electric tension' has been used in various senses by different writers. I shall always use it to denote the tension along the lines of force, which, as we have seen, varies from point to point, and is always proportional to the square of the resultant force at the point." "The hypothesis that a state of stress of this kind exists in a fluid dielectric," etc. "The state of stress which we have been studying." "If the medium is not a perfect insulator, the state of constraint which we call electric polarization is continually giving away. The medium yields to the electro-motive force, the electric stress is relaxed, and the potential energy of the state of constraint is converted into heat." "In the phenomenon called the electric current, the constant passage of electricity through the medium tends to restore the state of polarization as fast as the conductivity of the medium allows it to decay. Thus the external agency which maintains the current is always doing work in restoring the polarization of the medium which is continually becoming relaxed, and the potential energy of this polarization is continually being transferred into heat."

I consider the above as perfectly in accord with my statements in your issue of Jan 24.

On p. 257, § 642, he specifically defines "stress" as follows: "Hence the state of stress may be considered as compounded of (1) a pressure equal in all directions, (2) a tension along the line bisecting the angle between the directions of the magnetic force and the magnetic induction, (3) a couple tending to turn every element of the substance," etc. "The stress in this case is therefore a hydrostatic pressure, combined with a longitudinal tension along the lines of force," etc.

But Faraday was the first to conceive of these stresses, although I am not sure that he used this term. In his "Experimental Researches," 3249, he says, "With the electric force we have both the static and dynamic state; . . . still there are well-established electric conditions and effects which the words 'static,' 'dynamic,' and 'current' are generally

employed to express. . . . The lines of force of the static condition of electricity are present in all cases of induction. . . . No condition of quality or polarity has as yet been discovered in the line of static electric force, nor has any relation of time been established in respect of it." "No relation of time to the lines of magnetic force has as yet been discovered" (*Ibid.*, 3253).

Finally, on pp. 439 and 440 of "Experimental Researches" (vol. iii. edition of 1855), he gives in detail, too long for quotation here, his views of the different phenomena, which, it seems to me, fully support the position I have taken in this matter.

NELSON W. PERRY.

Cincinnati, O., Feb. 17.

Supposed Aboriginal Fish-Weirs in Naaman's Creek, near Claymont, Del.

IF the substituted letter of Mr. Hilborne T. Cresson to the *American Antiquarian*, published in your issue of Feb. 14, had ever been printed before, certainly I should not have received the impression that Mr. Cresson once fancied he had discovered the remains of pile-dwellings at Naaman's Creek, on the Delaware. The differences between the two versions are very striking to whoever takes the trouble of comparing them. I never before understood that Mr. Cresson regarded the version of his letter published in the *Antiquarian* in November, 1887, as "an atrociously garbled version" of it. I supposed he only complained of certain bad mistakes in the proof-reading, such as the substitution of "cave" for "cove," etc. Mr. Cresson's memory has played him false in regard to what he wrote to me when he kindly forwarded to me a selection of the objects discovered at the three "stations." On referring to the notes that accompanied the specimens, I find that he calls them "pile-structures." The fact is, that I supposed Mr. Cresson had changed his mind in regard to what these structures actually were; and as I had formed the opinion upon first reading what he had printed respecting them, that they were merely remains of Indian fish-weirs, I simply made that statement. I found nothing in what Professor Putnam had stated in the "Reports of the Peabody Museum" (vol. iv. p. 44) in regard to Mr. Cresson's discoveries to give me any different impression. Mr. Cresson's letter to me, to which he refers, containing the request that I should adopt his corrected views, came too late, as I wrote to him, because my manuscript was already in the printer's hands. That I should have drawn such inferences about Mr. Cresson's opinions does not seem to me so "inexplicable" as it does to him.

HENRY W. HAYNES.

Boston, Feb. 16.

MR. H. T. CRESSON, in his letter published in *Science*, Feb. 14, seems to want to get away from his own assertion, and so takes the opportunity to abuse the editor of the *American Antiquarian*. If you will allow me to quote the very words which he used in his letter, and which were published in the *Antiquarian* exactly as they were written, without any change whatever, your readers will see what his position was in the year 1887, though he seems to have changed his opinion since that time. The words are as follows:—

"The results so far seem to indicate that the ends of the piles embedded in the mud, judging from the implements and other *débris* scattered around them, once supported *shelters of early man that were erected a few feet above the water*—the upper portions of the *piles* having disappeared in the long lapse of time that must have ensued since they were placed there—(the flats are covered by four and one-half feet of water on the flood tide; on the ebb the marsh is dry and covered with slimy ooze several feet in depth, varying in different places). Three different *dwellings* have been located, all that exist in the flats referred to after a careful examination within the last four years of nearly every inch of ground carefully laid off and examined in sections.

"The implements found in *two* of 'the supposed *river dwelling sites*' are very rude in type, and generally made of dense argillite, not unlike the palæoliths found by my friend Dr. C. C. Abbott in the Trenton gravels.

"The character of the implements from the other or third supposed *river dwelling* on the Delaware marshes are better finished objects made of argillite, indicating a greater antiquity than ordinary surface found Indian relics. At this *pile dwelling* a human tooth has been found and fragments of a jaw bone, ends of scapulæ, etc. It is my intention later on to present my specimens to the Peabody Museum of Ethnology and Archæology at Cambridge, Mass."

The above is a quotation from the letter published in the *American Antiquarian* in 1887. Mr. Cresson desires the readers of *Science* to compare the two letters. In order that they may do so, I quote a part of the letter which appeared in *Science*, Feb. 14 (see p. 116, near the bottom of the page). It is as follows:—

"The results, so far (1877), seem to indicate that the ends of piles embedded in the mud, judging from the implements and other *débris* scattered around them, had once served as supports to structures intended for *fish-weirs*, these in all probability projecting a few feet above the water, and were no doubt interlaced with wattles, or vines, to more readily bar the passage of fish from the creek into the river. The upper portion of these *wooden structures* has entirely disappeared in the long lapse of time that has ensued since they were placed there. . . . At slack water it forms a low mud-bank slanting toward the creek. Three different *stations* were located, probably all that exist, in the bed of the creek referred to. This opinion is based upon careful examinations, made within the past four years, of nearly every inch of ground in the neighborhood of the wooden stake-ends, by dredging in sections between certain points marked upon the creek's bank. The implements found in one of the *stations* are generally made of argillite, with a few of quartz and quartzite. Some were very rude in character, and not unlike the palæoliths found by Dr. C. C. Abbott in the Trenton gravels. Objects of stone and pottery rather better in finish than those at *station* A have been found at the two other *stations*, B and C."

This is a quotation from *Science*, the sentences being consecutive. The Italics will show the words and clauses which in one letter convey one impression, and in the other letter convey an entirely different impression.

Mr. Cresson charges the editor with putting in the words "shelters of early man that were erected a few feet above the water," "three different dwellings," "two of the supposed river dwelling sites," "The character of the implements from the other or third supposed river dwelling on the Delaware marshes are better finished objects made of argillite, *indicating* a *greater antiquity* than ordinary surface found Indian relics. At this *pile dwelling* a human tooth has been found and fragments of a jaw bone, ends of scapulæ, etc." Now, the editor of the *American Antiquarian* does not pretend to be ingenious enough to fabricate such sentences, and interpolate them into a letter. It is beyond the skill of an ordinary man to interpolate remarks of that kind. If these words are not contained in the copy which Mr. Cresson says he kept, why did not Mr. Cresson change the wording, or request that it should be corrected, in the two years that have elapsed? Professor Haynes quoted from the *American Antiquarian*, supposing that Mr. Cresson's own words were to be relied upon. The statement went into "The Critical and Narrative History" on the strength of Mr. Cresson's own words. The editor of the *Antiquarian* at the time said nothing about the "find." If Mr. Cresson wishes to withdraw from the position taken, he is at liberty to do so, but he should not charge the editor of the *Antiquarian* with "garbling" or changing his letter, unless he can prove it.

STEPHEN D. PEET.

Mendon, Ill., Feb. 18.

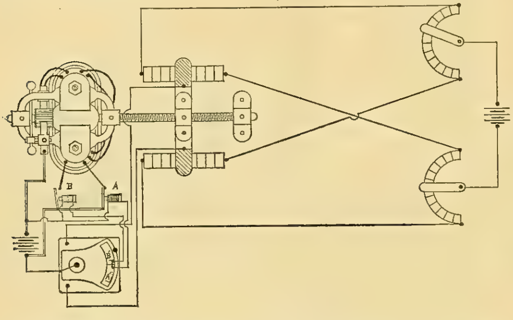
The Fiske Range-Finder.

I WAS much interested in the description of the Fiske range-finder, which appeared in *Science* on Jan. 24. There is much credit due Lieut. Bradley A. Fiske for the ingenious manner in which he has applied a most beautiful electrical combination to a practical purpose, and there is no doubt that its range of usefulness will extend beyond the realms of gunnery practice.

While reading the article, an idea came into my mind, which may also have occurred to Lieut. Fiske, and been rejected as im-

practical; yet I think I will speak of it, as I see no reason why it could not be applied with success, and still further increase the effectiveness of the range-finder. The object is to make the range-finder self-recording, to automatically adjust the balance, and to avoid the need of a third operator. The method is extremely simple. First, the "slider" is provided with a nut through which a spindle revolves, the spindle being the continuation of a small motor-shaft. The fields are wound with two coils in such a manner, that, when the circuit is closed through one, the motor revolves in a particular direction, and, when closed through the other, in the opposite direction; moving the slider backward or forward, as the conditions might require, to establish the balance. The motor is fed from one cell of storage or other battery, at about two volts potential.

The operating mechanism is equally simple. Two small magnets, *A* and *B*, are connected to the same cell that supplies the motor, and the return wire of each terminates in a drop of mercury, *A'* and *B'*, located each side of the galvanometer-needle, so that the least movement to one side or the other will cause contact with the globule of mercury. The circuit thus being closed through the needle to the other pole of the battery, the



corresponding magnet becomes energized, attracting the armature, which closes the corresponding circuit of the motor. The object of the magnets *A* and *B* is to reduce the sparking at *A'* and *B'*, and they might possibly be dispensed with. They were to be wound with considerable resistance, that the current might be so small as to prevent any trouble at *A'* and *B'* by burning or sticking of the contacts.

There are other arrangements whereby the above result might be accomplished, but I send this, as it may be of some interest should this plan of automatically adjusting the balance not have been previously thought of. J. F. DENISON.

New Haven, Conn., Feb. 15.

Soils and Alkali.

PLEASE grant me the use of your paper to reply to the article by Dr. Stockbridge in your issue of Jan. 17, on soils and alkali. When the bulletin was written, it was thought best to preface it with some general statements about soils. With this end in view, I collected, condensed, and arranged, from the sources at my command, the facts of the first eight pages of the bulletin. There never has been any claim made to originality in these eight pages. The facts were collected simply to make the bulletin more intelligible to the farmers. As far as I knew, I tried to give credit to every one for his work. The domain of science is too large, and human life is too short, to have any one mind even comprehend it. It was explained to Dr. Stockbridge that I did not collect all the material myself, and, if any of the matter was his, due credit would be given him. This should convince any man that I acted in good faith in the matter. He makes some very broad assumptions, that are not warranted in this day, age, and generation: 1st, That he has a patent right on German and other foreign publications, and that no one else has access to them; 2d, That no one else can translate them; 3d, If he translated them, and any one afterwards uses the facts, credit must be given to Dr. Stockbridge, and not to the author. When I use the facts of Dietrich, Hoffman, Liebenberg, or any other man, and I give him credit, my duty ends then: Dr. Stockbridge ha no claim to them, even though he may have translated them.

The statements in the eight pages referred to are commonplace, and are found in any good modern text-book that treats of the subject.

Nitrification is described in great detail in Part II. of the third supplement to Watt's "Dictionary of Chemistry" (p. 1397); also in Bloxam's "Chemistry" (p. 173) and Storer's "Agriculture" (vol. i. p. 298). The word "microbe" ("little life") was first used by Sédillot. The latest investigators are Warrington, Schlösing, and Müntz. The per cent of ash in plants is given in "How Crops Grow," by Johnson (p. 30); "How Crops Feed," by the same author (p. 364); "Chemistry of the Farm," by Warrington (p. 2). "Aschen Analysen Von Landwirthschaftliche Prouducten," by Wolff, gives 5 per cent of ash. "The Geological Survey of Ohio, 1870," p. 368; the average of 151 analyses, gives 4.84 per cent of ash. It has been thought that the transpiration of plants has been worked out in greater detail than any other subject. Nearly every possible condition has been investigated by some one. The law of transpiration from the upper and lower portions of the leaves has been worked out by Guettard, Unger, and Bonnet. The relation between the number of stomata and the rapidity of transpiration has been experimented upon by Von Höhnel and Garreau; the amount in wet and dry weather, by Moldenhawar; the effects of light and darkness, by Wiesnar and Van Tieghem; how transpiration is influenced by the liquid absorbed, by Sénebier, Sachs, and Burgerstein; the pressure in the growing plant during transpiration, by Meyen, Sachs, and Von Höhnel; even the effect of the different rays of the sun, by Wiesner; and the age of the leaves, by Höhnel and Dehérain. The amount of water transpired for wheat, barley, oats, beans, red clover, rye, peas, etc., has been determined by Hellriegel, while Sachs, Hofmeister, and Hales have determined the amount transpired from the grape-vine, sunflower, cabbage, etc.

The facts about the fineness or division of soil are stated in Williams's "Applied Geology" (p. 111). In "Chemical Bulletin, No. 10, Department of Agriculture," under the head (p. 10) "The General Fertility of Soils depends Principally on Their Texture," is the following language: "These qualities depend altogether on the state of division of the soil and of its geological origin" (see "Soils of the Farm," by Scott and Morton). When the same statement has been made by so many authors, it is difficult to state positively the source of information; but in two instances I had the references marked.

He quotes me:—	In Dana's "Manual of Geology," 1879, p. 714, this language is found:—
O'BRINE (p. 9). The heat comes from three sources: Solar heat, as the sun's rays; heat of chemical decomposition within the soil, and the original heat of the earth's interior. The latter cannot be of any value to plants; the heat of chemical decomposition is not of any value, except in a few special cases. The sun, therefore, remains the only source of heat of practical importance in relation to the production of crops from the soil.	The earth has three prominent sources of heat: (1) The sun; (2) The heat of the earth's interior; (3) Chemical and mechanical action.

In making the application of these facts to plants, what other conclusion could be arrived at?

He quotes me:—	The text-book of geology by Geikie, 1885, p. 326, in speaking about the organic matter in soils, says,—
O'BRINE (p. 4). Oats, rye and buckwheat thrive with the lowest amount of organic matter, requiring from one to two per cent. Wheat and tobacco seem to require most among the common agricultural products, and do their best upon soils containing from five to eight per cent of organic matter.	It is the experience of practical agriculturists in Britain that oats, rye, will grow upon a soil with one and one-half per cent of organic matter, but that wheat requires from four to eight per cent.

I added to the statement in the geology, "buckwheat and tobacco;" the one being proverbial for growing on poor soil, and the other for requiring a rich soil. The order of arrangement that I used is found in Loudon's "Encyclopædia of Agriculture," eighth edition.

He claims, in his article, that the facts I used are his, while in the preface to his book he lays no claim to the facts. Here is what he says: "The nature of the work is such that I have no claim for the presentation of new material." In regard to "Rocks and Soils," published by Dr. Stockbridge, I have lately examined it, and I can confirm what he has said, that it does not contain a single fact new to science. I believe *one* such claim is made, but the *facts* have been in print for *forty years*. We have the same publisher, and for that reason I do not care to make any comments upon it. Any of your readers that are interested will find a review of it in *Nature*, Jan. 24, 1889, p. 292.

D. O'BRINE.

Fort Collins, Col., Feb. 15.

INDUSTRIAL NOTES.

The Electric Light in Japan.

AN American electric-light system has again come out victoriously while competing with the older European systems. This time the battle-ground was Tokio, Japan, where a corporation of capitalists, The Takata Company, awarded a large contract for electric lighting to the Westinghouse Electric Company of Pittsburgh, Penn. The Westinghouse alternating-current system has gained great favor in eastern Asia, as an immense central station for electric lighting is now being installed with Westinghouse alternating-current apparatus in Canton, China. The Japanese plant will be put up at Shidznoka, near Tokio, and it will have a total capacity of 500 lights. This is the first alternating-current central-station plant in the land of the Mikado.

A Big Road goes in for Electricity.

DURING the last week Mr. Thomas Lowry, president of one of the largest street-railway combinations in the world, showed his confidence in the electric system of street-railway propulsion by deciding to equip all the lines of St. Paul and Minneapolis by electricity. The electric company to whom this contract was awarded is the Sprague Electric Railway and Motor Company, and the investment called for from the street-railway company is said to be in the neighborhood of two million dollars.

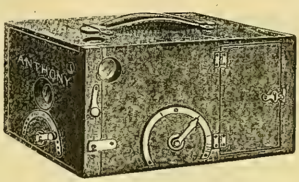
Before deciding upon any system to be used upon these roads, the president of the company, together with the directors, made a careful inspection of all the different methods of operating street-cars in large cities, and investigated the merits of each. As a result of this investigation, the contracts for the partial equipments of the road by cable were cancelled, and negotiations were entered into with the Sprague Company for the entire electrical equipment.

By the terms of the contract, the Sprague Company is to fully equip and put into working order the entire mileage owned by the railway company, the work to be completed by June 1; and the first delivery of electric-railway apparatus, which will include 360 Sprague improved motors for the equipment of the rolling-stock, will be made shortly.

This is probably the largest order which has ever been given for electric-railway motors, and evinces the confidence which prominent street-railway managers feel in the electric system.

Photography done Quickly.

THE initial letters of the above three words have been adopted as the name of the "P. D. Q." camera, a new detective camera of small size, manufactured by E. & H. T. Anthony of this city. This camera, which is shown in the cut, is adapted to the making of four-by-five inch pictures, either time or



THE P. D. Q CAMERA.

instantaneous, and which may be taken either vertically or horizontally. It is provided with a finder which may be used for either position. Three patent double holders are supplied with each camera, — one for dry plates and two for films. The double-film holders are very durable and compact, being only three-eighths of an inch thick.

This camera is fitted with a combination instantaneous achromatic landscape lens and a shutter of a new design, which by its peculiar mechanism is always closed except at the moment of exposure, the resetting being accomplished by an ingenious device, which requires only the movement of a lever to the right or left. The manipulation of the shutter is wholly from the outside of the box, and it may be made to work with greater or less rapidity, as desired.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Feb. 18.— D. S. Lamb, Olecranon Foramen; W. W. Rockhill, Tibet; Mark B. Kerr, The Origin of Llao Nous, a Legend of the Shasta.

Engineers' Club, St. Louis.

Feb. 19. — Professor Johnson read Mr. Edward H. Connor's paper on the "Substructure of the Cairo Bridge." The paper was accompanied by drawings, showing the spans, piers, and caissons; also by numerous tables, and the complete specifications of the bridge. The paper explained the work of construction in detail, and the difficulties met with in various parts of the work. The tables gave the results of numerous tests on cements, showing the effect of different proportions of salt, the effect of freezing, the effect of fine grinding, etc. The results were given for both Portland and Louisville cements. Under general discussion, Mr. Willard Beahan was called upon for some information regarding the outlook for engineers in South America, he having recently returned from that country. He stated that the prospects for American engineers were excellent at the present time. Railroads are few, but a large number are in prospect. Municipal engineering was just being taken up. The prices secured and salaries paid were good. Most of the engineers now in that country are French, there being only a few from America and England.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

I wish to exchange or purchase well-fixed or hardened vertebrate embryos for sectioning. Desire specially reptilian embryos, but will be glad to secure any material that I do not possess. Thomas G. Lee, M.D., Histological Laboratory, Yale University, New Haven, Conn.

Wanted—Books and journals, American or foreign, relating to Photography—exchange or purchase. C. W. Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmæa patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes, etc., wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred. — James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.— D. E. Willard, Albion Academy, Albion, Wis.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED—Books upon American Archæology. My publication, "Fort Ancient," in exchange. First-class standard works only. Warren K. Moorehead, Smithsonian Institution, Washington, D. C.

WANTED—Hall's works on Palæontology, and other works giving plates which show fossils of the Niagara Epoch. Address M. D. Sullivan, St. Ignatius College, Chicago, Ill.

WANTED—Set of Encyclopædia Britannica, Scribner's edition, at a discount. R. T. Robinson, 50 Pemberton St., North Cambridge, Mass.

IS THERE any device at present in use for grooming horses by electric power? Is there any power machine for cutting heavy cloth in clothing manufactories, carpet houses, etc.? Any reader having information on these points would confer a favor by addressing Mills, care of SCIENCE.

WANTED.—In the Peekskill Military Academy for Sept., 1890, an instructor in chemistry, physics and mathematics. Address, with full particulars, J. N. Tilden, Peekskill, N. Y.

A YOUNG MAN desires, about the 1st of July, a position as laboratory assistant, or as instructor in chemistry, physics, and lesser mathematics. References as to ability and character. 44 P.M.A. Address R. L. Porter, Penn. Mil. Acad., Chester, Pa.

PRACTICAL CHEMIST, with 10 years' experience in superintending manufacture of oil of vitrol, fertilizers, acetic acid, wood alcohol, etc., is open to an engagement. Bestre ferences. P. O. Box 43, Edgewater, Bergen Co., N. J.

AN M. S. GRADUATE of the University of Illinois is open for an engagement as teacher of the Natural Sciences, Biology a specialty, in an Academy, Institute, or High School. Three years' experience. Is a practical assayer and chemist. Good references. Address G. C., care SCIENCE.

WANTED.—A position in an Academy, Normal or High School, as teacher of the Natural Sciences and Modern Languages. Latin taught in addition if necessary. Address G., Box 441, Hanover, N.H.

A YOUNG SCOTCHMAN desires an appointment in America. Three years in English Government Office. Good references. Address "Jack" care J. Lawson & Coy, 17 Princes St., Aberdeen, Scotland.

WANTED.—To correspond with conchologists in America, especially in California, with a view to exchange. Many British land, fresh water, and marine duplicates; some foreign. Address Mrs. FALLOON, Long Ashton Vicarage, Bristol, England.

A YOUNG MAN can have lucrative engagement, not only a fixed salary, but according to his work accomplished in travelling for SCIENCE. A personal interview invited.
N. D. C. HODGES,
47 Lafayette Place, New York.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 370.

NEW YORK, MARCH 7, 1890.

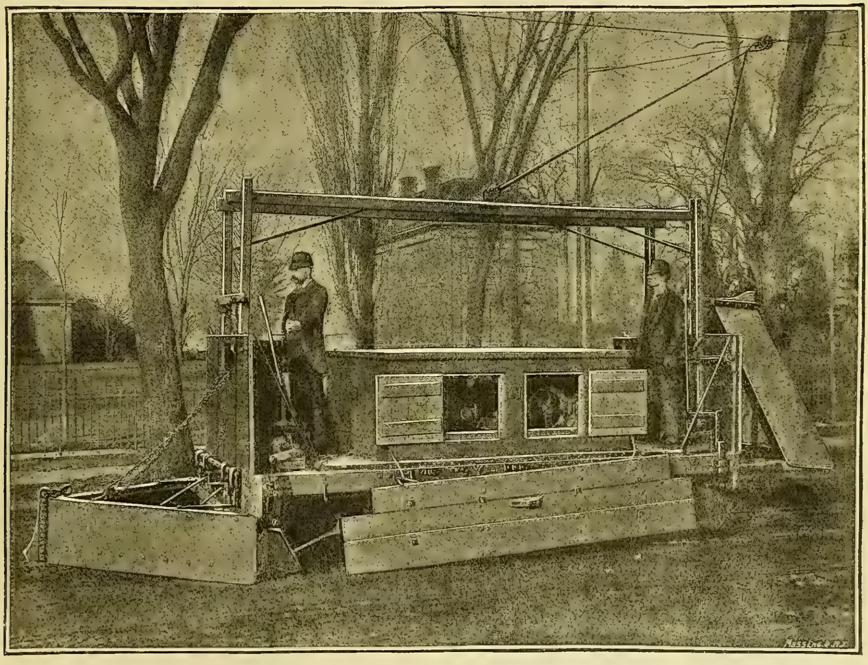
SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

AN ELECTRIC SNOW-PLOUGH.

THE rapidity with which the electric motor is displacing the horse as a motive power for street-cars is greater than is generally supposed. Some idea of the transition going on may be gathered from the fact that one company alone, the Sprague, has sold about eight hundred electric motors in the last sixty days, all for street-car purposes. When we consider that this is the record of only one out of the many electric motor companies in the field, the rapid growth of this branch of applied science seems little short of marvellous

The greater number of these electric railways are in the northern part of the country, where, during the winter months, snow often becomes a serious obstacle to travel. To rapidly and economically remove this obstacle from the tracks as soon as possible after each snow-storm, electric snow-ploughs have been constructed, one of which, manufactured by the Sprague Electric Railway and Motor Company, is shown in the accompanying illustration. It is fitted with two fifteen horse-power improved motors, and is so arranged that it can be run either forward or backward, similar to an electric car. The reduction in gearing between the motors and the car-axles is greater than in the ordinary electric car, so that a large amount of power is available from the motors in case of necessity. It is estimated that this plough will clear the track more speedily and effectually than an ordinary snow-plough drawn by twelve horses.

The view shown is from a photograph of a plough which has been in operation for some time on a street-railway in Troy, N.Y. Although the season has not as yet offered much chance to show the capabilities of the plough, it has effectually taken care of several light falls of snow which have obstructed th tracks this winter.



SPRAGUE ELECTRIC SNOW-PLOUGH FOR STREET-RAILWAYS.

THE HALE PATENT PAVEMENT.

THE Hale pavement, shown in section in the accompanying illustration, consists essentially of a shell of hard-burned bricks laid upon a board floor having a bed of sand below and above it. It is constructed in the following manner. The grade having been properly reduced and dressed to the required

shape, the ground is covered with a layer of loose sand a few inches in thickness, to form a more perfect bed for the boards to rest upon, and to keep the boards from contact with the earth beneath, so as to form a sub-drainage against the effects of freezing weather. The sand is struck off to a perfect surface by a templet made to suit the desired curve, and guided by slats set to grade stakes.

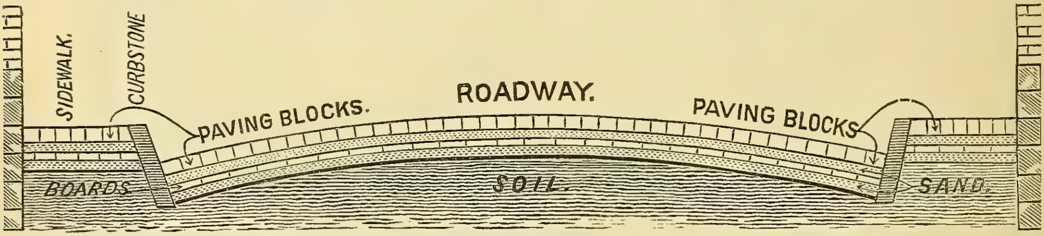
The boards to be used need not be more than one inch in thickness, and ought not to be less than ten inches in width. The best timber for the purpose is that least subject to rot under the circumstances. Good white oak has been used successfully. The boards should be dipped in hot coal-tar or other preserving material. They are then carefully laid upon the sand-bed — lengthwise with the street would be the most convenient way — from curb to curb, with a regular curve all the way. No gutters are necessary, except such as are formed by the crown of the pavement. The broad surfaces of the boards bridge over all minor irregularities of the grading, and widely distribute all weights or pressure; and the floor forms a complete and perfect foundation for the hard material to follow. It is best to cover the boards with a layer of loose sand an inch or two in thickness, to form a more perfect bed for the bricks, which can be struck off with the templet, as before described.

The hard-burned bricks are next laid down. If they are of the ordinary shape of building-bricks in common use, they should be placed on edge, and laid "herring-bone" style, by which means all joints in the board floor are straddled. The seams are then filled with sand, and the bricks settled in their beds with a flatter, well rammed, or rolled with a heavy roller.

In cities having very heavy traffic to follow immediately the laying of the pavement, it is sometimes preferred, after the interstices between the bricks are half filled with fine sand, to complete the filling with hot pitch made by boiling gas-tar until the more volatile portions are driven off. This, when it cools, makes the pavement at once impervious to water, cements the bricks together, and helps to hold them firmly in place. This is generally advisable wherever clean fine sand cannot be obtained to fill the interstices.

A perceptible elasticity tends to favor the bricks when subjected to a crushing weight. The bricks being in place, their flat surfaces agreeing with each other and with the flat surface of the boards beneath, the bearings are perfect and equal: they can be broken only with difficulty, and cannot get out of place; and if at any time it is desired to lay pipes or sewers beneath the pavement, the materials, being all disconnected, can be rapidly taken up and laid aside, and as rapidly replaced at small expense, no new materials being required, and no patching to be done, every thing fitting in its place.

The durability of this pavement has been tested by several years of hard service in the streets of Charleston, W. Va., and in other places. The cost of this pavement in any given locality depends upon the cost of sand, oak or other durable boards, hard-burned brick, gas-tar, and labor at such locality; but it is claimed that it can be laid in any city or town in the United States, having length of streets sufficient to warrant the undertaking, for very much less than asphalt or Belgian granite blocks, and in most places for less than well-laid wooden blocks, or even good macadam roadways. It is controlled by the Hale Pavement Company of Staunton, Va.



THE HALE PAVING SYSTEM.

MAJOR POWELL'S ADDRESS TO THE MINING ENGINEERS.[1]

Mr. President, and Members of the Institute of Mining Engineers,— It is with great pleasure that I greet you, and welcome you to Washington. The people of the United States obtain vast values from the rocks. The sum of the annual products of the mines of the United States is now more than six hundred millions of dollars. Over this production you preside. It is by your genius and skill that these industries are prosecuted. These affairs, which are confided to your guidance are not only great in themselves, but they constitute an integral part of all of the industries of the land, as they are all profoundly interdependent. The industries of manufacture, transportation, agriculture, and exchange have their interests, their prosperity, and their value to the people at large, all interwoven with the industry of mining, for the success and prosperity of which you are responsible.

Deep in the mountains lie the values which you seek; buried under the hills are the substances which you bring to light; concealed beneath the valleys are the materials which you resurrect. By your insight they are discovered. The prosperity of the land depends upon your knowledge of the structure of the earth and the secrets which lie buried in the depths of the rocks. By your knowledge and mastery over the powers of nature, all these substances are wrested from the adamantine grasp of mountain, hill, and valley, and placed in the possession of mankind. By your knowledge of the constitution of the rocks, and the various processes by which they may be transformed, these substances, so useful to mankind in the industries of civilization, are extracted, and transmuted into forms ready for the use of the people. But for your agency, the factory-wheels of the land would stop, the life of transportation would expire, the valleys of agriculture would be reforested, and the marts of exchange, now trodden by busy feet, would be clothed by a mantle of desolation.

That labor may be successful, that the ever-increasing wants of ever-increasing men may be supplied, labor must have guidance. In the centuries that have passed, tyrants have directed laborers as slaves, or held them under control as abject servants of want; but under modern culture the laborer is emancipated from slavery supported by chains and whip, and the slavery supported by want and dependence. Muscles of brawn are no longer shackled; but by your transcendent genius the powers that gleam from the sun upon the world, the powers that flow in great rivers, the powers that are concealed in banks of coal, filling the hills and mountains, the powers that lurk in the chemical re-actions of the rocks that constitute the crust of the earth,— all these powers are enslaved, all these powers are shackled, all these powers are made the servants of mankind. The crack of the lash is superseded by the glint of thought. The modern rulers are the men who control the powers of nature.

It is thus that the members of the American Institute of Mining Engineers constitute the greatest body of rulers now on the globe. When we consider the power that is wielded as a boon to mankind, there is no other parliament or congress whose delib-

[1] Delivered in Washington, D.C., Feb. 19.

erations and administrations so profoundly affect the welfare of mankind; and yet this body is held together as an organization of free men, each independent in his own sphere, governed only by a body of science, which is the common property of all, and the aggregated progress of research, invention, and exploitation. The efficient constitution and by-laws of this society are the formulated principles of science. For the organization of the labors of the past, the whip for the back has been the proper emblem of sovereignty. For the organization of the labor over which you preside, the hammer for the rock is the emblem of rule. You want in your deliberations no eagle on your mace, no unicorn and lion; but the balance and crucible properly symbolize to the world the power of your knowledge to control the industries of mankind.

Gentlemen, the industries which you control have their location in the foundations of the world. The valleys through which the living rivers roll, the prairies that spread their blossoms of beauty to the sun, the hills that billow with ripples of perpetual joy, the mountains where kissing clouds are transformed into cascades decked with rainbows, — all forms of land have their foundations laid in interlocked, crystalline gems, firmly set in a cement so delicately formed that the highest powers of the microscope fail to reveal its structure. The vast diastrophic powers of nature are forever engaged in mountain-building, against which the clouds hurl their storms to carve the hills and form the valleys; and, as the mountains appear above the level of the sea, the clouds bear them away on river-floods to build the fringing islands that are bathed by the tides. As these processes go on from geologic age to geologic age, the gold and the silver, the copper and the lead, the iron and the coal, and all the various substances with which you deal, are gathered in lodes, and segregated in bodies, and spread in strata, and are thus by nature separated from the great crystalline foundations of the world, and accumulated in masses. Then bounteous Nature repents of her generosity. Seeing what a store of wealth she thus brings together, she conceals it from the eye of the vulgar, and deems these treasures too precious to be intrusted to the ignorant. So she hides them away in fissures and in caves, she buries them under volcanic floods, she covers them with strata spread out by the waves of the sea; and she spreads over all a mantle of *débris* —of bowlders and gravels, and sands and soils; and over all she paints the bloom of the meadow, the variegated pattern of the copse, and the green of the forest; and then she smilingly exclaims, "My treasures are for those who can discover them. They who are worthy, by their intelligence may find; they who are unworthy, by their ignorance must remain destitute."

The people of the United States have chosen you — not by blind natural selection, but by intelligent choice—as their representatives; not to make laws, but to discover laws, — the laws of nature, by which all these concealed treasures may be brought to light, and fall into the possession of mankind. How well you administer the trust the six hundred millions of annual mining product in the United States attests.

I thank you, gentlemen, for this evidence of your labor and genius, and I congratulate your constituents for the choice they have made.

There is an organization with which I am connected, — the Geological Survey, — established by the general government, and endowed by the munificence of the people, that is working in cooperation with many other organizations established by the several States, the purpose of which is to aid you in your work. This organization is endeavoring to map the entire area of the United States for your purposes. It is endeavoring to trace the various geologic formations, and to discover their relations of sequence and interdependence. It is investigating the more recondite laws which control the distribution of values in the crust of the earth. All these things it is doing to aid you in developing the mining industries of America. Let me assure you, as a representative from this body, that we are informed with the same purposes as yourselves, and that we also believe that research is a boon to mankind, in part through the increase and diffusion of knowledge, but in larger part through the increase and diffusion of industrial blessings.

The history of the mining engineering of America is replete with the triumphs of science. In the Far West, where the soft breezes of the Pacific make music on giant Sequoian harps, there they harness rivers to monitors, and plough the mountains for gold; and the mining engineers, turning from these mighty tasks, engage in the deft and delicate work of extracting the grains of gold from the mountains of sand. Elsewhere they penetrate through shafts into subterranean depths, and employ, in gold and silver mining, machinery for power and efficiency elsewhere unparalleled. From the depths of the mountain they pump rivers thousands of feet to the surface, and they shoot cars of ore from the hell of darkness below, to the heaven of light above, as if they were playing with toy-guns, such Titan boys are they. Farther to the east, all over the land, the mining engineers are opening the great coal-fields, and gathering the sunshine which nature has been storing for unnumbered centuries in the depths of the earth. In the lost years the vegetation of America raised its verdant arms to heaven, and, grasping the glad sunlight, fell prostrate on the ground, and, still clinging to its boon of light and heat and power, was buried in great coal-formations beneath the accumulating sands of seas. This fossil power and heat and light are brought once more to the open day, and employed as powers for the machinery of America in warming the homes where wives and children dwell, and in illuminating the towns and cities of the land. These mining engineers have discovered that ofttimes the strata of the earth are domed by geologic upheavals, and that they thus constitute great natural receivers for the gases distilled in the depths below. Into these receivers they penetrate with their tubes; and, behold! light, heat, and power are given to the world. Time would fail to tell of all the triumphs of the mining engineers of America.

Gentlemen, I welcome you to Washington, and hope that your deliberations may be wise, and that your joy in our midst may be complete.

ELECTRIC WELDING.

IN accordance with instructions from the City of London Contract Corporation, Limited, Alexander B. W. Kennedy, F.R.S., vice-president of the English Institute of Mechanical Engineers, recently visited the United States in order to see what progress has been made in the direction of the practical carrying-out of the Thomson electric welding process. His report is dated Feb. 1. He visited the offices at Boston, and also spent about a week at their works at Lynn, Mass. He also visited five different works in the Eastern States (at Hartford, Ansonia, Brooklyn, and Trenton) where Thomson electric welders have been in use for some time (in some cases over a year) commercially.

The welding of iron and steel wire was one of the first matters successfully carried out by the company. He saw at the works of Messrs. Roebling, Sons, & Co., at Trenton, a welder which had been at work there for about thirteen months, for a great part of the time twenty hours per day, and the counter of which showed that 193,890 welds had been made with it. He also examined another wire welding machine at the Trenton Iron Works (Messrs. Cooper, Hewitt, & Co.), which had done about nine months' work, and had made 22,095 welds, and at the same works a portable machine, recently installed, which had made 9,022 welds. This last machine was so arranged that it could be carried about easily by two men, and connected with the mains at any part of the immense shop in which it was placed, so as to be used for mending or other welding, wherever required, without the necessity of bringing a heavy coil of wire to it. The managing partners of both the works spoke in the highest terms of the efficiency of the machines, and as to the great saving caused by their perfect utilization of short lengths and broken wires. The welding of brass and copper wire, especially the latter, naturally presented much greater difficulties than that of iron wire, but those seem now to have been overcome. Mr. Kennedy saw at the works of Messrs. Wallace & Sons, in Ansonia, a welder for this purpose, which was one of the first machines put down, and had made 30,415 welds (by register) during the last thirteen months in copper and brass wire; the latter, in

certain cases, of the very hard and poor quality used for making pins. It was at the time being used for welding coils of brass wire into continuous mile lengths (twelve coils to the mile length). The wire was about an eighth of an inch in diameter, and of a very good quality of brass.

Mr. Kennedy had five short pieces of the brass wire welded together into a length of about 18 inches and the burrs removed (the whole operation only taking four or five minutes), and then took the welded pieces to the wire-drawer and had it passed six times through the dies, reducing its diameter from .12 of an inch to .031 of an inch. The existence of the four welds made no difference whatever in the drawing, which was continued until the diameter was reduced to about .002 of an inch.

In order more thoroughly to examine the conditions of straight butt welding in ordinary sections, he made a number of experiments at Lynn. In these experiments, as it was impracticable to measure the power going to the dynamo, he measured the net electrical power going to the welder, and also the exact time during which the current was supplied to the welder. These measurements were made on 25 pieces of wrought iron and steel bar of diameters varying from half an inch to two inches. No sensible difference between the iron and the steel in respect to power or time was found. The horse-power required varied, of course, according to the duration of the operation, and it has been found convenient to make this duration vary directly in proportion to the diameter of the bar, taking forty seconds as the standard time for an iron bar of one inch diameter. Keeping to these conditions, the horse-power per square inch of material remained very nearly constant for bars between half an inch and an inch and a half in diameter, its average value being 20.8. This corresponds to about 30 indicated horse-power at the steam-engine per square inch of welded section during the time that the current was on. This power can be very largely reduced without detriment to the weld, if the saving of power should be of greater importance than the saving of time. Of course, with slower working, the quantity of work which a machine will turn out is proportionately decreased.

The Thomson welders have been used for brazing as well as welding. At the immense bicycle-works of the Weed Sewing-Machine Company in Hartford, Conn., Mr. Kennedy found a brazing welder which had been at work about nine months, and which had made, by register, 29,800 separate operations. The managing director of the works said that he was now modifying the design of his bicycles throughout, with the special object of brazing or welding electrically as many joints as possible.

Inquiries were made as to the wages paid to the men who worked the welders at the different factories visited, and it was found that in no case had highly skilled labor been found necessary.

In summing up the whole matter, it may be said that the Thomson electric welding process has already, in America, been carried fairly beyond the experimental stage, and has achieved sufficient success in regular commercial work of somewhat varied kinds to warrant the belief that its industrial future is one of the greatest practical importance.

The process of welding in use by the Thomson Electric Welding Company has been fully investigated also by a United States naval board, consisting of George A. Converse, A. S. Greene, S. W. Armstead, and Gilbert Wilks, which convened at Boston, Feb. 10. They find that at the present time this process renders it possible, practically, to weld wrought-iron, cast-iron, brass, and copper rods from the size of the smallest electrical conductors in use for distributing purposes, to rods of two and a half inches diameter, and to weld pipes of larger sizes; to weld dissimilar metals, and pieces of different forms of cross-section; to join by welding the ends of wire cables, and to form welded rings of small or large diameter.

The board is "convinced that the Thomson welding process can be found of great utility to the naval service, both on shore and afloat, for the following reasons: it can be used (*a*) in welding breaks in rods without altering them either in length or shape; (*b*) for welding tubes; (*c*) for welding angles and shapes of intricate form; (*d*) for welding copper, brass, cast-iron, or other metals; (*e*) for heating metals for forging, tempering, and upsetting; and (*f*) for welding wire cables."

HEALTH MATTERS.

Consumption in Hayti.

THE natives of Hayti believe phthisis pulmonalis, according to Dr. R. P. Crandall (*Medical Record*, Jan. 11, 1890), to be both contagious and infectious, and fear it much more than yellow-fever or small-pox.

A native who is believed to be affected with this disease is avoided and shunned by all who know him, and becomes an object of prayer for the priests, and of pity for the people.

When a consumptive dies, the entire contents of the room in which he died are either destroyed or thrown into some place set aside by the government for that purpose. This sacrifice of property not only includes the furniture of a room, but also articles of value, such as jewelry, gold, and precious stones. This idea of destruction is carried to such an extent by some, that the paper is sometimes removed from the walls, and the floors torn up. Cases have even occurred where small houses, in which deaths from phthisis have taken place, were burned down to the ground to prevent the spread of disease.

"While riding one day near the suburbs of Cape Haytien, the commercial capital of northern Hayti," writes Dr. Crandall, "I came across a sort of marsh or land of mud known as the Cimetière des Chevaux. Scattered over its surface, and half sunk in its muddy depths, were innumerable household articles, furniture of all kinds, sewing-machines, pianos, book-cases, books, etc. Here and there also appeared the whitened skeletons of animals. My curiosity being excited, I asked of a native standing near the reason for this apparent waste of property. He informed me that the Cimetière des Chevaux was a repository for the dead bodies of anmials, and for every thing that was found in the room of one who had died from *la poitrine* ('consumption'). When asked if any thing was ever removed from the cemetery, he answered that nothing would induce a Haytien to even touch any thing that had been placed there. I found this to be strictly true, as on several occasions I offered natives sums of money to bring me articles from the cemetery, and was always refused with looks of horror and repugnance. On careful investigation, I found that phthisis was regarded as contagious by all classes throughout Hayti."

THE HOUR AT WHICH DEATH OCCURS.—From a study of fifteen thousand cases, extending over a period of twelve years, Dr. J. F. Burns states, in the *New York Medical Journal* for Jan. 4, 1890, that it would appear that death occurs seemingly without any particular predilection for any certain hour, and that the number of deaths for each hour is very evenly proportioned, considering the large number of cases taken and the time covered. The only very positive conclusions the author has formed from the figures are (1) that the idea that more deaths take place in the early morning hours is an erroneous one; (2) if stimulants are to be pushed in disease during these hours, the practice must be justified upon some other ground than to avert the possibility of danger supposed to be very probable at this period; (3) that the vitality of an individual in disease is not regulated by the same influen es or subject to the same laws that govern the vitality of a healthy human being, the normal equilibrium maintained in health between the mental and physical states being altered.

PUTREFACTION AT GREAT DEPTHS IN THE SEA.—Dr. Regnard has raised the question, says the *Bristol Medical Journal*, as to whether a corpse which sinks to a very great depth is preserved indefinitely or otherwise from putrefaction. According to his researches, published in the archives of the Biological Society of Paris, putrefaction does not take place in decomposable substances submitted to a pressure of 600 to 700 atmospheres. These figures correspond to a depth of 6,000 or 7,000 metres at sea. From these experiments it must be concluded, according

to Dr. Regnard, that there is a total absence of putrefaction in the greater depths of the sea. The curious "abysmal" fishes discovered in the "Challenger," and other expeditions appear to rise after death, so that they are sometimes found on the surface; though, as a rule, they go to pieces, as the surrounding pressure diminishes, long before they reach the air. Still, there is no proof that bathybial or abysmal micro-organisms do not exist; and, if so, they could cause decomposition in the corpses of men as well as in the dead bodies of abysmal fishes. The question is of considerable medico-legal, and yet rather biological, interest, and it is far from settled.

NOTES AND NEWS.

ACCORDING to *Nature*, for the purpose of growing plants under more natural conditions than those usually afforded by the soil and surroundings of ordinary botanic gardens, M. G. Bonnier, the director of the Botanic Garden in Paris, has obtained from the director for higher education in Paris the grant of a piece of land in the forest of Fontainebleau as an annex for experimental culture. It has been placed under the special charge of M. Cl. Duval.

— A pamphlet published by the Cornell University Christian Association, containing a map of the campus, and giving detailed information about the village of Ithaca, the university buildings, examinations, boarding-houses, etc., will be sent free to prospective students. Apply to the treasurer of the Cornell University, Ithaca, N.Y.

— One of the problems presented by the frightful eruption of Mount Bandai in Japan, two years ago, was the manner in which a large number of holes in the earth in the neighborhood of the mountain were formed. It was suggested, says *Nature*, that they owed their existence to the falling of rocks and stones cast up by the eruption, while another theory was that they were formed by forces beneath the surface. At the last meeting of the Seismological Society of Japan, Dr. Knott read a paper on the first theory, in which he demonstrated that it was quite insufficient to account for the phenomena. Professor Milne, it may be added, has expressed the same view from the beginning.

— Mr. A. R. Bonsdorf has contributed to the *Izvestia* of the Russian Geographical Society (vol. xxv. 5) an elaborate paper on the conclusions as to the secular upheaval of the coasts of Finland which may be drawn from the accurate measurements made since 1858 under the direction of the Finska Vetenskaps-Societeten. It appears from the mathematical analysis to which the measurements have been submitted, as we learn from *Nature*, that the average upheaval of the coasts of South-West Finland is 55 centimetres per century; and that the rate of upheaval increases from Ut-ö (in the Aland Islands) towards the north, and towards the east as far as Porkala (not far from Helsingfors), whence it decreases again towards the east. The interpolation formulæ better correspond to actual measurements if the changes of the level of the Baltic Sea resulting from the changes of atmospheric pressure are taken into account.

—An expedition has been despatched by the Peruvian Government to the Javary River, on the borders of Peru and Bolivia. The primary object of the expedition, as we learn from the "Proceedings of the Royal Geographical Society," is a military one, being the chastisement of the Indians for the murder of white traders; but, as not less than five scientific men accompany the party, some important results with regard to the topography and ethnography of the region may be expected. Among the *savants* is M. Richard Payer, who, on returning to South America after a hurried visit to Europe, was invited to join the expedition.

—An industrial exhibition will be held at the Swedish capital during 1892, a remarkably well-positioned site in the proximity of the town having been fixed upon. A committee has been considering the financial question of the matter, and arrived at the result that the expenses would be likely to exceed the profits by 1,200,000 krona. This deficiency is proposed to be covered by a grant from the state of 400,000 krona (half to be taken from the industrial manufacture fund), by a grant of 300,000 krona from the city of Stockholm, and the balance of 500,000 krona it is proposed to raise through a lottery. Stockholm is a beautiful town, and the Swedish manufacturers are sure to exert themselves: so the exhibition should become one of some interest, even in these days of excessive exhibitions.

—The annual report of the trustees of the Lenox Library shows that there has been no change in the condition of the library since their last report to the Legislature. A re-arrangement of the various collections of which it is composed, begun during the year and still in progress, was determined on by the trustees with a view to its easier administration in the service of the public, who are freely admitted to its inspection and use. The total number of visitors in 1889 was 8,708. An addition of special interest has been made to the picture-gallery in the gift, by Mr. Alexander Maitland, of the portrait of Van Brugh Livingston, by Sir Henry Raeburn. The chief additions to the other collections have been made by the purchase of the library of the late president, Robert Lenox Kennedy. The Drexel Musical Library, the legacy of the late Mr. Joseph W. Drexel, has been completely arranged in special cases. The completion and publication of the catalogue, which is now in progress, will make available to the musical world what is perhaps the most important collection of the kind in this country.

—An interesting paper by Major Rogala von Bieberstein, German Army, has appeared in the February number of *Colburn's United Service Magazine*. The principal deductions derived from the last summer (1889) manœuvres in the presence of the Emperor, when "extensive use was made of smokeless powder by different divisions of the Guards, as well as by the whole of the Tenth Army Corps," may be summarized as follows. Cast-steel guns were seriously injured; bronze guns were unaffected; steel-bronze guns are recommended. It was found necessary to lubricate gun-barrels from time to time by means of an oily cloth. The cartridges take up less space in the powder-chamber. Whether with guns or rifles, "a better aim is obtained, as also quicker firing; it is easier to judge distances; a better view of one's own troops is obtained; a clearer general view is presented; and a better control in directing an attack or defence is practicable. . . . Troops can suffer great losses from an enemy's fire without knowing whence it comes, and whither they shall direct their fire in defence. . . . The artillery. . . will in future fill their shells with explosives which produce dense smoke, in order the better to observe the" bursts. "Cavalry will suffer more than any other branch of the service by the introduction of smokeless powder, for their best friend was always the smoke which veiled their attack. . . . Their tactical worth in field operations will become much less" than formerly. As to the defence, defenders "can use their weapons with more composure, especially in the front line, than can the attacking party. . . . The spade will play a more important part than formerly, as well for the infantry as for the artillery." As regards the attack, the cavalry will reconnoitre a position under great difficulties, they "must be prepared to suffer . . . greater losses than heretofore," and "must develop a more careful reconnoitring activity. . . . The attacking party of to-day must make great use of his artillery to shake the enemy's infantry" before the position is assaulted. Major Bieberstein considers that the "attacking force which leaves its cover to advance will be cut down by a murderous fire, better aimed than formerly. . . . The increased deadly effect of the repeating rifle and smokeless powder on an enemy repulsed after an unsuccessful storm, will tend to annihilation, and probably change an orderly retreat into hopeless flight." Applying these deductions, it appears more than ever necessary that generals in the field should be experts of the highest order. Also it appears that the preponderance of advantages gained by modern inventions lie with the defence, and that troops which may not possess sufficient experience to attack, may nevertheless defend a good position against the best soldiers in the world, and especially in an enclosed country.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

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CONTENTS:

BOOK-REVIEWS.

Emigration and Immigration. By Richmond M. Smith. New York. Scribner. 12°.

The New England States were settled y a set of persons with very fixed ideas as to the proper way of conducting Church and State, and those who came later from the mother country to settle found that they must follow exactly in the footsteps of those already there, or be subject to abuse and even most cruel persecution. Those early puritans must have looked on the later comers as immigrants among themselves who had colonized the land.

We are now experiencing a somewhat similar condition of affairs. Our author, with others, extends the colonization period to the time of the Revolution, or, as few new-comers came to the country from 1776 to 1820, even to this latter date. Those who possessed the country did not by any means agree among themselves as to what sort of a country, politically and socially, it should be; but still a very successful democracy was established, with a fairly uniform conception among the people of what was best for them.

But since 1820, owing to the existence here of vast tracts of unoccupied farming-land, and to the development of methods of transportation with an accompanying enormous reduction in the cost, millions of people have left Europe to make new homes for themselves in this country. The result is, that, as Richmond Smith puts it, nearly the half of our population is made up of persons either of foreign birth or whose ancestors came to this country since 1820.

"What is to be the effect on our institutions?" is the query to which this book on emigration and immigration is written.

The need of such a book is obvious when one considers the paucity of available literature on the subject. There are, of course, numerous magazine and review articles, and numberless newspaper squibs. The last are buried hopelessly, and the former are by no means easily accessible even in the largest libraries. Every one knows what repulsive volumes are the government reports on any subject, published, as they mostly are, without any intelligent editing. So it happens that Richmond Smith has given us a most convenient and needed summary of the facts on the subject under discussion.

That the question of government regulation of immigration has been a burning one, goes without saying. The immigrants come here to earn a living, and a better living, as they believe, than they have had in their old homes. But in going to work, on arrival, Tom or Jerry appears to displace some one already in possession of a good job: so over and over again a cry has gone up from the laboring classes for a checking of this inflow of rival workers.

In the main, the immigrants come because their husbands, families, or friends are already here; and no reason appears why this process should not continue, so long as any inducement exists for them to come. This is what is happening as the result of affairs as they have come naturally to exist. Now, our author is one of that new school of economists who think that the haphazard evolution of mankind should not be allowed to go on longer unguided. This school would have all things human guided, and, as the State, whatever that may be, is the only body strong enough to enforce its guidance, guided by the State. The State is doubtless wiser than it once was, but then it has more difficult problems to deal with as it grows more developed. But how is that acme of State wisdom to come that shall make it possible for the State to deal intelligently with the immigration of a million of people to this country in a year? How is it likely that the State can wisely do more than say that paupers and members of the other defective classes shall not come, and possibly that the bringing in under contract of bands of laborers is no longer necessary?

That this influx of new population is going to have an effect in changing our institutions is doubtless true; and let us hope that the remnants of some of the institutions of our revered pilgrim fathers may be swept away, now that we no longer believe the devil is lurking beind every wood-pile, as did our ancestors.

Let us see that the immigrants coming are sound in body and mind, that they are brought here in human fashion, and that they are not fleeced after their arrival; but let us not dread the effect on the institutions of the future of sane men living in a free country.

LETTERS TO THE EDITOR.

⁂ Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Cause of Rain.[1]

In a paper entitled "On the Cause of Trade-Winds," which I recently had the honor of reading before the society, I gave my reasons for assuming that the actuality which lies behind the really abstract term "a centre of high pressure" is a body of unsaturated or dry surface-air, or what may be called an air-cushion. I now propose to continue this train of thought by dealing in a similar way with low pressures, or cyclones, thereby trying, if possible, to arrive at a definite conclusion as to the actual cause of rain; rain being the most prominent feature of cyclones, or low pressures.

The difficulty in approaching this subject lies perhaps herein, that, as Mr. Scott says in his "Elementary Meteorology," 1887, "almost every one imagines himself a born meteorologist," and therefore in all likelihood almost every one of my present audience has formed for himself a more or less definite opinion of the cause of such an every-day occurrence as rain. To shake this faith a little, and to show you that we here really stand before a problem which has not as yet been solved, I may commence by quoting what a man of Mr. Scott's experience says. "We must admit," says he, "that the study of weather has made next to no progress at all in gaining an insight into the agencies which are at work in producing the various phases of weather;" and, "unless this be secured by careful and long-continued attention to a few simple and obvious principles, the labor bestowed on the most complete mathematical discussion of the results will be thrown away."

It is indeed a curious fact that the more pains meteorologists have of late years taken in trying to bring the accumulated facts of observations to agree with theory, the farther they seem to have gotten away from their goal. They may not all admit this, but it is a sign of a wise man that he admits when he knows nothing; and, as we have just seen, Mr. Scott for one is evidently fully aware of the defects of his science, which he declares can hardly be called a science as yet.

To make you a little familiar with the difficulties we have to

[1] The substance of this letter was read before the American Society of Civil Engineers, Feb. 19, 1890.

encounter, I may commence by giving an account of the rain theories which have been popularly adopted by meteorologists. These have been condensed in the following words by Mr. Scott:—

"Rain is produced by the chilling of air more or less charged with moisture. This is effected in various ways, of which the following are the principal: No. 1. The ascent of a current of damp air, which is chilled as it rises; No. 2. The contact of warm and damp air with the colder surface of the ground, as in case of our own west coasts in winter [England], where the land is colder than the sea-surface; No. 3. The mixture of masses of hot and cold air."

In the first place, it seems strange that rain should be caused by the chilling of the atmosphere, as rain is almost invariably accompanied by milder weather. A certain type of mild weather is nearly always the forerunner of rain. During the rain the temperature hardly sinks, although the sun is prevented from shining on the ground; and we generally expect warmer weather to follow after the rain. These remarks may serve to rouse suspicion against the theory of rain being caused by chilling, for we may feel perfectly sure that any theory which goes straight against the general weather indication must be wrong from the outset. However, let us now examine the theory in detail.

Of these three causes, No. 3 is by the author himself placed *hors de combat*, when he states that Dr. Haun of Vienna has calculated, "that even by assuming a very extreme case, which could hardly occur in nature, there could not be produced as much as the twentieth part of an inch of rain."

Cause No. 2 is by the author partly included in cause No. 1, as the sloping land-surface causes the air moving against it to ascend. As to the other part of it, I fail to see how contact between a cold surface and warm air can produce rain. It can produce deposit of dew, as, for instance, when we bring a glass of cold water into a heated room; but rain always falls from a considerable distance from the ground, and is therefore not created at the place of contact of the air with the land-surface.

We are therefore now reduced to cause No. 1 as the only possible cause of rain. This is, however, worse than any cause at all, as may be seen from the following simple and well-known experiment. If, under the piston of a strong glass cylinder, we have air saturated with moisture, and press the piston down, a portion of the moisture is condensed into water, as is seen by the mist formed, and the trickling of dew down the inner surface of the glass vessel. The temperature is raised by the compression, but not sufficiently to prevent condensation from taking place. If we now draw the piston back to its first position, we find the air under the piston in the same condition as when we started the experiment. But this means, that, by expanding the air, the moisture which was condensed into water by the compression has again evaporated. The air, therefore, gets chilled by the expansion, but not sufficiently to prevent this evaporation from taking place.

The consequence is, that the chilling produced by expansion during the ascent of a current of damp air can under no circumstances cause condensation of its moisture into rain. The experiment, however, shows that condensation or rain can be produced by a body of saturated air being brought under greater pressure; and of this we will just make a passing note.

The modus or the ascent of a current of damp air is by most meteorologists considered to be the chief cause of rain, and is supposed to take place at the centre of a cyclone. It is thus maintained that there is a certain inward movement of the circulating surface-air in a cyclone, and that for the air (this is supposed to be always damp air) which is carried by it towards the centre there is no other means of escape but to rise at the centre. How absurd this whole explanation must appear to anybody who has been living in deserts or arid districts, will be observed when I mention, that, while I was in Australia during a period of very severe drought, a break in the drought was caused by a series of cyclones crossing the country,[1] entering in the northern part of New South Wales, and passing out again through Victoria, thereby drenching a narrow strip of land about 50 miles wide and 400 or 500 miles long with rain, while on both sides the drought continued uninterruptedly. It seems difficult to explain how this cyclone should have gathered its supply of moisture from moisture rising from the dry surface-air over a perfectly dried-up country.

[1] See H. C. Russel, Report on Rainfall of New South Wales.

What we want is evidently a rain theory which is capable of accounting for rain, whether the surface over which a cyclone passes is wet or dry, or whether it is giving off vapors or not; and I have taken pains to show how utterly incapable the existing theories are in this respect, so as to clear the atmosphere from old cobwebs which might stand in the way of an entirely different view of the whole question, being well aware of the opposition with which new theories are generally met at the beginning.

In my pamphlet on drought I called attention to the aqueous vapor as the element of the atmosphere to which some unknown quality was likely to adhere, and by knowing which we should be able to explain the whole atmospheric puzzle. With the object in view of finding this secret, I undertook in April, 1888, a series of observations from the tower of the Rouen Cathedral in France.

The object of these observations was to ascertain the difference in barometrical pressure existing between the two ends of a vertical air-column, and to observe how far and in what manner this difference, or the weight of the air-column, changes when the state of humidity of the air varies. At the base and top of the steeple of the cathedral, which is upwards of 500 feet high, was established a station containing quicksilver barometers (and aneroid barometers to check the readings of these) and dry and wet bulb hygrometers. At convenient places between the two stations, thermometers were hung out with the object of attaining a fair average of the temperature of the air-column.

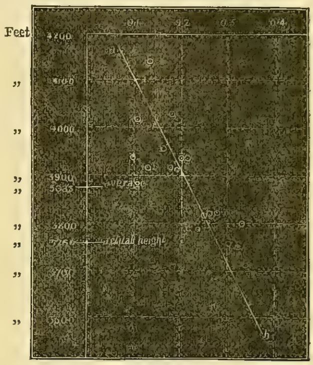


FIG. 1.

The two stations were connected with a telephone; and at convenient hours, at any time during the day or night, for a period of about fourteen days, synchronous readings of all instruments were taken at both stations.

The instruments were the best and newest made by Messrs. Negretti and Zambra of London, and were all adjusted at the Kew Observatory. It is my pleasant duty to mention here that this well-known firm of instrument-makers wrote me a polite letter, in which they offered the loan of their instruments free of charge, considering the interest involved in my researches. To assist me in making these observations, I secured the services of Mr. McClellan of the Greenwich Observatory, who has had many years' experience in handling the most delicate meteorological instruments.

Thus every thing possible was done to obtain reliable observations, and the result was as stated below. Instead of reproducing here the figures of my own personal observations, I think it will be more to the purpose to point out how the same result can be

distinctly traced in the observations made by others, who at the time were not aware that these results could be deduced from their observations.

As such, I have selected Professor S. P. Langley's "Professional Papers, Signal Service, No. XV., War Department, U.S." On p. 191 is a table showing the results obtained by measuring the altitude between sea-level and Lone Pine, Mount Whitney. Of these forty measurements, I have in the following table given the ten highest (upper half of table) and the ten lowest (lower half), arranged according to the height.

Table of Barometric Measurements of Altitude between Sea-Level and Lone Pine, Mount Whitney.

Time of Observation. 1881.	Results in Feet.	Weight of Vapor in Inches of Mercury.	At Lone Pine	
			Relative Humidity.	Temperature, Fahrenheit.[1]
Aug. 26, noon	4,140	0.1354	10.3	87.8°
Aug. 26, 9 P.M.	4,030	0.1823	28.8	65.7°
Sept. 3, noon	4,020	0.1060	8.7	85.4°
Aug. 29, noon	3,960	0 1627	15.6	80.6°
Aug. 25, noon	3,940	0.2081	18.1	83.6°
Sept. 3, 9 P.M.	3,940	0.0960	13.5	69.1°
Aug. 24, noon	3,940	0.2158	16.0	88.6°
Aug. 17, noon	3,920	0.1782	14.9	84.6°
Sept. 2, noon	3,920	0.1302	9.9	87 8°
Aug. 24, 9 P.M.	3,915	0.1931	29.0	67.2°
Aug. 20, 9 P.M.	3,820	0.2787	35.5	72.0°
Aug. 19, noon	3,820	0.2615	17.8	91.3°
Aug. 23, 9 P.M.	3,815	0.2508	38.3	66.7°
Aug. 18, 9 P.M	3,800	0.3314	78.0	54.7°
Aug. 31, 9 P.M.	3,790	0.2190	45 7	57.6°
Aug. 30, 9 P.M	3,790	0.2352	53.1	55.6°
Aug. 27, 9 P.M.	3,760	0.2543	68.0	51.0°
Aug. 21, 9 P.M.	3,760	0.3034	38.4	72.2°
Aug. 22, 9 P.M.	3,750	0.3232	70.1	56.7°
Aug. 19, 9 P.M	3,710	0.3405	71.5	57.6°
Sept. 7, 9 P.M.	3,625	no record		
Sept. 6, 9 P.M	3,620			

[1] The ten highest give an average of 80° F.; the ten lowest, 63° F.

Alongside of each of these figures will be found a number representing the weight of vapor per unit of volume contained in the atmosphere at the time of observation. These latter numbers are obtained by multiplying the relative humidity at Lone Pine (see table in Langley, p. 177) by the elastic force of vapor (Glaisher's tables).

The difference between the maximum and minimum result is 520 feet, or 14 per cent of the trigonometrically surveyed height, 3,760 feet. This latter number was obtained by the engineers who built the railroad passing Lone Pine. Langley's party wrote to the engineers for this information, and awaited their reply with considerable anxiety.

From the table it will be noticed that the amount of vapor in the atmosphere was considerably less when the ten highest results were obtained than when the ten lowest were obtained; and, as perhaps may be better illustrated by the accompanying diagram (Fig. 1), there appears to be an unmistakable relation between the measured heights and the humidity of the atmosphere. The heights are here placed at distances from the vertical line to the left proportional to the amount of vapor in the air, and the line *a b* shows the general tendency of the figures. That these do not follow the line *a b* more closely, may be accounted for by the humidity of the air having been measured only at one end of the air-column; namely, at Lone Pine. This seems to prove the greater buoyancy of cold vapors compared with warm.

We may, however, trace another coincidence in our table. It will be noticed that the ten highest results are generally from observations taken at noon, when the thermometers showed a relatively high temperature, while the ten lowest results are all (except one) from observations taken at 9 P.M., when the temperature was considerably less This is only what we might have expected, and shows that the buoyancy or tending upwards of the vapors in the atmosphere is considerably greater at a lower temperature than at a higher, as explained elsewhere.

Professor Langley's observations give results corresponding to those I obtained at Rouen, and the relations here pointed out may be traced in numerous works from ancient and modern times, though perhaps not in all. However, it should be remembered that it is not so much my present purpose to show how the measurement of altitudes by means of barometers may be carried out with greater accuracy than hitherto (this method being highly unsatisfactory for obvious reasons) as to show that the hidden agencies which are at work in the atmosphere, and without assuming which the whole atmospheric problem remains unsolved, may be distinctly traced in the observations carried out by others. Surely we must expect to find the secrets well concealed, or they would have been demonstrated ages ago; but here, as elsewhere, it is the instances when "the sky is unobscured by clouds," to use a figure of speech, which we must select to make our observations, and Langley's table is such an instance.

The results of my experiments above referred to showed that an air-column 150 metres high, between the top and base of this tower, became 1.3 per cent lighter by an increase of atmospheric humidity, indicated by an increase of elastic force of vapor of from .2 to .3 of an inch pressure. The temperature was reduced to 40° F., and the atmospheric pressure to 30 inches.

According to Glaisher's "Hygrometrical Tables," one cubic foot of dry air at 40° F. at a pressure of 30 inches, weighs 557.8 grains, while one cubic foot of saturated air weighs 556 grains. The difference, 1.8 grains, is about .0033 per cent of the whole weight. The dry air, by becoming saturated, has therefore suffered a loss in specific gravity of .0033 per cent, or, what is pretty nearly the same, it has been expanded .0033 per cent.

According to my observations at Rouen, the loss in weight would, under similar conditions, have been 3.2 per cent, or ten times greater than shown by the tables.

How are these seemingly contradictory results to agree? The method of taking the weight of a certain volume of air confined in a vessel, by which the tables have been computed, is eminently adapted to give us the exact specific gravity; and the experiments have been repeated so often by excellent observers that we have no reason to doubt their correctness. If, therefore, we take it for granted that only one-tenth of the loss in weight sustained by the open column of air was due to expansion, the rest, or nine-tenths, must have been due to the buoyancy[1] of the aqueous vapors, which would carry a part of the weight of the air-column; and this force could under no circumstances have shown itself under the experiments with air in confined vessels, whose absolute weight is taken in a vacuum.

We have hereby been able to demonstrate the buoyancy of aqueous vapor in the atmosphere as a force that must influence the readings of the barometer very considerably, and we now understand fully why the readings of the barometer are lower when the atmosphere is moist than when it is dry, as in an anti-cyclone or air-cushion, simply because the greater amount of vapors in the moist air carries a greater portion of the weight of the air-column overhead than when the air is in a dryer state.

The atmosphere being a perfect mechanical mixture of air ($O+N+CO_2$) and aqueous vapor (H_2O), the buoyancy of the latter must mainly depend upon the difference in specific gravity between the vapor and the air by which it is surrounded; and

[1] See my paper, "On the Cause of the Diurnal Oscillation of the Barometer," in Engineering, London, Jan. 11, 1889.

we will now examine how this changes for different temperatures and at different levels. The following table is gathered from Glaisher's "Hygrometrical Tables" (IV. and VI.):—

Weights in Grains of One Cubic Foot, at 30 Inches Pressure.

Temperature, Fahrenheit.	Dry Air. (a)	Vapor. (v)	Ratio. $\frac{a}{v}$
0°	606.4	0 55	1,000
10°	593.4	0.84	700
20°	581.1	1.30	447
30°	569 2	1 97	300
40°	557.8	2.86	200
50°	546.8	4.10	133
60°	536.3	5.77	91
70°	526.2	8 01	66
80°	516.4	10 98	47
90°	507.0	14.85	35
100°	497 9	19 84	20

It will be seen from this table how much lighter vapor is than air, and that the difference in specific gravity is highly increased as the temperature sinks. While air follows Gay Lussac's law by expanding by heat and contracting by cold, the vapor follows a law the reverse of Gay Lussac's by contracting by heat and expanding by cold, but at a much greater rate for equal temperatures: $\frac{v}{a}$ gives us the specific gravity of vapor, that of the surrounding air being 1; it shows how the buoyancy of vapor $\left(\frac{a}{v}\right)$ is strongly increased as the temperature sinks. At 100° the specific gravity of vapor is one-twentieth of that of the surrounding air, and at 0° it is only a thousandth part of it. The weights are measured under a pressure of 30 inches, the pressure at the earth's surface. To find the weights at higher levels, where the pressure is less, we have only to multiply the numbers of columns (a) and (v) with the same factor according to Marriott's law. As $\frac{v}{a}$ hereby remains unchanged, it appears that the buoyancy of vapor in the atmosphere depends entirely upon the existing temperatures, and is independent of the pressure, or the level at which the vapors are found. As the temperature constantly sinks as we rise in the atmosphere, the buoyancy of vapor, or the force with which vapors tend upwards as they rise to higher levels, is constantly increased, and at an astonishingly high rate. While, therefore, the speed with which vapors rise in the atmosphere may be more or less imperceptible at the ordinary temperatures at the earth's surface, it is rapidly increased as the vapors rise, and may attain an almost inconceivable magnitude in the extreme cold which exists at a great distance from the earth's surface.

With the results deduced from the table fresh in our mind, we may now draw a picture from nature while trying to follow the vapors on their upward passage through the atmosphere, and we shall see how far our calculations agree with the natural phenomena. To take a distinct case before us, let us suppose that on a fine day, with high barometer, we are in a dry locality in which is found an isolated swampy place or lake (Fig. 2). While the surface-air is dry generally, we find it moister over the swampy place, as the sun and the warm and dry air which passes over it cause a strong evaporation to take place. The warm surface-air, though expanded by heat, moves over the ground without rising. It is first caused to ascend by being intermixed with the vapor-particles. According to their buoyancy, the vapor-particles tend upwards through the atmosphere, thereby carrying the air with which they are intermixed upwards also, and the ascent of a current of damp air is established. The vapors are the real cause or life in this motion, each and all of its particles acting as so many minute balloons. Some eight or ten thousand feet overhead, perhaps at a little distance laterally from the moist ground, according to the direction in which the air moves over the ground, we notice an enormous cumulus-cloud being formed, and we have no doubt whatever that it is caused by the current of damp air ascending from the moist piece of ground. The ascending current, after having passed through the heated surface-air, gets suddenly into a much colder stratum, and condensation takes place by mixture of the rising damp air with the cold air it is passing through. As a rule, the chilling caused by the expansion of the ascending current gives it a temperature pretty nearly the same as that of the air through which it passes. It is only when it is met by a sudden change in the temperature of the surrounding air that condensation takes place by mixture, which we may express by saying that the ascending current has "caught a cold." Instead, therefore, of it being the chilling by expansion which causes condensation into clouds and thereby rain, we see that it is a fact that the chilling was not sufficient when the ascending current was taken by surprise by the sudden change in temperature If the colder stratum of air be moving along, we may notice a row of detached cumulus-clouds at some distance from the one nearest to the moist piece

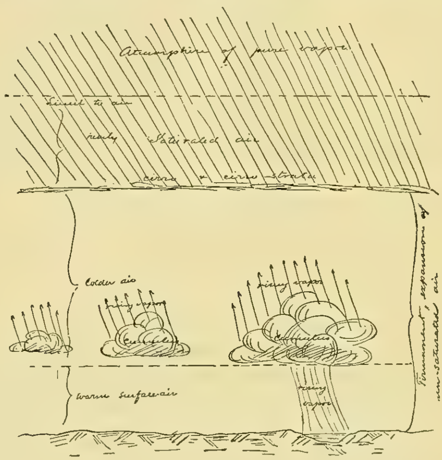


FIG. 2.

of ground, but they grow smaller and smaller the farther away they pass. They are thus cut off from the supply of damp air, and being surrounded by unsaturated air on all sides, and exposed to the sun's rays, they rapidly evaporate.

The formation of these cumulus-clouds was therefore only a passing event in the ascent of the current of damp air; and as the vapors rose before they were condensed, so they will rise again when they are turned into invisible vapor again, and the more quickly, the faster the temperature sinks during the ascent. While, therefore, air and vapor are equally expanded by decrease of pressure during ascent, the decrease of temperature acts differently upon them, having the effect of contracting the air, while the vapors are very much expanded. For both these reasons the buoyancy of the vapor is increased during the ascent. The vapors must therefore necessarily rise as long as there is any air to pass through, unless they meet with a layer of saturated moisture, or air saturated with moisture.

The clouds produced by the ascent of a current of damp air are cumulus-clouds, and they resemble in their shape very much the mist caused by steam escaping from a chimney. The phenomena are, in fact, precisely similar; and the cumulus-clouds are in their nature as unstable a product as the mist from a chimney, only the first phenomenon is on a much larger scale, and consequently it takes a much longer time for the cumulus-clouds to evaporate.

The formation of this class of clouds has, however, had a very disturbing effect upon the conclusions arrived at as to the cause of rain, particularly as they are not absolutely rainless, but occasionally give a shower of rain. A shower, however, is a distinct case, which has nothing in common with the great rain, day's rain, or cyclone-rain, capable of yielding eight to ten inches of rain *per diem*.

To continue our sketch from nature, at a considerable distance overhead we will generally on such a fine day, notice some extremely thin and airy clouds,—the so-called mare's-tails, cirrus, or cirro-stratus. The sky is often suddenly changed from a perfectly cloudless one to one completely covered by a thin layer ("pallium," or cloak, as it has been called) of clouds; and records show that not only has it been the case with the small part of the sky we can observe from one place, but that the sky has been suddenly covered by these clouds far and wide for thousands and thousands of square miles.

As to the height at which these clouds are found, I have particularly asked Mr. Glaisher, who is famous for his wonderful balloon-ascents. He told me that he had gone up five and six miles, and passed through other clouds, but he never seemed to get any nearer to the cirrus-clouds. He even went up seven miles; but then he became senseless, and unable to observe any thing. To estimate their height at thirty or forty miles seems, therefore, hardly to be an exaggeration.

What is the cause of these clouds, and where do they get their supply of vapor to keep them permanent often during the whole long day in the face of the shining sun? As they are strata-like, and entirely different in their shape from cumulus-clouds, we may feel certain that they are not, like the cumulus-clouds, caused by the ascent of damp air. But if their supply of vapor is not to be found below them, it must be on the other side of the strata, or above them. The occurrence of cirrus-clouds is therefore an unquestionable proof of the existence of a uniform layer of saturated air at an exceedingly high level.

FIG. 3.
a, moist air; *b*, rotating body of surface-air.

Our table has shown us clearly where the invisible vapors must go to, and the cirrus-clouds now show us where they are stored up at a great distance from the earth. Our only difficulty now is to explain how the vapors are brought down from this high level, or how they become condensed into clouds and rain. For all we know, a cyclone is a body of surface-air brought into rotary motion, and the effect of this rotation is that rain occurs, if anywhere, at or towards the centre of the rotating body of surface-air; and this takes place whether the cyclone passes over the sea, over moist ground, or over dry land. The centrifugal force sweeps the surface-air from the centre of the cyclone. The partial vacuum which is thereby produced can only be filled up by the descent of the air or vapor above the rotating body of surface-air. This is thereby brought under greater pressure; and, as the experiment referred to above shows that condensation or rain can be produced by compression, we have hereby arrived at a possible explanation of cyclone-rain. This theory agrees with such a general observation as that the clouds are at their lowest level when rain comes from them.

In agreement with this compression theory, we may explain the prevalence of rain on the rising slope of coast mountains, or mountain-ridges in general. While rain falls at the centre of a cyclone, the sky at some distance from where the rain falls is in a condition not far from giving off rain, and so the extra pressure brought to bear upon this saturated air by meeting an obstacle, such as a mountain-ridge, causes rain to set in.

The sketch may represent in section a mountainous coast, against which the moisture-laden clouds are driving from out at sea. The current of air, by meeting this obstacle, is caused to rise, following something like the course shown in Fig. 4. At *a* there is always shelter during such a gale, as shown by the sheep and cattle which gather there. In other words, the current rises to its maximum height at *b* above the inland slope of the mountain. Consequently that is where, according to the theory I am opposing, we should expect the greatest downpour; but there is generally next to none, while the rain nearly all falls on the front side of the mountain. At *c* the current is forced out of its horizontal direction, but a force can only be communicated to an elastic body like air by compressing it. The rain has therefore been caused by compression of saturated air.

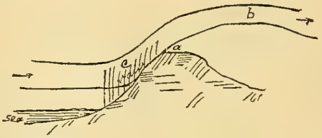


FIG. 4.

Fig. 5 represents a section of the atmosphere of the southern hemisphere for the month of July, the section being made through the Tropic of Capricorn (see map in my paper, "On the Cause of Trade-Winds"). The intersected parts of the three southern continents are at that time of the year in a dried-up state, and the air-cushions which consequently develop over their surfaces are thrown westwards over the oceans. The height of the vapor atmosphere over the surface of the earth is varying and at its maximum in the anti-cyclones. If we should imagine for a moment that there is no surface-evaporation, or that the earth is perfectly dried up, the dry air would arrange itself in a uniform layer between the earth and the vapor atmosphere as a continuous air-cushion of uniform thickness, and there could be no possibility of rainfall. The tendency of the vapor atmosphere is towards such a regular shape, but this tendency is counteracted by the varying degree of evaporation at different parts of the earth's surface. A strong surface-evaporation has the effect of decreasing the height of the vapor atmosphere over the surface of the earth, while little or no surface-evaporation has the opposite effect. In the space between the anti-cyclones the height of the vapor atmosphere over the ground is comparatively small, and it reaches a minimum when (say, for instance, in the V-depression between two anti-cyclones) the surface-air is, by the currents of opposite directions along the borders of the anti-cyclones,

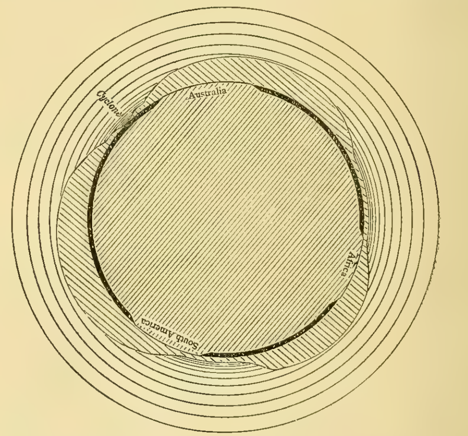


FIG. 5.—IDEAL SECTION OF ATMOSPHERE AT THE TROPIC OF CAPRICORN.

(The circles indicate the outer atmosphere of invisible vapor.)

brought into rotary motion, which drives the surface-air away from a centre. The vapor atmosphere is thereby caused to approach the earth's surface, and by thus descending is brought under greater pressure, so as to give off rain at the centre of the cyclone, as explained above.

Having, by a simple way of reasoning, arrived at the conclusion that an atmosphere of pure aqueous vapor must exist outside the atmosphere proper, we should not feel justified in stopping without carrying our idea out in at least some of its consequences, although the following remarks do not concern our immediate subject, the cause of rain. Supposing there was an outer limit to this aqueous atmosphere, the difficulty which would present itself is, that we should find aqueous vapor alongside of the vacuum of space. It is well known that when moisture is brought into an artificially produced vacuum, the latter gets instantaneously filled with aqueous vapor. How is this experiment to agree with the popular notion that vapor, as well as the other constituents of the atmosphere, is kept within limits round the earth by means of gravitation? If the vapors of the supposed outer border of the atmosphere were prevented from entering space owing to gravitation, how much more would the vapors at the bottom of an artificial vacuum be prevented from filling this space, as the force of gravity is much the greater at the earth's surface than at a supposed outer border of the atmosphere?

Surely, we must conclude that it is impossible to imagine how moisture could remain in the air or on the earth's surface, unless space were filled with aqueous vapor. The earth's surface being practically that of a huge drop of water, and this drop moving round the sun in a supposed vacuum, how could this moisture be prevented from escaping into space unless space was filled with aqueous vapor? The only thing to prevent such an emergency is the thin veil of an atmosphere; but this, being itself all permeable and permeated with aqueous vapor, seems indeed a very poor protection.

Laplace's nebular theory of the evolution of the solar system points towards the same fact; for, if aqueous vapor has once been uniformly dispersed throughout the solar space, it follows of necessity that this space could not afterwards have become perfectly exhausted of aqueous vapor: gravitation towards the sun and the planets could not establish such a vacuum.

If it should be used as an argument against my theory, that we might with just as much right expect to find the other constituents of the atmosphere dispersed through space in a rarefied state, then I would say, as has been pointed out above, that these follow the reverse law of aqueous vapor by being contracted by cold, and that makes all the difference.

The general conclusion I arrive at is, therefore, that the interplanetary space is filled with vapor in an extremely rarefied state. The sun and each of the planets is surrounded by a vapor atmosphere of a denser state, the quantity of vapor surrounding each of these bodies depending upon its size and its surface-temperature. The sun will for both reasons have by far the lion's share of such a vapor envelope. This theory seems to agree perfectly well with the following observed facts:—

1. The retardation suffered by the comet Encke indicates that this comet, when nearest to the sun (that is, at a distance from the sun about that of Mercury), passes through a medium of a certain resistance.

2. The present condition of the surfaces of the four inner planets varies according to their distances from the sun, or, what is likely to be in proportion thereto, their surface-temperatures. On Mars we find more land than water surface, and a clear sky. The conditions on the earth in this respect need not be repeated here. As to Venus and Mercury, they possess an atmosphere of great density; and, as they are constantly covered by clouds, we have no means of ascertaining the proportion between land and sea surface, but their clouded state seems to indicate that they must be entirely or almost entirely covered by water. These varying conditions seem to indicate that the planets are gradually approaching a state of being dried up, or that their waters and vapor envelope are gradually leaving them; and the conditions on the moon indicate that this state will have been reached when they have become extinct planets.

3. The moon being an integral portion of the earth, there can be no doubt but it must once have possessed surface waters and a vapor envelope in proportion to its size. It is now an extinct planet, and its surface is void of waters. What has become of this water, unless it has passed into space?

We have hereby gained a fresh point of view, from which it may be worth our while to reconsider the former, present, and future conditions on the earth. Geologists have come to the conclusion that at the time of the coal period there must have been much less land surface than now, and that the atmosphere must then have been much warmer and moister than it is now. The land may, of course, gradually have emerged from out the seas since then, the quantity of water on the earth remaining constant; but it seems exceedingly more natural to suppose that the earth contained much more water during the coal period than it now contains. When, therefore, we nowadays find ancient sea-beds in the highest of mountain-ridges, we need not feel so sure that these have risen to their present elevated position from under the present level of the sea, as probably the sea-level was formerly quite different from what it is now.

Mathematicians have at various times attempted to determine the outer limit of the atmosphere by calculating at what distance from the earth there would be equilibrium between the centripetal and the centrifugal forces acting upon the smallest particle of air, thereby arriving at results varying from fifty to two hundred miles, the difficult point being how to determine the actual mass and density of the particle of air. Other philosophers have seen the absurdity of imagining the situation of an air-particle in a state of uncertainty as to whether to remain with the earth or go off at a tangent, and therefore have concluded that the atmosphere is practically unlimited.

Another series of considerations has led to the conclusion that outside the atmosphere of air, which may be estimated at forty or fifty miles, must exist an atmosphere exceedingly thinner than air. These various theories are brought into perfect agreement, and the absurdities are avoided, by assuming my theory of an outer atmosphere of vapor, which is unlimited.

It is truly said that there is nothing new under the sun, and we might therefore expect to find that my definition of the atmosphere is merely a repetition of what has been said at former times. In his excellently written book, Mr. Scott points out that the old biblical scriptures, particularly the Book of Job, contain many a sound reasoning on the atmosphere which holds good to this very day. Not having found the information I wanted in modern works on this subject, I took the hint, and looked up these ancient sayings, until I came to a passage by Moses which made me pause. Perhaps Col. Ingersoll may some day point out some serious mistakes in my argument or in the figures I have produced to support it, but at present it seems rather as if Moses managed to give us a pretty clear definition of the atmosphere when he wrote, "And God said, Let there be a firmament [Hebrew, "expansion"] in the midst of the waters: and let it divide the waters from the waters. And God made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament: and it was so."

The coincidence between this observation of Moses and the result I have arrived at may perhaps, in our advanced age, be considered merely as a curiosity; but, considered as a purely objective and perfectly unbiased view of the matter, it seems to me to afford some further interest. Moses could not argue much on atmospheric subjects, as he had no natural sciences to guide him, but neither could they lead him astray. His knowledge of air was very limited. He did not know that it exerts a pressure of fourteeen pounds per square inch, and that this pressure grew much less when he went on to Mount Sinai to write the Commandments; and neither could he have any knowledge of the existence of invisible vapor. But when he walked about in the desert for forty years under a generally serene blue sky, and on rare occasions saw a cyclone set in, then he would observe this phenomenon exactly as Mr. Scott describes it nowadays: "He saw the thin cirro-clouds overhead gradually change into stratus, and these gradually growing further condensed and sink to a lower level, until rain ultimately set in." He saw the clouds and rain being formed on the spot, and could have no suspicion of their being caused by vapors rising out of the dry sand of the desert, and so he wrote faithfully according to what he saw. Although, therefore, no doubt, there are more things between heaven and earth than was dreamt of in the philosophy of Moses, when he tells us that there is a firmament between heaven and earth, dividing the waters from the waters, the time may perhaps not be far distant when we shall all agree with him on that particular point.

The nomenclature of clouds being a question which of late years has provoked considerable dispute, it seems to me, that, according to my explanation of the general atmospheric arrangements, clouds might more properly be grouped according to their cause or origin, rather than entirely according to their appearance, which is so varying and deceptive. We find, thus, two distinct groups of clouds; namely, what we may call "evaporation clouds" and "condensation clouds."

Evaporation clouds are cumulus-clouds in shape. They are formed by mixture at the summit of a current of damp air rising from the ground. They are unstable and merely indicate a stage in the upward passage of vapors. They are essentially rainless clouds, and found in the expansion or cushion of unsaturated air. They have their supply of vapor from below.

Condensation clouds are stratified clouds, cirrus, and stratus. They are formed by condensation by compression at the lower limit of the outer atmosphere of vapor. They are essentially rain-clouds, or those from which the great rain ultimately comes. They have their supply of vapor above them.

FRANK A. VELSCHOW, C.E.

A New Meteorite.

AT a meeting of the Rochester Academy of Science held Feb. 17, Mr. E. E. Howell gave an account of a new iron meteorite recently added to the Ward and Howell collection.

This meteorite was found April 30, 1888, about one and a half miles north of Welland, Ontario, Canada. It was ploughed up by Walter Caughell, and attracted attention by its specific gravity. Before throwing the mass aside as worhthless, a small piece was with much difficulty broken off. This piece, weighing five ounces, was kept by a Mr. Holland until September last, when he gave it to a friend, who, being convinced it was meteoric, forwarded it to Mr. Howell.

After careful search, the original mass was at last rediscovered in a pile of old iron. It is impossible to determine the original size of the mass, as it has been so long exposed that none of the outer crust nor characteristic pittings are preserved, but only the general form, which is a kidney-shaped mass, with the inner edge and smaller end drawn out thin. At two or three points the octahedral structure is well exposed. After being freed from all loose scales, the total weight, including the piece first broken off, is seventeen pounds and three-quarters. Mr. Howell proposed to call it the "Welland meteorite," from the locality where it was found. Mr. Howell stated that this was the second meteorite they had received from Ontario.

The first one fell about 2 P.M., Jan. 21, 1887, in the village of De Cewsville. It struck in the ditch by the side of the street, about fifteen feet from a lady who was passing along the middle of the street at the time.

It broke through a thin sheet of ice, and was not found until the 16th of the following month, about four feet to the east of where it fell. It is an aerolite weighing twelve ounces, with specific gravity roughly calculated at 3.43.

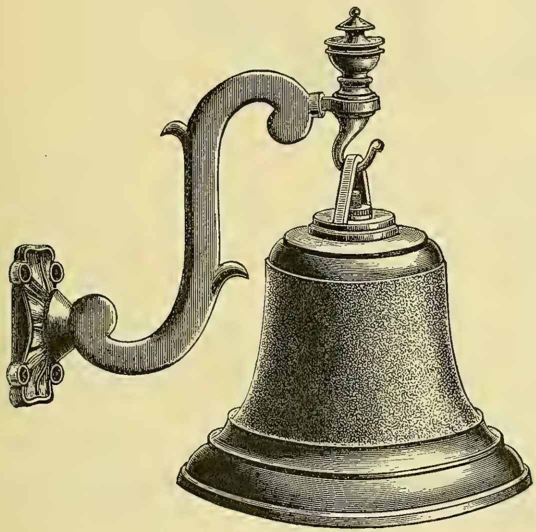
H. L. PRESTON.

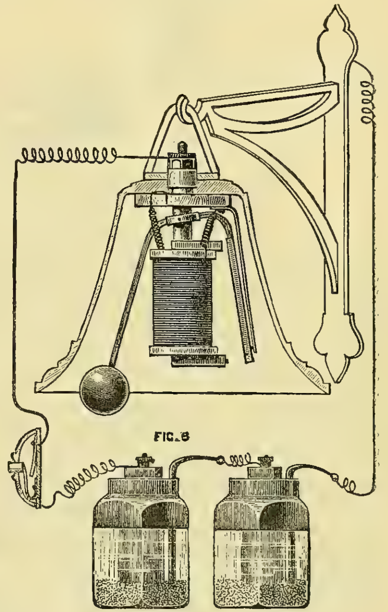
Rochester, N.Y., Feb. 28.

INDUSTRIAL NOTES.

A Novel Electric Bell.

THE Jensen electric bell shown in perspective in Fig. 1, and in section in Fig. 2, possesses some novel features worthy of notice. It will be seen, by examination of Fig. 2, that the operating mechanism and the method of making the electrical connections differ materially form those in ordinary use. Only one magnet is employed instead of two, and by the use of extension pole-pieces at each end of the core the attractive force of the magnet is exerted on a line parallel to its axis. In the ordinary form, the armature acts at right angles with the axis of the magnet. This new device, owing to its compactness, is peculiarly adapted to this form of bell; and this style of magnet gives a powerful magnetic field, insuring quick and vigorou action.





FIGS. 1 AND 2.—THE JENSEN ELECTRIC BELL.

By reference to the sectional illustration, it will be noticed that the method of hanging the clapper is novel and very ingenious. Advantage is taken of gravitation, to an excellent purpose. This form of bell admits of its being used in many places where it would be impracticable to put bells of the ordinary kind. For instance, it can be hung to a clock, and with the use of proper appliances made to strike the hour, or oftener if desired. It is also adapted to church chimes, which can be rung on this principle as easily as playing on the keyboard of a pianoforte.

One great advantage of this invention in its application to locomotive bells is quite obvious. Instead of the fireman spending half his time pulling the bell-cord, the bell by this new method would be placed at the command of the engineer, the same as the whistle or brake, and would be instantly sounded and the alarm made continuous by simply turning the switch. This adaptation alone makes the invention valuable, to say nothing

of the numerous applications, such as street-cars, mills, factories, private dwellings, and public buildings; in fact, wherever a bell is needed. These bells may be made to vibrate or make single strokes, as desired. This bell, which is extensively used in England, is being introduced into this country by Mr. C. M. Lyman of the Eureka Electric Company of this city.

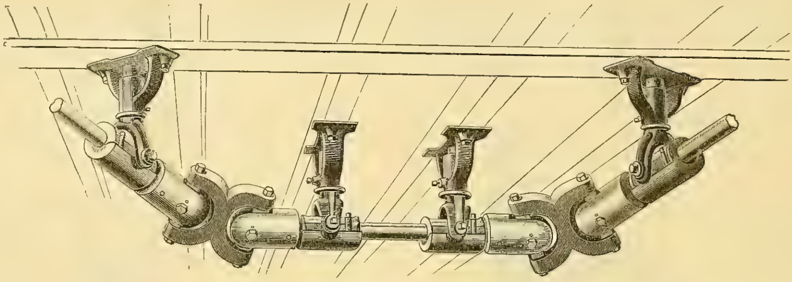
The Robes Improved Shaft-Coupling.

There was on exhibition at the late Maritime Fair in Boston a most interesting and valuable mechanical device, of which we present an illustration. This invention has for its object to provide a universal shaft-coupling of simple construction for connecting shafts placed at a variety of angles or at different levels, or both, and which will be noiseless in its action, and will transmit motion steadily from one shaft to another with a perfectly uniform and regular speed without regard to the load, thus avoiding the sudden jerks and irregular motion common to universal shaft-couplings as heretofore constructed, and which have rendered them unsuitable for general purposes.

The invention consists in the combination, with a pair of shafts adapted to run at different angles or levels, or both, and each having a slot at its extremity, of an intermediate connecting shaft supported in suitable bearings between the ends of the two main shafts, and having a slot at each end, and a pair of coupling-links or connecting pieces bifurcated at each end to form jaws. One of these is arranged between each of the main shafts and the adjacent end of the intermediate connecting shaft, and they are coupled with the shafts by a pair of oscillating or rocking bars, each pivoted at its centre on a pin or bolt within the slotted end of one of the shafts, in line with the axis, and having its opposite ends pivoted or journaled within the adjacent jaws of the coupling link. By this arrangement the power is transmitted from one shaft to the other in a direct axial line, and a steady and uniform motion insured under all conditions. All those who have had to labor with the appliances of the past for bringing about the same end must certainly be pleased with this forward step in mechanics.

A visitor to the exhibition who was interested in mining was impressed with the great value of this device in being so readily adjusted to all the varieties of angles required in working a mine, and intimated his intention of using one as soon as possible. Another visitor claimed that it would entirely obviate the well-known difficulty among the builders of marine engines in adjusting the propeller-shaft to the engine, the adoption of the coupling rendering the absolutely straight shaft from engine to propeller unnecessary. Another thought it exceedingly useful in enabling a canal-boat to be lifted over sand-bars and other obstructions of like character.

There are two or more in use in Boston at present, one of which has been running for three years, another two years; and both are giving perfect satisfaction. Further information may be had on application to the Wyman Machine Company, 226 Devonshire Street, Boston.



THE ROBES IMPROVED SHAFT-COUPLING.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

March 1. — G. Brown Goode, The Origin of our National Scientific Institutions; C. R. Van Hise, The Pre-Cambrian Rocks of the Black Hills of Dakota.

Natural Science Association of Staten Island.

Feb. 13. — The secretary of the building-fund committee made an informal report of progress, showing the following status of the building fund: acknowledged at date of last meeting, $1,050; since pledged, Capt. A. L. King (additional), $150; A. G. Methfessel, $100; Hon. George William Curtis, $100; C. W. Hunt, $100; J. Kadletz, $10; total amount pledged at date, $1,510. Among the various communications read was one from a prominent resident of the island, offering to donate half an acre of land for the building. The old milestone, formerly standing at the junction of Signs Road and Richmond Turnpike, was on exhibition, having been secured by the association since the last meeting. This was supposed to be the last one remaining on the old post route between New York and Philadelphia, or at least upon that portion of it which crossed Staten Island. Mr. E. M. Eadie presented a large piece of drift-rock from Old Place, probably Oriskany sandstone, containing *Spirifer arrectus*.

Royal Meteorological Society, London.

Feb. 19.— Hon. Ralph Abercromby, Observations on the Motion of Dust, as Illustrative of the Circulation of the Atmosphere, and of the Development of Certain Cloud Forms; Capt. D. Wilson-Barker, Cloud Nomenclature; E. S. Bruce, An Optical Feature of the Lightning-Flash.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

To correspond with colleges, seminaries and other schools where cabinets of fossils and minerals are being collected. I have an extensive private collection of fossils from every geological period, and minerals illustrating the common and many of the rare forms. This collection is in duplicate, and the duplicates are for exchange or sale. Every thing is scientifically classified. W. A. Bronnell, professor of geology, 905 University Ave., Syracuse, N.Y.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

I wish to exchange or purchase well-fixed or hardened vertebrate embryos for sectioning. Desire specially reptilian embryos, but will be glad to secure any material that I do not possess. Thomas G. Lee, M.D., Histological Laboratory, Yale University, New Haven, Conn.

Wanted—Books and journals, American or foreign, relating to Photography—exchange or purchase. C. W. Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmæa patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes, etc., wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred.—James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED—Books upon American Archæology. My publication, "Fort Ancient," in exchange. First-class standard works only. Warren K. Moorehead, Smithsonian Institution, Washington, D. C.

WANTED—Hall's works on Palæontology, and other works giving plates which show fossils of the Niagara Epoch. Address M. D. Sullivan, St. Ignatius College, Chicago, Ill.

A YOUNG MAN desires, about the 1st of July, a position as laboratory assistant, or as instructor in chemistry, physics, and lesser mathematics. References as to ability and character. 44 P.M.A. Address R. L. Porter, Penn. Mil. Acad., Chester, Pa.

PRACTICAL CHEMIST, with 10 years' experience in superintending manufacture of oil of vitrol, fertilizers, acetic acid, wood alcohol, etc., is open to an engagement. Bestre ferences. P. O. Box 43, Edgewater, Bergen Co., N. J.

AN M. S. GRADUATE of the University of Illinois is open for an engagement as teacher of the Natural Sciences, Biology a specialty, in an Academy, Institute, or High School. Three years' experience. Is a practical assayer and chemist. Good references. Address G. C., care SCIENCE.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 371.

NEW YORK, MARCH 14, 1890.

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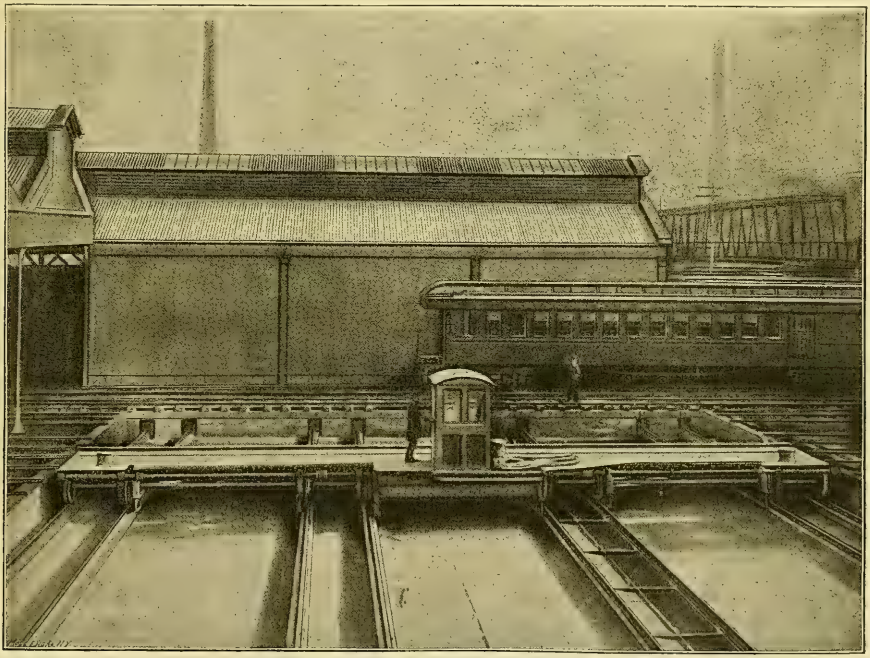
A NEW ELECTRIC TRANSFER-TABLE.

WE illustrate on this page an electric transfer-table, recently installed by the Sprague Electric Railway and Motor Company for the New York Central and Hudson River Railroad. This table differs from the earlier ones installed by the same company chiefly in the electric motor, which is of fifteen horse-power instead of seven and a half, and also in the contact arrangement. The contact is obtained from a couple of heavy copper wires stretched about three feet apart over the second of the four parallel tracks, the wire being carried on insulators fixed to light cast-iron cross-beams so as to be a few inches above the rails. The conductors are kept taut under all changes of temperature by springs at one end. Over these wires two contact rollers travel beneath the table, being kept in contact by gravity only. In the Altoona electric transfer-table, installed by the same company for the Chicago, Burlington, and Quincy Railroad, there is an outer contact maintained by springs, while at the Waukesha electric transfer-table, installed by the Sprague Company for the Wisconsin Central Railroad Company, there is an overhead contact. The current used is only 220 volts, and hence, while not wholly pleasant to take in one's body, it is in no way dangerous. The current is taken from the same dynamo that furnishes light for the station. The full current capacity of the table-motor is 60 ampères.



RAILROAD TRANSFER-TABLE OPERATED BY AN ELECTRIC MOTOR.

The speed of the electric motor is governed by a switch, which throw the winding of the field into different combinations, thus altering the current, maintaining a practically constant strength of field without the use of any wasteful resistance. The control over the speed of the motor is perfect, and no complicated nest of gearing for changing speed is required.

The motor is supported at one end, according to the regular Sprague method, by double compression springs playing upon a bolt which rests upon the platform of the transfer-table. This method has been developed in street-railway work and other places where it is desirable to start slowly under a heavy load, and has proved very satisfactory. At the other end the motor is sleeved to a rigid support. By means of this flexible

attachment, all danger of stripping the gears is eliminated, and the strain upon the gears is always a progressive one.

The advantages of electric power for this work are claimed to be great. The equipment is very much lighter than if steam-power were used, and there is no expense of operation when the table is not in use. One man can easily handle the table, and more conveniently and directly than with steam.

The two end capstans shown on the table are fixed. The centre one is revolved in either direction by a simple clutch-gear. It is used, of course, for working cars on to or off the table without locomotive power.

The capacity of the table is 100,000 pounds. Ordinary car-axles, bearings, and wheels are used throughout for the running gear, and the total cost of the table and motor complete was under $7,000. Its speed is about 150 feet per minute, the same as the old wire-rope table which it replaced. The old pit was lengthened somewhat, and accommodates ten tracks. The rails are carried on wooden longitudinals resting on small masonry foundation walls. The pit drains directly into the city sewers.

Electric transfer-tables have now been adopted by the Pennsylvania Railroad Company, the Philadelphia and Reading Railroad Company, the Chicago, Burlington, and Quincy Railroad Company, the Wisconsin Central Railroad Company, and other prominent corporations; and they are now recognized as an essential feature of every extensive and well-equipped railway switch-yard.

ASIA.[1]

ASIA, the birthplace of man, the mother of nations, is our theme to-night. Here are found the two great races of the world, — the Mongolian and Caucasian; here the great religions of the world had their origin, — the Jews, the Buddhists, the Christians, and Mohammedans. Here is the Pamir, the "roof of the world" or the steps to heaven, the abode of the gods; the centre of primeval tradition, as well as of modern theory regarding the primitive history of man. Here the Paradise of Adam has been most frequently located. Here is the lake from which the four rivers of the Garden of Eden diverge to the four quarters of the earth.

Beyond the Pamir, Alexander, the conqueror of the world, could not pass. Aristotle calls it the Mountain Parnassus, the greatest of all that exist towards the winter sunset, — the great snow mountains, which, in the morning and evening vapors, rise up opposite one like gem spires. This wonderful mountain-range is a series of high plateaus, running nearly north and south about 400 miles, and from 100 to 250 miles in width. These plateaus are covered with snow for nine months of the year. The lowest passes from east to west are from 12,000 to 15,000 feet in height, while all along the range numerous snow-peaks rise to 20,000 and even to 25,000 feet. The plateaus are inhabited only in the summer season, when the shepherds from Afghanistan and Turkestan on the west, and from China on the east, feed their flocks on the rich herbage.

The Pamir has been crossed at different times within the past five hundred years. Marco Polo was one of the early travellers; Bonvalot, a French traveller, one of the latest. Bonvalot chose the months of March and April to cross the Pamir, because there were no herdsmen to obstruct his progress. Many explorers have lost their lives in these wild inhospitable passes, and among the shepherds, more wild and inhospitable than the country.

From the Pamir high mountain-ranges run north-east, east, south-east, and south-west. From the north-east the Thian-Shan and Altai ranges of mountains run in an easterly and north-easterly direction for nearly 3,000 miles, separating Siberia from Mongolia. From Mongolia the range runs more northerly, passing through the eastern part of Siberia, forming the great divide between the waters of the Arctic and Pacific Oceans.

In Kamtchatka the mountains of the range become volcanic, and are met by a range of volcanoes from Alaska. The combined range then turns and runs south, through Japan and the Philippine Islands, into Borneo. In this chain, miles in length, is the largest number of active volcanoes in the world.

From the middle of the Pamir the Kuen-lun Mountains run in an easterly direction 2,700 miles. They separate Mongolia from Thibet. From the central part of the Kuen-lun range, cross-ranges of mountains run southerly through Thibet, past the Himalayas, into and through the peninsula of Indo-China. In Thibet these cross-ridges maintain a normal elevation of 12,000 feet, with occasional passes nearly 17,000 feet high. From the south-east of the Pamir the Himalayas run in a continuous curve about 1,500 miles, with a width of 200 miles, separating Thibet from India. They are rightly named the "Abode of Snow," for through their entire length a mean elevation of 18,000 feet is maintained. Forty peaks have been measured which exceed 24,000 feet in height, while a few range from 26,000 to 29,000 feet. From the south-west of the Pamir the Hindu-Kush extend in a westerly and south-westerly direction through Afghanistan (with many peaks over 20,000 feet in height), connecting with other ranges which form the boundary between Persia and Turkestan, to the Caspian Sea; then around the south end of the Caspian Sea, culminating in Mount Ararat. A continuation of this range crosses Asia Minor to the southern coast of the Black Sea, and thence to the Bosporus.

These ranges of mountains radiating from the Pamir are 10,000 to 12,000 miles in length. Along their whole course are snow-mountains and great glaciers. The Himalayas are supposed to be the highest mountains in the world, though none of these ranges have been thoroughly explored. These mountains, and the elevated plateaus on their sides, give Asia an average elevation of 1,650 feet, much higher than either of the other continents.

The Rivers of Asia.

These great chains are the source of the great rivers of Asia. In Siberia are the Irtish, Obi, Yenesei, and Lena. The Yenesei traverses in Siberia a territory which corresponds in length to the distance between the Gulf of Mexico and Lake Winnipeg.

The Amur is the only river of northern Asia that does not empty into the Arctic Ocean. Its general course is east; but, on passing wholly into Siberia, it turns and runs to the north, where its mouth is in inhospitable regions.

In China are the Hoang-Ho and the Yang-tse-kiang. They rise in the plateau of Thibet, near the Pamir. A great range of mountains running north and south obstructs their course, through which they force their way, and flow in an easterly direction, and empty into the Pacific Ocean; while the rivers of Indo-China, which rise in the same plateau close to these rivers, flow south into the Indian Ocean.

The Indus, and its main branch the Sutlej, rise on the north-western side of the Himalayas, follow the mountains several hundred miles, then find a way through the mountains in wonderful cañons. That of the Indus is said to be 14,000 feet in depth. Near the head waters of the Indus, another great river, the Sanpoor, rises, flowing in the opposite direction, and undoubtedly running into the Brahmaputra; but no traveller has followed the Sanpoor through the wild savage regions of lower Thibet to its mouth.

The waters from the south-eastern or Indian slopes of the Himalayas for 700 miles flow into the Ganges, which, near its mouth, unites with the Brahmaputra; while the waters from the west of the Himalayas flow into the Indus and its branches. Thus these two mighty rivers collect all the waters of the Himalayas, and discharge them into the Bay of Bengal through the many shifting mouths of the Ganges, or through the Indus into the Persian Gulf.

On the western sides of the Pamir, the great rivers of Turkestan, the Jaxertes, and Oxus, or the Syr-Daria and Amu-Daria, have their source, and flow through Turkestan into the Aral Sea. Numerous rivers rise in the Hindu-Kush, and run through the valleys of Afghanistan, but none of them reach the ocean: they are lost in the salt lakes or in the desert. The Tigris and Euphrates rise in the mountains on the coast of the Black Sea, run

[1] Address delivered before the Geographic Society, Washington, D.C., Feb. 26, by its president, Hon. Gardiner G. Hubbard.

An edition of this address, with numerous additions, will be published in pamphlet form at an early date.

through the ancient plains of Mesopotamia, by the ruins of Babylon and Nineveh, and empty into the Persian Gulf.

The Great Basins of Asia.

The several ranges of mountains enclose great basins, and the streams and rivers that flow into these basins have no outlet into the ocean, but empty into lakes or are absorbed by the desert.

There are three great basins, — the Aral-Caspian, the Balkash, and the Tarim, — and many smaller, six million square miles in extent, or more than all Europe. The Aral-Caspian includes the whole of Turkestan, the eastern half of Russia, and the western portion of Siberia. The lowest point is the Caspian Sea, about 80 feet below the level of the Black Sea. The Aral Sea is a little over 200 feet above the Caspian. Into these seas the Volga, Syr-Daria, and Amu-Daria empty, and a few other streams. The Balkash depression lies to the north-east of the Aral-Caspian, and is separated from it only by a low divide. The Tarim depression is east of Turkestan, on the other side of the Pamir.

These rivers, lakes, and seas were formerly much larger than at present. The lower course of the streams that fed them are traced only by their dry beds. The rivers flow in diminished channels into the lakes, or are lost in the desert. All these streams and rivers carry mud and gravel from the mountains, which are deposited in the lakes; and they become shallow, and broaden. As the lake shoals, the stream that runs into it broadens, the evaporation is greater, and more of the water is absorbed by the desert. If the evaporation is greater than the rainfall and inflow, as in the Caspian Sea and Lake Lob Nor, the sea will eventually be filled. Lake Lob Nor has already become nearly dry, and the Caspian Sea is much shallower than formerly.

The seas and lakes now salt were once fresh. All river-water holds salt in solution, which is deposited in the lakes which have no outlet. The fresh water, being lighter, is evaporated, and the lake gradually becomes salt.

The Aral-Caspian basin was formerly filled with a dense population. This region Attila ruled. Here he raised his armies of Huns, which overran all south-eastern Europe, Italy, and even France. Tradition tells us of large cities; and travellers, of their ruins, half buried in the sand, and of traces of numerous irrigating-canals. It was called the "Garden of the World." For hundreds of miles a nightingale could fly from branch to branch of the fruit-trees, and a cat walk from wall to wall and from housetop to housetop.

War, and the pestilence that follows, have devastated the land, for nowhere in the world have so many fallen by the sword as in Asia, while the destruction of the irrigating-canals has reduced this once fruitful land to barrenness. The Balkash and Tarim basins resemble the Aral-Caspian. In the valleys of the Balkash and Tarim, where was formerly a large population, now

"Mere sluggish leagues of great black morass,
Without a shrub, or tree, or blade of grass."

Grand Divisions of Asia.

These great mountain-ranges of Asia are not only the source of the rivers, but they also separate Asia into several natural divisions. The principal are Siberia, Mongolia, China, Indo-China, India, Afghanistan, Persia, Turkestan, and Turkey in Asia, each with peculiar features caused principally by its mountain-ranges and rivers, for these fix the occupation and character of the inhabitants.

Siberia.

The whole of north-western and northern Asia is called Siberia. It stretches from the Ural Mountains east over 4,200 miles to Bering Strait, and from Mongolia north to the Arctic Ocean 2,000 miles, and forms one country, alike in all its natural features. It is separated from the rest of Asia by the Balkash depression, the Thian-Shan and Altai Mountains. The general trend of the country is towards the north. Siberia has the most extensive but least serviceable water system of any country in the world. All its rivers except the Amur rise in plateaus 5,000 feet above the sea, and, flowing north, empty into the Arctic Ocean. On either side of these rivers, large tributaries flow in an easterly and westerly direction, thus affording an almost uninterrupted water highway from the Ural Mountains to the Pacific, and from the south to the Arctic Ocean. From the river Ural east to the river Lena, 2,500 miles, this magnificent waterway is only broken by two or three short portages; and through these, Russians are now constructing canals. A zone of rich black earth runs through south-western Siberia, not in mere patches of fertile land, but prairies covering 25,000,000 acres, sufficient to support millions of inhabitants. These prairies, with but little labor or expense in cultivation, yield year by year the most abundant crops. Vast flocks of birds of many species fly from all parts of Asia — from the islands of the Indian Ocean, from southern Europe and northern Africa — to breed in Siberia. A few of these species extend their flight even to the Arctic Circle.

The northern coast of Siberia is a low plain, the rainfall is much greater than the evaporation, the rivers overflow their banks, and the whole country for four thousand miles in length and three hundred miles in breadth is a great bog called the Tundra. On these plains the ground remains frozen the greater part of the year to a depth of several hundred feet. In midsummer the ground thaws about one foot in depth, and the top of this ice bed is covered with moss and lichens and many varieties of flowers. Under the lichens are found miniature pine-forests one or two hundred years old, — the beginning of a coniferous region which extends from the Ural east to the neighborhood of the Sea of Okhotsk 2,400 miles, and from the 58th to the 70th parallel of north latitude, 600 miles far north of the Arctic Circle.

In some parts of the Tundra an earth stratum alternates with a stratum of ice; and in these, carcasses of elephants and rhinoceroses have been preserved for thousands of years, and the trunks of large trees with their roots bedded in the ice. In this dreary, uninhabitable land, ice-bound for nine months of the year, exposed to the fury of the fierce gales of the Arctic Ocean, De Long lost his life. In summer the mercury rises to 102°, and falls from November to February to —40°. No other region can show such extremes. "It is colder than the north pole and hotter than the equator."

With rich lands and rivers navigable for thousands of miles, Siberia is capable of supporting an immense population. Unfortunately the only outlet for its commerce and produce is through the Arctic Ocean, and thus far all efforts to open this way have been unsuccessful.

Chinese Empire.

The Empire of China lies to the east of the Pamir, and is bounded on the north by the Thian-Shan, on the east by the Pacific Ocean, on the south by the Himalayas. It is divided into three great natural divisions, — Mongolia, Thibet, and China proper.

Mongolia.

Mongolia is bounded on the east by the Pamir, on the north by the Thian-Shan, and on the south by the Kuen-lun. Mongolia is divided into western Mongolia — called sometimes eastern Turkestan, but more properly the Tarim — and eastern Mongolia, or the Gobi Desert.

The region that gives birth to the Tarim River is on a scale of grandeur such as no other river can boast. It is girt round by a wide amphitheatre of the loftiest and grandest mountains, rising in ridges of from 18,000 to 20,000 feet, while the peaks shoot up to 25,000, or even 28,000 feet. From all sides the waters rush headlong into the valley. The smallest disappear in the sand; others flow some distance into salt basins, and are there absorbed. Sixty streams, according to the Chinese, unite to form the Tarim. Along the foot of the mountains are fruitful oases, irrigating-canals, and flourishing towns and cities.

The Tarim steadily diminishes until, after flowing over a thousand miles, it broadens into an extensive reedy marsh, known from ancient times as Lob Nor, or the salt lake. When the land was well cultivated, the mild south winds which brought the sands from the desert were eagerly looked for, as they brought

richness and fertility to the soil; but with the decrease of population the sand drifted over the cultivated fields, and now covers them to the depth of six to twelve inches. Prjevalsky describes the "lake-dwellers of Lob Nor:" "Their food consists chiefly of fish, fresh in summer, dried in winter. They eat neither bread nor meat on account of its scarcity." The people are changed so little from the picture history has given of them, that Prjevalsky's description sounds like an echo of the most ancient Chinese records.

The eastern part of Mongolia is the Desert of Gobi or Hanka ("a dry sea"). It is a rocky, desolate region, with wells and small oases scattered through it. The routes across the desert follow the lines of the wells. Marco Polo says it would take a year or more to ride from one end of it to the other.

The Mongolian of to-day is the living representative and descendant of the ancient Huns and the more ancient Scythians. From Mongolia came the vast hordes that overran Asia and Europe. Their greatest leaders were Genghis Khan and Tamerlane.

In the twelfth century Genghis Khan conquered the eastern part of Asia and Turkestan. Two hundred years after him came Tamerlane, the last of the great conquerors, who carried his conquests into Persia and India, and even into Europe. They boasted that the grass never grew where the feet of their horses had trod, and that a horse might run without stumbling over the places where great cities had stood. The Mongols were powerful only under their great leaders. As soon as the despotic rule was withdrawn, they were broken up into separate families and tribes. To restrain the Mongols, the Chinese Wall was built; but it did not prevent them from conquering China and ascending the throne.

The Pamir, with the Himalayas on the south and the Thian-Shan on the north, forms an impassable barrier between eastern and western Asia. But some 300 or 400 miles north of the Pamir there are three valleys near the 46th parallel of latitude, which afford the only accessible route. Through these valleys caravans go from China to Russia; and for hundreds of years the great hordes of Huns, Mongols, and Tartars poured through these passes into the fertile valleys of Turkestan, forcing the inhabitants of those regions into Europe.

Thibet.

The southern part of the high plateau of Asia is called Thibet. It is bounded on the east by the Pamir, north by the Kuen-lun Mountains, and south by the Himalayas. It is the highest plateau in the world. At the Pamir its elevation is about 15,000 feet, falling to 11,000 feet at its eastern side. Snow-clad mountains shut it in on every side, and cut it off from the rest of the world. It is a cold, rocky country, dry and barren, hardly affording nourishment to its scanty population. The people are poor, and peculiar as their land. The men are unable to maintain separate families, and one wife suffices for two or three brothers. Here, as in a few other poor countries, polyandry is practised, the surplus females being sustained at public expense in the nunneries. The French-Catholic missionaries in Thibet tell us that the population is about 4,000,000; that the mountains run through the country from west to east, with deep valleys or cañons between them.

Gold is found in most of the rivers, and there are also mines of gold, silver, and copper. The government is a despotism. We are told that one of the early rulers of Thibet ordered an equal distribution of property among all the people; but the property was soon in the possession of the former owners, while the poor were poorer than ever. This experiment was repeated three times with similar results.

China.

China is situated east of Thibet. The lands trend toward the east, the high mountains of Thibet become lower, and from the foot-hills low plains extend to the Pacific Ocean.

The population of China is 400,000,000,—more than one-fourth of the world. The number of inhabitants to the square mile is greater than in any other country. This vast population is supported by the two great rivers, the Hoang-Ho and Yang-tse-kiang, which run through the whole length of China, and by the great tracts of rich yellow earth called loess. The land is highly cultivated, and well watered by irrigating-canals, which carry the water of the rivers to all parts of the country. The loess is a solid but friable earth of a brownish-yellow color, and spreads alike over high and low lands, extending over a tract of country larger than France, and, whether on a plain or at an elevation of 7,000 or 8,000 feet, is available for agricultural pursuits. This region is called Hoang-Lu (or "Yellow Land"); and the river that runs through it, Hoang-Ho (or "Yellow River"). Its origin and constituent parts have long been a subject of inquiry. Richthofen, and our own Pumpelly, describe the loess as hundreds and even thousands of feet in thickness, an almost impalpable calcareous and silicious loam, so soft as to be easily crushed in the hand; and yet its consistency is such that it will support itself for many years in vertical cliffs 200 feet high. These plains have been cultivated for four thousand years by irrigation, without requiring any fertilizer.

Richthofen believes that the loess was a sub-aerial deposit without the intervention of water. The products of disintegration from the mountains and steppes, instead of being carried seaward, were blown from the hills into the valleys of a treeless continent. Grass and heather grew, only to be covered again and again by the deposits. This covering nourished the new vegetation, while the decay of the old produced the capillary tubes which give to this material its vertical structure and strength. An immense quantity of land-snails and the bones of land-animals have been discovered in the loess, but no traces of marine or fresh-water life.

Great perpendicular cliffs rise in many places 500 feet in height. In these cliffs caves have been dug in which it is said several millions of people live. The same formation is found in some parts of Europe and in the Mississippi valley, and was formerly supposed to have been a sub-aerial deposit; but three of our geologists in different localities followed the beds of loess to their source in the terminal moraines of ancient glaciers, and proved that the loess is the fine white dust or powder produced by the grinding of the glaciers over the ground, which has been carried down by the streams. Some of our ablest geologists believe the loess of China was formed in a similar way.

Japan.

Japan consists of four large and four thousand small islands. It extends from the Sea of Okhotsk 1,800 miles to the southern part of Corea. The Gulf Stream of the Pacific bathes the south-eastern coast of Japan, and there the climate is warm and equable. The north coast is cold and disagreeable, the wind blowing from Siberia and the cold waters of the Arctic Ocean, which gives to this part of Japan a climate more like that of northern America than that of Europe in the same latitudes.

A chain of volcanic mountains runs the whole length of Japan, and occupies seven-tenths of the islands. There are no rivers, but many torrents rush down from the mountains in the wet season and after every storm. The earliest inhabitants of Japan were the Ainos, who at that time probably occupied all the islands. As a race, they are inferior to the Japanese. They are gradually retiring before their superior civilization, and are now confined to the remote districts, where they live by hunting and fishing. The Japanese are of the Mongolian type, resembling the Coreans and the former inhabitants of Siberia rather than the Chinese. Their early civilization seems to have come from Corea.

In some parts of the islands they have intermarried with the Ainos, while in the southern portions there are traces of the Polynesian race. Formerly and for many centuries the Mikado ruled with despotic power; but in the seventh century the Shoguns, or military rulers, seized the control, and held it until 1868, when they were deposed by the people and the Mikado restored, but with only a portion of his former power. At that time, after a sleep of centuries, Japan awoke in a day, and, independent of outside influences, threw off the rule of the old oligarchy, established a government largely representative in its

institutions, and inaugurated a free national assembly, to meet for the first time this year.

The visit of Admiral Perry shortly after the deposition of the Shoguns introduced Japan to the civilized world. Instructors in the arts and sciences were obtained from America and Europe. Their young men were sent to our institutions, and on their return replaced foreign teachers. Post-offices were established, highways and railroads constructed. A new era, unheard of in the history of the world, has dawned upon Japan, and its progress is watched with the greatest interest.

There are few domestic animals in Japan. The horse is little known, and travelling for long or short distances is in a jinrikisha. This vehicle, introduced by the Americans within twenty years, is drawn by the natives forty or fifty miles a day.

The beautiful art of Japan is well known to us. Its bronzes and metal-work, its pottery and porcelain, are our admiration. Unfortunately, to meet the demands of foreign markets, the art of Japan is deteriorating, and the painstaking and loving labor of past centuries is giving place to coarser and rapid work.

The Peninsula of Indo-China and India.

South of the Pamir, its south-eastern and south-western ranges of mountains, the Himalayas and Hindu-Kush, Asia throws out two great peninsulas—Indo-China or Malay, and India—extending south to the equator. Indo-China or Siam is about 1,800 miles long, 700 miles wide at the north, sloping away to a little over 60 miles at the south. Through this peninsula four great rivers, rising in the northern part of Thibet, flow in long narrow valleys between ranges of high mountains. The rainfall is from 60 to 200 inches, the rivers are ever full, the climate is moist and unhealthy for foreigners. The soil is rich, producing abundantly all tropical products.

India.

In India the great rivers that flow from the Himalayas, instead of running the whole length of the peninsula as in Indo-China, are turned to the east and west by ranges of mountains that cross India near the central part. These ranges run to the ocean, and then follow both the eastern and western shores into Ceylon. The land is rich and fertile, the people industrious. The cultivation of tea and grain for export has recently been introduced into India, and now more tea is imported into England from India than from China, while its grain competes with the grain from America in the London markets.

Nothing is more remarkable in the history of our race than the manner in which the ancient civilization of India has maintained itself. Before the time to which the annals of Europe go back, India had made great material and intellectual advancement; the character of its inhabitants became fixed; and, though subjected to greater changes and vicissitudes than have happened to any other country, they have remained substantially the same that they were two thousand or three thousand years ago. They have been under rulers of different races, though generally of the same religion, with like customs and manners. The population of India is 250,000,000, or about one-sixth of the population of the world.

While portions of Asia are among the driest regions of the earth, the peninsulas of Indo-China and India are among the wettest; for in some parts of upper India the rainfall is from 400 to 600 inches a year, or from 33 feet to 50 feet.

Afghanistan, Persia, and Arabia.

South-east of the Pamir are Afghanistan, Persia, and Arabia. I class them together for convenience, because they have several physical features in common. Through Afghanistan, the Switzerland of Asia, ranges of mountains run in different directions. The country is generally well watered with numerous rivers, though not one of them empties into the ocean. The valleys are rich and fertile. Its inhabitants, unlike those of India and Persia, have rarely been conquered. They are free and independent, robbing each other and the neighboring nations.

In Persia, or (as it is called by the Persians) Iran, the Iranians or Caucasians and Turcomans or Mongols met three thousand years ago, and the races to-day are as distinct as then. The Iranians inhabit eastern Iran; the Turcomans, western.

Iran was formerly much larger than at present, and was bounded on the north by the Caspian Sea, by the Indian Caucasus, Paropamis separating it from Scythia or Turkestan; on the east by the Indus; south by the Indian Ocean; and west by the Persian Gulf. It included Mesopotamia, Persia, Afghanistan, and Beloochistan.

The whole of Iran is either mountainous or a high plateau, excepting Mesopotamia, the coast of the Caspian Sea, and a few of the valleys of the interior basins, which are very rich and fertile. The rainfall is very slight, not over ten inches. There are a few great salt deserts, "covered in winter with brine, and in the summer with a thick coat of salt." The country has been described as either a "salt waste or a saltless waste." One-half the entire drainage is into the salt basins.

There is but one considerable river east of Mesopotamia that empties into the ocean. A few run into the basins, and empty into the salt lakes.

From Karachi, on the Persian Gulf near the mouth of the Indus, to Teheran in the northern part of Persia, nearly one thousand miles, there is not a single stream more than two feet deep.

Persia, even when densely populated, was no better watered than now, for a comparison of the ancient and modern maps does not show any change in the river system. The sand has in many places drifted over land formerly highly cultivated. A perpetual struggle for the mastery seems to be going on between the arable tracts and shifting sands, and the country is changing from a series of rocky ridges to one of undulating sandy wastes.

There are only one or two good roads of short length in Iran. The whole traffic is carried on by mules in the mountains, and camels on the plains, "no wheeled carriages existing."

The higher plateaus are barren, but Mesopotamia and the shores of the Caspian are very fertile; and near here, on the southern coast of the Caspian Sea, was the geographical centre of the eastern continent. It was formerly the centre of population; but, after the destruction of the Medes and Persians, the geographical centre moved eastward to the southern plateau of Thibet; but with the growth of Europe, the centre of population is moving westward.

Persia was for centuries the centre of civilization and the great power of the world. During a period of two thousand years before the Christian era, its great cities of Babylon, Nineveh, Ecbatana, Persepolis, and Susa rose, flourished, and fell. These cities were the wonder of the Old World, and their ruins are still the wonder of the New. In vast extent, in the magnificence of their temples and palaces, in the strength of their walls, in their great water-supplies, they have never been equalled.

This mighty empire was composed of many tribes and many races, held together for centuries by the power of its rulers, Cyrus, Darius, Xerxes, and others. At the time of its conquest by Alexander the Great, it stretched from the Desert of Sahara to the mountains of the Pamir; but under his successors it fell into pieces, and was never again united under one rule; and for two thousand years Persia has been gradually declining in power, influence, and population. It has lost Mesopotamia on the west, Afghanistan and Beloochistan on the east, and a part of Turkestan on the north. The present Shah of Persia has three times visited Europe. Since his last visit he has determined to inaugurate reforms in his government. His power over his people is absolute; but, should his desired reforms seem inconsistent with the sacred laws of the Koran, he may be at any time deposed.

He has granted a charter to Englishmen for an imperial bank, giving not only banking privileges, including the right to issue paper money as a legal tender, but also the monopoly of all mines save those of gold and silver.

The Persians are by nature traders and artists. Persian merchants are met with everywhere in the Old World,—in the bazaars of Cairo, Constantinople, and Damascus; at the fair of Nijni Novgorod; in Rome and Paris. The Parsees, the leading merchants of Bombay, are the descendants of the ancient Perses, and are still worshippers of fire.

In Arabia, as in Persia, mountains follow the line of the coast, and rise from the Red and Arabian Seas and from the Persian Gulf, making the whole interior of Arabia an elevated plateau, —a desert but little known, and with few inhabitants. Such is the dearth of running water, that in the whole of Arabia there is not a single perennial stream. If there is any country which has seemed to lie completely outside the stream of ancient history, it is Arabia. In spite of its vast extent; in spite, too, of its position in the very centre of the civilized empires of the ancient East, midway between Egypt, Babylon, and India,— its history has been almost a blank. For a brief moment, indeed, it played a conspicuous part in human affairs, inspiring the Koran of Mohammed, and forging the sword of his followers; then the veil which had covered it for untold centuries was drawn over it again. Yet modern research tells us that culture and civilization existed there, of which only echoes remain in Mohammedan traditions. Three thousand years ago it was easier to travel through the length of Arabia than it is to-day. It was formerly supposed that our numeral system was devised by the Arabians. Later research shows that it had its origin in India, but came to Europe through the Arabians.

Asiatic Turkey.

Asia Minor, Armenia, Koordistan, Mesopotamia, and Syria form the remnant of the Turkish Empire in Asia, misgoverned, and sustained only by the sufferance of the European powers and the fear of Russia.

Much of the land is rich and fertile, and capable of supporting a large population; but, under the misrule of the Turks, some portions have become depopulated, and it is steadily diminishing in population.

Asia Minor is a peninsula connecting south-western Asia with Europe, and bounded by the Black Sea on the north, and Mediterranean on the south and west. A range of mountains runs round the coast, and portions of the interior are a desert. Miletus, the ancient metropolis, was twenty-five centuries ago the chief centre of geographical studies, and here the earliest known charts were planned. The capital of Asia Minor is Smyrna, which has a large trade with Europe.

The population is composed of Greeks and Turks. The Turks are an indolent, self-indulgent race, while the shrewd and active Greeks are the merchants, lawyers, and bankers of the country, and are steadily supplanting the Turks.

Armenia is a mountainous country. In the south-eastern corner is Mount Ararat, 17,000 feet in height. Here Turkey, Persia, and Russia meet.

Lake Van, a large and beautiful salt lake, lies on the borderline of Armenia and Koordistan. It is on an elevated plateau, nearly 6,000 feet above the sea-level. It is the only lake of Asia which is steadily increasing in size.

The Armenians are nominally Christians,— shrewd business-men. They are great travellers, and thousands seek employment in Constantinople and foreign cities. Their numbers are steadily decreasing.

The Kurds are shepherds, inhospitable and warlike, and robbery is with them an honorable occupation.

Syria will ever be revered as the Holy Land. Pilgrims from every quarter of the world visit the river Jordan, the Sea of Galilee, and Jerusalem.

The valley of the Jordan, and its mouth, the Dead Sea, are the deepest valleys in the world. At the Sea of Galilee the Jordan is 600 feet below the level of the Mediterranean. The valley grows deeper until at the Dead Sea it is 1,300 feet below the level of the Mediterranean.

Turkestan.

West and north-west of the Pamir, and north of Persia, is Turkestan. The trend of the country is from the high lands of the Pamir, west to the Aral and Caspian Seas.

Here is the Aral-Caspian basin, already described. The whole of this country, excepting on the banks of the rivers and a few oases, is a great desert. A recent French traveller says it is a dismal region, where all vegetable and animal life ceases,— the domain of death; formerly densely populated, now inhabited by wandering tribes of Turcomans, until their recent conquest by the Russians living by pillaging each other, or occasionally uniting for incursions into Persia.

From this summary it will be seen, that, while two-thirds of the population of the world is in Asia, only about one-fifth of its area is thickly inhabited. Much the largest part is a desert. Beginning in eastern Mongolia, almost within sight of the Pacific Ocean, this desert runs through Mongolia and Thibet, crosses the Pamir, to appear again in Turkestan and Persia.

It occupies all Arabia. The Red Sea does not stop it; for on the other side the Desert of Sahara begins, and only stops when it reaches the Atlantic Ocean,— a desert extending from the Pacific to the Atlantic, across Asia and Africa.

The earliest civilization of Asia was in Mesopotamia. Its authentic annals are over four thousand years old. Here the proud empires of the Old World—Chaldea, Assyria, Babylon, and Persia—rose and fell. Here stood the ancient cities of Nineveh, Babylon, and Bagdad.

Now the traveller finds only ruins, and scarce inhabitants sufficient to aid in the explorations. The Tigris and Euphrates run through the whole length of the country, and are both navigable several hundred miles from their mouths. The waters of the Euphrates rise within 80 miles of the Mediterranean. The valley of the Euphrates was the great trade-route of the ancients, and the English have made surveys for a railroad through it.

The Commerce of Asia.

The commerce of Asia has for four thousand years given wealth and power to the cities and countries that have monopolized it. The men of Tyre and Sidon, the seaports of Phœnicia, were once the merchant princes of the world. They gave to the Greeks their alphabet, their weights and measures, and their ships. They established colonies all along the coast of the Mediterranean. They traversed all the known seas, and circumnavigated Africa six hundred years before the Christian era. They brought the gold and silver of Tarshish from Spain, tin and copper from England, and carried the products of India and Babylon to every part of the world. After the conquest and decay of Tyre and Sidon, the commerce of Asia passed to Greece, and from Greece to Rome.

The Grecians introduced new methods of exchange, and developed a true coinage where the dealers of Tyre and Sidon had been confined to a cumbrous system of barter.

In the middle ages, Venice and Genoa sent their ships to every part of the Mediterranean. They founded colonies in Asia Minor and in the Crimea. They controlled the commerce of Asia; and its wealth poured into these cities, making them the richest in the world. It was the commerce of India that Columbus sought in his Western voyage; but where Columbus failed, the Portuguese succeeded, by sailing around the Cape of Good Hope, and thence north to India. For a short period Portugal was the richest country of Europe.

The ships of England and Amsterdam quickly followed this new route, and the commerce and lands of the Orient passed into their control.

But again the route changes. The Suez Canal was built by the French, notwithstanding the opposition of the English. The canal was opened by the Emperor of France, but it was English steamers that used it. England obtained a controlling interest in the canal, and further strengthened its hold by acquiring at first joint control with the French in Egypt, and then the exclusive control, and for a time secured the canal, and with it the commerce of Asia.

The French, Italians, and Austrians found it cheaper to bring the products of Asia to Marseilles, Venice, and Trieste than to buy them in London; and their steamers now sail through the canal to India and China. They have obtained a small but daily increasing share of the commerce of Asia, formerly monopolized by England.

A few years ago, Russia crossed the Caspian, and was defeated by the Turcomans. To aid them in the second campaign, the rails and materials collected in the Crimea for a railroad across

the Balkash to Constantinople were transferred to the eastern side of the Caspian Sea, and a railroad built east across the desert.

After the conquest of the Turcomans, difficulties arose between Russia, Afghanistan, and England, and the railroad was continued in a south-easterly direction towards Herat and India. When the Afghanistan boundary was settled, the line of the railroad was turned to the north-east. It was carried through Merv, across the Oxus to Bokhara and Samarcand, nine hundred miles from the Caspian.

The railroad runs for two hundred miles along the foot of the mountains, separating Turkestan from Persia. All the mountain-passes in Persia are controlled by the Russians; and Russian products are taking the place of English in the markets of northern Persia, Turkestan, Afghanistan, and even Thibet. The influence of Russia in Persia is to-day paramount to that of Great Britain.

France was formerly a competitor with England for the Empire of India. Defeated there, she has built up for herself a principality in Cambodia, Anam, and Tonquin.

The Future of Asia.

England has successfully met and stopped the progress of Russia in Europe, but in vain has she opposed her in Asia.

Only a few years ago Russia was bounded on the south and east by the Caspian Sea: now her outposts are one thousand miles east of the Caspian, bounded by the Pamir and China, and only Afghanistan separates her from India and the English Empire. They will soon meet among the mountains of Afghanistan as friends or foes. These nations from either extremity of Europe are neighbors in Asia, but are as far apart as the poles in their methods of dealing with conquered Asia.

The Russians are Asiatic in their origin, and easily adapt themselves to Oriental customs and manners. Their conquest of Asia is a conquest of Orientals by Orientals. After a sojourn in civilized Europe, they return as colonists, as merchants, as inhabitants, where they soon become acclimated. The expansion of Russia in Asia is the natural growth of the parent stem.

The English are mere sojourners in Asia as officials for a longer or shorter term of years. Every Englishman yearns for the expiration of this contract, and for his English home. The English are of a race entirely foreign, never becoming one with a conquered people, but widely separated in interest, thought, and habit. They instruct the people, send missionaries to them, build railroads and irrigating-canals, substitute low and regular taxation for irregular and exorbitant exactions of all kinds, yet in every act and deed they are conquerors, and not inhabitants.

The climate of India presents an insurmountable obstacle to the English, and renders English colonies an impossibility. The expansion of England in Asia is like a graft on an uncongenial stem.

Whether England will maintain her sway in India, notwithstanding all she has done for the prosperity of the country, is a question which Englishmen are discussing. The English are hated by the Hindoos, and it is said even by Englishmen that India would prefer the lawlessness of their old rulers to the order and rule of England.

Long before the mariner's compass or the invention of gunpowder in Europe, canals were in use in China. For hundreds of years they have intersected the country. Centuries ago they had made great progress in civilization; but then they came to a stand-still, beyond which they have only recently advanced. For many years the more advanced and intelligent Chinese have tried to introduce telegraphs and railroads into China, without success. But now the party of progress has prevailed, Chinese steamboats crowd the inland seas and rivers, and a railroad will soon be built from Peking, through Nankin, to China Kiang, 600 miles, crossing the two great rivers of China, the Hoang-Ho and the Yang-tse-kiang, following the line of the Imperial Canal. French, German, and American engineers are waiting at Ticutsin to take the contract, but it will be undertaken and completed by the Chinese.

Until recently, the carrying trade between the seaports of China, and the commerce between China and Europe, were in the hands of English and American merchants; but the Chinese have bought or driven off the foreign steamers and taken the business, and now only one English and one American house remain. The Mandarins have recently opened a large depot in London to sell their teas and silks. China has awakened from her long sleep, and has entered on a new course. Her emigrants are found in the islands of the Pacific, and are only stopped by our laws from passing the Pacific Ocean and possessing the western coast of America. China, like Japan, has awakened from the sleep of centuries to a new and higher life.

Europeans have taken possession of the whole continent of America, and have exterminated the aborigines. Not content with America, the Europeans have surrounded Africa with a fringe of white settlements. They have occupied the valley of the Kongo, have worked their way from the Cape of Good Hope north towards the centre of Africa, from Zanzibar west to the Great Lakes, and from Algeria south towards Timbuctoo. The English have taken possession of Australia and New Zealand, and the natives are disappearing as rapidly as they disappeared from America. Over all the islands of the Pacific the flags of European nations wave.

All the northern and western portions of Asia are under Russian rule. Persia and Afghanistan are neutral; Russian influence predominating in Persia, English in Afghanistan. The Queen of England, the Empress of India, has extended her empire over Burmah and the Straits Settlement, down Indo-China to Singapore and the equator. East of the English are the French in Anam and Tonquin. Over the islands of Sumatra and Borneo, Holland and England rule.

There remain, then, China and Japan. Again and again foreigners have apparently succeeded in affecting an entrance into China and Japan, but as often they have failed, met by a steady, persistent, and inflexible resistance. China and Japan are the only nations in the world that have successfully resisted the encroachments of Europeans.

NOTES AND NEWS.

IT is reported from Paris that the engineers sent out to examine the condition of the Panama Canal found that only three-tenths of the necessary work has been done, and that much that has been done will have to be done over if operations are ever resumed.

—It is reported that a bridge across the Bosporus is projected by a syndicate of French capitalists. At the points elected for bridging, the channel is about half a mile wide.

—Mr. Robert Moore stated at a meeting of the St. Louis Engineers' Club, March 5, that *lignum-vitœ* ties were being used successfully in Mexico. Their cost was about a dollar each, and they lasted indefinitely.

—Among the subjects to be discussed by the International Labor Conference at Berlin are the regulation of mine-work with reference to the prohibition of the labor of women and children under ground, the shortening of the shifts in particularly unhealthy mines, the insuring of a regular output of coal by subjecting the working of the miners to international rules, the regulation of Sunday labor, and the regulation of the labor of women and children. The question whether there shall be future and periodical conferences of the same nature will also be discussed.

—The Pan-American Conference has adopted a report recommending that the governments represented give their adhesion to the treaties on literary and artistic copyright, trade-marks, and patents adopted by the South American Congress at Montevideo. These treaties, which were subscribed to by the Argentine Republic, Bolivia, Brazil, Chili, Paraguay, Peru, and Uruguay, provide that authors and inventors shall enjoy in all States the rights accorded them by the laws of the State in which the original publication or grant takes place, but that no State is obliged to recognize such rights for a longer time than that allowed in the original State. The conference also recommends the adoption of the metric system by the United States in all official business.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

MENTAL SCIENCE.

The Rivalry of Mental Impressions.

Whenever two or more impressions are presented to the mind at the same time, there results a rivalry between them in attracting the attention and getting into the focus of consciousness. Usually the attention is divided between them, though this flitting of the attention is at times so rapid and so unconscious that we hesitate to believe that it has really taken place. If the one process is automatic in character, or nearly so, the interference is reduced to a minimum. When both processes are voluntary, mutual interference is inevitable; and its extent will depend upon the complexity and other characteristics of the task, and will doubtless vary, too, with each individual. Some simple experiments in this field by M. Binet, though they hardly do more than open out the possibilities of research in this direction, may be here recounted for their general interest and suggestiveness. The subject of the experiment is asked to take hold of a rubber bulb connected by means of a tube with a recording apparatus consisting of a point raised and lowered by the air-pressure within the tube, and writing upon a smoked surface fastened to a rotating drum. He is required to press this bulb once a second, and the result is a tracing on the smoked surface showing very regular curves. With this is compared the tracing produced when at the same time he is required to perform some simple mental exercise, such as reading aloud, adding or multiplying numbers, and the like. The most usual result is that the intervals between the pressures are lengthened, with some persons only slightly, with others more noticeably; and in some cases the pressures even cease altogether for a brief period. Very frequently, too, the movements are less forcible, so that the curves are not as high as normally. Again, let the subject be told to make a series of five pressures, then allow a second's interval and begin another series of five; and so on. This is done very constantly and regularly; but, if the subject performs another task at the same time, we have, in addition to the other irregularities, an irregularity in the number of pressures in a series, sometimes only four, and sometimes six. Sometimes the interval is neglected or two pressures overlap, and in every way the mental friction and inco-ordination is shown. The pressure upon the rubber tube, in turn, interferes with the mental task, although this cannot be so accurately noted. The addition of simple numbers takes considerably longer than normally, and the result is often wrong. M. Binet notices, too, that the pressures soon get to be done subconsciously, the subject not knowing at the end of the experiment whether he has made an error, or has written irregular curves or not. The pressures thus become more or less unconscious while still remaining voluntary. It is interesting to note, that, if the pressure be done by both hands, the errors and irregularities are the same. If, for example, the one hand presses four times instead of five, while its owner is engaged in some mental task, the left, pressing at the same time, will also write four instead of five curves, thus indicating that one volition brings about both actions. The degree of interference depends upon the nature of the two tasks; and if we keep the one task the same, and vary the other, we have a kind of test of the power of an individual to do two things at once. It was found that some subjects could perform simple additions and keep up a series of two pressures in a second, but not with more than two; others could keep up as many as five in a series. But all these actions are extremely fatiguing, and some individuals refused to go on with them on account of the headaches they are apt to produce.

A different aspect of this interference is revealed when the two hands attempt to make two different movements at the same time. In all such cases there is great mutual interference, not alone because the two tasks are closely similar, and so employ allied brain-centres, but especially because the movements of the two hands are subject to a special co-ordination, and their disassociation is proportionately difficult. If one hand attempts to draw curves and the other straight lines, the curves will be somewhat straightened out, and the straight lines somewhat curved. If the one hand is to beat two beats to every five of the other, this may be done correctly for a time, but soon the two tend to beat the same number of times. If one hand attempts to write a sentence while the other draws circles, the writing and the circles will both materially suffer. All this when the two tasks are different: if the two hands make the same movement, they seem to aid each other, and especially does the preferred hand (right or left handedness) help the other.

M. Binet has studied another phase of the subject, introducing us to a quite different order of mental phenomena. If the attention, instead of being divided between the operations, is sharply concentrated upon one, we approach the case in which a person abstractedly does one thing while his attention is devoted to another, — an artificial absent-mindedness, which, as usual, implies an extreme "present-mindedness" in another direction. The subject is given something to read, and his one hand he is told not to consider at all. If the attention be sufficiently engrossed (and this can be done with only a few subjects), the hand will reproduce slight movements imparted to it by the operator in total unconsciousness of their origin. Such movements are spoken of as automatic movements. These are of a quite different character from the foregoing; for while there the two acts interfered with each other, and the more so the less intense the effort to produce them both, here the two acts do not interfere with each other, and are best performed when no conscious effort at all is made. This difference M. Binet

regards as important enough to warrant the reference of the latter to a different stratum of the personality, a different *ego*. The reason of this is, that in the case of the voluntary movements we have a mental representation of the act about to be done, and we unite its elements into a single idea. As this becomes difficult by reason of the disparity of the various acts, the evidences of mental conflict become prominent. On the other hand, in the automatic acts no mental representation is present to the mind, and therefore no conflict arises. In brief, we can do two things at a time with advantage in two quite different ways. The first is when they contribute to the same end, such as the different movements of the two hands of the pianist or the violinist, and so on; the second, when the one is done automatically and unconsciously; and both of these capabilities will vary very considerably in different persons.

M. Binet has reduced to experiment a further class of automatic reproductions. We all appreciate the tendency to beat time when listening to a lively musical production, or the unconscious adaptation of our gait to the selection of a band on the street. The same fact is shown in the case of an hysterical subject in whose hands is placed a recording dynamometer while a metronome is beating in the room. The result is an unconscious series of pressures to the time of the metronome beats.

THOUGHT AND RESPIRATION. — The experiments of Professor Leumann indicating the adaptation of the rate of reading, and possibly of other mental work, to such physiological rhythms as the respiration (v. *Science*, Nov. 22, 1889), have called forth some interesting comments upon his thesis. Attention has been directed to the analogy between this and the methods adopted by the Yogi to reach the condition of abstract contemplation and rapt ecstasy. Professor Max Müller contributes some extracts from the Sanscrit *Yoga-sûtras* describing this *prânâyâma*, or expulsion and retention of the breath for the purpose of steadying the mind. The Yogi must assume a firm and easy position, and then begin to regulate his breath. He draws it in through one nostril, pressing his finger on the other, and then, after retaining it some time, emits it through the other nostril. "All the functions of the organs being preceded by that of the breath,—there being always a correlation between breath and mind in their respective functions, — the breath, when overcome by stopping all the functions of the organs, effects the concentration of the thinking principle to one object." The time devoted to each of the three factors is regulated by so many repetitions of the syllable *om* or other mystic formula, or by turning the left hand round the left knee a given number of times. The time devoted to inspiration is the shortest, and that to the retention of the breath the longest. The operation is performed as a preparation for an abnormal mental state in which incredible powers are exemplified. The theory of the process is thus given in a commentary. "By the motion of the breath the thinking principle moves; when that motion is stopped, it becomes motionless, and the Yogi become firm as the trunk of a tree: therefore the wind should be stopped. As long as the breath remains in the body, so long it is called living. Death is the exit of that breath: therefore it should be stopped." Another writer, Mr. Ley, notices the use of deep and rapid respiration as an anæsthetic. Some dentists ask their patients to breathe quickly and fully some four or six minutes, at the end of which the patient becomes giddy, to some extent loses consciousness, and a short operation may be painlessly performed. While in this condition, the patient has no power to move his arms, but will open his mouth at the bidding of the dentist (v. *Nature*, Feb. 6, 1890).

HEALTH MATTERS.

THE ORIGIN OF FEVER.—M. Roussy, in a paper read before the French Academy of Medicine by M. Schutzemberger, states that fever is often the result of soluble non-organic principles, but of microbian origin, being introduced into the animal economy. He has ascertained, according to the *British Medical Journal*, that injecting into the blood or under the skin water in which different organic matter has been macerated also determines a febrile condition. M. Roussy has isolated the pyrexogenic element, and concludes from the results of his experiments that certain diastasis or zymosis (soluble ferments) have a febrile influence: the water in which the yeast of beer has been macerated is an instance. M. Roussy used the same method as M. Berthelot for obtaining "invertine," and it is possible that the body discovered by M. Roussy is identical with the invertine.

EUROPEAN INFANTILE MORTALITY.—We learn from the *Medical Record* that a comparative study of infant mortality in different European countries has been made by Dr. Fodar, with the following results: of 1,000 children born alive, 106.3 die during the first year in Norway, 137.1 in Sweden, 154 in England, 169.1 in France, 217.7 in Prussia, 220.1 in Italy, 254 in Hungary, 258.2 in Austria, 317.1 in Bavaria, and 329.5 in Wurtemburg. With regard to Bavaria, there is considerable difference in the infant death-rate in different districts. Thus in Suabia it reaches the enormous figure of 409 (nearly four times as great as that of Norway), and in Upper Bavaria it is 406, while in the Bavarian palatinate it is only 187. From these statistics it would appear that the hygiene of infancy is better understood in Norway than elsewhere, and that German nurslings are either particularly delicate or particularly unfortunate in the mode of their bringing up.

THE FATE OF CADAVERIC MICROBES.—It is a comfort to learn, on the authority of M. Esmarch, that most pathogenic microbes succumb sooner or later after their victims have died. Experiments were carried out with nine different micro-organisms, says the *Medical Press*, and the bodies of the animals on which they had wreaked their wicked will were either buried or kept under water, or exposed to the air. The bacillus of septicæmia survived ninety days, while that of anthrax disappeared within a week. The bacillus of fowl cholera was seldom found after three weeks, but the tubercular microbe did not lose its virulence until 204 and 252 days had elapsed. All trace of the other organisms was lost in from three days to a week, including those of typhoid-fever, Asiatic cholera, and tetanus. As a general rule, the more active the decomposition, the sooner did they perish, and this is another argument in favor of "earth-to-earth" burial, pending the universal adoption of cremation.

RECENT SAVING OF LIFE IN MICHIGAN. — In a carefully prepared paper read before the Sanitary Convention at Vicksburg, the proceedings of which are just published, Dr. Baker gave official statistics and evidence which he summarized as follows: "The record of the great saving of human life and health in Michigan in recent years is one to which, it seems to me, the State and local boards of health in Michigan can justly 'point with pride.' It is a record of the saving of over one hundred lives per year from small-pox, four hundred lives per year saved from death by scarlet-fever, and nearly six hundred lives per year saved from death by diphtheria, — an aggregate of eleven hundred lives per year, or three lives per day, saved from these three diseases. This is a record which we ask to have examined, and which we are willing to have compared with that of the man who 'made two blades of grass grow where only one grew before.' "

GASTRIC JUICE AS A GERMICIDE.—Drs. Straus and Wurtz have conducted a series of experiments in order to ascertain the action of the gastric juice on the bacilli of tubercle, charbon, typhoid, and cholera-morbus. The gastric juice from man, dogs, and sheep was selected for the experiments. It was found, as stated in the *British Medical Journal*, that digestion for a few hours at a temperature of 100° F. destroyed all the germs. The bacillus anthracis was killed in half an hour, the bacillus of typhoid and cholera in under three hours, while the bacillus of tubercle bore digestion for six hours, under which time it was still capable of provoking general tubercular infection. Even when digested for from eight to twelve hours, the

bacillus was still capable of producing a local tubercular abscess, not followed by general infection. Over twelve hours' digestion destroyed it completely. The germicide influence of gastric juice appears to be due to its acid contents, as it was found that hydrochloric acid alone, dissolved in water in the same proportion as it is in gastric juice, proved as active a destroyer of the bacilli. The pepsin appears to have no influence on the germs. Drs. Straus and Wurtz, who publish their researches in *Archives de Médecine Expérimentale*, wisely remind their readers that the germs, when protected by animal and vegetable tissues and introduced into the stomach in ordinary nutrition, are not exposed to so direct and prolonged action of the acid constituents of gastric juice as in these experiments.

BOOK-REVIEWS.

Electric Light Installations and the Management of Accumulators. By Sir DAVID SALOMONS. New York, Van Nostrand. 12°. $1.50.

As this is the fifth edition of a work which first appeared only two or three years ago, it is unnecessary to say that it fills a very important place in the literature of electrical science. It is not intended as a text-book on electric lighting, nor is it addressed to electricians as such; but it covers a field of its own, which had been previously neglected, or, rather, a field which had not been as alluring to writers on the subject as had other departments of the science.

Though the author disclaims any pretence to literary style, his work proves that he possesses in a high degree the three essential requisites of a successful writer; namely, to have something interesting to say, to be able to say it so that it may not be misunderstood, and to stop when he has said it. As a result, he has given us a plain statement of facts in regard to the practical side of electric lighting and the management of accumulators, attractively and clearly presented, and in as concise a manner as is consistent with the nature of the subject. The author proceeds on the assumption that the reader has a general knowledge of electric lighting, omitting minor details, which may best be found in any elementary book on the applications of electricity.

To those familiar with the work in its previous editions, it may be well to mention that this edition has been carefully revised and greatly enlarged, besides which many new engravings have been introduced, rendering the text more intelligible and at the same time showing the various types of electrical apparatus adopted by different manufacturers. To those who have never read the book, its scope may best be gathered from the author's statement that previous to its appearance no book had been written on the special subject of the management of the accumulator. Of the two classes of persons most directly interested in the secondary battery, manufacturers and purchasers, the former, as a rule, know comparatively little of its properties, their knowledge being confined mainly to laboratory tests. The true knowledge of how a battery will act is gained only by long experience. While it is in the hands of a nonprofessional user, rarely competent to examine the question for himself, this knowledge cannot be gained or turned to account. There are but few who have both the opportunity and the qualifications necessary to observe, scientifically as well as practically, the working of an accumulator, and fewer still with time, opportunity, and inclination to write upon the subject. To fill this gap, between the manufacturer and the general user, the author has attempted; and the demand for the present work proves that his attempt has met with a full measure of success.

The book is divided into two parts, the first treating of cells and their mode of employment; the accumulator house; charging and discharging; and failures, with their causes and remedies. The second part is devoted to installation work and practice, treating of engines, dynamos, and motors; switchboards, switches, instruments, lamps, and wiring; rules for the prevention of fire risks; action of cells with dynamo; methods of working and governing; alternating currents, testing, and estimating, etc.; ending with a description and history of the author's own private installation of secondary batteries at Broomhill. The book is fully illustrated, and provided with a very complete index.

A Text-Book on Roofs and Bridges. Part II. Graphic Statics. By MANSFIELD MERRIMAN and HENRY S. JACOBY. New York, Wiley. 8°. $2.50.

THIS volume, as its name indicates, is a treatise on graphic statics as applied to the discussion of common roofs and bridges. It is an outgrowth of the course of instruction in the subjects named, given to the students of civil engineering in Lehigh University, in which institution the authors are respectively professor of and instructor in that branch of applied science. The course in civil engineering in the university mentioned consists of four parts; namely, the computation of stresses in roof-trusses and in all the common styles of simple bridge-trusses; the analysis of stresses by graphic methods; the design of a bridge, including the proportioning of details and the preparation of working drawings; and the discussion of cantilever, suspension, continuous, and arched bridges. In this volume the second part of this course is presented, together with much additional matter.

Being offered as an elementary text-book, we need not look for many novelties in the work aside from the method of arrangement and presentation, though we may call attention to the abbreviated processes employed in some of the diagrams for wind-stresses, to the determination of stresses due to initial tension, and to portions of the analysis of maximum moments and shearing strains under locomotive wheel loads, as possessing some points of novelty as well as of practical value.

For the convenience of students, blank leaves are provided, alternating with the printed pages, upon which to record the numerical computations necessary in the preparation of graphical analyses, and upon which to make sketches of the stress diagrams required in the problems. The book is divided into three main parts, treating respectively of general principles and methods, of roof-trusses, and of bridge-trusses. An appendix contains the answers to the problems. The work is written in a clear and attractive style, and, though intended mainly as a text-book for students, it is not without value to engineers and others.

Elements of Logic as a Science of Propositions. By E. E. CONSTANCE JONES. Edinburgh, T. & T. Clark. 8°. $3.

THIS book is a very ambitious, but, as it seems to us, very unsuccessful, attempt to reconstruct the science of logic. The author takes the ground that logic is an objective science, and not a branch of psychology, and then goes on to define it as "the science of the import and relations of propositions," denying altogether that it is a science of reasoning or of the laws of thought. The chief characteristic of the treatise, however, is not the view taken of the science, nor any new or startling theory of its fundamental principles, but the employment of an immense number of new-fangled terms in place of the familiar ones that have been in use for centuries. What the object of such an innovation may be, unless to give the work an air of originality, we do not know; for we fail to see in what respect the new nomenclature is an improvement on the old. Thus, we cannot see the propriety of calling existence "quantitiveness," nor of using the phrase "subject of attributes" instead of the familiar term "substance." Essential attributes are termed by the author "intrinsic," and accidental ones "extrinsic;" an absolute attribute is called "independent," and a relative one "dependent;" hypothetical propositions are "inferential," and disjunctive ones "alternative;" and so on throughout the book, till the reader who looked at the terminology only might almost fancy that he was studying a new science. Yet, apart from this strange terminology, we fail to find in the work any thing specially new or noteworthy, while in some passages there is evidence of much confusion of thought. This is specially apparent in

the chapter on abstraction and conception, and also in many cases in the use of the new terminology. Those who wish for novelty in a scientific work may be interested in this one; but most people, we think, will prefer to walk in the old ways.

AMONG THE PUBLISHERS.

IN *The Jenness-Miller Magazine* for March is an article on "Physical Culture," by Mabel Jenness, and another on "The Luxury of the Turkish and Roman Baths," by Annie Jenness-Miller.

—The issue of London *Engineering* for Feb. 28 is devoted mainly to an exhaustive and handsomely illustrated article on the recently completed bridge across the Firth of Forth in Scotland. Including advertisements and inserted plates, the number contains 268 pages. It is as notable a work in its way as the bridge it treats of.

—The *Home Journal*, which was founded in 1846 by George P. Morris and N. P. Willis, preserved its original form, four very large pages, until a few weeks ago, when it assumed the more modern form of eight smaller pages. The journal has every appearance of increasing prosperity.

—"A Digest of English and American Literature" is now in the press of S. C. Griggs & Co. of Chicago, being the last work completed previous to the death of its author, Professor A. H. Welsh, whose "Development of English Literature and Language" has passed through ten editions.

—P. Blakiston, Son, & Co., Philadelphia, will publish about March 15 a new medical dictionary, by Georege M. Gould, A.B., M.D. It will be a compact one-volume book, containing several thousand new words and definitions collected from recent medical literature, while the total number of words is beyond that in any similar book. It includes also tables of the bacilli, leucomaines, ptomaines, micrococci, etc.; of the arteries, nerves, etc.; and of the mineral springs of the United States; together with other collateral information.

—*Poet-Lore* for March 15 will give another of Mr. Nathan Haskell Dole's papers on the Russian drama, with translations from Tolstoi and Pushkin. Mr. W. G. Kingsland, a friend of Browning's, whose recollections of him date for twenty years past, will give some personal memoranda. Among other incidents, the origin of Browning's poem "Memorabilia" is told. The first of a series of selected specimens of Anglo-Saxon poetry, literally translated, by Anna Robertson Brown of Wellesley and Oxford, will be begun. The first selection is from Beowulf. Mr. J. S. Stuart Glennie's opinion of Shakspeare's attitude on the land question, as given in the January *Poet-Lore*, has called out a letter from a special student of Shakspearian records, Mr. A. Hall of London, which will be among the minor matters of the magazine for March.

—The directors of the "Old South Studies in History" have just added to their general series of "Old South Leaflets," published by D. C. Heath & Co., a translation of the Constitution of Switzerland, by Professor Albert B. Hart of Harvard University, with historical and bibliographical notes. It will be of use to those both inside and outside of our colleges who are engaged in the comparative study of politics. Equally interesting to many, at a time when several new States in the Union are just adopting constitutions, will be the Constitution of Ohio, which has also recently been added to this series of leaflets. It is the purpose of the directors of the "Old South Studies" to follow up these with several similar leaflets, enabling every student to possess for a few cents good copies of the constitutions of leading European nations as well as of representative States in the Union. Our young people are very seldom familiar with the constitution of their own State. It is too often because they cannot easily get at it.

—A good figure of our native St. John's wort, which was discovered by the Swedish botanist Kalm at Niagara Falls, and named in honor of him *Hypericum Kalmianum*, is given in *Garden and Forest* for last week. Another illustration is of a giant African aloe, which would probably flourish in our Southern States, and make a superb garden-plant. Mr. F. W. Burbidge, curator of the Botanical Gardens of Dublin University, writes of the home of the pitcher-plants on the mountain slopes of Borneo; Mr. Charles C. Binney, secretary of the American Forestry Association, discusses the means of forest-reform; and Charles Eliot proposes a plan for saving the grand Waverly Oaks.

—A cable despatch calls attention to the space occupied in the March reviews by social and economical discussions. *The Nineteenth Century*, which keeps its lead, has the third of a series by Professor Huxley. In this one, entitled "Capital, the Mother of Labor," he once more attacks Mr. Henry George and his theories. Mr. J. D. Christie, who announces himself as a pastry-cook, contributes to the same review what he calls a "Workingman's Reply to Professor Huxley." Lord Bramwell writes on property. Perhaps Mr. Herbert Spencer's paper on justice may be referred to the same category, though it is, as usual, an *a priori* argument rather than a practical help toward any valid theory of political ethics. Similar topics are uppermost in *The Contemporary Review*, where M. de Laveleye discourses on communism, neatly applying the knife to some of its favorite dogmas; Mr. Fletcher Moulton argues for taxaton of ground rents; and Mr. Lyulph Stanley discusses free schools, — a social question that goes deeper than most others.

—David Starr Jordan, president of the University of Indiana, will open the April *Popular Science Monthly* with a vigorous article on "Science in the High School." Its object is to show up the make-believe character of what is offered in many schools to satisfy the modern demand for science-teaching. An article by Professor Huxley, entitled "On the Natural Inequality of Men," will be printed. It deals with Rousseau's idea of the equality of men in the state of nature, with applications to the recent controversy on the land question. The ladies are not yet through with Grant Allen's "Plain Words on the Woman Question." Another answer to Mr. Allen's article will appear in the same number by Miss Alice B. Tweedy, who asks, "Is education opposed to motherhood?" and answers the question with a vigorous negative. Professor C. H. Toy o Harvard will contribute a thoughtful essay on "Ethics and Religion," in which he shows that religions have mainly borrowed their rules of conduct from what men have regarded as right, and that it is doubtful if ethics has received any thing from religion.

—Messrs. Mudge & Son of Boston have issued a small work by Mary Boole, widow of George Boole, entitled "Logic taught by Love." It is not a connected treatise, but a series of detached essays which had previously appeared in various periodicals. Why it is called "Logic" we cannot see; for there is nothing in it about logic except a few quotations from Mr. Boole and one or two other writers. The greater part of the book is occupied by religious essays of a more or less mystical character, the writer's religious views being a queer compound of pantheism and Judaism. Her leading doctrine is that of "pulsation," which she expresses by saying that "the very life of all that lives consists of some mode or other of pulsation or alternate action;" and again she says that "sound thought is always essentially a free pulsation between extremes." She makes no attempt to prove this doctrine or even to explain it, but takes it for granted throughout the book; yet she does not draw from it any noticeable conclusions. In dealing with religious and educational themes she has some interesting remarks, though none that can be called original; and if she had avoided mysticism and kept within the bounds of common sense, she might have written something of real value.

—Messrs. Porter & Coates, Philadelphia, have just published "Essays of an Americanist, — I. Ethnologic and Archæologic, II. Mythology and Folk-Lore, III. Graphic Systems and Literature, IV. Linguistic," — by Daniel G. Brinton. This

valuable contribution to the study of the native American tribes, their history, antiquities, religion, and literature, by one of the best-known scholars in this branch, should be in the hands of every person interested in the subjec t, and on the shelves of every library. Among the questions discussed are, under Part I., the data for the study of the prehistoric chronology of America, palæoliths (American and other), the alleged Mongolian affinities of the American race, the probable nationality of the mound-builders of the Ohio valley, the Toltecs of Mexico and their fabulous empire; under Part II., the sacred names in the mythology of the Quiches of Guatemala, the hero-god of the Algonkins as a cheat and liar, the journey of the soul in Egyptian, Aryan, and American mythology, the sacred symbols of the Cross (the Svastika and the Triquetrum) in America, the modern folk-lore of the natives of Yucatan, the folk-lore of the modern Lenape Indians; under Part III., the phonetic elements in the hieroglyphs of the Mayas and Mexicans, the iconomatic method of phonetic writing used by the ancient Mexicans, the writing and records of the ancient Mayas of Yucatan, the books of Chilan Balam (the sacred volume of the modern Mayas), translation of the inscription on "The Stone of the Giants" at Orizaba, Mex., the poetry of the American Indians, with numerous examples; under Part IV., American aboriginal languages and why we should study them, Wilhelm von Humboldt's researches in American languages, some characteristics of American languages, the earliest form of human speech as revealed by American languages, the conception of love as expressed in some American languages, the lineal measures of the semi-civilized nations of Mexico and Central America, the curious hoax about the Taensa language. In Part IV. there is also an index of authors and authorities, and an index of subjects.

—Messrs. Longmans, Green, & Co. have issued "The Skipper in Arctic Seas," by Walter J. Clutterbuck, being an account of a voyage northward from Scotland toward Greenland and Jan Mayen Island, and culminating at Spitzbergen. The book is in many parts amusing, the events of the voyage being described in a humorous vein and in a pretty good style. The principal object of the trip was seal-shooting, though this was pursued, by the author of the book at least, as a pleasure rather than a business. Some account is given of the mode of hunting seals and of preparing their skins and fat for use. There are also occasional remarks on the climate, the birds, and the scenery, of a more or less interesting and instructive character. Still, we could wish there had been more of this kind of information, and less about the personal haps and mishaps of the author and his companions; and this not merely in the interest of science, but for the sake of readers generally. Travellers are too apt to think that the personal incidents o their trip are as interesting to their readers as to themselves; whereas what readers chiefly care for is the country visited, and not the personal affairs of the visitors.

— During 1889, R. W. Shufeldt contributed a series of articles to *The American Field* on the extinct mammals of the United States. These short sketches have now been reprinted in pamphlet form, and, as they are illustrated, one may gather from them some idea of the curious animals, now extinct, that once roamed over this country.

— In *Outing* for March are articles on "The Art of Boxing," by A. Austen; "The National Guard at Creedmoor," by Lieut. W. R. Hamilton; "The Waterloo Cup," by Hugh Dalziell; and "By-Ways near Natchez," "Hunting and Fishing in the Northwest," "The Yachting Outlook," "Our Home-Made Trip to Europe," and "Quail-Shooting in California."

— At the beginning of the ninth volume of *The Forum*, The Forum Publishing Company remind its friends of the following cardinal facts about its career and plan of conduct: "Advance is made in society, in politics, in religion, and in practical affairs, not by revolutionary methods, but it is helped by enlightened and candid discussion conducted within the limits of reverence and dignity. All safe leaders are conservative, because they know that human progress is achieved rather by evolution than by revolution. *The Forum*, therefore, being sincerely devoted to the advancement of sound and safe thinking, has never admitted to its pages advocates of revolutionary methods, but has sought to give its readers the benefit of the thought and experience of the safest guides. It is to this fact — that *The Forum* is always constructive and never destructive in its conduct — that its great success is attributed. The mass of the people who are in search of the truth, and who have not lost their bearings by reason of any of the wild theories of the time, have found in its conduct a constructive purpose in sympathy with their own ideas of progress; and *The Forum* has had the good fortune to draw to itself, for this reason more than for any other reason, the support of the great number of intelligent and conservative people in the country. The patronage that has kindly recognized this effort during the volume that is just completed has doubled the busi-

Publications received at Editor's Office, Feb. 24–March 8.

AREY, A. L. Laboratory Manual of Experimental Physics. Syracuse, N.Y., C. W. Bardeen. 200 p. 16°. 75 cents.
BARKAN, L. How to preserve Health. New York, Exchange Pr. Co. 344 p. 12°.
BOOLE, Mary. Logic taught by Love. Boston, Alfred Mudge & Son. 177 p. 12°.
CENTURY Dictionary, The. An Encyclopedic Lexicon of the English Language. Prepared under the Superintendence of William Dwight Whitney, Ph.D., LL.D. Vol. II. New York, The Century Co. 1222 p. 4°.
CREMONA, L. Graphical Statics: Two Treatises on the Graphical Calculus and Reciprocal Figures in Graphical Statics. Tr. by Thomas Hudson Beare. Oxford, Clarendon Pr. 161 p. 8°. (New York, Macmillan, $2.25.)
ELLIS, J. Address to the Clergy, and Skepticism and Divine Revelation. New York, The Author. 260 p. 12°.
FRIESE, P. C. Semitic Philosophy: showing the Ultimate Social and Scientific Outcome of Original Christianity in its Conflict with Surviving Ancient Heathenism. Chicago, S. C. Griggs & Co. 247 p. 12°.
GEOLOGICAL and Natural History Survey of Canada, Annual Report of. Vol. III. Parts I. and II. Montreal, W. F. Brown & Co. Maps. 8°.
GODWIN, H. C. Railroad Engineers' Field-Book and Explorers' Guide. New York, Wiley. 358 p. 16°.
HOLMES, W. H. Textile Fabrics of Ancient Peru. Washington, Government. 17 p. 8°.
ILLINOIS State Board of Health, Tenth Annual Report of the. With an Appendix. Springfield, State. 313 p. 8°.
JONES, E. E. C. Elements of Logic as a Science of Propositions. New York, Scribner & Welford. 208 p. 8°. $3.
KNOFLACH, A. Sound-English: A Language for the World. New York, Stechert. 63 p. 12°. 25 cents.
LELAND, L. A Woman's Journey around the World Alone. New York, Am. News Co. 358 p. 12°. 25 cents.
MACAULAY, T. Lays of Ancient Rome. (Riverside Literature Series, No 45.) Boston and New York, Houghton, Mifflin, & Co. 117 p. 16°. 15 cents.
OPEN Sesame! Poetry and Prose for School-Days. Ed. by Blanche Wilder Bellamy and Maud Wilder Goodwin. Boston, Ginn. 316 p. 12°. 90 cents.
PILLING, J. C. Bibliography of the Iroquoian Languages. Washington, Government. 208 p. 8°.
——Bibliography of the Muskhogean Languages. Washington, Government. 114 p. 8°.
SMITHSONIAN INSTITUTION, Fifth Annual Report of the Bureau of Ethnology to the Secretary of the, 1883–84. By J. W. Powell, director. Washington, Government. 564 p. 4°.
SWEDENBORG, E. Heaven and the World of Spirits, and Hell. New York, Swedenborg Pub. Society. 416 p. 24°. 14 cents.
THOMAS, C. The Circular, Square, and Octagonal Earthworks of Ohio. Washington, Government. 33 p. 8°.
——The Problem of the Ohio Mounds. Washington, Government. 54 p. 8°.
U.S. GEOLOGICAL SURVEY. Topographical Maps of Portions of Montana, Massachusetts, New Hampshire, Iowa, Virginia, Connecticut, Rhode Island, Alabama, North Carolina, South Carolina, Kentucky, Tennessee, Colorado, and West Virginia. Washington, Government. 28 maps. f°.
VON SACHS, J. History of Botany (1530–1860). Tr. by H. E. F. Garnsey. Oxford, Clarendon Pr. 568 p. 12°. (New York, Macmillan, $2.50.)
WAGNER, M. Die Entstehung der Arten durch räumliche Sonderung. Basel, Benno Schwabe. 667 p. 8°.

ness of The Forum Publishing Company, and the magazine enters upon its ninth volume with a degree of prosperity that was not expected at so early a date."

— *Garden and Forest* for March 27 contains a figure of the prairie rose of the South-west, from one of Mr. Faxon's best drawings, with a description of it by Mr. Sereno Watson; and an illustration of an alley of orange-trees in the Garden of the Tuilleries, with some notes on the planting of the open spaces in the city of Paris. In the same paper Professor Bailey discusses the principles of grafting, and Dr. George Thurber writes in his entertaining way of the so-called poisonous properties of the primrose, which has been a source of irritation to many gardeners. "Garden Flowers in Midwinter," "Fern Notes," and "Botany for Young People," are the titles of a few more of the articles which help to make up an attractive and useful number.

— In the March number of the *Political Science Quarterly*, Professor Anson D. Morse of Amherst College examines the political theories of Alexander Hamilton; Professor Edwin Seligman of Columbia College traces the history of the general property tax in Europe and in the United States, and shows why all attempts to reach personal property have failed; J. P. Dunn, jun., Indiana State librarian, writes strongly on "The Mortgage Evil in the West;" Professor Simon N. Patten of the University of Pennsylvania criticises David A. Wells's "Recent Economic Changes;" Irving B. Richman discusses United States citizenship; and Professor Frank J. Goodnow of Columbia College completes his description of the new Prussian system of local government, in which the ideas of Stein have obtained complete expression. The number also contains reviews of more than twenty recent political, economic, and legal publications.

— We glean the following notes from the *Publishers' Weekly*: Prince Jerome Napoleon is busily engaged in preparing his memoirs of the Second Empire. Mrs. Humphry Ward's new novel, dealing with the experiences of a successful mechanic who tries many kinds of life and phases of thought, and who finally joins the Elsmere brotherhood, is ready for the publisher. At the time of his death, a few weeks ago, Peter Henderson, the well-known seedsman, had just completed a new edition of his "Handbook of Plants and General Horticulture." The preface which he wrote is dated in January last. This edition contains a great deal of new information, and will make still more useful a work which has already become a standard. *The Writer*, post-office box 1905, Boston, Mass., has in preparation a "Directory of American Writers, Editors, and Publishers." Chatto & Windus have in press the first two volumes of Justin Huntly McCarthy's "History of the French Revolution." It is to be in four volumes, and will be published uniform with his father's "History of the Four Georges." Bellamy's "Looking Backward" passed 301,000 copies last month, and the demand is reported to have been over 1000 a day. It is estimated that of the foreign pirated editions, about 50,000 copies have been sold in England. France comes next, followed by Germany and Denmark. The Catholic Publication Society Company will soon publish in pamphlet form "Who was Bruno? A Direct Answer to a Plain Question, from the Latest Published Documents," by Mr. John A. Mooney. It is the first book published in this country giving the Catholic side of the Bruno affair. E. P. Dutton & Co. will publish at once "To Europe on a Stretcher," an account of an invalid's travels, by Mrs. Clarkson Potter. T. Y. Crowell & Co. announce "Recollections of a Private," by Warren Lee Goss, the author of "Jed." Part of these recollections have already appeared in the *Century Magazine*. A. C. Armstrong & Son will publish a book by Professor T. W. Hunt of Princeton College, entitled "Studies in Literature and Style." Harper & Brothers have in press "Two Years in the French West Indies," containing the literary results of a voyage by Lafcadio Hearn, the author of "Chita." The introductory chapter, entitled "A Midsummer Trip to the Tropics," consists of notes taken on a voyage of nearly three thousand miles, and the remainder of the book is devoted to sketches of life on the island of Martinique, describing the manners, customs, and characteristic types of the island. An appendix to the volume gives some Creole melodies. The book is illustrated. The Cassell Publishing Company have just ready "Australian Poets, 1788–1888," being a selection of poems upon all subjects written in Australia and New Zealand during the first century of the British colonization, with brief notes on their authors and an introduction by Patchett Martin, edited by Douglas B. W. Sladen of Melbourne, Australia; and "Star-Land," by Sir Robert S. Ball, based on notes and recollections of the lectures delivered to children at the Royal Institution of Great Britain in 1881 and 1887, which makes a readable book on astronomy for young people.

LETTERS TO THE EDITOR.

Supposed Aboriginal Fish-Weirs in Naaman's Creek, near Claymont, Del.

IN reply to the letters of Messrs. Haynes and Peet in your issue of Feb. 28, I have to say that it is evident that Professor Haynes was misled by the version of my letter published in the *American Antiquarian* of November, 1887 (vol. ix. No. 6) and did not receive my letter suggesting that the remains in question were fish-weirs until too late for use in his work executed for "The Narrative and Critical History of America." It seems to me, however, that I might have received an earlier notice of the contemplated work; but, as the reason why is given by Professor Haynes, we will let the matter rest there. A footnote in my letter to *Science*, published Feb. 14, 1890, p. 117, explains why the term "station" was used. It does not seem to me that the term "pile-structures" ought to suggest "pile-dwellings." The term "pile-structures" was adopted at Professor Putnam's suggestion, as we deemed it best to designate them in this way until investigations upon the spot were finished. "Stake-ends," "log-ends," or "post-ends" would have served equally well for the same purpose.

In answer to Mr. Peet's remarks, I desire to say that I have no intention of withdrawing from my position hitherto taken, and call upon him to prove that I ever wrote any such letter as that which is the subject of this interchange of civilities. It is evident that the comparison which he makes in *Science* of Feb. 28, 1890, is but a reversion to the account already disapproved by me, and denounced as erroneous.

I desire here to make a correction in my last letter to *Science*, published Feb. 14, 1890; viz., on p. 116, second column, sixth line from the bottom, "(1877)" should read "(1887)".

HILBORNE T. CRESSON.

Philadelphia, March 1.

The June Drought in the Rocky Mountain Region.

IN your notice of the meteorological observations on Pike's Peak, in *Science* for Feb. 21, are the folowing statements:—

"A very decided secondary minimum [of precipitation] occurs in June. . . . The June minimum appears very remarkable, but its authenticity seems assured in view of the fact that at Colorado Springs, at the base of the mountain, and at Denver, nearly 80 miles to the northward, similar rainfall conditions obtain."

The occurrence of a minimum of precipitation during June can be affirmed not only of the country near Pike's Peak, but also of a large part of the Rocky Mountain region, also of the Great Plains and the Great Basin. It is one of the most constant meteorological epochs of the region in question. It marks a decided change in the character of the storms. During April and May most of the precipitation falls from stratus or cumulo-stratus clouds being driven up the slopes of the plains and mountains, and such storms often cover a large part of Colorado simultaneously. These storms end in late May or early June as cold rains or with hail and snow on the mountains. From the 6th to the 10th of June there is usually a frost among the foot-hills, and this sometimes descends on to the plains to 5,000 feet or even lower. Then for some weeks the general temperature is cool and delightful, gradually rising till early in July, when the summer storms begin. These are local thunder-storms of the ordinary type.

It is well known that over the plains in Colorado crops are now being raised without irrigation in places where this was formerly supposed impossible. This is in large part due to the adoption of improved methods of cultivation specially adapted to the climatic conditions. The farmer early observed the dry weather of June, and came to expect it as a rule. On these plains successful agriculture was possible only after a careful study of the June drought. At the present time the aim is to have the times of planting so fixed that at the time of this drought each crop shall be at that stage of its growth in which experience shows it can best endure the dry weather.

G. H. STONE.

Colorado Springs, March 5.

The Fiske Range-Finder.

WITH reference to the very interesting suggestion of Mr. J. F. Dennison concerning my range-finder, which appeared in your issue of Feb. 28, I can only say that the plan which he suggests has been the subject of much thought on my part, and has been sketched out in many modified forms. The only objection to it is the very commonplace, but very potent one, that the end attained is hardly worth the apparatus required. Some person must be at hand to read the distances indicated, and he can very easily move the contacts himself. As a general principle, I think it is agreed that mechanism should never be introduced where it can be avoided, for mechanism is liable to disarrangement; and simplicity should, it seems to me, be the aim of all invention.

BRADLEY A. FISKE, U.S.N.

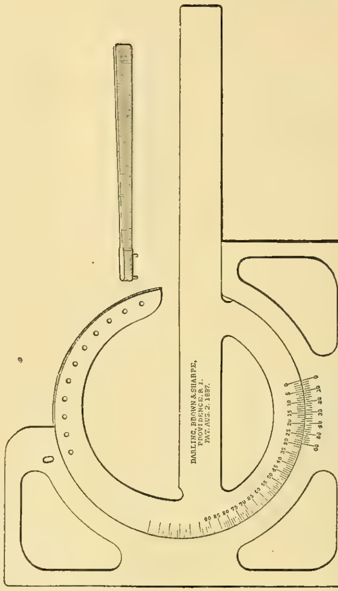
New York, March 5.

INDUSTRIAL NOTES.

A New Draughtsman's Protractor.

THE protractor shown in the accompanying cut is made from one-sixteenth inch sheet steel, and is light and durable. The length of the blade is eight inches and a half. The graduations read to degrees, and the vernier reads to two minutes. This protractor is chiefly used in connection with a T-square or straight-edge. It can be quickly and accurately set by hand to any angle. A lever is, however, provided as of possible advantage in obtaining very fine settings.

There are no projections on either face of the instrument, and consequently it can be used on either edge of the blade or either side up. This makes it particularly convenient in dividing circles, transferring angles, drawing oblique lines at right angles to each other, or laying off given angles on each side of a vertical or horizontal line without changing the setting. For laying out tapers and dividing circles and laying out geometrical figures, tables are furnished with the instru-



ment, which give the settings that are necessary. In many instances the protractor takes the place of the ordinary 45-degree and 60-degree triangles, and it is also used as an extension to the T-square when the work is beyond the end of the blade of the square. It is made by Darling, Brown, and Sharpe, manufacturers of fine tools, of Providence, R.I.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

March 4. — G. R. Stetson, Christophe Plantin, the Antwerp Publisher of the Sixteenth Century; Thomas Wilson, The Société d'Anthropologie of Paris.

Biological Society, Washington.

March 8. — B T. Galloway, Notes on a Fungous Disease of the Apple; C. L. Hopkins, Animal Life observed above Snow Line on Mount Shasta; Notes upon the Timber and Timber Line of Mount Shasta; W. H. Dall, On Dynamic Influences in Evolution.

Appalachian Mountain Club, Boston.

March 12. — C. E. Fay, A Visit to the Adirondacks of the North: the Sources of the Saguenay; W. M. Davis, The Old Mountains of Pennsylvania.

Boston Society of Natural History.

March 5. — W. O. Crosby, Interesting Occurrence of Decomposed Granite in Blandford, Mass.; J. Walter Fewkes, Some Rare Marine Animals from California.

Engineers' Club, St. Louis.

March 5. — Willard Beahan, American and Foreign Railways.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

To correspond with colleges, seminaries and other schools where cabinets of fossils and minerals are being collected. I have an extensive private collection of fossils from every geological period, and minerals illustrating the common and many of the rare forms. This collection is in duplicate, and the duplicates are for exchange or sale. Every thing is scientifically classified. W. A. Bronnell, professor of geology, 905 University Ave., Syracuse, N.Y.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED. A Harvard Senior who has made a specialty of chemistry, and has had some experience in teaching and in analysis, would like to secure an appointment for the fall. Best of references given. Address, J., Harvard College, Cambridge, Mass.

CHEMIST (30) wants situation at once; Ph.D., and for three years Demonstrator of Chemistry, Leipzig University. Practical experience in technical branch of the subject. X., 13, Worcester Place, Oxford.

A YOUNG MAN aged nineteen, who is a graduate of the Exeter High School, wants a situation with some Manufacturing Chemist or in Laboratory of some Analytical or Private Chemist; must be chance where he can have access to books in evening. Is willing to work; has good knowledge of General Chemistry. Sam. L. Hills, South Lee, N.H.

A SUBSCRIBER of SCIENCE would be grateful for any information on the following points: 1. As to the kind of wax used in the preparation of embryological and anatomical models; 2. How it can be made and manipulated; 3. References to any literature on the subject. Wm. Patten, Grand Forks, North Dakota.

WANTED—Books upon American Archæology. My publication, "Fort Ancient," in exchange. First-class standard works only. Warren K. Moorehead, Smithsonian Institution, Washington, D. C.

WANTED—Hall's works on Palæontology, and other works giving plates which show fossils of the Niagara Epoch. Address M. D. Sullivan, St. Ignatius College, Chicago, Ill.

A YOUNG MAN desires, about the 1st of July, a position as laboratory assistant, or as instructor in chemistry, physics, and lesser mathematics. References as to ability and character. 44 P.M.A. Address R. L. Porter, Penn. Mil. Acad., Chester, Pa.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 372.

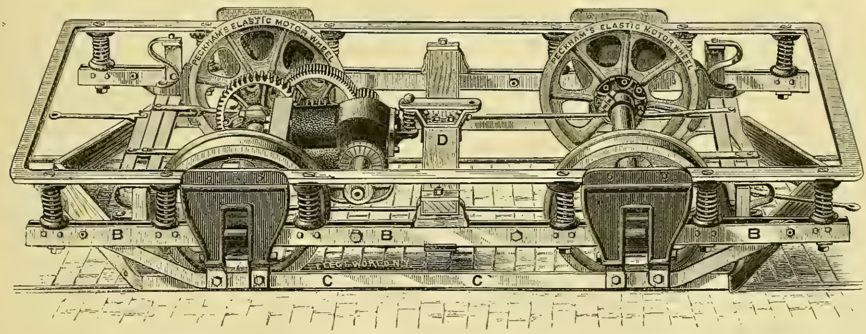
NEW YORK, MARCH 21, 1890.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

AN IMPROVED TRUCK FOR ELECTRIC CARS.

THE improved motor-truck for electric cars shown in the illustration on this page is designed to prevent, or at least to greatly lessen, the oscillating motions of cars with short wheel-base, such as all four-wheeled street-cars must of necessity be. It is also intended to strengthen the ends of car-bodies by providing additional support nearer the ends of the car than is possible with the usual truck.

The main double side-bars, marked *B* in the engraving, support, by means of the twelve springs shown, the upper frame upon which the car-body rests. The side bars are in turn supported by the cantilever trusses *C*, which are suspended from the journal-boxes by malleable iron yokes, to which the side-bars are securely fastened. The electric motor is suspended by a bolt and spring from the hanger on the cross-bar *D*. The hanger is arranged to support either one or two motors. A part of the side-bar *B* is detachable, so that it may be unbolted and taken off when it is necessary to remove the armature for repairs. No other part of the truck need be disturbed when repairs to the motor are needed.



THE PECKHAM CANTILEVER MOTOR-TRUCK FOR ELECTRIC CARS.

These trucks are equipped with compound lever brakes of great strength and simplicity, which, in quickness of action, are claimed to be much superior to the brakes generally used on car-trucks.

A peculiar feature of these trucks is that they are equipped with elastic wheels, the parts of which they are composed being interchangeable, so that worn or damaged parts may be readily and cheaply replaced. The wheels have malleable iron hubs, which are forced on the axles by hydraulic presses at a pressure of thirty-five tons to the square inch, so that there is no possibility of their ever working loose. The wheel webs can be removed and replaced by any ordinary workman, without the aid of special machinery, and without removing the motors from the axles. Tubular rubber cushions are inserted between the hub and the web, supporting the axles and motors, and relieving them from shocks, and lessening the tendency to crystallization of the iron. The journal-boxes are dust-tight and self-lubricating, and have been in use on various roads a sufficient length of time to demonstrate their efficiency. The axles are made of fibrous wrought steel, and are provided with enlarged bearings and screw threaded collars.

These cantilever trucks, which are made by the Peckham Car Wheel Company of this city, are now in actual use on many electric street-railways in this country, and the companies using them are well pleased with their many points of superiority over trucks not specially made for motor service.

THE INFLUENCE OF LEARNED INSTITUTIONS UPON THE PROGRESS OF MODERN SOCIETY.[1]

IT is sometimes urged, as a criticism upon institutions of higher education, that many men of intellectual eminence, subjected to their training, have acknowledged small obligation to it. One recalls, as an example of this, the grotesque picture of the University of Edinburgh, drawn by the satirical humor of Carlyle in "Sartor Resartus:" "Had you, anywhere in Crim Tartary, walled in a small enclosure; furnished it with a small, ill-chosen library; and then turned loose into it eleven hundred Christian striplings, to tumble about as they listed, from three to seven years; certain persons under the title of professors being stationed at the gates, to declare aloud that it was a university, and exact considerable admission fees, — you had, not indeed in mechanical structure, yet in spirit and result, some imperfect resemblance of our High Seminary." Mr. Darwin has furnished us a more recent instance, declaring that, during the three years which he spent at Cambridge, his "time was wasted, as far as the academical studies were concerned," — "sadly wasted, and worse than wasted." It is not difficult to adduce unflattering estimates like these in considerable number from men distinguished both in letters and in science. Literary genius has been particularly impatient of academic methods. Acquaintance with the thought of the past, indispensable to those who would enlarge the area of exact knowledge, is less necessary to production in pure literature;

[1] Address delivered on the fourteenth anniversary of the Johns Hopkins University, by Professor E. H. Griffin, dean of the college faculty, Feb. 22, 1890.

and accordingly some of the greatest masters in this department stand outside of all scholastic association, while others, who have passed through the ordinary discipline, have failed to discern its advantage. It is in no small degree disappointing to note the relation in which so many of our English poets have stood toward the established educational system. They are, no doubt, a "genus irritable," somewhat likely to re-act against methods intended for the ordinary mind. Yet we do not like to add to Shakspeare, Pope, Burns, Scott, Keats, and the many others who accomplished their work without aid from learned institutions, so many critical and dissatisfied recipients of that aid: such as Shelley, prematurely dismissed from academic privileges; Byron, Goldsmith, Swift, who perhaps deserved to be; Southey, who declared that of all the months of his life those passed at Oxford were the most unprofitable, — "All I learned was a little swimming and a little boating;" Wordsworth, who showed his contempt for the ceremony of graduation by devoting the days preceding the final examinations to the reading of "Clarissa Harlowe;" even Milton, the most learned of our poets, whose discontent with his alma mater led him to speak of Cambridge, in his "Reason of Church Government," in this wise, "As in the time of her better health, and mine own younger judgment, I never greatly admired her, so now much less."

Nor is it the more strictly imaginative departments of literature alone that have been largely non-academical in their spirit. The fragment of autobiography in which Gibbon has given us so vivid a picture of his intellectual life comments with unsparing severity upon the learned body intrusted with his education: "To the University of Oxford I acknowledge no obligation: and she will as cheerfully renounce me for a son as I am willing to disclaim her for a mother." His great contemporary, Hume, owed so little to scholastic influences that the bare fact of his residence as a student is with some difficulty established. Adam Smith devotes a well-known passage of the "Wealth of Nations" to a consideration of public endowments of education from a point of view sufficiently indicated in remarks like these: "The discipline of colleges and universities is in general contrived, not for the benefit of the students, but for the interest, or more properly speaking for the ease, of the masters. . . . Those parts of education for the teaching of which there are no public institutions are generally the best taught." The low esteem in which Locke held the curriculum of his day is stated, expressly or by implication, in each of his writings on education. Francis Bacon criticised the learned foundations of his time on historical grounds in the "Advancement of Learning," and on grounds of theory in his "Novum Organum."

It is needless to multiply instances of this revolt of individual genius from the ideas and methods embodied in institutions of education. It seems necessary to admit that the academic discipline has not been very successful in dealing with the highest order of minds. Yet, obviously, there are various things that may be said in reply to such an allegation. It does not follow, because the work of a great man seems to himself or to others to have been uninfluenced by his early education, that it really was so. We sometimes forget the source of impulses that have been of great consequence to us; and it is not difficult to show, in the case of some distinguished critics of the educational system, that their obligations to it are much greater than they suppose. All human things have periods of relative decline and inferiorit , which it is not just to treat as representative. Some of the s verest strictures proceed from men who happened upon evil days, and in such cases the exceptional character of the time should be taken account of. During the eighteenth century, for example, the English universities were unproductive. Many of the professors treated their positions as sinecures, and gave no instruction. The story goes that one of the non-resident professors, subjected to the cruel hardship of a journey four times a year for the drawing of his salary, who had made various attempts to induce the authorities to forward the stipend, at last discovered a statute which obliged them to do so, and thus succeeded in absolving himself from the solitary function which he had ever been known to discharge. It is no wonder that the indignant comments of the author of the "Wealth of Nations" were provoked by an administration of a public trust under which such abuses were possible. So far as there is any incompatibility between provision for the original and creative mind, and due consideration for persons of inferior endowment, it may with some reason be maintained that the latter is the more important duty. Genius can take care of itself: it will not suffer its path to be too narrowly marked out: it is the man of average powers who needs instruction and direction. Society may be better served by an educational regimen adapted to the great mass of those subjected to it than by one higher in intellectual quality, but narrower in the range of its application. We must not allow too great weight to the fact that so many distinguished names can be cited in criticism of methods of education. Such criticisms are often unfair as to the matter of fact, withholding acknowledgments that ought to be rendered. Just as applied to a particular time, they are often unjust as general propositions. The distinction which ought always to be kept in view between the ordinary mind, for which systems of instruction are largely designed, and the exceptional mind, which is in great degree a law unto itself, they often disregard.

I have thought that it might be suitable to the occasion which brings us together, if, instead of discussing a theme of more specific character, which might not be of interest to us all, I were to remind you, through a few illustrations, how potent and effective the influence of learned institutions has been upon the progress of modern society. The conception of scholarly life as remote from practical things is sufficiently common to make it well sometimes to enter protest against it; and however little influenced we may be by derogatory estimates, such as have been referred to, an occasional resurvey of salient facts of academic history cannot be without value. One who considers how hard it is to name an important movement of thought or life, since society emerged from the middle ages, in which institutions of higher education have not been a discernible factor, will understand how honorable and dignified is the learned tradition which we have inherited. "I have felt," said Frederick D. Maurice, "the close connection between the learning of the scholar and the life of the world." The realization of this, as a personal consciousness, is one of the most ennobling and invigorating experiences of which one is capable; the perception of it, merely as a fact observed in history, is by no means unimportant.

In June, 1888, the University of Bologna celebrated the eight hundredth anniversary of its founding. Unless the succession of teachers said to be traceable at Athens, from Plato down to the suppression of Pagan philosophy by Justinian, be admitted as an exception, this is the longest existence attained by any such institution in the civilized world. This length of time takes us back to that early awakening of the intellect of Europe which has been happily termed the "Roman Renaissance." Various influences contributed to make this period of the twelfth and thirteenth centuries one of new life, — Mohammedan civilization, acting through the Crusades and the Saracen conquests, awakening an interest in physical science, bestowing upon western Europe important portions of the philosophy of Aristotle; the commercial enterprise of the busy Italian cities, creating wealth, introducing refined tastes and habits, developing political relations and ideals before unknown; the resuscitation of ancient philosophy, under the direction of the Church, expressing itself in the speculative and dogmatic movement known as scholasticism. The early universities were the product of these pregnant influences. In their origin they were essentially popular; not established by bounty of king or patron, but rising, without preconcerted plan, in response to recognized needs, around the persons of famous teachers.

The most characteristic of the intellectual tendencies of the age was the scholastic philosophy, and it was only natural that the newly founded schools should for a long period of time be mainly devoted to its promulgation. Mr. Hallam, writing scarcely more than fifty years ago, declared that he knew of only one Englishman, since the revival of letters, who had

"penetrated into the wilderness of scholasticism." When one remembers that Thomas Aquinas is the accredited exponent of the theology of the Roman Catholic Church, this seems hardly creditable to English scholarship; nor is it to our credit that the only idea which so many persons have of these philosophers and theologians of the middle ages is derived from the grotesque and silly discussions in which they are popularly represented as delighting. But the dispute as to the nature of universals, which has been the special occasion of the cheap ridicule visited upon them, is not a mere word-play. Its historical genesis and its intellectual affiliation are in the concepts of Socrates, the ideas of Plato, the forms of Aristotle. However alien in spirit and form to the Greek philosophy, scholasticism is its continuation, and nominalism and realism are only the mediæval way of expressing the antithesis of sense and reason, phenomena and noumena, the empirical and the ideal, which, under one name or another, appears in every age of human thought. That this antithesis should have taken a theological form was only natural under the circumstances then existing: in the absence of a knowledge of nature, there was little else to philosophize about, except the data furnished by the Scriptures. It is easy, no doubt, to blame the scholastic thinkers because they did not adopt the inductive method as expounded by modern authorities; but we all know that men must be judged by the standards of their time, and it is certain, that, in its best period, scholasticism was immensely stimulating and influential. We cannot easily understand how these dry and subtle abstractions of logic and metaphysics could have been so interesting; but we know that the old curriculum, inherited from the declining days of the empire,—the trivium and quadrivium, — was abandoned on all sides for this new instrument of discipline and culture; that admiring pupils flocked in vast numbers to listen to masters like Abelard and Scotus; that even the street brawls of the students turned on the issues between the nominalists and the realists. One can have little of the historic spirit who supposes that these great results were accomplished by what Erasmus contemptuously described as "quibblings about notions, and relations, and formalitations, and quiddities, and haecceities." This mediæval philosophy and theology was a genuine expression of the human mind, as good a theory of the universe as the times made possible.

The number of eminent men who taught in the schools of England, France, and Germany during the predominance of scholasticism was by no means small. Such men as Albertus Magnus, Thomas Aquinas, Duns Scotus, William of Occam, would command respect in any age of the world. The greatest of them all according to modern standards, Roger Bacon, we can hardly regard as a product of the spirit of his time so much as a protest against it; and we find in his case, as in that of others, that powerful influences in behalf of intellectual and spiritual freedom proceeded from schools of scholastic learning. Few movements in English history have taken deeper hold upon the masses of society than that of Wycliffe, the centre of whose activity was at Oxford. At the reforming councils of Constance and Basle the deputies from the universities were conspicuously independent; John Huss was supported by the influence and enthusiasm of the University of Prague. Thus in this age anticipations of a new era of human thought appeared. It is to the honor of the early universities of Europe that they were produced by this first intellectual awakening of the modern world, and that they so effectively contributed to it.

The great defect of the intellectual life of the middle ages was that it had not at its command sufficient material of knowledge. In keenness and subtlety, and in constructive ability, the mediæval thinkers have perhaps never been surpassed; but a far wider range of facts was necessary, that these powers might be profitably employed. The revival of ancient learning, therefore, which, beginning at least a century earlier, spread so rapidly throughout Europe after the middle of the fifteenth century, was a natural and indispensable step in the development of thought. It restored the continuity of history; it made antiquity and classic culture again objects of knowledge.

The relation of schools of learning to this eager study of the past was modified by a variety of circumstances. In Italy, where the passion for classical studies was earliest and most intense, private patrons played the most prominent part in the movement. The collection and transcription of manuscripts, the formation of libraries, the encouragement of learned men, — these services were more munificently rendered by powerful families like the Medicis, by Popes like Nicholas V. and Leo X., by the academies which sprang up in all the leading cities, than by the universities. Of them — in Italy and in every other country—the scholastic philosophy had possession. It is not strange that everywhere it declined to yield its ground. Within limits, the resistance to new methods and new materials of thought, of which the history of education furnishes so many examples, may be admitted as reasonable. Institutions stand in historical relations to the past and to the future, and must act in view of these, making sure that a given change is wholesome before sanctioning it. But the conservative impulse has ordinarily been in excess: habit and sentiment and vested interest have made change more difficult than the public good would dictate. In particular, effete and outworn disciplines have always offered bitter resistance to competitors. The phase of scholasticism which had become prevalent in the fifteenth century combined a strenuous assertion of orthodoxy with fundamental scepticism. The nominalism of William of Occam denying objective validity to general notions, making them mere words or names not answering to reality, carried with it, of course, the consequence that reasonings founded upon general terms are invalid; that no conclusions can be reached by rational argument; that no tenets of theology or philosophy are rationally demonstrable; that faith and the authority of the Church are the foundations of belief. We cannot wonder that a mode of thought so suicidal, which renounced all natural and verified knowledge, should have recognized an irreconcilable opposition between itself and a broadly human and rational movement like the revival of learning.

It must be remembered, also, that humanism passed into various extravagances which might well awaken the alarm of those who adhered to the ancient faith. Even so ardent a friend of the new learning as Erasmus dreaded the results of its importation into the north. "One scruple still besets my mind," he said, "lest under the cloak of revived literature Paganism should strive to raise its head." How largely a refined and sceptical Epicureanism pervaded Italian society at the time of the classical revival, the art and literature of the period abundantly testify. The cynical frankness with which even high ecclesiastics avowed their unbelief is something startling. The theoretical preference of Paganism to Christianity was not uncommon. "Christianity," said Machiavelli, "teaches men to support evils, and not to do great deeds." It must be admitted that the opposition of the academic adherents of scholasticism was not wholly without excuse.

It would, however, be a mistake to suppose, that, even where the traditional influences were strongest, schools of learning were without share in this decisive and critical movement of human thought. The opposition of the existing authorities was in some cases avoided through the expedient of founding colleges. Thus through the institution by Francis I., in 1531, of the Royal College of Three Languages, the Univers ty of Paris, a stronghold of the old dialecticians, became an important centre of Greek and Hebrew scholarship. This expedient was much employed by the patrons of the new learning in England. The preponderance of the colleges in the English university system is largely due to the fact that so many sprang into being, or into a more vigorous life, at this time, as instruments of the new culture. Nowhere was the classical revival more effectively promoted than in the English universities. There are few chapters of literary history more fascinating than that which, beginning, let us say, with the gift of classical books at Oxford by Shakspeare's "good Duke Humphrey" about 1435, and ending with the death of Sir Thomas More in 1535, should indicate the leading events and personages of this century of intellectual revolution. The prevalence of Greek scholarship at Oxford and Cambridge is often attributed to the influence of

Erasmus; but there is little doubt that, upon his first visit, he found there attainments quite equal to his own. The encomium of Erasmus upon his English friends has been often quoted: "When I listen to my friend Colet, I fancy I am listening to Plato himself. Who but must admire Grocyn, who is nothing short of a complete encyclopædia of knowledge? Did ever any one possess such taste, so acute, polished, and searching, as Linacre? Has nature ever produced a mind gentler, sweeter, or more richly gifted than that of Thomas More?" The bantering compliment which Erasmus paid More illustrates the delightful intellectual sympathy which united this remarkable body of men to one another. He entitled his famous work, composed at More's house, the "Praise of Folly;" the Latin words containing a play upon his host's name, *Encomium Moriæ*. The thoroughness with which the new culture took possession of the centres of English education is indicated in the literature produced in the succeeding generation. The Elizabethan dramatists were nearly all, except Shakspeare, university bred: they often use their classical knowledge with indifferent judgment and taste, but they make it a prominent element in their work. Shakspeare's classical allusions need not be explained by denying his identity: intercourse with his university trained compeers sufficiently accounts for them. Much of the interest of this early group of scholars was centred in the elucidation of the Scriptures. Colet lectured at Oxford on the Epistles of St. Paul: Erasmus worked at Cambridge on his edition of the Greek text of the New Testament. The practical aims and the moral earnestness of the English revival of letters distinguished it from that of Italy, from which it took its origin, and rendered it influential upon the higher life of the nation.

The leaders of German humanism were, if possible, more interesting in personal traits than their English co-laborers. Agricola, Reuchlin, Ulrich von Hutten, Melancthon,—these names suggest a variety of character and achievement peculiarly attractive. The development, however, of the movement in Germany was cut short by the advent of the Reformation. This had been foreseen by Erasmus, who had from the first looked with little sympathy upon Luther. A typical man of letters, his chief concern was for literature, the interests of which he would not jeopardize by theological disputes. But the extent to which the classical revival had leavened the thought of the universities may be seen in the fact that the Reformation derived from them its chief impulse. This great movement of faith and conduct was pre-eminently academical in its character. It was not in origin a popular revolution, but a learned one: the study of Greek, pursued for the sake of scriptural interpretation rather than of merely elegant accomplishment, was its inspiration. Whatever view one may take of the German Reformation, it must be conceded that institutions of learning have rarely acted upon society with greater effect than did universities like that of Wittenburg, which first encouraged humane studies, and then used them as instruments of social change.

In 1612, Descartes completed his studies at the Jesuit School of La Flèche. The account which he gives us of his education shows how largely the classical learning had then been accepted by the historical successors of its old scholastic adversaries. If we take the fall of Constantinople as an approximate date for the beginning of the movement, and consider that the Jesuit ideas of education were fairly in operation by the beginning of the seventeenth century, a period of about one hundred and fifty years would seem to have been occupied in winning recognition for the new learning. The magnitude of the interests involved in this momentous intellectual change may explain its slow accomplishment.

The term ordinarily applied to the intellectual awakening of the fifteenth and sixteenth centuries accurately describes its character. It was a renaissance, a revival of the past. It is evident, that, unaccompanied by any other influence, this reinvigoration of the sentiments and ideas of antiquity was an inadequate impulse and basis of civilization. No age can afford to content itself with what has already been. It is difficult to overestimate the importance, as an element in the formation of modern society, of the new studies, which, after the force of the renaissance was in a measure expended, attracted the best thought of the time. "The fifteenth century," it has been said, "restored the broken links of time; the seventeenth unveiled space. The former had shown to man his place in history; the latter was to assign him his place in nature."

The great age of physical discovery, beginnnig about the middle of the sixteenth century, but falling mainly in the seventeenth, was distinguished above all preceding eras by independence of the past. No generation of thinkers has ever appeared which derived so little from its predecessors as that which, acting concurrently in each of the leading countries of Europe, laid the foundations of modern science. It is significant that so many of the great men of that epoch interested themselves about the question of method. Bacon wrote a new Organum, discussing the laws under which the object is to be known, as the Organum of Aristotle had discussed the laws under which the subject thinks. The first important work of Descartes was the "Discourse on Method," reversing the procedure of Bacon, and seeking the knowledge of effects through their causes. Pascal's fragment on method is well known. Spinoza, Leibnitz, Hobbes, Locke, — their common characteristic is that they begin with first principles, and manifest an almost unprecedented degree of intellectual independence. It would hardly be expected that an era so self-reliant and so original would have much concern with the traditions and institutions of previous learning. Yet the investigation of nature which created physical science in the seventeenth century founded itself at first upon what had been done in the past. Copernicus evolved his system after an exhaustive study of the various astronomical systems of the ancients. All the discoverers who co-operated in giving this new direction to men's thoughts were trained in schools of education; most of them filled professor's chairs. It is an interesting fact that so many who have contributed to scientific thought have been teachers. This was noticeably the case at the originative epoch of the seventeenth century: Galileo was a professor at Pisa and Padua, Kepler at Prague, Torricelli at the Florentine Academy, Newton at Cambridge. The founders of modern science were indebted to the universities of their day for the equipment of knowledge, without which, novel as were their methods and results, they could not have done their work. Nor, since their time, have contributions to knowledge in this department been often made by men who have not enjoyed the advantage of regular education. A man of letters may dispense with this: it is not necessary that he be widely familiar with the productions of the past. A man of science must know what has been accomplished by his predecessors: the subjects with which he deals have a rigorous continuity of development. Eminent inventors have often been imperfectly educated; but the originating thought, which makes invention possible, comes from a well-furnished mind. Of course, this is more and more the case as experimental methods are developed. The perfecting and multiplication of mechanical aids to investigation, the founding of laboratories and museums and libraries, tend to concentrate activity at points where these facilities are furnished, and thus make the service of learned institutions increasingly indispensable. As the philosophical and theological element in modern thought goes back to the universities of the twelfth and thirteenth centuries, which were produced by it; and as the humanistic and classical tradition finds its origin largely in the learned schools of the renaissance,—so the scientific factor is, even more distinctly, academic in its history. Since the study of nature requires acquisitions and facilities which cannot be commanded by the isolated individual, and must always demand associated and organized endeavor, we see how enormous is the indebtedness of the industrial and commercial civilization of the modern world to institutions which it sometimes thoughtlessly considers unpractical.

In consideration of the sacrifices and sufferings of the citizens of Leyden during that memorable siege whose heroic and picturesque incidents have been made familiar to us by Motley, they were offered by the states of the Netherlands their choice

between immunity from taxation and the establishment of a university. With a foresight which has been rarely paralleled, they chose the latter, and the University of Leyden was accordingly founded in 1575. To this seat of learning, during the years immediately following, came, as teachers and students, a remarkable body of men. One of the earliest professors was Lipsius, an industrious and prolific scholar, for the honor of whose adhesion Protestants and Roman Catholics contended, the latter finally prevailing. To make good this defection, Joseph Scaliger was called, descended from the princely house of Verona, whose tomb all travellers remember, possessed of a wonderful memory, such as, in these days when memory is a lost art, seems scarcely credible, but with still better title to remembrance in the fact that he was the first to form the conception of the science of historical criticism. His conjecture that the Chronicle of Eusebius must originally have consisted of two books, and his conjectural restoration of the lost one, subsequently confirmed in the main by its discovery, must rank as one of the most noteworthy triumphs of historical imagination. Salmasius was another of the teachers at Leyden, in reply to whom Milton composed his "Defense of the People of England;" whose abusive personalities toward his antagonist are equalled only by those of that antagonist toward him; in regard to which, however, it must be admitted that Milton was the aggressor, since, desiring to render his opponent ridiculous, Milton describes him, in graceful allusion to the supposed ascendency of Madame Salmasius over her husband, as "an eternally speaking ass, ridden by a woman;" to which polite characterization the Dutch scholar retorts with various amiable epithets, such as "puppy," "silly coxcomb," "unclean beast." Such, couched in irreproachable and sonorous Latin, are some of the pleasant compliments which the controversial ethics of that day did not condemn. Grotius was another of the famous men produced at Leyden, a philosophical jurist of Christian temper and of varied learning, often spoken of as the founder of the modern science of the law of nations. Arminius was a student at Leyden, whose name survives in polemical theology, the seriousness of whose departures from Calvinistic orthodoxy would not, I fear, be altogether appreciated, were I to recount them in this place. These and many other distinguished men gave the University of Leyden European celebrity. "In the Batavian Netherlands," says Sir William Hamilton, "when Leyden was founded, erudition was at a lower ebb than in most other countries; and a generation had hardly passed away when the Dutch scholars of every profession were the most numerous and learned in the world." The burghers had made a good bargain; the fame of their city was carried all over Europe by the fame of its university; they got good return for the taxes of which they were not relieved. We may perhaps think of a city of our day, known far and near through the work of its university, and may possibly regret, that, in the matter of the taxes, the parallel fails to be complete.

Equally signal examples of the influence of learned institutions upon the general welfare of the communities in which they are, might be easily multiplied. In 1807, when Fichte delivered his "Addresses to the German People," his voice often drowned by the trumpets of the French troops, setting forth his idea of a common education as the basis of a common nationality, the political condition and prospects of Germany seemed well-nigh hopeless. The humiliations suffered at the hands of Napoleon were not so discouraging as the fact that these did not seem to rouse a united national spirit. The brilliant literary production which marked these years of disaster seemed to show that the intellectual activity of the people was without relation to their political life. We can now see the far-sighted wisdom of the declaration of Frederick William III., in accordance with which the University of Berlin was founded, that the State must repair its outward losses through the development of its spiritual energies. The connection between the educational and the political history of Germany during the present century, no one can overlook: it was the intellectual and moral conditions created by the work of its universities which contributed in no small degree to make the united and triumphant empire possible. We sometimes regret the multiplication of colleges in our own country; but, whatever evils have attended it, we must not forget that every one of these institutions has been a centre of enlightening and civilizing power.

It is remarkable how many movements which have become popular and widespread have originated in select circles of men gathered in academic relations. What was it which restored to Christianity its influence upon the English nation, after it had been so far lost that Bishop Butler declared, in 1736, "It is come, I know not how, to be taken for granted by many persons that Christianity is not so much as a subject of inquiry, but that it is now at length discovered to be fictitious"? The distinguished apologetic writers of the period contributed little to this result. It was the little company of Oxford students, contemptuously stigmatized as "Methodists," who wrought this moral and social transformation. Reformations in religion have ordinarily proceeded from institutions of learning, but reformations of all sorts are very likely to have this origin. The reason is because the element of ideality is more largely present in such communities than anywhere else, because things are judged in the light of principles more dispassionately and disinterestedly by minds engaged in the pursuit of truth than by persons absorbed in the ordinary pursuits and rivalries of life. The most hopeful appeal in behalf of any interest of human progress is to those who are for the time removed from immediate connection with the existing order, whose enthusiasms are fresh, unselfish, and responsive. One can hardly conceive an atmosphere more congenial to all high inspirations than that which pervades those select circles of young men not rarely gathered in our institutions of education.

Let me recur, in conclusion, to the expressions of criticism and discontent of which I spoke at the beginning, in order briefly to raise the question whether these are likely to be as sharply urged hereafter against present methods as they now are against those which have preceded. There are, as it seems to me, many reasons for believing that the educational work of our time is indefinitely better than any in the past.

The various intellectual interests are harmonized with one another to a greater degree than at any previous time. Scholarly activity is not predominantly determined in any one direction. The legitimacy of all spheres of knowledge is admitted. No one of any authority constitutes himself the partisan of one discipline as against another. Specialization, no doubt, tends to narrowness of view; but this tendency is counteracted by a profounder realization of the unity of knowledge, leading us to understand that every thing in some sort involves and leads to every thing else. Provision is thus made for all minds to an extent impossible under a narrower conception of the scope and relations of learning. The undogmatic candor with which knowledge is imparted is in favorable contrast to the political and ecclesiastical prejudices and prescriptions which have so often impaired the freedom and impartiality, if not the integrity, of academic teaching. That peculiar sentiment, inadequately described in the words "love of truth," whose ethical value is attested by the laborious, self-denying lives so often produced by it, has never been more fully developed among scholars and teachers than it is to-day. The historic method, whose abuse, as leading to intellectual indifferentism, is acutely indicated by Mr. John Morley, — "In the last century men asked of a belief or story, Is it true? We now ask, How did men come to take it for true?"—in its real spirit and in its chief influence, is singularly humane and practical, since it leads us to consider every department of knowledge in its relation to the life of society and the welfare of mankind, and blends in happy and admirable combination the scientific and the philanthropic temper. It may surely be claimed that never in the history of educational institutions have they approached so nearly as now the standard of duty and service indicated by Cardinal Newman: "If a practical end must be assigned to a university course, I say it is that of training good members of society. Its art is the art of social life, and its end is fitness for the world." That aspiring and

ingenuous minds, subjected to the influences which control the schools of learning in our day, will revolt from them with the keen dissatisfaction and bitter sense of injury and loss which so many have felt in the past, it does not seem possible to believe.

President Gilman delivered an address, on the occasion of this anniversary five years ago, upon a subject closely akin to that which has now been presented. His opening words I will quote: "To be concerned in the establishment and development of a university is one of the noblest and most important tasks ever imposed on a community or on a set of men. It is an undertaking which calls for the exercise of the utmost care, for combination, co-operation, liberality, inquiry, patience, reticence, exertion, and never-ceasing watchfulness. It involves perplexities, delays, risks. Mistakes cannot possibly be avoided; heavy responsibility is never absent." This statement, in no wise exaggerating the arduous and responsible nature of the task, may remind us how large a measure of honor and gratitude is due to those who have co-operated in the founding and upbuilding of this university, and especially to him, of whom in his absence we may speak more freely, to whose energy and wisdom and self-devotion the success of these years is, by common consent, pre-eminently to be ascribed.

NOTES AND NEWS.

WALLED up in the cellars of a brewery at Burton-on-Trent, there was discovered not long ago some beer which had been brewed in the year 1798. It resembled sherry more than it did a malt liquor, and was in good condition.

—The American Society of Mechanical Engineers have purchased a commodious building at 12 East 31st Street, this city, for permanent headquarters. Part of the building will be occupied by the Institute of Electrical Engineers, and the libraries of both societies will be merged into one.

—Late reports from the engineers at work on the Nicaragua Canal indicate that the preliminary harbor improvements at Greytown are going ahead successfully and rapidly. Senator Warner Miller has been elected president of the construction company, succeeding Mr. A. C. Cheney, who is now vice-president.

—A special train on the Philadelphia and Reading and the Central Railroad of New Jersey, on March 10, made the run between Philadelphia and New York, a distance of ninety miles, in eighty-five minutes. This is at the average rate of 63.53 miles per hour. At times the train is said to have exceeded eighty-five miles per hour.

—The American Tunnel Construction Company have contracted to construct a tunnel under the East River, from New York to Brooklyn, work to begin as soon as the consent of the local authorities shall have been secured. Meanwhile the tunnel under the Hudson, which has passed into the hands of English capitalists, is making slow progress.

—M. D. Bellet contributes to the *Compte Rendu*, 1889, No. 14, a note on some tables furnished by the director of the McGill Observatory, Montreal, to Gen. Greely. The observations extend over fifty years, from 1839 to 1888 inclusive, and form an exhaustive exposition of the climatic conditions of the country. During those years the variations of the seasons have been confined within very narrow limits. The last frosts have occurred at the beginning of May. The earliest spring was that of 1878, when the last frost was on April 2, and the latest was in 1856, in which year the thermometer fell to freezing-point on May 21. The frost, except in 1867 and 1874, always returned before November, the latest recorded being on the 5th of that month, and the earliest on Sept. 15 in the year 1859. In 1860 snow fell on Sept. 29, the only occasion when it fell during that month. Its latest appearance was in 1846, on Nov. 28. In 1839 snow ceased to fall in March, an event which did not happen again until 1889. The latest snow recorded fell on May 27, 1871. Snow fell during this month in only nineteen years out of the fifty. The mean temperature at Montreal during the seven years 1851 to 1856 inclusive was 41.56° F., the maximum 100.1° F., and the minimum 36° F. During the fourteen years ending in 1888, the mean was 41.58° F., though the last year the mean was only 39.83° F. The mean rainfall for 1851 to 1857 was 43.004 inches, and for the last fourteen years only 27.2 inches; but the figures for the months of July and August, 1888, are the largest recorded. The annual fall of snow for the years 1851 to 1857 was 95.76 inches; for the fourteen years ending in 1889, 125.8 inches.

—The construction of railways was commenced in Japan about twenty years ago; and now 579 miles of line are in working order, of which 497 are in Hondo, and the remainder in Yezo. Some of these lines, according to *Compte Rendu*, 1889, No. 14, belong to the state, others to the Japanese Railway Company. The former run from Tokio to Yokohama; from Yokohama to Kodzu; from Kobe, through Ozaka and Kioto, to Otsu on Lake Biwa; from Handa, through Nagoya and Nagahama, to Tsuruga on the west coast of the island; from Takasaki to Yokokawa; and from Naoyetsu to Sikiyama. The company's lines run from Tokio to Sendai, and from Tokio to Takasaki and Mayebashi. In Yezo there are only two state lines, — the one from Otaru to Sapporo, and thence to the coal-mines of Horonai; the other connecting the sulphur-mines of Kushiroko with the river of the same name. Besides the above-mentioned lines, there are in course of construction a line connecting Kodzu and Nagoya, with a branch to the naval station Yokosuka; another from Yokokawa through Nagano to Sikiyama; a branch from the Sendai line to Utsunomiya and Mito; and a line from Koyama to Kiryu, through Tochigi, Sano, and Tatebayashi. Lastly, numerous lines are projected, of which one from Sendai to Aomori, at the northern extremity of Hondo, is among the chief.

—Sir J. H. Drummond-Hay believes that Marocco might export a large quantity of agricultural produce under a just and prudent government, says the London *Chamber of Commerce Journal*. The soil is very fertile, particularly in the southern provinces, and produces wheat, barley, maize, and other grains, cotton, oil, fruits, cattle, etc. The people are strong and intelligent, and the climate more temperate than in southern Spain. But the inhabitants do not care to waste their labor in producing more than suffices for their maintenance, when any surplus there may be is taken from them by the tax-collectors, and any show of wealth attracts the unpleasant attentions of the government officials. The prohibitions and duties on exports also exercise a prejudicial influence on agriculture, as was proved in the case of maize. Sir John Drummond-Hay succeeded in getting the prohibition on the exportation of that grain removed by the convention of 1856. The first year one vessel only was laden with maize, but in subsequent years one hundred vessels were annually laden with it, and a large quantity of fresh land was brought under cultivation. Yet, in spite of the fanaticism of the Sultan's advisers and the unsettled state of the country, trade does to some extent increase. In the years 1875–85 the value of the imports averaged £1,033,918 annually, of which about three-fourths represented British goods. The imports at Tangier in 1887 amounted to £748,000, about £62,000 more than in the previous year.

—M. V. Turquand presented last year a statistical album to the Paris Geographical Society (*Compte Rendu*, 1889, No. 14). It contained, among others, six maps showing the geographical distributions of the different nationalities in France. There are 80,000 Spaniards living in France, most of them in the Basse-Pyrénées and Pyrénées Orientales. It is curious that there are hardly any in Ariège. The Swiss, who also number 80,000, occupy chiefly the basins of the Loire and of the Upper Rhone and Saône. The Italians are spread over the country from the Maritime Alps to Paris, but are most numerous in the departments of the Alpes-Maritimes, Var, and Bouches-du-Rhône. In the first-mentioned they form one-twentieth per cent of the population. The total number of Belgians in France is nearly 500,000: they dwell in the northern half of the basin of the Seine. Lastly, the Germans are found principally along the

frontier, in the departments of the Vosges and the Meurthe. It is a curious fact that the *quartier* of Paris most densely peopled by foreigners of a certain nationality corresponds to the country district where their compatriots are most numerous; for instance, Germans live chiefly in the north-east of Paris as well as of France.

—The arrangements for holding an exhibition in Jamaica in 1891 appear now to be fairly complete. The exhibition is to be opened on the 27th of January, 1891, and to remain open for a period of not less than three months. It will be managed by a commission, of which the Governor of Jamaica is at the head. The exhibition will comprise specimens of all Jamaica products, — sugar of all qualities, and its allied industry of rum-manufacture; liqueurs, cordials, etc.; coffee; oranges, pine-apples, and fruits of all kinds; pimento, cacao, annatto; woods in all degrees of preparation for use; spices, condiments, etc.; fibres and fibrous materials; cinchona-bark, oils, essential oils, perfumes, etc.; medicinal and economic substances; works of art, pictures, fancy articles, and ornamental work; horses, cattle, and live-stock of all kinds. The botany and geology of the island will also be fully illustrated. The exhibition will also contain examples of foreign products imported into Jamaica. The date given for the receipt of applications for space is the 1st of May next. No charge is to be made for space. A guaranty fund of over $115,000 has been raised in the island; and this, it is believed, will nearly suffice for the purposes required. A committee to insure the due representation of British industries has been formed in London. Mr. Washington Eves, C.M.G., is the chairman; and, at the request of the committee, the Council of the Society of Arts have nominated one of the members, Mr. C. M. Kennedy, as a member of that committee. For further information, application should be addressed to Mr. Washington Eves, 1 Fen-court, E.C., London, Eng.

—Mr. J. L. Shand sends the following extract from a letter from Mr. James Taylor of Toolecondera Estate, dated June 25, 1888, to the *Journal of the Society of Arts*, London, which gives, on undoubted authority, the dates of the first importation into Ceylon of Assam hybrid tea-seeds, and also of its first successful planting. The first tea was sold in Kandy early in 1872, just about the time of the arrival in the colony as governor of Mr. (now Sir William) Gregory, who at once paid a visit to Toolecondera to see what was going on there. Mr. Taylor writes, "The first Assam hybrid tea-seed arrived here in the early part of 1868. That lot all failed, and our second lot came in the first days of 1869, and our clearing of twenty acres was planted with the plants from this seed in the latter part of the same year. Tea was first planted on Toolecondera in 1866 along the roadsides. This was China tea, the seed of which had been got from the Peradenia gardens, and the plants raised here in small nurseries. Our tea-house was built in 1872; but some tea was made for sale before that, and we had been making it experimentally for years before. Our first experiment was about 1866, when an Assam planter passing through showed me how to do the rolling, and told me about the rest of the performance. This was with leaves off old tea-bushes in the garden of my bungalow."

— The richest petroleum districts of Roumania are situated at the south-east of the Carpathian Mountains, where the oil is obtained at five different spots. In many places, especially at Ploiesti, the ground is charged with gas to such a degree that it is only necessary to bore a hole, and a jet of inflammable gas issues at once. The working of the oil, as described in the *Oil, Paint and Drug Reporter*, is conducted in shafts and galleries, the roofs and walls being closed in with boards. The total yield from Walachei amounts to 9,000 tons, and the product contains 20 to 23 per cent of solid paraffine. It is exported to Vienna to a considerable extent, and yields about 15 per cent of petroleum naphtha on refining. The wells are 50 to 70 metres in depth, some as much as 120 metres. Deeper borings and large refineries have been established recently by foreign enterprise, and the output of oil has increased rapidly of late. The oil districts stretch along the southern side of the Carpathians to an extent at present unknown, in the provinces of Prahova, Dimbowitza, and Buzen; and the fields appear to be connected with those of Galicia. Two varieties of crude oil are distinguished, — (1) Pacura and (2) Titeiu. The latter contains the material for refining purposes, and yields 78 per cent of burning naphtha. It cannot be imported into Austria-Hungary on account of the high duty, but is freely exported to Germany, where there is no duty on the raw product; and after refining, the lighting-oil can be sold at 18.4 marks per hectolitre, while American oil commands 27 marks (this refers to 1884). The petroleum from Momesti and Casin flashes at 17° to 19° C. (10° below Russian petroleum), and begins to distil at 80°, yielding a large proportion of distillate up to 150°. Roumanian oils from eight districts are described by Istrati (*Jahrbuch des Organischen Laboratoriums zu Bucharest*, 1888–89), and contain from 42 to 65 per cent of photogen, 5 to 20 per cent of petroleum naphtha, and 11 to 25 per cent of solid paraffine. The residues yield nearly 50 per cent of photogen when carefully rectified. A sample from Pacureti (Prahova) yielded 50 per cent of lighting-oil of specific gravity 0.800, and distilling between 125° and 280°. Austrian and American crude petroleum both yield about 50 to 55 per cent of good burning oil, while the Russian product does not give more than 20 per cent.

—Of 122 varieties and seedlings of the potato tested the past season at the Agricultural Experiment Station, Madison, Wis., the following ten were most productive, yielding in the order named: seedling from C. E. Angell, Rose Beauty, Monarch, Duplex, Late Beauty of Hebron, Mullaly, Alexander's Prolific, Seneca Red Jacket, White Beauty of Hebron, and Wisconsin Beauty. Placed in the order of their table quality, these varieties would rank as follows: Alexander's Prolific, White Beauty of Hebron, Late Beauty of Hebron, Duplex, Monarch, Wisconsin Beauty, Seneca Red Jacket, Rose Beauty, Mullaly, seedling from C. E. Angell. The tests made at the station, taken as a whole, favor heavy rather than light seeding. Cutting off the "seed-end" was found detrimental to the yield. No advantage followed sprinkling the cuttings with plaster before planting.

— Dr. Thomas Taylor, microscopist of the United States Department of Agriculture, proposes the following new method of detecting oleo in butter: Dissolve in 20 cubic centimetres of petroleum benzine 140 grains of a mixture of oleo and butter. Heat slightly to secure a perfect solution of the fats. Caseine and animal tissues may be readily removed by passing the liquid while warm through fine muslin. Fill a test tube with the solution, and place in ice-water. In about twenty minutes the oleo-fat will separate from the butter-fat, and fall to the bottom of the tube, being insoluble in cold benzine, while the butter-fat will remain in solution in the benzine. Separate the oleo-fat from the liquid butter-fat by filtration. The fat recovered may be solidified by mechanical pressure, placing it between several layers of bibulous paper to absorb the remaining benzine, after which the sheet of solid oleo may be removed from the paper with a palette-knife. The butter may be recovered by evaporating the benzine by means of a sand-bath.

— Dr. Thomas Taylor, microscopist of the United States Department of Agriculture, proposes the following new method of detecting cottonseed-oil in lard: Dissolve in 20 cubic centimetres of petroleum benzine 140 grains of a mixture of lard and cottonseed-oil. Heat slightly to secure a perfect solution of the lard. Animal tissues should be carefully removed by passing the liquid while warm through fine muslin. Fill a test-tube with the solution, and place in ice-water. In about twenty minutes the lard falls to the bottom of the tube by reason of its insolubility in cold benzine, while the cottonseed-oil remains in solution in the benzine. Separate the lard from the cottonseed-oil by filtration through fine bibulous paper, and subject the recovered fat to mechanical pressure between several folds of the filtering-paper, by which means the remaining benzine is absorbed. The solidified fat may be removed from the paper with a palette-knife. The cottonseed-oil is separated from the benzine by means of a sand-bath, which evaporates the benzine.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

SHOULD FARMERS RAISE THEIR OWN VEGETABLE-SEEDS?

This is a question of considerable importance, and one to which attention is frequently directed by the agricultural journals. It has been made the subject of an experiment by George C. Butz at the Pennsylvania State College Agricultural Experiment Station, with a view to determining some facts that would aid in its consideration. Cultivated vegetables, as a rule, are further removed from their original or "wild" forms by the natural development due to high culture than are the cereals and other ordinary farm-crops: therefore the conditions of soil and cultivation under which vegetables are grown have much to do in fixing the value of the seeds maturing on these plants. We have only to compare the wild carrot of our fields with the cultivated form of the garden to note the change which has been wrought by cultivation. The former is an annual, with a slender root, toughened by much woody fibre; the latter is a biennial, with a fleshy, tender root. It has often been observed, too, that reversions are common among carrots growing in poor soil. These and similar facts concerning other vegetables should not be ignored in considering this question.

Undoubtedly there was a time when many farmers bought commission seeds with but few satisfactory results, for often these seeds were greatly impoverished and adulterated, and reflected much discredit on the seed-business. It is fair to say at this time, however, that the seeds found in country stores, bearing the names of reputable firms, are quite as good as seeds obtained direct from the warehouses. The results of some tests of such seeds made last year may be found in Bulletin No. 4 of the Pennsylvania station. The germinative value of the seeds thus tested compared very favorably with that of the seeds obtained in bulk. Considered from a financial standpoint, no farmer or gardener can complain about the price of seeds, when for a dollar a full assortment of good clean seed, in quantity sufficient for a family, can be obtained. If, however, the farmer tries to save this expense by raising his own seeds, he finds in a few years that his vegetables are not so choice as they once were, because the seeds are not selected with care, and the proper cultivation has not been given to the garden.

The question in its scientific aspect presents itself in the following form: Are seeds which have matured under high cultivation (as on our best seed-farms) better for our less enriched farm soils than seeds which have matured in this poorer soil? The answer must be found in a comparison of results regarding earliness, productiveness, vigor, and quality of the products. The conditions at the station were very favorable to the work, and in 1888 seeds were gathered from the best of those vegetables that seeded. The ground in which they grew is not a rich garden soil, but only an ordinary farm soil. These seeds were planted last year along with seeds of the same varieties from the seed-houses of Landreth, Dreer, Thorburn, and others. In March the seeds were examined and careful weights taken of a hundred seeds of each variety. From the figures in the tables of tomatoes, radishes, and lettuce, it appears that in nearly all varieties of the first two vegetables mentioned the station-grown seeds were heavier than those from the seed-houses, while those of the lettuces in the majority of cases were lighter. Following this examination, a test of the germinative values was made by putting a hundred seeds of each variety in the germinators. These results are slightly in favor of the station seeds in case of radishes, but against them in that of the tomatoes.

The seeds of each vegetable were sown at the same time, and given similar treatment. The beans and tomatoes suffered somewhat from a severe late frost, and hence we cannot attribute much value to the figures on earliness and yield, except perhaps as comparisons under like conditions.

It was observed after the frost, which occurred on the 29th of May, that the plants from station seeds were, as a rule, more seriously affected than the others.

The indications of the tables are, (1) the station seeds were, as a rule, heavier than the purchased seeds; (2) the weight was no indication of the germinative value of the seeds; (3) in the majority of cases the earlier marketable products were obtained from the purchased seeds; (4) the greater yield, with but few exceptions, was obtained from purchased seeds; (5) lettuce from purchased seed produced heads that did not "shoot up" to flower as early as the plants from station seed; (6) radishes from purchased seeds were larger, more tender, and more uniform than those from station seeds; (7) on the whole, the results are strongly in favor of seeds from good soil, however rich that may be.

The experiment will not cease with the present results, however conclusive they may appear, as it is desired to determine how much is lost by several years' use of seeds raised on average soil.

CLIMATOLOGICAL TEMPERATURE.

It is well known that the sensation produced by heat and cold of the atmosphere upon the exposed surface of the human body has no direct constant relation to the rising and falling of the temperature in the shade, commonly regarded as the temperature of the external air. When overheated, we fan ourselves or court a draught, and wind produces a like cooling effect. In stagnant air the heat of the tropics is unbearable. In polar regions the cold of winter is unsupportable in high winds. Thus a cooling sensation is maintained by a breeze throughout the thermometrical range of temperature. But, whatever the temperature of the air may be, in sunshine we experience additional warmth, especially if there is little or no wind. Hence our sen-

sations of heat and cold are due not merely to the temperature of the air, but also to the direct solar radiation and the wind's velocity. Upon this basis, Mr. J. Vincent, the Belgian meteorologist, as we learn from *Engineering*, has experimented on the temperature of the exposed surface of the human body, as the hands and face, and given an account of his investigation in *Ciel et Terre* under the title "Climatological Temperature." A long series of observations has conducted him to the formula, adapted to Fahrenheit's thermometer, $\frac{99.7-A}{S-A}=1.42$, whence $S=70.3+0.3A$, where 99.7° is the interior temperature of the human body; A, the temperature of the air; S, the temperature of the exposed skin when in shaded and calm air. Let E be the excess of solar radiation above the temperature of the air, V the velocity of the wind in miles per hour; then C, the climatological temperature, or the temperature of the skin, as influenced by A, E, and V, is

$$C=70.3+0.3A+0.2E-\sqrt{4.34\,V}.$$

Thus, if $A=48°$, $E=4°$, $V=20$ miles, then $C=76.3°$, and this is the temperature of the exposed skin; whereas in calm air it would have been 85.5°, and in calm and shaded air 84.7°. Here the effect of sunshine is very small. It is often very considerable. Observations carried out in this manner during December, 1889, show that the thermometrical coldest day, 20.8°, was the 3d; the warmest, 48°, the 24th; whereas the greatest sensation of cold, 71.4°, was due to the 9th; of heat, 88.8°, to the 15th. Although the air was not so cold on the 9th as on the 3d, it felt colder because there was no wind; and although the 24th was much warmer than the 15th, the 15th felt warmer because there was much less wind and powerful sunshine. The observations were made at noon. The investigation is exceedingly curious and interesting; gives a direct utility to observations of solar radiation; and, without doubt, ought to enlist the attention of meteorologists, and be carried out more extensively, for which purpose the original memoir must of course be consulted.

Probably it will be found that these relations are only tolerably identical in healthy subjects; for physiological and pathological influences, as well as those of the weather, determine the bodily sensations. This investigation, however, clearly makes manifest that our individual bodily experience is in several respects quite a different meteorological indicator to the unsentimental thermometer.

KILIMA NJARO.

THIS mountain, as is well known, consists of two summits, the Kibo and the Kimawenzi, connected by a saddle studded with hills of lava. From this saddle Dr. Meyer tried, in 1887, to scale the Kibo (*Scottish Geographical Magazine*), but had to give up the attempt on account of the weather. Last October he pitched his tent on the saddle, at an elevation of over 14,000 feet, and on the 3d of the month set forth at half-past two in the morning, accompanied by Herr Purtscheller, and provided with the usual equipment of the Alpine climber. During the darkness they made their way to the glacier valley which descends from the flanks of Kibo in a south-easterly direction, and at dawn stood on the rocky northern boundary, looking down into the valley nearly 500 feet below. Crossing this valley, the climbers reached the ridge of lava forming its southern boundary, up which they purposed to make their way to the summit of Kibo. Here they met with the first patches of snow, lying under the protection of the rocks at an elevation of 16,400 feet.

Their route now led over blocks of stone and heaps of *débris*, up the steep lava ridge,—a toilsome way,—where they had to make frequent halts to recover their breath, for the rarity of the atmosphere became more and more perceptible. Shortly before ten o'clock they came to the lower edge of the icy mantle which encircles the summit and conceals it from view. The height of this spot was about 18,270 feet. The rocky declivity over which the climbers had ascended had an inclination of 30°: the icy wall which rose above it, 35°. Dr. Meyer and his companion found it very exhausting work to scale this slope, cutting steps, as they advanced, in the ice, which, far from being firm at the bottom, became still more unsound and uneven as they ascended. At length the crevasses were crossed, the highest undulation of the ice visible below was surmounted, and at a quarter to two o'clock the climbers stood on the edge of the crater. Here they perceived that the highest point of the crater wall lay about one and a half hours' march to their left on the southern side. Weary as they were, they did not venture to run the risk of being caught in a fog, or of being obliged to bivouac on the mountain-side without any protection against the cold. They therefore turned back, and, after a day of sixteen hours, reached their camp on the saddle, congratulating themselves that at any rate the true nature of the summit had been discovered. Three days later they again went forth, and passed the night in a cave they had remarked in the right side of the glacier valley, whither Dr. Meyer's negro follower carried their blankets, etc. No fuel could be procured; but, considering the elevation, 15,150 feet, the night was mild (10.5° F.), for their bivouac was sheltered from the wind blowing over the glacier. Starting at three o'clock, the climbers reached the point where they turned back on the former occasion, at a quarter to nine. Its elevation above the sea-level was 19,220 feet. Beyond this point no great difficulties were encountered.

The edge of ice which runs round the crater slopes gradually up towards the south, where it is pierced by three peaks. It was impossible for the eye to decide which of these three was the highest, and therefore Dr. Meyer ascended all three, and found that the middle one was 50 to 65 feet higher than the others. This, the highest point in German territory, being somewhere about 19,680 feet above the sea-level, he named "Kaiser Wilhelm Spitze." From this position the crater could be well observed. Its diameter is about 6,500 feet, and it sinks to a depth of 650 feet. On the north and east the ice descends from the edge inwards in steep terraces, while on the west and south lava precipices take its place. A little to the north of the centre a slightly arched eruptive cone, composed of dark-brown ashes, rises to a height of 490 feet above the crater bottom. Its upper portion is bare, but its base is covered by a mighty glacier which escapes from the crater through a cleft in its western side.

About a fortnight later Dr. Meyer visited the northern side of the mountain, where he found the ice mantle much narrower than on the other side, beginning at an elevation of 18,820 feet, but so steep and hard that only experienced mountaineers would be able to cross it. He also descended through the great eastern cleft into the crater itself. Dr. Meyer also made several expeditions up Mawenzi, or Kimawenzi. It is evident that a much longer period has elapsed since this crater became extinct, for the whole mountain is riven, eroded, and degraded in a marvellous manner, so that it is both difficult and dangerous to climb over its rocks. Dr. Meyer considered it vain for two men to attempt the ascent of the highest pinnacle, but he reached the top of another not much lower, which he found to have a height of 17,250 feet. Towards the east the flanks of the mountains sink precipitously. The lava is so friable, and has been so much denuded by wind and rain, that the mountain is reduced to a mouldering skeleton. It is a mass of turrets, pinnacles, pyramids, and battlements, intermingled with heaps of detritus.

BOOK-REVIEWS.

Sound-English. A Language for the World. By AUGUSTIN KNOFLACH. New York, Stechert. 12°. 25 cents.

THIS is another attempt at spelling-reform. The author justly holds that the English language, by its simple structure and its extensive and rapidly increasing prevalence, is entitled to become the universal language for international communication. But the present orthography of English is an insuperable obstacle to its adoption as the world-language, and this obstacle can only be removed by a phonetic spelling. Apparently, also, he is not satisfied with the phonetic systems that others have proposed, though he offers no criticism of them. His own system has three essential points, though some of them are not peculiar to it. He

gives most of the vowel letters their Italian sound, and proposes to introduce at first five new letters, to be followed by six more at a later time. But the chief peculiarity of his system is the "strengthening" of the vowels to denote their long sound. This is done in printing by the use of full-face type, thus, "uph**o**ld," and in writing by a heavier shading of the letter. This, as it seems to us, will be an insurmountable obstacle to the adoption of the system; for who will take the trouble, in rapid writing, to shade now and then a letter more heavily than the rest? Moreover, we gravely doubt if any system can be brought into use that contains new letters; and, if new letters are to be introduced, there are other systems that have quite as good a claim to be adopted as Mr. Knoflach's.

On the Relative Advantage of Tubs with Bottoms and Tubs without. Printed for the author. New York, for sale at 20 Cooper Union. 12°.

This anonymous work consists of two parts, the first being in the main a polemic against the views now held by many of the Swedenborgian clergy, and the second a statement of the author's own views. He maintains that the professed followers of Swedenborg misunderstand or misinterpret the doctrines of their master, and in particular he condemns their pantheism, which he thinks Swedenborg would have regarded with aversion. In this polemic against pantheism he makes some good points. He affirms also that the doctrines he criticises have no rational basis, they are tubs without bottoms; while the real doctrines of Swedenborg, as the author of this book understands them, have a basis that is all-sufficient. He then proceeds to state some of these doctrines in a simple and popular way, the leading one being a mystical interpretation of the doctrine of the Trinity. Every thing that exists, he tells us, consists of three elements, — substance, form, and force; and of these elements he says, that, though "essentially different, they yet shall have a common name, 'person,' for each *is* a person." He then goes on to maintain that in the Divine Being substance is the Father, form the Son, and force the Holy Spirit. Such, according to our author, is the true doctrine of the Trinity, and the highest principle of religion. We greatly fear, however, that this tub also has no bottom, for we can see no rational basis for such mysticism. The author expresses himself well, and with greater simplicity than most writers on such topics, and his work will doubtless have an interest for Swedenborgian readers; but to other men it is not likely to be of much use.

The Way out of Agnosticism. By Francis Ellingwood Abbot. Boston, Little, Brown, & Co. 12°. $1.

This book consists of a series of papers based on lectures delivered at Harvard College, and originally published in the *New Ideal* newspaper. They are in the main a briefer and simpler statement of the views expressed in the author's "Scientific Theism." The introduction is a lively attack on the agnostics for maintaining a purely negative attitude, and refusing to make any attempt toward a positive theory of the universe. Mr. Abbot justly holds that mankind can not and will not remain without such a theory, and declares that the liberalism of the present day, on account of its negative character, is "infinitely inferior to the Christian mythology which it has displaced." Yet he maintains that liberalism alone can furnish the true constructive theory of the universe which is now so greatly needed, and his own aim is to present the outlines of such a theory.

As his theory has already been given to the public in his earlier and larger work, we need not devote much space to an analysis of it. His leading doctrines are these: 1. "The universal results of the special sciences, including the method common to them all, are the only possible data of philosophy or universal science." 2. "The universe is known as at once infinite machine, infinite organism, and infinite person, — as mechanical in its apparent form and action, organic in its essential constitution, and personal in its innermost being." This theory, in its identification of the deity with the universe, is pantheistic, but in affirming the personality of the deity, it is opposed to pantheism. Another of Mr. Abbot's essential doctrines is his realism, which he maintains in opposition to the phenomenalism or idealism of the prevailing modern philosophies. The book is written in a vigorous style; and, whether one agrees with its doctrines or not, it is interesting to read.

AMONG THE PUBLISHERS.

W. A. Linn's article on "Co-operative Home-Winning," through building associations, will appear in the May *Scribner*.

— Henry Holt & Co. will publish soon "Introduction to Systematic Botany," by Charles E. Bessey, professor in the University of Nebraska, and author of Bessey's "Botanies" in the American Science Series.

— The last issue of *Garden and Forest* presents a complete list of the works treating of landscape-gardening which have been published in English, French, German, and Italian since 1625, the date of Lord Bacon's famous essay. It includes not only all books and pamphlets, but all articles and reviews on the subject, and covers nearly five closely printed pages. To make room for this list, which is a work of permanent value, the paper has been enlarged, and contains, besides an illustration of Clermont on the Hudson, with a description by Charles Eliot, its usual amount of matter in the various fields of horticulture and forestry.

—Frederick W. Whitridge, the well-known New York lawyer, who contributes an article to the April *Scribner* on "The Citizen's Rights as a Householder," tells the following story: "The series of papers upon the rights of citizens, of which this is the first, happened lately to be mentioned before a person of ripe and sound judgment, who has seen much of the world, but who is not a native of this Monte Cristo of nations; and this person, illuminated by the knowledge of many cities and men, thereupon exclaimed, 'Rights of citizens! You Americans haven't got any rights; or, if you have, you are all so afraid of each other, you dare not assert them.' "

—A curious phenomenon, in virtue of which electric cars are aided in ascending heavy grades, is alluded to by Joseph Wetzler in his article on "The Electric Railway" in the April *Scribner*. This phenomenon, which was probably first observed by Leo Daft, at his works in Greenville, N.J., in 1882, is, that, when the current passes from the car-wheel to the track, it causes an increased friction or resistance to sliding between them, the result of which is that slipping is to a large degree prevented, and heavier grades can be attempted. The explanation of this phenomenon, though not completely established, seems to lie in the direction of a slight welding action which takes place between the wheel and the rail, caused by the heat generated by the current.

— Messrs. Griggs & Co. of Chicago have published "Semitic Philosophy," by Philip C. Friese; and a singular book it is. The author professes to have the only true interpretation of Christ's doctrine of the kingdom of God, claiming that it is known "instinctively;" and he here gives a statement of the doctrine and its practical applications. He presents to us "so much of the unwritten, instinctive, rational, ideal, or natural constitution of the kingdom of God, or universal society of the races of mankind, as may, when universally assented to and adopted by tacit or express general agreement, be established as such in writing." It is drawn up in articles and sections like the Constitution of the United States, and provides for a republic of letters, a republic of the Church, a republic of industry, a republic of charity, and a republic of government, the organization and functions of each of which are duly set forth. What it all amounts to. we are unable to see. The book is a curious compound of crude social projects and hazy metaphysics, and that is all we can say for it.

—The opening article of *The Chautauquan* for April is by Professor James A. Harrison, Ph.D., LL.D., of Washington and Lee University, on "The Archæological Club in Italy;" "Life in Modern Italy," by Bella Stillman, follows; the eminent philologist, Professor Federico Garlanda, of the University of Rome,

Publications received at Editor's Office, March 10-15.

ALLEN, G. The Colours of Flowers as illustrated in the British Flora. London and New York, Macmillan. 12°. 119 p. $1.
BRINTON, D. G. Essays of an Americanist: I. Ethnologic and Archæologic; II. Mythology and Folk Lore; III. Graphic Systems and Literature; IV. Linguistic. Philadelphia, Porter & Coates. 489 p. 8°. $3.
FLOWER, W. H. Fashion in Deformity as illustrated in the Customs of Barbarous and Civilized Races. London and New York, Macmillan. 85 p. 12°. 50 cents.
HICKS, W. M. Elementary Dynamics of Particles and Solids. London and New York, Macmillan. 397 p. 12°. $1.60.
LIEBIG, G. A., jun., and ROHÉ, G. H. Practical Electricity in Medicine and Surgery. Philadelphia and London, F. A Davis. 383 p. 8°. $2.
LONGFELLOW Leaflets. Compiled by Josephine E. Hodgdon. Boston and New York, Houghton, Mifflin, & Co. 108 p. 12°. 30 cents.
SENSENIG, D. M. Numbers Universalized: An Advanced Algebra. Part Second. New York, Boston, and Chicago, Appleton. 178 p. 12°
SMITH, J Dictionary of Popular Names of Economic Plants. London and New York, Macmillan. 457 p. 8°. $3.50.
STEVENS, F H., ed. The Eleventh Book of Euclid's Elements. Propositions 1-21. London and New York. Macmillan. 48 p. 16°. 30 cents.
TUBS with Bottoms and Tubs without, On the Relative Advantage of: being a Rambling Letter from a Cooper's Apprentice to a Swedenborgian Clergyman. New York, 20 Cooper Union. 345 p. 12°.
WENDEL, F. C. H. History of Egypt New York, Appleton. 158 p. 16°.

writes of "The Indebtedness of the English Language to the Latin;" Professor Adolfo Bartoli begins a series on "Italian Literature;" "The Politics of Mediæval Italy" are considered by Professor Philip Van Ness Myers, A.M.; Principal James Donaldson, LL.D., of the University of St. Andrews, Scotland, contributes his second paper on "Roman Morals;" Albert Shaw, Ph.D., predicts a hopeful future for "Rising Bulgaria;" a new realm of investigation open to the physicist is discussed by Professor Edward L. Nichols of Cornell University, in "The Production of Artificial Cold;" the English writer, Arabella B. Buckley, continues her studies on the "Moral Teachings of Science;" and Mrs. Carl Barus does the same with "What are our College Women Doing?" New to most readers will be the information in the article, "A Botanical Garden in the Island of Java." "A Study of Spiritualism" likely to attract attention is contributed by a member of the Seybert Commission, Robert Ellis Thompson, of the University of Pennsylvania. The usual space is given to editorials and C. L. S. C. matters.

— The March *Magazine of American History* contains a chapter, "Celebrating the Birth of William Bradford," by Thomas Bradford Drew of Plymouth, taking us backward to the first settlement in New England; then we find some personal memories from the pen of Hon. Charles K. Tuckerman, writing from Italy on "Sir John Bowering and American Slavery." We have an account by W. R. Garrett, A.M., of the controversy concerning "The Northern Boundary of Tennessee," which stretched over sixty-eight years, and is interesting just now in view of the boundary suit recently instituted by Virginia against Tennessee in the Supreme Court of the United States; and entertainment is given in "Hawthorne's First Printed Article," by Kate Tannett Woods. "The Story of the Greatest Auditing Office in the World," by Milton T. Adkins, is statistical, but desirable to possess and preserve; and the "Neglected Grave of Seth Pomeroy," by Frank Sutton, will awaken sympathy. The leading illustrated paper of the number is a picture of "Life in New York Fifty Years ago," by the editor. The period reproduced opens with the completion of the Erie Canal; and glimpses are given, through the diary of an old New-Yorker for twenty-five years, of characters and affairs, of inventions, politics, and panics, of clubs, dinners, fancy balls, and foreign visitors. Dickens was here, and, being then regarded as the greatest living novelist, was feted and complimented beyond any other writer of his generation.

— Messrs. Ginn & Co. announce to be published in April or May, "Directional Calculus," by E. W. Hyde, professor of mathematics in the University of Cincinnati. This work follows in the main the methods of Grassman's "Ausdehnungslehre," but deals only with space of two and three dimensions. The first two chapters give the theory, and fundamental ideas and processes, of Grassman's admirable and comprehensive geometric method, with sufficient fulness and completeness, it is believed, to enable the student to pursue the subject satisfactorily through the remaining chapters, containing applications to plane and solid geometry and mechanics, or to enable him to read with comparative ease Grassman's original works. A very elementary knowledge of trigonometry, the differential calculus and determinants, will be sufficient as a preparation for reading this book. It is the hope of the author, that, by providing a textbook on this subject in English, he may contribute in some measure toward a more general study and knowledge of that wonderful mathematical system which, though published by its discoverer in 1844, has met with the most remarkable indifference and neglect at the hands of mathematicians up to the present time.

—Interest seems never to be lacking in the controversy over the relative value of realism and idealism in the researches of natural science, and those who insist upon using the "subjective" method of investigation in studying phenomena of the "objective" work are still severely criticised. S. C. Griggs & Co. have now in press, and will issue at an early day, "The World Energy and its Self-Conservation," in which the author, W. M. Bryant, reasoning from the standpoint that "truth in its vital reality is to be attained only through a complete blending of these two methods," discusses the deepest questions of science.

—Briefly stated, the results of the inquiry by W. E. Stone regarding the saccharine substance in the sweet potato. reported in the February number of *Agricultural Science*, are these: the saccharine substance of the sweet potato exists chiefly, if not entirely, in the form of sucrose; the use of the polariscope in the quantitative determination of the same seems possible (such determinations showed one and a half to two per cent of sucrose in the fresh potatoes); the temperature of cooking (baking) inverts the sucrose, and converts more or less of the starch into a soluble form. A part of Mr. Stone's investigation was made at the laboratory of the Tennessee Experiment Station, the remainder at Purdue University.

—"The Scratch Club," by Hugh A. Clarke, Mus. Doc., professor of music in the University of Pennsylvania, has been issued by the Poet-Lore Company, Philadelphia. Under the title of "The Scratch Club," the author has given a lively record of the meetings of an imaginary group of musicians, who discuss music and kindred subjects, and tell stories, some grave, some gay, forming a sort of musical "Tales of a Wayside Inn." Musical taste in America, Handel's "Messiah," Beethoven's "Aurora" Sonata, music in the public schools and in the churches, international copyright, and bad music, are some of the subjects touched upon in the course of these animated conversations.

—We learn from *The Scottish Geographical Magazine* that a new and corrected edition of the topographical map of France, which was commenced in 1818, will shortly be issued. The map printed from the original copperplates is now, of course, out of date; but to alter these large plates is a work so tedious, that it has been put off as long as possible, new roads, etc., being marked on the zincographic edition. The latter process, however, lacks the clearness and sharpness of copperplate engraving; and therefore the Service Géographique de l'Armée, presided over by Gen. Derrécagaix, is engaged in correcting the original plates. In the new edition, alterations and extensions of roads and railways will be duly marked, the towns be enlarged to their present size, the spelling of names corrected, and even fortification works will appear. The unwieldy sheets will be divided into four sections each, measuring 40 by 25 centimetres (about 15¾ by 9¾ inches). Each section will be sold for 50 centimes.

—Lieut.-Col. Sir Andrew Clarke delivered an address before the London Chamber of Commerce on Nov. 6, 1889 (*Chamber of Commerce Journal*, Dec. 5, 1889), in which he demonstrated the remarkable rapidity with which the British protected states have developed. The foreign trade of Perak has increased from £248,796 in 1876, to £3,134,685 in 1888; and the little state of Selangor, with an area of about 3,000 square miles, which in 1873 had practically no trade at all, exported and imported in 1888 goods to the value of £2,372,756. Revenue and population have correspondingly increased. The twenty miles of railway opened in Selangor in 1887 pay a dividend of 25 per cent, and the eight miles completed in Perak in 1888 pay 8½ per cent. These railways are now being extended, and will promote the prosperity of the country, and yield a satisfactory dividend. Half the tin in the world is exported from these states, and there is a large auriferous region, watered by a navigable stream. The agricultural prospects are equally bright. Perak can produce coffee of fine quality, and yields abundance of pepper and nutmegs. Selangor grows coffee, pepper, tea, and tapioca; indigo has been successfully tried; and land has been granted for the cultivation of tobacco. In Sungei Ujong, 35,871 acres are already under cultivation, and good crops of coffee are produced. Pahang, which has only recently been received under British protection, has hardly been exploited at all; but it will probably prove to be the richest of all these states. Besides its mines, it has fine timber, and most tropical products have been grown in small quantities.

— The discussion on anonymity in journalism will be continued in the March *New Review* (New York, Longmans), with extracts from letters by Labouchere, Lang, Justin McCarthy, Grant Allen, and others; and Mr. Allen also contributes an article on the "Origin of Animals."

— "Motive Power for Street-Cars" is the title of a book published by the John Stephenson Company of this city. The volume is made up mainly of extracts from the proceedings of a recent meeting of the American Street Railway Association. It is handsomely illustrated.

— Harper & Brothers have just issued the second volume of "What I Remember," by the octogenarian novelist Thomas Adolphus Trollope, the elder brother of the late Anthony Trollope. The first volume, which was published about two years ago, closed with the death of Mr. Trollope's first wife in 1865; the new volume covers the period from that date to the year 1889. Among the well-known people with whom the reader becomes acquainted in these pages are Liszt, Von Bulow, Gen. Sheridan, King Humbert, Pope Leo, Salvini, Ristori, Cardinal McCloskey, Jenny Lind, Lanciani, and Holman Hunt.

— Messrs. Ginn & Co. announce "Open, Sesame!" edited by Mrs. B. W. Bellamy and Mrs M. W. Goodwin. This book is a collection of prose and verse, comprising more than a thousand selections carefully edited, and arranged for committing to memory. It is in no sense an elocutionist's manual, the editors having made the first test of each selection "Is it worth learning?" and the second, "Is it adapted to recitation?" The book is representative of English literature, and also comprises many translations from foreign sources. Its various departments contain many of the familiar classics, and also many extracts from late literature never before included in such a collection. It is arranged in three volumes, each complete in itself, and specially adapted to the age for which it is intended. Volume I. is designed for children from four to ten years old; Volume II., for those from ten to fourteen; and Volume III., for the oldest students. The purpose of the book is to train the memory, to educate the literary taste, and to supply the student with the long-needed standard collection of poetry and prose for recitation.

—The Scientific Publishing Company, P.O. Box 1833, New York, announce the publication of "Gems and Precious Stones of North America," by George F. Kunz, gem expert with Tiffany & Co. This book is a popular description of their occurrence, value, history, and archæology, and of the collections in which they exist, with a chapter on pearls. The standing of the author will serve as a guaranty for the excellence of the work. The several species and varieties of precious stones are described systematically, and the work is far more detailed and thorough than has hitherto been attempted. This magnificent work is profusely illustrated with the finest colored plates ever engraved for a work of this kind, being the very best work of Messrs. Prang & Co.

—In *Garden and Forest* for March 19, Mr. Charles Eliot continues his series of articles on old American country-seats, with a delightful sketch of Montgomery Place; and this fine old home of the Livingstons is illustrated by a view of its entrance-front, and another of an avenue on the grounds. The same number contains articles on street trees, the dwarf Japanese plants at the Paris Exposition, the winter colors of the bark of trees and shrubs, and the cultivation of strawberries, besides much seasonable information concerning the garden in early spring.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

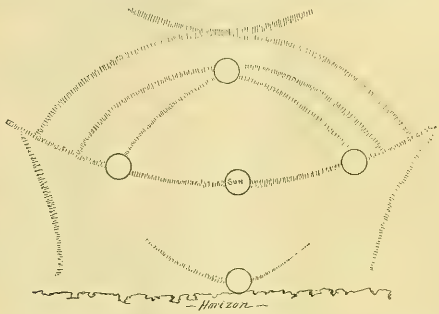
The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Solar Halos.

THE forenoon of March 2 in central and southern Arkansas was cold and calm, and the sky was cloudless though somewhat hazy. About eight o'clock white and colored bows appeared in the haze about the sun, and continued to be visible until about half-past ten, when it gradually disappeared. This phenomenon seems to have been most brilliant in the south-western part of the State. One of my assistants on the Geological Survey of Arkansas, Mr. James Perrin Smith, who witnessed it in Howard County, Ark., sends me the figure accompanying this (made on the ground), and a letter, a part of which I append.

Mr. Smith writes from Venetia Grove, Howard County, Ark.: "At 8.30 there was not a cloud in sight, but the eastern sky had a hazy appearance. The sun was shining with full brilliancy; and on the right and left of it, and above it at equal distances, three other suns appeared, shining almost as brightly as the sun



proper. The figure called for a fourth secondary sun, but it was too near the horizon for this to be seen. Radiating from these suns were brilliant rainbows forming regular spherical triangles. The brightness of the suns and bows lasted but a few minutes, and then began gradually to fade. Within fifteen minutes, however, the sun had risen high enough to bring the fourth secondary sun to view, but by this time the rainbow lines with it were very indistinct. By ten o'clock the whole spectacle had faded away."

JOHN C. BRANNER.

Little Rock, Ark., March 10.

Lake and River Temperatures.

A SERIES of temperatures of the water taken during last summer near the outlet of Lake Ontario and in the St. Lawrence and other rivers by the writer, and during the last and previous seasons in the Georgian Bay by Staff Commander Boulton, R.N., appears to establish some interesting results, which will be detailed in the forthcoming number of the *Canadian Record of Science*. While some of the results are not novel, they all exemplify some characteristics of fresh water in the great masses in which it occurs in the Great Lakes and the St. Lawrence and its tributaries, under the varying conditions of climate which the geographical position of these lakes and rivers presents. The points of interest are,—

That the Georgian Bay, as well as Lake Superior, forms a great area of cold water,—apparently considerably colder at the bottom than even the deeper parts of the central basin of Lake Huron, and varying in July and August between 37.75° and 39.5° F.

That the occurrence in midsummer of a temperature at the bottom of the Georgian Bay, below that of water at its maximum density, is remarkable, and may be due to strong bottom currents.

That the waters of the lakes and St. Lawrence flow onward in areas of different temperatures; the variation being generally from 1° to 3°, and being equally observable under as well as at the surface.

That the general rise in the temperature of the Lake Ontario waters, as the summer advances, is at first slow, compared with the general rise in the temperature of the air; but, as midsummer is reached, the rise is more rapid.

That motion in water, as in a long rapid, appears to at least sensibly raise its temperature. Continuous strong currents, on

the other hand, tend to equalize the temperature even to a depth of forty fathoms.

That the temperature of the water of the main channel of the St. Lawrence is always considerably lower than that of the waters nearer shore, or of the harbors or the affluent streams.

That no general rule can be laid down regarding the changes of temperature with the increase of depth, each case being influenced by its own special circumstances.

That in high summer temperatures the surface of comparatively still, shallow, sheltered water, unaffected by main channel currents, absorbs and retains heat to a much greater degree than the immediately overlying air; the difference depending on the surroundings, but being in one instance as high as 11°.

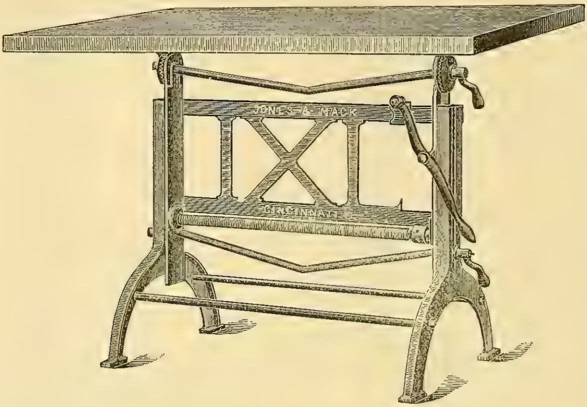
A. T. DRUMMOND.

Montreal, Can., March 12.

INDUSTRIAL NOTES.

A New Drawing-Table.

THE principal features of the improved drawing-table shown in the illustration are that the drawing-board may be raised or lowered with one motion of the hand, and that the board can be tilted to any desirable angle. The vertical sliding pieces attached to the under side of the board have racks engaging with wheels on the ends of the horizontal shaft, shown at the bottom of the sliding frame. A spiral spring is wound around this shaft for the purpose of balancing the weight of the parts to be raised, and insuring the board against falling if left at any elevation without clamping. The board is raised or lowered by means of the lever attached to the sliding frame which works on a fulcrum fastened to the stand. The clamping arrangement consists of a bent tube, its ends bearing against the inner sides of the sliding pieces. A bolt is passed through



this tube, and, in clamping, it tends to straighten the tube, thereby forcing the ends of the tube against the inner faces of the sliding pieces, and holding these pieces firmly at any height. The advantage of this clamping device is that it does not tend to draw the stands together. The arrangement for tilting is easily seen, and the device for clamping is the same as the one just described.

The stand is very light, and at the same time extremely rigid and firm, and, with the clamping-screws tightened, there is no liability to slip, even if the draughtsman rests his entire weight on the edge of the board. These drawing-tables are manufactured by Messrs. Jones & Mack of Cincinnati, O.

CALENDAR OF SOCIETIES.

Women's Anthropological Society of America, Washington, D.C.

March 1. — Mrs. Anita Newcomb McGee, A Study of Group Life.

Philosophical Society, Washington.

March 15. — G. E. Curtis, The Relation of Surface and Climatic Conditions to the Flow of Water Courses; B. E. Fernow, The Relation of Forests to Water-Supplies.

Connecticut Academy of Arts and Sciences, New Haven.

March 19. — Arthur W. Wright, Hertz's Experiments on Electrical Oscillations and the Theory of Light.

Boston Society of Natural History.

March 19. — H. V. Wilson, On the Formation of the Alimentary Canal and the Lateral Line in Teleosts; J. H. Emerton, The Spinning Work of Spiders (with exhibition of photographs by Horace P. Chandler).

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

To correspond with colleges, seminaries and other schools where cabinets of fossils and minerals are being collected. I have an extensive private collection of fossils from every geological period, and minerals illustrating the common and many of the rare forms. This collection is in duplicate, and the duplicates are for exchange or sale. Every thing is scientifically classified. W. A. Bronnell, professor of geology, 905 University Ave., Syracuse, N.Y.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

I wish to exchange or purchase well-fixed or hardened vertebrate embryos for sectioning. Desire specially reptilian embryos, but will be glad to secure any material that I do not possess. Thomas G. Lee, M.D., Histological Laboratory, Yale University, New Haven, Conn.

Wanted—Books and journals, American or foreign, relating to Photography—exchange or purchase. C. W. Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmola patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes, etc., wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886,) for scientific books — those published in the *International Scientific Series* preferred. — James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A WILLIAMS SENIOR who has had two and one-half years' work in chemical laboratory, and one year in a biological laboratory, desires position as teacher of natural science and lesser mathematics, desires a position as instructor in these branches, or as assistant to some chemist. References as to ability and character. E. E. Towne, Box 74, Williamstown, Mass.

A REGULARLY graduated physician in his 32d year, who has been in active practice for eight years, excepting the time he was interne in a hospital and taking a post-graduate course, and who has done considerable work both in literature and science, more particularly connected with medicine, being now engaged in editorial writing for one of the first-class medical monthlies, wishes to learn of a town, not particular as to the size or location, where, in addition to practising his profession, he may become connected with a school or other institution as teacher of elementary and advanced physiology, chemistry, and hygiene, one or all; or would accept position with an older physician who is engaged in literary or scienific work, as an assistant, either in his practice, or as amanuensis or secretary, or in any capacity requiring knowledge of medicine and cognate branches; or would accept a position as librarian, having had experience as acting librarian while at college. Can furnish unexceptionable references as to ability and character, and, if the position offers opportunities for advancement, will accept for a time a nominal salary. Is married, but has no family beside his wife. Address Dr. W., care of *Science*.

WANTED. A Harvard Senior who has made a specialty of chemistry, and has had some experience in teaching and in analysis, would like to secure an appointment for the fall. Best of references given. Address, J., Harvard College, Cambridge, Mass.

CHEMIST (30) wants situation at once; Ph.D., and for three years Demonstrator of Chemistry, Leipzig University. Practical experience in technical branch of the subject. X., 13, Worcester Place, Oxford.

A YOUNG MAN aged nineteen, who is a graduate of the Exeter High School, wants a situation with some Manufacturing Chemist or in Laboratory of some Analytical or Private Chemist; must be chance where he can have access to books in evening. Is willing to work; has good knowledge of General Chemistry. Sam. L. Hills, South Lee, N.H.

A SUBSCRIBER of SCIENCE would be grateful for any information on the following points: 1. As to the kind of wax used in the preparation of embryological and anatomical models; 2. How it can be made and manipulated; 3. References to any literature on the subject. Wm. Patten, Grand Forks, North Dakota.

WANTED—Books upon American Archæology. My publication, "Fort Ancient," in exchange. First-class standard works only. Warren K. Moorehead, Smithsonian Institution, Washington, D. C.

WANTED—Hall's works on Palæontology, and other works giving plates which show fossils of the Niagara Epoch. Address M. D. Sullivan, St. Ignatius College, Chicago, Ill.

A YOUNG MAN desires, about the 1st of July, a position as laboratory assistant, or as instructor in chemistry, physics, and lesser mathematics. References as to ability and character. 44 P.M.A. Address R. L. Porter, Penn. Mil. Acad., Chester, Pa.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 373.

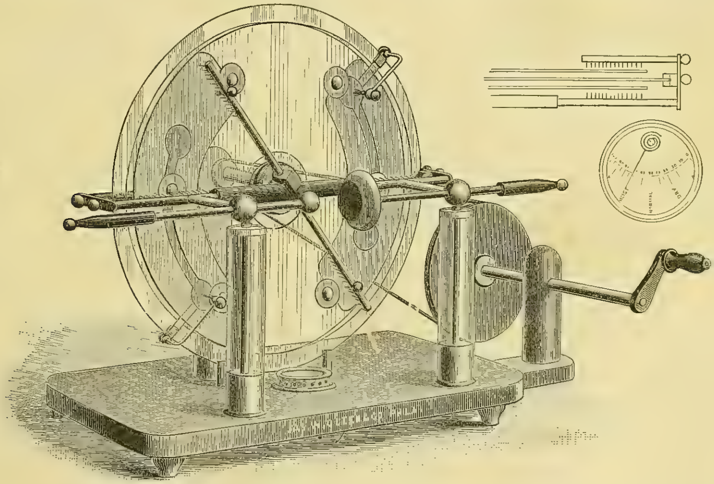
NEW YORK, MARCH 28, 1890.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

QUEEN'S NEW TRIPLE-PLATE TOEPLER-HOLTZ MACHINE.

ON this page we print a cut showing some of the details of the new Toepler-Holtz machine, which has just been patented by James W. Queen & Co., the well-known manufacturers of philosophical apparatus and electrical test instruments. This machine, unlike very many that have appeared from time to time, is not simply a modification of the orthodox model, embodying certain conveniences, but is an entirely new thing, owing its efficiency to entirely novel ideas of construction and action.

This machine, as its name indicates, is a three-plate machine; it is not, however, the same thing as the machine usually spoken of as the "double revolving plate machine," although it does have two revolving plates. The latter machine is simply an ordinary Toepler-Holtz machine doubled; i.e., with a revolving plate behind the fixed plate, exactly like the one in front, and acting in exactly the same manner. In this new form, the additional plate is not like the front revolving plate, nor does it act in at all the same way. The third and additional plate is here a perfectly plain glass plate, mounted upon the same axis as the usual revolving plate, and placed behind the fixed plate. Its *modus operandi* is, like many other points in the theory of the Holtz machines, not entirely understood, although there is no doubt but that much of the increased efficiency obtained by its use is due to the screening effects it has upon the other plates; i.e., to the leakage that is prevented by its presence. There is also supposed to be a considerable generation of electricity by friction of the plain plate and the air. Undoubtedly many other causes also tend to increased effects, of possibly even greater importance than those just mentioned. The advantage of this new form of machine becomes especially marked during moist weather. At such times ordinary frictional machines will not work at all; and all older text-books direct that electrical experiments must be performed during January and February, when the weather is clear and dry. With the Toepler-Holtz machine, as now known, this requirement has not been so rigid, although such machines are not to be always trusted during damp seasons, as lecturers have found out to their sorrow. This difficulty it has been desired to do away with in this new form, and that it does it very effectually will be evident from the following letter sent to Queen & Co. by Professor William A. Anthony, the well-known electrician, and late professor of physics at Cornell University. Says he, "Below is a report of the small Holtz machines you sent up a few days ago. First, in order to determine whether the extra plate gave any increased effect to the machine, I set up both machines, and arranged them so that they both could be revolved by means of one crank, and so that they would both run at the same speed, and then adjusted the terminals until the sparks occurred with about the same frequency in both. Then I removed the combs from one of them, so that the third plate would have no effect in the development of electricity, and found that the frequency of sparks on that machine was very much less than on the other. I repeated this several times, with the same result, and tried the same experiment on the other machine; that is, leaving the combs on the first machine, I removed them from the second, when that one was found to give considerably less electricity than the first. I can say unhesitatingly, therefore, that the addition of the third plate does



NEW TRIPLE-PLATE TOEPLER-HOLTZ MACHINE.

very much increase the rate of discharge, and, as nearly as I could tell by this rough experiment, about double the rate.

"In regard to the general action of the machine, I can say that I have never seen any machines of the Holtz or Toepler-Holtz pattern that worked so uniformly well in all weathers. One of these machines has been standing on the table here in the office for several days, and I have tried it almost every day, and have never had it fail to generate. During some of the time it has been here, the weather has been very damp and rainy, — sometimes so damp that I did not expect the machine to work at all, — but I have never found it fail to build up quickly, and give a spark two inches long. [This was one of the smallest-sized machines.] This shows that you have succeeded in finding some very good glass, and also that the insulation of the various parts is of the very best. The addition of the round disk, with the insulator in front of it, as one of the electrodes, is also a very interesting one, as it permits of one of the best experiments that I have ever seen for showing the difference in the discharge when the polarity is reversed. The difference in the character of the discharge from the knob is very marked when the knob changes from positive to negative. I may say, therefore, that I consider all the special features of the machine as distinct and important improvements."

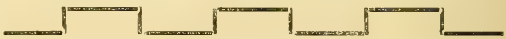
Another great improvement that is made in this machine is the form of the electrode which is used. This is made of a metallic disk two inches or more in diameter, and hollow, so as to have very gradually rounded edges, thus preventing any leakage at the edges. Over this disk, separated from it by about an eighth of an inch, and nearer the other electrode, is fastened a thin disk of vulcanized rubber about half an inch less in diameter. This rubber disk plays the part of the rubber sheet sometimes held between the electrodes, and compels a much higher potential to be established between the two electrodes before a spark can pass. It can be used upon either one or both electrodes, as desired.

These new machines are being sold by Messrs. Queen & Co. at the same price as the ordinary form heretofore used, and are gotten up in the finest possible manner. It may be mentioned, also, that the plates used in Messrs. Queen & Co.'s machines are manufactured and prepared by Voss himself, the inventor of what is usually known as the Toepler Holtz machine, and are guaranteed to give much finer and more reliable results than any plates made in the American market. There are certain little tricks of the manufacture and application of the insulating shellac which Americans have not yet mastered, pursued by the Germans to perfection, and which add greatly to the efficiency of the machine.

It may not be generally known that Messrs. Queen & Co. were the first to introduce the Toepler-Holtz machine into this country. In 1880 the manager of their physical department, Joseph J. Walton, while on a business trip abroad, accidentally learned of the existence of this machine, examined it, and was so favorably impressed by it that he purchased a number for introduction into this country. This was the first appearance of the now well-known Toepler-Holtz machine in the United States. It was exhibited soon afterwards by the before-mentioned gentleman at the meeting of the American Association for the Advancement of Science, and attracted much attention. It immediately became popular, and had such a large sale that it was straightway copied by various American makers, and patents secured upon modified forms.

WYNNE'S ELECTRIC TRAMWAY SYSTEM.

The system of electric tramways invented by Mr. Frank Wynne of 5 Westminster Chambers, London, aims at connecting a moving tramcar with an electric conductor buried beneath the roadway, without the use of an open slot. To effect this there is laid in the centre of the track a crenellated contact-plate or rail, in short sections, of the form shown in the annexed engraving. It is half an inch wide on the surface, and about four inches and a half deep, the form being such as to follow the junction line of the sets. It will be seen that the contact-plate will be quite different in its effect upon vehicles from the tramway rail; wheels will cross it without difficulty at any angle, since they cannot slide along it for more than a few inches; horses will also find a good foothold upon it. The plate is laid in short sections entirely disconnected from each other, and each piece is coupled by a wire to the electric conductor beneath. In this wire is an automatic switch which makes circuit between the section and the conductor as the car comes over it, and breaks the connection when the car has passed. Only three sections are ever connected to the conductor at a time, and generally there are only two. A strong wire brush on the car rubs along the sections, and conveys the current from them to the electric motor, whence it flows to the rails and to earth. The automatic switch is exceedingly simple: it consists merely of an electro-magnet, an armature, and two contact-pieces. Supposing the car-brush is in contact with No. 1 section, the current will flow from the main conductor across one contact to the armature, through the armature to a second contact, thence through the magnet-coils to the section and the motor. A fine wire connects the armature



to the magnet of the next section, but, as no current flows through it, the armature of that magnet is not attracted. But immediately the car-brush touches that section, the current flows, the armature is attracted, and the section is connected directly to the main conductor. At the same time, the armature of the section over which the car has just passed drops, and breaks the circuit. Thus, as the car proceeds, it successively takes sections into circuit and drops them out. The details of the system have been very carefully worked out with the view of meeting every contingency that may arise in working, and it is estimated that the system can be applied to an existing tramway for an expenditure of $11,000 per mile of single line; that is, for about the cost of horses and horse-cars. *Engineering* says, "This seems one of the most promising schemes for electric tramways which has been yet brought out in this country [England], and it is well worth a trial. The astonishing success of electric trams in America will be repeated here as soon as a system has been developed suited to English tastes and ideas."

WATER-SPOUTS.[1]

Having sailed from New York the 16th of October in the United States steamship "Pensacola," we had first a few days of westerly winds and moderate sea, and then fell upon a region of easterly winds, generally south-easterly, and with every indication that we were in the easterly portion of a cyclonic region, the storm-centre being three hundred to five hundred miles to the westward. From such observations as we were able to make on shipboard, it was concluded that the storm-centre, which on the 20th of October was south-westerly, was slowly moving to the north-eastward, and would overtake us and pass beyond. This it apparently did, and disappeared from our observation on Friday the 25th. Meanwhile we experienced warm south-easterly winds, with numerous showers of rain and occasional squalls of wind.

On the morning of Tuesday the 22d we were favored with a remarkably fine development of water-spouts. About 9 A.M., occasional whirls of spray were seen on the surface of the sea, at points bearing between south-south-west and west-south-west. These whirls, and the subsequent water-spouts in that region, were all on the north-easterly side of a region of cloud and rain, the interior of which constituted a veritable rain-squall. The north-easterly side of this region, as seen from the vessel looking south-westward, was bordered by rolls of low scud upon which the sun shone; but beyond and below this the clouds, being mostly in the shade, had the dark-blue tint that belongs to the rain-cloud and the rain. The water-spouts apparently originated in the scud-clouds, which, as I have just said, formed the north-easterly border of the squall proper. These scud-clouds were

[1] From Bulletin No. 6, by Cleveland Abbe (Nov. 7, 1889), of the United States Scientific Expedition to West Africa, 1889 (David P. Todd, director).

moving towards the north-west, and therefore nearly perpendicularly to our line of sight. By 10 A.M. the conditions for the formation of the water-spouts, namely, the long axis extending down from the clouds, had become very favorable; so that from 9.30 until 10.15 there was a continued succession of such spouts, forming and disappearing in this portion of the horizon. At one time as many as five and seven were visible simultaneously; and the total number that formed and disappeared was estimated at about thirty by some, but at about twenty by myself. The first ones formed were at a distance from us estimated at about four miles; the last ones, at a distance of two or three miles. As the squall grew in dimensions and approached us, it was hoped that spouts would be formed much nearer; and in fact one was observed endeavoring to form in a mass of rain, at a distance of scarcely a quarter of a mile on our starboard bow. A number of drawings of these phenomena were made, and some photographs were taken. The latter, however, are not considered very successful, owing to the insufficient contrast. Among the features noted in these water-spouts, which will, I think, deserve to be ranked as general phenomena for all such spouts, are the following:—

1. The whirling motion of all the spouts took place in the same direction, so far as could be judged, and was that ordinarily called "counter clock-wise."

2. The general motion of the water-spouts as a whole was from left to right, or from the south-east toward the north-west, and therefore counter clock-wise, considered as a partial rotation round the centre of the rain-squall.

3. As this rain-squall was essentially a part of the formation of a cumulus-cloud out of a mass of what would otherwise have been called low scud, and as no water-spouts, or any tendency to the formation of such, were seen on the other side of the cloud after it had overtaken us, as it did at 10.30, I conclude that the formation of the water-spout requires a special upward ascending current due to a special buoyancy in one portion of the cloud; and, other circumstances being the same, such buoyancy must generally be found, as in this case, on the sunny side of the cloud, and is due largely to the action of the sun's heat on the surface of the cloud, combined of course with the buoyancy of the ascending cloud masses. As regards the individual tornadoes or water-spouts, it is very evident that a less rapid whirl was required to form the little saucer-shaped mass of spray at the ocean's surface than was required to form the axial cloud that reached down from above. There were, I think, more cases in which the spray appeared first, before the cloudy axis was visible, than the reverse cases; but there was nothing to show that the ascending movement started at the ocean's surface, and carried the sea-water upward into the cloud. On the contrary, all the details of the phenomena showed that the spray carried up from the surface of the sea attained only a height of perhaps a hundred feet, and was then thrown out, and descended from the rim of the saucer. In some cases the axial cloud apparently descended into, and was lost sight of in, the lower spray, but its appearance was such that it was always possible to distinguish it from the spray. The axial cloud invariably began its formation at the lower surface of the general cloud, and stretched downward by spasmodic efforts, gradually increasing its length until it perhaps reached the spray, and then began retreating, forming and re-forming several times, until finally either a permanently steady, tubular cloud was formed, which would continue in sight, bending and swirling about for several minutes, or, as in many cases, after several efforts the whirl broke up, and no permanent tube was formed. When the cloud was about to shoot down to a considerably lower level than it had hitherto attained, the shooting was generally preceded by the appearance of an exceedingly fine axial line; and when the tubular cloud shot down, as seen by the distant observer, I should say that this apparent descent was merely the sudden expansion to a visible diameter of the fine line that had just preceded it. The appearance of this fine line was very similar to that of the sting of a bee protruding from its sheath; and frequently I saw this line shoot down and disappear a number of times before the rapid whirl was finally able to produce an axial cloud of permanent size. In many cases the axial cloud itself showed a fine line down its centre, the cloud itself being whitish; while the central line was either dark or bright, depending upon the background against which it was seen. This agrees perfectly with the accepted theory of the formation of the spouts, according to which the long narrow cloud is not a solid mass of cloudy material, but rather a hollow cylinder; so that when one looks through it the central portion is much more transparent than the edges.

At numerous points, from the general cloud under which the water-spouts were formed, there were descending showers of rain; and scud, from which rain descended, afterwards formed between us and the tornadoes, and finally again off the port side of the vessel; so that by 10.20 we were enveloped in a heavy rain, with the wind from the south-east or starboard side. This continued ten or fifteen minutes, after which it slackened up. In hopes that we might get near enough to the whirl that surrounds the spout, and experience an appreciable depression of the barometer, I carried an aneroid in my hand; but in no case was I able to see that it was affected by any or all of the spouts. The barometer at 9 A.M. had read 30.12; at 9.35 it read 30.08; at 10.20, after the rain-squall had struck us, the pressure rose to 30.20, and at 1 P.M. had sunk again to 30.18. These fluctuations are those that attend ordinary rain-squalls, and have, I suppose, no connection with the water-spouts as such. It was not to be expected that the barometer would fall except within the whirling wind, and possibly within a hundred feet of the axes of the water-spouts.

It has frequently been supposed that the discharge of a cannon will break up a water-spout. On the present occasion, it so happened that a six-pounder was ordered to be discharged in order to clean it out; and this took place in the midst of the display of water-spouts, which were then three or four miles distant. The discharge of the cannon was followed within a few seconds by the breaking-up of one of the spouts; but others remained, and several others were formed a few minutes afterward, so that the breaking-up of the one can only be considered an accidental coincidence; nor is there to my mind any conceivable reason why the discharge of a cannon, at a long distance from a spout, or even the firing of a cannon-ball through the spout, should be considered likely to have any appreciable influence on the great mass of revolving air.

The general discussion of the mechanism of a water-spout has been so well given by Ferrel in his newest work, "A Popular Treatise on the Winds" (New York, 1889), that I need only say that every thing observed by us on the 22d of October fully confirmed the views therein set forth by him.

On the next day, the 23d, about 8.30 A.M., the clouds looked favorable for a repetition of the water-spout phenomena, and beautiful mammiform clouds were indeed seen developing into the axial clouds of water-spouts. One of these lasted over twenty minutes, but did not reach any considerable distance down toward the sea; nor was any whirl of ocean spray to be seen beneath it.

Of all the spouts seen on the 22d, the largest appeared to have a horizontal diameter of about one-tenth its vertical height. This one also lasted the longest, and, after breaking up, was apparently followed by rain to a greater extent than in the other spouts. The narrowest of these spouts had an apparent diameter of about one hundredth part of its height. The general height of the tops of the spouts was pretty uniform, like that of the scud to which they belonged, and was, I should estimate, about twelve hundred feet.

AMENDED ORTHOGRAPHY.[1]

THE alphabetic representation of language has long occupied much of my attention, although my efforts hitherto have been directed to means of facilitating the use of orthography as it is, and not to the advocacy of any changes in spelling. The funda-

[1] From a letter addressed to the House Committee on Printing and to members of Congress and of the Senate, by Alexander Melville Bell, on the scheme of amended orthography recommended by the commission of the Legislature of Pennsylvania.

mental principle of alphabetic writing — namely, a separate letter for every sound, and a single sound for every letter — has been so widely departed from in English orthography that spelling-reformers have not dared to advocate the application of the principle in its perfect and beautiful simplicity, but have contented themselves with attempts to remove the most obvious anomalies in practice.

I should prefer to add at once the necessary radical improvement of new letters for unrepresented sounds; but comparatively few persons seem yet prepared to carry reform to this extent, and therefore the application of a completely phonetic orthography must at present be confined to the initiation of children and of foreign learners of our language. A simplification of general spelling is, however, very desirable, and it is easily practicable by the means recommended by the commission of the Pennsylvania Legislature; namely, by adoption, in the public printing of the United States, of the Joint Rules for Amended Spelling, which have been approved by the Philological Society of London and the American Philological Association.

With your permission, I shall state briefly some of the chief recommendations of the simplified spelling proposed in these rules.

First, Economy of time. About one-half of the time now spent in learning to read will be saved by simplified spelling. Phonetic initiatory systems have been largely tested during a number of years, and the result has uniformly been a saving of not less than fifty per cent in the time required to make good readers.

Second, Economy in printing. In the report of the Pennsylvania commission, made in April, 1889, the saving in expenditure for paper and printing, from the use of simplified spelling, is calculated at seventeen per cent. I have tested this computation by comparing the number of letters in some pages of ''World-English'' and of ordinary typography: and I find a difference in favor of the phonetic letters of one in seven, or a little over fourteen per cent in the number of types. Adding the values of labor and paper, this calculation will amount to very nearly the same as that in the report. This economy cannot be considered unimportant, when we reflect that we now waste nearly one column in six in our newspapers, one page in six in our magazines, and one volume in six in all our works of literature. In hand-writing and type-writing, also, for every six letters that we really require, we have the trouble of writing at least seven.

Third, Rationality in teaching. The want of correspondence between letters and sounds stultifies children, and hinders the development of the reasoning faculty in education. We might as well allow a fluctuating value to the numerals 1, 2, 3, etc., as to the alphabetic letters. If *e*+*a* may sometimes sound *ē* (read), sometimes *ā* (great), sometimes *ĕ* (head), and sometimes *ah* (heart), why may not 1+2 be sometimes equal to 1, sometimes to 2, sometimes to 3, and other times to 6? The mental confusion in the learner would not be greater in the one case than in the other; and the latter case is not merely supposititious, but, unfortunately, real and existent. In phonetic spelling the learner pleasedly recognizes the truth of relationship between letters and sounds, whereas in common orthography he is painfully aware of the falseness of the pretended relation. He is thus taught a life-lasting lesson of truth or of falsehood in the very beginning of education.

Fourth, Simplicity and practicability. The scheme proposed has the sufficient recommendation of approval by the English and American Philological Societies. As an instalment of spelling-reform, it is entirely unobjectionable, and it will undoubtedly effect a large part of the advantages of a more phonetic system. Every change consists in reduction of the number of letters used in spelling: consequently the plan is altogether a simplification of the method of representation. We who can use the old cumbrous orthography have nothing to learn in connection with the new scheme: we have only to dispense with superfluities.

Fifth, Ultimate perfectibility. A scientific scheme would necessarily include new letters for unrepresented sounds. The introduction of these is not contemplated in the present movement, but is left to the action of those who will, under phonetic training, be more and more free from existing ''orthographic'' prejudices. The scheme indorsed by the philological societies will facilitate the removal, in time, of all remaining anomalies; while it will not create difficulties to stand in the way of future improvements. What we do now within the prescribed limits, will not require to be undone at any time hereafter.

Sixth, Justice to the young. Children are condemned to a positive wrong when they are unnecessarily subjected to a long and severe task in order simply to acquire the use of the instrument of learning. The helplessness of the victims of this wrong should be one chief recommendation of such a measure of redress as that which is now proposed. The time saved in learning to read will be so much added to that for acquisition of knowledge. Teachers and learners will be alike benefited and elevated by the elimination of so much of mere drudgery, and the addition of so much valuable opportunity for profitable study. Brighter and more intelligent pupils will rise to higher standards in the common schools, and every department of education will participate in the advantages begun with learners of the A B C.

Such considerations as are here briefly presented should not require the addition of a single word to induce all but those predetermined against any change to favor the adoption in the public printing of the nation of the proposed scheme of amended orthography.

A short time would suffice to test the influence of this example on general practice. The conductors of the periodical press will not be slow to adopt the changes if these shall be widely approved by the public. At the same time, adoption or rejection will be equally voluntary. The old orthography will remain as legible as it is now; and the vast capital invested in permanent literature will lose none of its present value.

I have spoken of this plan of amended spelling as only an instalment of what is due to our language. To attempt more as a beginning, might be impolitic; to do less would be worthless.

The substance of the rules embraced in the recommendation before you might be expressed in a single sentence; namely, omit all silent and phonetically dispensable letters. This principle would cover every change included in the twenty-four rules.

I cannot refrain from adding that observance of these rules ought to have prevented such a manifest inconsistency as is exhibited by the Spelling-Reform League in dropping *u* from the combination *ou* in *favour*, *harbour*, *valour*; and dropping *o* from the same combination, with the very same sound, in *nourish*, *journey*, *double*. Every change should be a step in a strictly phonetic direction, or it had better not be made. The rule in the ''Report of the Pennsylvania Commission'' (p. 36, No. 7) is phonetically right: the League's concomitant to it (p. 37, No. 1) is phonetically wrong. The limits prescribed by the rules must be observed with exactness, or the latter can no longer be called the rules indorsed by the philological societies. This action of the Spellig-Reform League seems to show the same principle at work which has frustrated all previous attempts at amended orthography: namely, prejudice in favor of what is already in use. In a question between the right and the wrong use of letters, such a consideration should have no place.

This is not a subject respecting which enthusiastic advocacy or passionate discussion can be roused. Those who are called to act will be themselves unaffected by the result, for we have passed the stage when the right use of letters was a trouble to us. May we never reach the stage when the difficulties of beginners shall cease to excite our sympathy and inspire our efforts!

The one impediment to the changes which we seek to accomplish — and which reason, right feeling, and policy demand — is simply that of prejudice. We are accustomed to the pres-

ent aspect of words: they serve our purpose very well as they are, and we are inclined to deprecate any alteration, lest it might give a foreign or a mutilated look to what is now familiar and symmetrical to our eye. We should not think of ourselves at all in this matter, but think only of the helpless juvenile throng who crowd into the places which we vacated years and years ago. Simplify spelling for the sake of the little ones who must suffer from our neglect.

One other point calls for notice; namely, the moderate character of the present proposal. The full amount of change that can result from this measure of simplified spelling is but a small part of what is necessary to make the writing of our language phonetic. We shall still have to use double letters for single sounds in a large proportion of both vowels and consonants, and to tolerate many irregularities in such compounds. In fact, the utility of a purely phonetic initiatory method, such as that of "World-English," will be still almost as marked as it is now.

Why, then, advocate this measure? Because it is a step in the right direction, and step by step is the best mode of making progress. There is more to be done than can be effected by one impulse, and improvements once commenced will be carried farther and farther by succeeding generations. Our language is apparently destined to spread over the world. It is worthy of the most perfect vehicle of communication that skill can devise. If we cannot complete the work, we can at least help it on, and leave it one stage more advanced than we found it.

Something must be done. Our spelling is a disgrace. Responsibility for its lawless condition attaches nowhere in particular, but rests everywhere. The burden of this responsibility should be laid on some accountable official empowered to consider and inaugurate improvements. In the absence of any such delegated authority, the direct action of the representatives of the people is invoked, not to impose changes on the unwilling or the indifferent, but only to exemplify, and by example to invite adoption of the method of improvement recommended by competent advisers.

Private efforts have already been most liberally devoted to the work of amending orthography; but no private efforts can be made on the scale, or with the influence, of a measure emanating from Congress. Besides, this work is peculiarly of public and not of private benefit. It must be done by you, or else it must remain unaccomplished.

HEALTH MATTERS.

The Bacteriology of Whooping-Cough.

AT the third general meeting of Russian medical men at St. Petersburg, Professor Afanasïeff read an able and exhaustive bacteriological essay on the subject of pertussis. At the suggestion of Professor Afanasïeff, who was anxious to verify his results, Dr. Semtchenko took up the line to further investigate the matter, especially in clinical regards. The conclusions arrived at by the Kazan pædiatrist, says the *London Medical Recorder*, may be given thus: 1. Afanasïeff's bacterium is actually specific, and hence fully entitled to bear the name of the *bacillus tussis convulsivæ*; 2. The micro-organism makes its appearance in the sputum during the catarrhal stage, somewhere about the fourth day of the disease, but possibly still earlier; 3. Subsequently its numerical strength increases, the intensity of paroxysms keeping pace with the increase; 4. The microbes disappear from the discharge, apparently somewhat before a complete cessation of whoops (about the time when the number of paroxysms sinks down to four or two per day); 5. As soon as pertussis becomes complicated with catarrhal pneumonia, the bacilli in the patient's sputa show an enormous increase in number; 6. Altogether, the pertussis pneumonia seems to be quite different from other varieties of pulmonary imflammation; 7. The *bacillus tussis convulsivæ* presents a great importance not only in etiological and diagnostic, but also in prognostic regards; 8. As to the behavior of the microbe toward antiseptic agents, its vitality is destroyed as soon as the medium (jelly) contains corrosive sublimate in the proportion of 1 to 60,000, or resorcin in that of 1 to 1,200, or phenol in the same one, or hydrochlorate of quinine in that of 1 to 800. Drs. Afanasïeff's and Semtchenko's researches were repeated (at least partially) by Professor Tschamer (*Wiener med. Wochensch.*, No. 17, 1888) and Dr. E. C. Wendt of New York (*Medical News*, June 2, 1888). On the whole, both of the authors confirmed the statements made by the Russian observers. Dr. Wendt, however, differs from Dr. Semtchenko in some more or less subordinate points. Thus, he could not detect the presence of the bacilli in earlier stages of the affection; neither was he able to notice any co-relation between the number of paroxysms and that of the bacteria in the patient's sputa; while, on the other hand, he found still the bacilli in the discharge, even after a complete disappearance of whoops. In conclusion, Professor Afanasïeff draws attention to the several points which demand further elaborate investigations. It is necessary, he says, (1) to more closely examine the distribution of the microbes in the respiratory mucous membrane, as well as in broncho-pneumonic foci; (2) to study the behavior of the bacterium toward various coloring-matters (in order to discover a characteristic differential test for the bacillus); (3) to study the spore-formation (which is important, especially in prophylactic regards); (4) to most carefully inquire into a clinical bacteriology of the pertussis sputa from the beginning to the end of the attack, and even during convalescence (which is important for diagnostic, prognostic, and prophylactic purposes); and (5) to further study the behavior of the bacillus toward all possible parasiticide agents (to possibly discover some specific bactericidal substances, which discovery would prove of untold value in regard to the therapeutics of the infantile scourge in question).

Sea-Water and the Nutrition of Marine Animals.

Drs. Pouchet and Chabry have recently conducted some experiments of great biological interest. They have reared larval germs of sea-urchins in artificial sea-water and in sea-water deprived of all or more or less of its lime, in order to observe the influence of the composition of the water on the development of the larvæ. Normally a distinct skeleton should develop. According to the *British Medical Journal*, it was found, that, when the larvæ were reared in sea-water deprived of about nine-tenths of its lime, not even a rudimentary skeleton was developed. A very trifling diminution in the normal amount of lime, effected by careful precipitation by chemical re-agents, was found sufficient to interfere markedly with the growth of the skeleton in the larvæ: hence the medium in which some marine germs of life exist would appear to act as a nutritive agent as well as an atmosphere whence oxygen may be obtained for respiration. The influence of the chemical composition of the water in different seas probably determines many differences in the anatomy of marine animals, but Drs. Pouchet and Chabry admit that this question requires much consideration. How far the embryo in the higher terrestrial forms of life may receive nutrition direct from substances in solution in the *liquor amnii*, as well as through the placental circulation, is another question worth solving.

NOTES AND NEWS.

PROFESSOR C. S. PLUMB of Knoxville, Tenn., has accepted the position of vice-director of the Agricultural Experiment Station of Purdue University, Lafayette, Ind., and after the 1st of April next his address will be at the latter place.

— At a recent meeting of the Paris Geographical Society, as we learn from *Nature*, an interesting lecture was delivered by Dr. Hamy on the history of scientific missions in France under the old monarchy. He commenced practically with the reign of Francis I., and described many missions abroad, with purely scientific aims, which are now either forgotten, or the results of which have never been published. Thus, the apothecary to Henri IV. went all over the globe in search of the peculiar products of each country, especially medicinal and food plants; still earlier,

another explorer went to Brazil to study dyeing woods; and, in the last century, Condamine, Dombey, Bougainville, and La Pérouse went on their well-known expeditions. The president, Comte de Bisemont, mentioned that there were still in the archives of the Ministry of Marine copies of the instructions given to travellers and navigators in past centuries, and that these were "positively models of their kind, which could not be followed too closely now." Professor Bureau, of the Museum of Natural History in Paris, observed that a botanical collection made by Paul Lucas in the reign of Louis XIV. still existed in the museum; and he referred especially to Tournefort, of the same period, whom he described as the scientific traveller of former times who perhaps most nearly approached moderns in his methods of observation. He was sent by the king on a botanical expedition to the Levant, with very precise instructions, among others, to collect and observe the plants mentioned by the ancients. He did not confine himself to this, but formed a complete herbarium, which is still preserved at the museum, and is one of its treasures. He was accompanied by an artist named Aubriet, who brought back a large collection of colored sketches, which forms an important part of the unrivalled collection in the library of the museum.

— The fifteenth session of the Sauveur College of Languages will be held at the University of Vermont, Burlington, Vt., commencing at 8 A.M. on Wednesday, July 9, and continuing six weeks. The situation of Burlington on a hill which slopes down to Lake Champlain, and the frequent fresh breezes, make the climate in summer cool and healthful. It is a place of great natural beauty, and the University of Vermont commands a most beautiful view. Mansfield and Camel's Hump of the Green Mountains, the noble range of the Adirondacks, and the lake with its islands, form a picture which will delight all. The university is a new and handsome building. It contains collections in various departments of knowledge, and a valuable library. The instruction of the college will include, for the adults, French, German, Italian, Spanish, modern Greek, and Romance languages; Latin and ancient Greek; comparative grammar of the English language and the formation of modern English; English literature and rhetoric. There will be each day, for the adults, seven hours of French, seven of German, three of Latin, three of Greek, three of Italian, two of Spanish, one hour each of English literature and rhetoric, comparative grammar of the English language, and the formation of modern English; for the children, two hours of French and two hours of German. The classes will meet every day except Saturday, and the lessons will be given from 9 A.M. to 1 P.M., and from 4 P.M. to 5 P.M. Saturdays will be devoted to recreation. Excursions will be arranged for, at moderate rates, to Ausable Chasm, Mount Mansfield and Camel's Hump, Lake George, Montreal, and other places of interest. Those who purpose attending the College of Languages, or who know but little of this summer school, are recommended to send for a copy of the programme, which may be had at the bookstores of F. W. Christern, New York: Carl Schoenhof, Boston, Mass.; John Wanamaker, Philadelphia, Penn.; Robert Clarke & Co., Cincinnati, O.; and will be sent to applicants by Dr. A. N. van Daell, 28 Atherton Street, Roxbury, Mass.; Dr. William Bernhardt, City High School, Washington, D.C.; Dr. James H. Dillard, Mary Institute, Washington University, St. Louis, Mo.; or Dr. L. Sauveur, Copley Terrace, Roxbury, Mass.

— The stay of some 306 natives from various French colonies, etc., for about six months, in Paris last year, in connection with the exhibition, was an interesting experiment in acclimatization. According to *Nature* of March 6, owing to wise hygienic measures (such as vaccination, good water-supply, isolation of closets, and surveillance of food), these Annamites, Tonquinese, Senegalese, etc., seem to have escaped most of the common endemic diseases. According to the *Semaine Médicale*, they had no typhoid-fever, scarlatina, or measles, though these were in Paris at the time. Some 68 natives were attacked by mumps. The fatigues of a voyage and the change of climate led to a recurrence of intermittent fever, with grave symptons, in twenty cases. It was thought at first to be typhoid fever of a severe type; but the rapid and durable efficacy of sulphate of quinine, given in doses of two to three grams a day, proved the paludine nature of the disorder. It is noteworthy that most illnesses of this population, especially that just noticed, and those from cold, appeared during the first part of the time, when the weather was mild; while in the second period, with unfavorable atmospheric conditions, the illness diminished, whether owing to precautions in the matter of dress and food, or to more complete acclimatization. The negroes of Senegal and the Gaboon seem to have been the greatest sufferers, while the Indo-Chinese race acclimatized the best.

— There are in Berlin 16 *Gymnasia*, — 5 government and 11 municipal *Gymnasia*. The government *Gymnasia* are those of which the expenses are wholy or partly borne by the government. In the 5 government *Gymnasia* there are 82 classes with 3,194 pupils; in the 16 others there are 165 classes with 5,687 pupils. There is one government *Realgymnasium* with 15 classes and 665 pupils, and seven municipal *Realgymnasia* with 102 classes and 3,982 pupils. There are 2 *Ober-realschulen* and 5 higher burgher schools, all municipal. There are 7 high schools for girls, having 114 classes with 5,210 pupils. These 7 schools for girls, compared with the 31 schools for boys, are altogether inadequate. Private schools for girls have therefore sprung up in all parts of the capital, but they are all subject to the inspection of the school committee. There are more than 48 private high schools for girls, with 11,493 pupils. As a bridge between the higher and the lower schools, there are the so-called *Gemeindeschulen* (municipal schools). In these, pupils are specially prepared for the higher schools, and some are directly connected with them. They number 22, and contain 80 classes with 4,105 pupils. Besides these, there are 15 private schools with 116 classes and 3,832 pupils, mostly preparing for the higher schools. A few private elementary schools were kept going through the deficiency in the number of public schools. The municipality placed in them its surplus school population and paid the fees. But the chief *raison d'être* of these schools disappeared with the abolition of school fees and the introduction of free elementary education. Their day is past, and there will no longer be any complaints about the inefficiency of the teaching given in them as compared with that in the public schools. The present cry in Berlin is for more schools and smaller classes. The latter complaint, indeed, is not confined to Berlin, but is becoming general in all parts of the country. The abnormal growth of the capital since 1870 has rendered it very difficult for the municipality to keep pace with the population and provide enough schools. The number of classes in Berlin of overgrown size has risen in the space of one year, 1888-89, from 55 to 106. The cause of this is the thinning of the ranks of the elementary teachers through the low rate of salaries.

— A curious phenomenon is reported from Batoum, says *Nature*. On Jan. 23, at 4 P.M., during a complete calm, the sea is said to have suddenly receded from the shore, leaving it bare to a depth of ten fathoms. The water of the port rushed out to sea, tearing many of the ships from their anchorage, and causing a great amount of damage. After a short time the sea assumed its usual level.

— The Boston Manufacturers Mutual Fire Insurance Company reports the causes of 206 fires occurring during 1889, as follows: foreign matter in stock, 45; picker fires (unknown whether foreign matter or friction), 23; friction of stock, 17; hot journals, 17; spontaneous ignition of oily material, 15; spontaneous ignition of dyes, 12; chafing of belt, 5; gas-jet, 5; kerosene lamp, 4; matches, 3; lightning, 3; steam-pipes, 3; rocket, 1; sulphur bleach, 1; electricity from belt, 1; overheated oven, 1; sparks from broken machinery, 7; sparks from chimney, 3; sparks from cupola, 2; sparks from forge, 2; sparks from burning building, 1; sparks from locomotive, 1; sparks from boiler-setting, 1; sparks from furnace, 1; sparks from core-oven, 1; sparks from card-grinder, 1; back draught, 3; derailed train, 1; various fires in mill tenements, 3; suspected incendiary (two by insane persons), 5; unknown, 18. The times of starting of the fires were as follows: day, 151; night, 39; unknown (all extinguished without claim), 16. The property was classified as follows: cotton-mills, 115; woollen-mills, 39; machine and metal works, 15;

hosiery-mills, 9; storage, 7; paper-mills, 5; bleach and dye works, 3; tenements, 3; jute factories, 2; rubber-works, 2; silk-mill, 1; linen-mill, 1; cordage-works, 1; miscellaneous, 3. The processes where the fires started were as follows: cotton-picker, 58; wool-picker, 19; mules, 16; cotton-drier, 7; wood-drier, 6; cotton-card, 6; shafting, 6; spinning-frames, 4; fly-frames, 4; boiler-house, 4; looms, 3; engine room, 3; wool-card, 2; blacksmith, 2; office, 2; wheel-pit, 2; sulphur bleach, 1; jute-card, 1; rag sorting, 1; brushing-machine, 1; core oven 1; wire drawing, 1; japanning room, 1; wool dyehouse, 1; slasher, 1; card-grinder, 1; storage and miscellaneous, 52.

— Those who are interested in the subject of manual and industrial education may like to read a pamphlet on "Manual Training in the Public Schools of Philadelphia," by James MacAlister, superintendent of the city schools. It is issued by the New York College for the Training of Teachers, and gives an account of the courses in manual training and industrial art that have been in operation for some years in certain of the Philadelphia schools. These institutions, however, — the Industrial Art School and the Manual Training School, — are special schools, consisting of picked volunteer students; so that their success or failure is no criterion of the usefulness of manual training in the ordinary public schools. Both the institutions have had good success in their special field, as such schools usually have had where they have been tried. More recently kindergartens have been established in Philadelphia, with manual training as one of the features, but sufficient time has not elapsed to show the effects of their working. Sewing has been introduced into the higher girls' schools, and with favorable results. Mr MacAlister's pamphlet will be of interest on special points.

— In Bulletin No 4 of the Rhode Island Experiment Station, the apiarist gives much information about bee-keeping, and reports the work done in this department the first season. Quotations from crop and other reports of the United States Agricultural Department are given to show the importance of this industry in the United States, while facts and figures from the Rhode Island census for 1885 show its condition in that State. Old-fashioned bee-keeping is compared with modern management, its improved hives and better varieties of bees. The value of bees as honey and wax producers is shown; and their greater value as carriers of pollen from flower to flower, thus fertilizing and causing the fruit to set and mature, is considered, and many opinions and facts presented. The desirability of the cross fertilization of flowers and the aid rendered by insects in this work is shown, as well as the adaptability of the honey-bee to the flowers of the most important fruit and vegetable crops dependent upon insect visits. The question as to whether bees injure fruit is presented; the opinion of the government entomologist that they do not, and an account of the careful experiments carried out under his direction to settle the matter, are given. The views of Professors Packard and Gray, as well as of prominent fruit-growers in Rhode Island, are also given. Attention is called to the decision of the Supreme Court of Arkansas as to the unconstitutionality of prohibiting bee-keeping; also to laws lately passed in Germany which give all land-owners the privilege of keeping bees anywhere, promise protection by civil right and law, as well as punish the destruction of bees by poison or any other way by a fine of $150 or imprisonment for one year. No one need refrain from keeping bees on account of opposition due to ignorance, fear, jealousy, or the ill will of their neighbors, though all reasonable precautions should be taken to prevent accident An account of the work done at the station during the limited time allowed for it is given. A yard of ten colonies was established, and made as near as possible a model working apiary. The desirable varieties of bees were procured, a daily record taken of a hive on scales, a show of bees in glass hives made at the county fair, and a collection of the different kinds of hives, fixtures, etc., used by prominent American producers, and designed as a permanent exhibit at the station, was commenced. Sixteen colonies were prepared for winter, — three placed in the cellar, and the rest packed in outer cases on their summer stands. Acknowledgments are made of hives and other articles donated; and samples of different kinds of honey from different parts of the country, as well as all articles of interest to bee-keepers, are solicited, and will be acknowledged in the bulletin. This work is in charge of Samuel Cushman, and the address is Bee Department, Experiment Station, Kingston, R.I.

— The carbons in the new Westinghouse alternating-current arc-lamps are flat, two inches wide, seven-sixteenths of an inch thick, and eight inches and a half long. The upper and lower carbons are the same size, and are consumed at the same rate. One set of carbons is said to last forty-eight hours.

— A project is on foot to dig a ship-canal from a point opposite Grand Island in Lake Superior to the northern extremity of Green Bay in Lake Michigan, cutting across the narrowest part of the long peninsula between those two lakes. The proposed canal is to be thirty-six miles long, and would save two days and a half for steamers and five days for sailing-vessels that would otherwise have to go around the peninsula.

—The report of the Bidston Observatory for the five years 1884–88 is mainly composed of meteorological observations from which it appears that the anemographs furnish very questionable data. The velocity of the wind has been computed on the assumption that the motion of the anemograph's cups is equal to one-third that of the air. The anemograph's pressure-plate presents a surface of two superficial feet to the wind. Both these anemographs are about 210 feet above the sea-level. The investigations conducted by Sir G. Stokes tend to show that the constant for the cups is not 3, but more probably 2.4; and the experiments made by Dines establish the relation between the velocity and the pressure of the wind to be $P=V^2 \times .0035$, though hitherto it has been considered to be $P=V^2 \times .005$. On Jan. 23, 1884, the pressure of wind recorded at Bidston was 70.2 pounds per square foot, and the velocity 78 miles per hour. Other extraordinary pressures with accompanying velocities are as follows: Oct. 26, 1884, 40.6 pounds and 64 miles; March 30, 1886, 41.9 pounds and 62 miles; Dec. 9, 1886, 40.4 pounds and 69 miles; Feb. 3, 1887, 40.1 pounds and 66 miles; May 20, 1887, 65.2 pounds and 78 miles; Nov. 1, 1887, 40.0 pounds and 57 miles; Jan. 26, 1888, 49.2 pounds and 74 miles; May 3, 1888, 44.4 pounds and 66 miles; Nov. 20, 1888, 49.0 pounds and 71 miles. The five maximum pressures, about 40, averaging 40.6, accompany consistently hourly velocities, averaging 64 miles. Now, if the constant for velocity must be reduced from 3 to 2.4, this 64 becomes 51 miles. According to the old formula, the pressure corresponding to 51 miles would be 13, and according to the new formula only 9 pounds, which numbers are in startling contrast to 40.6. Conversely, accepting 40.6 pounds, the velocity by the old formula would be 90, and by the new formula 108, which figures are in startling contrast to 64 miles. Hence, whichever way the data are considered, the results are eminently unsatisfactory. For a pressure of 70 pounds, the corresponding velocity would be 141 miles per hour by the new formula. Only the highest pressures have here been tested, but similar discrepancies prevail all through the series of these anemological statistics. Assuming these maxima pressures to be correct, then the given velocities are greatly in defect; but as the factor 3 has been employed, which is now considered to be one-fifth too great, the given velocities are just as much too large: hence that which is already great should be greater, — an absurdity which leads to the inference that the instruments are unreliable. The mean velocity per hour is really given, whereas the absolute velocity, expressed as rate per hour, of the most violent gusts, lasting perhaps only a few seconds, is wanted. *Engineering* points out that it seems too much of a stretch of confidence to accept the pressures as reliable, inasmuch as none so high have been obtained anywhere else. The inference, therefore, must be that the accuracy of the anemographs at Bidston is extremely doubtful, and it becomes important to make these apparatus the subject of critical investigation. Until this has been efficiently done, no reliance whatever can be put upon their results, which is very much to be regretted, as the data extend over a long series of years, and if reliable, or could be made so, would be of the utmost scientific value.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE SAILOR AS AMATEUR ENGINEER is not always a success. A naval court of inquiry has recently been in session which has revealed some interesting phases of the amateurishness of the "Yankee tar," and of his inclination at times to play the jack at all trades without much regard to consequences affecting either his own reputation or the efficiency of his vessel. It seems that the commander of a naval vessel, assuming himself to be possessed of the requisite professional knowledge, took charge of the engineering of his ship, and "gave the engineer permission" to make repairs only when he (the skipper) saw fit. The chief engineer had been "ordered not to use salt water in the boilers," had been "told that fresh water would be used in boiler No. 3." The captain had told him that "salt water would not be used except at sea;" but the engineer, apparently thinking himself as well informed of the principles and the customs of the case as was the captain, actually did on one occasion fill a boiler with salt water when in port, after some repairs had been made upon it, for the purpose of testing it to ascertain if it was tight. He endeavored to explain to the superior officer, when called upon to defend this practice, that it was for this purpose; but the commander promptly informed him that he cared nothing for his opinion, and so "sat down upon" and "walked over" the junior officer (figuratively speaking, if we understand aright) that the latter was moved to inquire, mildly of course, whether it was the fact that he was to be "treated like a pickpocket." This is an interesting illustration of the ethics, the amateur engineering, and the manners, accepted, as it would seem, on board at least one of the ships of our great "navee."

We need not here concern ourselves with the ethics of the case. The court of inquiry will probably establish the code for the naval service, and we may presume that the dignity of the amateur-engineer commander will be properly vindicated. No subordinate officer will probably be allowed with impunity to protest against being "treated like a pickpocket" by his senior, whatever be the altitude of the latter on a scale which measures in terms of good sense, good manners, and good feeling, such as becomes a "gentleman and an officer." We may be permitted to doubt, however, that the senior officer will be called seriously to account for any lack of officerlike quality which may manifest itself in his treatment of his juniors—unless the secretary of the navy, Gen. Tracy, who is himself familiar with the accepted ethics of civil life, as well as with the exactions of military "discipline," shall determine to act in the matter. The line which separates the gentleman from the officer is sometimes made so broad, in cases involving discipline and admonition of the junior by his senior, that the latter fails to detect the fact that the two should be, and should always remain, fairly coincident. We may perhaps be permitted to mildly suggest, however, that the importation into the navy of gentlemen, and the deportation of men of other stripe, might apparently be carried on to considerable extent, and with great advantage. The suggestion is with diffidence respectfully submitted to the honorable secretary of the navy.

On the other aspects of the case, as involving a question of chemistry applied to engineering, we may, we think, be permitted to hold an opinion without asking leave of the very respectable, but we think too decidedly amateurish, sailor on horseback who mounts his hobby to such manifest discomfiture of those over whom he is by his commission enabled to ride. If it should prove that the engineer in charge was so grossly ignorant as to imagine that he might safely and continuously employ salt water in his boilers on a long cruise, even though he had surface condensers, and was not aware that the result would be the precipitation of sulphate of lime in large quantity, to the utter demoralization of his coal-pile and the injury of his furnaces, we should say that this officer was right in treating him, not like a pickpocket, to be sure, but with distinct severity. Even an amateur engineer should know better than that; a commanding officer, if fit for his place, should certainly know at least so much. If it should prove that the engineer desired simply to test his boilers for the purpose of detecting a leak, knowing that it requires a temperature approximating 300° F. to cause precipitation of calcium sulphate, we should consider him to be right in using it, and the commander very ignorant, even for an amateur engineer, not to know better than to interfere. There is a popular feeling—which it will probably be very difficult for the aspirant amateur to remove, notwithstanding his acknowledged and unquestionable ability to become a jack at these several trades which go to make a cruise successful — that the commander is placed on board ship to direct its general operations; and that he is given a corps of engineers to attend to details, with which they only are trusted, and with which, as experts, they only can deal; while the amateur-engineer captain, like the amateur-naval architect, even though the latter be the ablest of lawyers, had best keep himself within those lines which bound his own specialty, and play the amateur only in unimportant matters, in which no great interests are involved.

BOOK-REVIEWS.

A Handbook of Engine and Boiler Trials, and of the Indicator and Prony Brake. By R. H THURSTON. New York, Wiley. 8°. $5.

THIS work, being virtually the first of its kind, must of necessity fill an important place in the literature of the steam-engine; and the fact that Professor Thurston is the author is sufficient guaranty that it may safely be accepted as a standard of reference while present methods of steam-engine and boiler tests are in vogue. Engineers making tests of this kind have hitherto been compelled to do so without any definite standard of reference; and no generally accepted criterion has been available for the engineer who wished to record the results of engine or boiler trials in an acceptable and permanent manner. The long-existing want of such a criterion has led to a general concurrence among engineers that a system, provisional though it may be, is feasible, according to which both engines and steam-generators may be satisfactorily tested. This system, which is based upon the work of a committee of the American Society of Mechanical Engineers, of their brother engineers in Germany, and of other recognized experts and authorities, is admirably presented in Professor Thurston's work.

This treatise presents, in a concise though clear and easily understood form, those methods of trial of heat-engines which have become standard; exhibits the processes of their application; describes the best forms of apparatus in current use in conducting the trials and in securing the data sought; and illustrates the uses and capabilities of these apparatus. It also presents examples of the reports made by distinguished engineers on important work of this character, and thus gives good examples of the form of such reports, and of the data and results deduced from them in the case of the better classes of machinery and apparatus.

The system of boiler trial described in this work is that proposed by the committee of the American Society of Mechanical Engineers, since become standard in this country, and to a great extent abroad. It is complete and satisfactory, having been found sufficient, so far, to meet every ordinary requirement.

A chapter is devoted to the steam-engine indicator, giving a brief and simple account of that instrument and its capabilities, as well as a description of the usual and best ways of handling it, though no attempt has been made to elaborate to any great extent the study of the diagram. Many forms of diagram, however, are illustrated, and the student is referred to special treatises on the indicator for further information on the subject. A description of the methods usually considered best and most exact in the measurement and computation of the indicator diagram is given in a separate chapter, as well as of the processes leading to the more important of the results attainable by the use of the instrument.

A series of valuable reports, written by able engineers as models of data summaries and of conclusions derived from such summaries, add to the completeness of the work. One example in each of the more important classes of steam-engine is studied in this manner, and any engineer, by a study of the series, should be enabled to secure satisfactory results in making tests, even though previously inexperienced in such work. An appendix contains all needful constants and reference-tables, and an abundance of illustrations adds much to the clearness and value of the text.

The Origin of the Aryans. By ISAAC TAYLOR. (Contemporary Science Series). New York, Scribner. 12°. $1.25.

THIS is an able and interesting book, the object of which is to give the latest results of the controversy concerning the origin of the Aryan races. It opens with a chapter on the history of the subject, beginning with the assumption of the philologists that the original home of the undivided Aryans was in Central Asia, whence the various branches of the common family migrated to their present seats. This assumption is easily shown to be baseless, and the old theory has now been abandoned by the majority of archæologists. Moreover, it is now generally held that the greater portion of the population in the countries we now call Aryan really belongs to other families of mankind, and that the widespread prevalence of the Aryan languages is due to conquest by Aryan peoples. The evidence of this is mainly anthropological, and its presentation occupies a considerable portion of Mr. Taylor's book. He repeats the various arguments that have been adduced to prove that the original home of the Aryans was in Europe, which he regards as conclusive. But the question then arises as to which of the prehistoric races of Europe is to be regarded as the original Aryan stock. On so difficult and so unsettled a question we shall not here offer any opinion, but will briefly indicate the evidence and the arguments that have thus far been adduced.

The skulls and other remains of the neolithic age point pretty clearly to the fact that at that time the greater part of Europe was peopled by four distinct races, — the Iberians in Spain, Britain, and some other places; the Ligurians in central France; the Celto-Slavic race in central Europe; and the Teutons, or Scandinavians, in the north. Of these, the Iberians seem to be related to the Hamites, and the Ligurians to the Turanian family; so that, if the original home of the Aryans was in Europe, the original Aryan race must be either the Teutonic or the Celto-Slavic. Here, therefore, is now the main point of contention, the German writers generally upholding the claims of the Teutons, and the French those of the Celts. The dispute has been conducted with considerable acrimony and with a rather unseemly exhibition of national feeling on both sides, and is still unsettled. Mr. Taylor inclines in favor of the Celts, but maintains a judicial attitude, and avoids a decisive expression of opinion. He presents the evidence on the whole subject, however, at considerable length, and the clearness of his style makes it intelligible to the reader. Those who wish to know the latest views and arguments on the question will find his book useful.

Laboratory Manual of Experimental Physics. BY ALBERT L. AREY. Syracuse, Bardeen. 24°. 75 cents.

THE author of this book is a civil engineer by profession, and at present is instructor in physics at the Rochester Free Academy. The aim of the book is to describe such experiments as will lead to quantitative work on the part of the student, and the author lays considerable stress on the importance of bringing home to the students the existence of a personal error in observations, that within limits can be much reduced by using intelligence and care. All simply illustrative experiments are omitted from the book, the author believing, with most teachers in this field, that such can be carried out to the best purpose on the lecture-table.

It is needless to say that the experiments described can be performed with apparatus of the simplest kind, most of it capable of being home-made. Many of them are new, and are sure to be suggestive to those engaged in teaching of this character.

Whether we approve of the alternate blank pages intended for notes supplementing the text, we can hardly say; yet that these notes will be well entered by some is very true, and for such the benefit of forming a habit of noting down points brought out at the time of experimenting will be considerable.

Fort Ancient. By WARREN K. MOOREHEAD. Cincinnati, Robert Clarke & Co. $2.

MR. MOOREHEAD and a competent staff of assistants spent the season of 1889 in making a careful survey of Fort Ancient, the renowned earthwork of Ohio. The results of his investigations have been published in the present volume, which is most beautifully illustrated with excellent photo-engravings, which greatly enhance its value. From his extended researches the author draws the following inferences: Fort Ancient is a defensive earthwork, used at times as a refuge by some large tribe of Indians, and at times there was a large village situated within its walls. The fields within the wall, especially in the enclosure of the old fort, are covered with pottery fragments, bones, arrow-heads, and flint chips. The ground has many

burnt stones below the surface. There are traces of villages in the country surrounding the fort. The author expresses his conviction that the fort possesses nothing of a religious nature.

A pavement which has been found inside may have been used as a place for the war-dances or councils of the tribes assembled in the fort. The author believes that these tribes were in advance of the Shawnees, the Delawares, and others who occupied the territory in 1787. But they did not know the art of smelting, though they used hammered copper and galena. In concluding, the author calls attention to the similarity of the arts of the Mandans and the tribes who inhabited Fort Ancient, and expresses the opinion that they may have been the builders of the works. The book proves to be the result of a very careful and detailed investigation, for which ethnologists will be thankful to the author, even should his theories not find general acceptance. The endeavor, which appears throughout the book, to represent the finds and the methods in which they have been obtained as clearly as possible, which is supported by the excellent illustrations accompanying the descriptions, gives the work value aside from all theoretical considerations.

Railroad Engineers' Field-Book and Explorers' Guide. By H. C. Godwin. New York, Wiley. 16°.

To the many railroad engineers who do not consider themselves expert mathematicians this field-book will prove of exceptional value. It contains, in small compass, every thing that can reasonably be sought for in a book of the kind, intended solely for use in the field; leaving those things which pertain to extreme accuracy, and which may be rarely needed, for a supplementary or complementary volume, which may be assigned a place with the camp equipage. The idea which prompted the preparation of the volume is good, and we think it has been well worked out. The author has avoided as much as possible the intricacies of mathematics, and at the same time has produced a work of more general application than might have been expected by engineers familiar with books of its kind.

The book is divided into four principal parts, the first dealing with railroad location, the second with railroad construction, the third with reconnaissance and exploratory surveys. The fourth is devoted to general information of a miscellaneous but no less useful nature. To these are added an appendix and a set of tables. The book is will adapted to the use of railroad engineers engaged on location and construction work, as well as to the use of the explorer in making exploratory surveys.

AMONG THE PUBLISHERS.

Readers of all classes, young and old, will be glad to know that the Scribners are issuing a new book by Mrs. Frances Hodgson Burnett. It will be entitled "Little Saint Elizabeth, and Other Stories," and is an attractive picture of child-nature.

— The second volume of Donald G. Mitchell's latest work, "English Lands, Letters, etc.," will soon be published by the Scribners. It will contain the author's talks about historical and literary England from the time of Elizabeth to Queen Anne, Shakspeare being the first, and Swift the last, personage of importance who passes under review.

— A timely article is "Stanley's Emin Pasha Expedition" in *Lippincott's* for April. A concise biographical account of Emin Pacha is given, and also the reason of Stanley's expedition, with other information.

— Mr. Marston, of the London publishing-house of Sampson Low, Marston, & Co., wrote recently from Cairo, where he was in company with Mr. Henry M. Stanley, "Mr. Stanley is devoting absolutely the whole of his time, from early in the morning (sometimes as early as 6 o'clock) till late at night, in writing his great book. I have read a good part of the text, and I think I may say, without being accused of puffing, that it is profoundly interesting. I am happy to add that Mr. Stanley was well pleased to learn from me that I had completed satisfactory arrangements for simultaneous publication in France by Messrs. Hachette & Co., in America by Messrs. Scribner's Sons, in Germany by Mr. Brockhaus, in Spain by Espara & Co., in Italy by Messrs. Treves, and in Scandinavia by Mr. Mallings."

— There is an article on "Egypt at Home," by Rev. Dr. W. C. Winslow, vice president of the Egypt Exploration Fund, in the April number of the *New England Magazine*. It is an account of the Egyptian collection in the Boston Museum of Fine Arts, the most important Egyptian collection in America, and is illustrated. The number will also contain a full page portrait of Miss Edwards, from a recent photograph by Sarony, with an article upon her work by Mrs. Sallie Joy White, and several facsimiles of passages from her letters and manuscripts.

— To Shakspeare students the plan and scope of Dr. Furness's "Variorum Shakspeare" are known, as are the pains, judgment, and critical faculty expended upon them. Each play as it appears brings into one focus all the wealth of a great Shakspearian library, so arranged as to be immediately accessible. "As You Like It," the eighth volume of this splendid edition, will be published by J. B. Lippincott Company on April 25 The volumes previously issued are "Romeo and Juliet," "Hamlet" (two volumes), "Macbeth," "King Lear," "Othello," and "The Merchant of Venice."

—The publishers of the *Electrical World* have secured the services of Dr. Louis Bell, who will in future have editorial control of that enterprising journal. T. C. Martin and Joseph Wetzler, who have heretofore edited the *Electrical World*, have taken editorial charge of the *Electrical Engineer*, and that well-known paper will henceforth appear as a weekly.

— Civil-service reform has a champion in Mr. Oliver T. Morton, who, in a paper called "Some Popular Objections to Civil-Service Reform," which appears in the *Atlantic* for April, is not afraid to say that the spoils system "is at war with equality, freedom, justice, and a wise economy, and is already a doomed thing fighting extinction. Its establishment was in no sense a popular revolution, but was the work of a self-willed man of stubborn and tyrannical nature, who had enemies to punish and debts to pay." This certainly strikes no uncertain note. The article is divided into sections, each one of which is headed by a paragraph which embodies some objection to the movement.

— The April issue of the *Quarterly Journal of Economics*, published for Harvard University, will contain articles by President Francis A. Walker on "Protection and Protectionism," in which arguments for and against protection are temperately discussed; by Professor Taussig of Harvard, on the "Silver Situation, its History and its Dangers;" E. C. Gonner of Liverpool, Eng., on "Ricardo and his Critics;" F. B. Hawley of New York, on "Profits and the Residual Theory;" N. Matthews, jun., of Boston, on the "Taxation of Mortgages in Massachusetts." There will also be notes and memoranda on the law against socialists in Germany, on recent works on finance and political economy, and the usual bibliography.

— Of the contents of *Outing* for April, we note "Signaling for Antelope on the Staked Plains," by William H. Johnston, jun.; "Wheel and Camera in Normandy," by J. W. Fosdick; "Melton Mowbray; or, Fox Hunting in the Shires," by "Merlin;" "Some Defects in Tennis," by D. C. Robertson; "Tennis Scores," by William Strunk, jun.; "Bowling for Women," by Margaret Bisland; and "Yacht Racing in Great Britain," by F. C. Sumichrast.

— The wide-felt interest in the present discussion of the revision of the Westminster Confession of Faith has manifested itself in a steadily increasing demand for the recent publications relating to the subject. The Scribners have brought out a third edition of Dr. Briggs's "Whither?" and the pamphlets entitled "Biblical History," and "Whither? O, Whither?" by Dr. McCosh; also a new edition of Dr. Schaff's "Creed Revision," with an appendix containing a report of the discussion in the Presbytery of New York. The same publishers are issuing a new contribution to the subject by Dr. Shedd, entitled "The Proposed Revision of the Westminster Standards."

— The Scribners will publish immediately a small book by George W. Cable, entitled "The Negro Question," containing the address delivered by the author on Washington's Birthday before the Massachusetts Club in reply to the memorable speech by the late Henry W. Grady; also several open letters by Mr. Cable on this subject.

— The Scribners will issue shortly the first of a series of interesting memoirs of "Three Famous French Women," translated from the French of M. Imbert de Saint-Amand, by T. S. Perry. The subject of the first volume will be the Empress Josephine, and will be entitled "The Wife of the First Consul." Other works will follow on Marie Antoinette and the Empress Marie Louise.

LETTERS TO THE EDITOR.

Means of increasing the Accuracy of locating Vessels at Sea.

IN looking over some meagre accounts of the recent meeting of the International Maritime Congress, I failed to find any mention of a very important branch of navigation to which my attention was attracted some years ago. I refer to the question of the present accuracy of the instruments for determining the position of a ship at sea, and the steps that must be taken in order to improve this accuracy. The reasons that make this an important matter are so obvious that it is not necessary to catalogue them. I need only say that in approaching any coasts, dangerous reefs, shallow waters, and, in the case of sailing-vessels, the paths regularly frequented by steamers, it is of the greatest importance to be able to locate the ship's position with all the accuracy attainable.

In 1881 Professor W. A. Rogers, the eminent American astronomer and physicist, read a paper before the Naval Institute at Annapolis, published in the "Proceedings" of the institute, bearing the title "The Co-efficient of Safety in Navigation." This paper is spoken of by Commander P. F. Harrington, U.S.N., as being "remarkable for the extent and thoroughness of its investigations, and valuable in the application of its results to the practice of navigation. . . . Its practical conclusion and warning ought to be impressed upon every man who is permitted to lay a vessel course."

In this paper Professor Rogers shows the various errors which enter into the determination of a ship's location at sea; and he determines, finally, an average error and a possible error of position from a large number of observations, as shown by logs of vessels in various quarters of the globe. Upon his inquiring of a number of sea-captains as to the limits within which a ship's place can be ordinarily determined, most of them said a mile was the limit, some few said half a mile, and only one man gave so high an estimate as five miles.

The chief sources of error seem to be those pertaining to the compass, chronometer, and sextant. For the compass, Professor Rogers does not come to any very definite conclusion; at least, no numerical estimates of error are made.

A discussion of the rates of a large number of chronometers shows, that, for a chronometer of average excellence, at the end of twenty days an average error of 3.6 miles must be expected, and an error of 11.5 miles must be looked out for. The error of the chronometer increases with the time occupied in the voyage; and a discussion of the errors of one hundred chronometers by Mr. Hartnup of Liverpool (and probably no more capable man has ever examined into the matter) showed that at the end of a voyage of twelve months the error in one of the ship's positions was 524 miles. Another extreme instance cited is the case of Lord Anson's voyage around Cape Horn, in which one ship "actually made land on the wrong side of the continent, the error of position being over 600 miles."

For the sextant observations it is difficult to determine the limit of accuracy; but "the average error of a single observation at sea is not far from 3 miles, and the average co-efficient

Publications received at Editor's Office, March 17-22.

EARL, A. G. The Elements of Laboratory Work. London and New York, Longmans, Green, & Co. 179 p. 12°. $1.40.
ELECTRICS, Practical: A Universal Handy-Book on Everyday Electrical Matters. London and New York, Spon. 135 p. 18°. 75 cents.
GEDDES, P., and THOMSON, J. A. The Evolution of Sex. New York, Scribner & Welford. 322 p. 12°. $1.25.
HURST, J. T. Spon's Tables and Memoranda for Engineers. 10th ed. New York, Spon. 140 p. 48°. 40 cents.
MAYCOCK, W. P. Practical Electrical Notes and Definitions, for the Use of Engineering Students and Practical Men. London and New York, Spon. 130 p. 24°. 60 cents.
NEW YORK State Board of Health, Eighth Annual Report of the. Transmitted to the Legislature Feb. 27, 1888. Albany, Troy Press Co., pr. 348 p. 8°.
——Same. Ninth Annual Report. Transmitted to the Legislature Feb. 26, 1889. Albany, Troy Press Co., pr. 609 p. 8°.
SPRAGUE Electric Railway & Motor Co., Applications of Electro-Motive Power by the. New York, Sprague Co. 47 p. 8.°
——Stationary Motors, Facts about the. New York, Sprague Co. 31 p. 8°.
STREET Railway Companies, To Managers of. New York, Sprague Electric Railway and Motor Co. 26 p. 8°
TAYLOR, I. The Origin of the Aryans. New York, Scribner & Welford. 339 p. 12°. $1.25
TUNZELMANN, G. W. de. Electricity in Modern Life. New York, Scribner & Welford. 272 p. 12°. $1.25.

by which this number must be multiplied in order to provide for every contingency of danger is 3.5.''

Having called attention to the accuracy, or rather the inaccuracy, with which a ship's position is found at sea, I wish to make a few suggestions which have occurred to me in the course of my professional work, and which ought, perhaps, to be considered by marine authorities.

In each of our large seacoast cities the Maritime Exchange is the principal place where ship-masters, ship-owners, shippers, marine underwriters, and other men interested in ocean commerce, meet for the purpose of arranging matters connected with the transportation by sea, and it is through these exchanges that the plan I have to propose could be most readily carried out.

What I have to propose is this: that there should be an enforced frequent inspection of the instruments used by ships' officers in determining the positions of vessels at sea.[1] Whether it would be necessary to have a law enacted by legislation, or whether the marine insurance companies would demand such an inspection before issuing policies, or whether the Maritime Exchanges would take up such a work on their account, I cannot more than surmise. I think likely that the former would be necessary; but, as the details of the work would be about the same in any case, I have assumed that the members of the exchanges would be willing to carry on the work without any ''pressure'' from outside.

Let, then, the maritime exchanges of each port adopt a rule that the sextants, compasses, and chronometers of all vessels with which the exchange has dealings shall be inspected every three months, or every six months, or at the close of each voyage, or whatever length of time may be considered sufficient. Let each exchange request the secretary of the navy to assign to duty at its port a sufficient number of officers and men to carry out this inspection. That this last is possible, is shown by the fact that for some years officers of the navy have been assigned to duty at several of these exchanges for the purpose of collecting observations made on shipboard (the United States Signal Service was also represented there in connection with meteorological matters). Probably one lieutenant and two subordinate officers would be sufficient to do all the work necessary for the port of New York. As to the details of such a work as is proposed, there is only space to mention enough to show the necessity of it, and to show its practicability.

Upon the master of a ship reporting his arrival at the exchange, let the naval officer at once take steps to inform himself of the condition of the sextant, chronometer, and compasses carried by the vessel.

The sextant is very easily thrown out of adjustment; and, the errors being determined with great difficulty without proper apparatus, they are usually left for the maker to re-adjust. The result is, that in many cases a sextant is used until it is found to be utterly worthless, and then only is it taken to be repaired.

Let each ship-master be required to show a certificate of examination of his sextant: this to hold good for a stated time, and to be furnished free of charge by the exchange. It would not be such a laborious task as it may seem, to examine the sextants; for, if a Neumayer sextant stand (a description is given in the ''Archiv'' of the Deutsche Seewarte, Jahrgang I. 1878, p. 16) be mounted in a convenient place, it would take the operator but a few minutes to detect the errors in adjustment of a sextant placed thereon, and he could even undertake any minor re-adjustment; but for any serious fault in the instrument it would have to be corrected by an instrument-maker.

The sextants belong to what are known as constant instruments, and may keep unchanged for a long time; but chronometers are variable instruments, and have to be compared with a standard as frequently as possible. This difference in the instruments is so easily and generally recognized, that, while the sextants are so seldom inspected, the chronometers, on the other hand, have been taken to chronometer-shops at the end of each voyage, no matter how short, to have the rate of change determined, and to have the error noted just before the departure on the next voyage. I say ''have been,'' because, much to my astonishment, the leading chronometer-maker of Boston informed me some years ago, and shortly after the Boston time-ball had been established, that this time-ball had about ruined the chronometer-rating business, and that most of the ship-masters (especially those of foreign vessels) rated the chronometer on shipboard by observing the fall of the time-ball at noon of each day. As these time-balls have now been established in the principal ports all over the world, it is safe to conclude that this change in the methods of rating chronometers is universal. I consider that this is a step backward in the progress of maritime science, and that there is much less security against navigators getting out of their ''reckoning'' than existed before this change of method took place. I will state briefly my reasons for thinking this.

1. A chronometer needs frequent inspection by an expert chronometer-repairer in order to see that all parts of the instrument are in good order. By the old method this could be done every voyage when the chronometer was being rated; but now it is probable, that, in cases where a time-ball can be observed, these instruments will not be submitted to the repairer until after experience has shown it to be in a decidedly bad condition.

2. A chronometer cannot possibly be rated as accurately by observations of a time-ball as by the means employed in the regular chronometer-shops. In the former case, observations cannot be made on days with rain or fog; it is quite probable that the same person will not be able to make the comparison for the whole succession of days, and a personal difference of half a second or more may occur between two observers; the error in observing the drop of a time-ball is probably not less than half a second, and many observers would not get the time closer than a second; the time-ball is usually dropped only once daily, so that any error in observing it cannot be detected; the observer on shipboard can have no idea of the errors and the daily changes in the standard clock by means of which the ball is dropped, and must rely implicitly on the accuracy of this signal during spells of cloudy weather, when, as well known, the standard clocks of the best astronomical observatories may be some seconds in error; and if the ship is in port only a brief time, and the chronometer rating should occur during a week when no observations can be made at the observatory, the probability is that a very erroneous rate would be assigned to the chronometer, for use during the coming voyage.

3. In the chronometer-shops the electric time-signals are received from the observatory or standard clock at regular intervals, usually every second or two seconds or minute. The signals are received daily, and comparisons can be made without regard to the weather, so far as distinguishing the signal is concerned. The chronometer comparisons are made by means of a ''hack'' chronometer, which has been accurately compared with the time-signal, and are made by some one person. A skilled man can compare two chronometers without having an error of more than one-tenth of a second, and the comparison can be made several times a day if it is desirable; and this is an important matter if the ship is to be in port only a few days. During cloudy weather, when it is impossible to make astronomical observations, and it sometimes happens that a whole week will pass without an observation being made, it is possible for the chronometer-maker, who usually has on hand a large number of first-class time-keepers, to keep his own standard clock nearer to the true time than that given by the observatory clock, because he relies on the average results given by a large number of time-pieces, while an observatory seldom has more than two. In this case the chronometer-shop rating of a ship's chronometer is much more accurate than that by means of a time-ball. Accidental errors in the standard clock-signals due to occasional mistakes made by the astronomer can be detected (if they are large) by the

[1] This proposal is by no means a new one, but some points which I shall mention in connection with it I have not seen mentioned before.

chronometer-maker, but the navigator rating his own chronometer is easily misled by them.

4. There is still a point to which I wish to make a brief reference; viz., the absolute accuracy of time-singals in general; for this question is one of great importance in rating chronometers. The best data that have yet been obtained for determining this question are the series of daily comparisons of time-signals of the Naval Observatory at Washington, the Cambridge (Mass.) Observatory, and the Allegheny (Penn.) Observatory; this having been done for some years by Mr. James Hamblett of the Gold and Stock Exchange of New York City, in order to regulate the standard clock which furnishes New York with accurate time. The comparisons frequently show differences of two and three seconds between the observatory standard clocks, and I believe instances are not wanting in which the amounts reached even five seconds.

Recognizing that these comparisons could not, perhaps, lay claim to the greatest accuracy attainable, an elaborate plan was matured some years ago by which the United States Signal Service should make a daily comparison of the time-signals of a dozen of our principal observatories, and thus find out with certainty the accuracy attainable by a single observatory, and to inquire into the desirability of the permanent organization of a sort of clearing-house system of time distribution, by means of which a very accurate time-signal could be distributed over the whole country, no matter what the weather might be. For various reasons this plan was not carried out, but its execution is still very much to be desired.

Taking into account the just mentioned facts, and others which might be given, I think that a careful inspection of the ships' chronometers and their rates should be made as frequently as may be found possible. The exact form of this inspection, which might be undertaken by the exchanges, and the best method of securing the greatest accuracy in rating ships' chronometers, cannot be discussed here.

Concerning the compasses on shipboard, I will only say, as has been frequently urged, that they should be examined and tested at every opportunity. The possible errors of the compass have been thoroughly studied, and those existing can be accurately determined; but the subject is too technical to be explained in a few words. FRANK WALDO.

Cincinnati, O., March, 1890.

Storage-Batteries.

MANY a person who has experimented with secondary batteries has become convinced, as I have, that the Planté form of battery was superior, especially as regards durability, to any of the various batteries in which the "active material" is applied in the form of paste. Realizing that this superiority was mainly due to the relation of the molecules of the active material with each other, and also their relation with those of the support part of the electrode, I was led to make experiments, the outcome of which was a storage-battery, which I have patented. For the sake of illustrating how the Planté form of battery is superior to the pasted forms, I will suppose that a piece of wood represents the support of the pasted plates, and that sawdust represents the oxide which is to be applied to the support part of the electrode in the form of a paste. The sawdust may be mixed with this, that, or the other liquid, and made to adhere to the wood, to a greater or more likely to a lesser extent. I immerse this wood electrode, if I may be allowed to call it such, in sulphuric acid: the sawdust will fall off in a comparatively short time, leaving the wood support to a more gradual destruction. If the surface of wood could be changed in some way so that it would resemble sawdust. and yet in such a way that the molecules of this changed surface preserve to a considerable extent their original relation with each other (that is to say, their original attraction for each other), and at the same time preserve their attraction for the molecules of the unaltered portion, we would then have a wood electrode (I apologize for the term) which would resemble the lead electrode of Planté. Almost invariably, when the pasted electrodes peel, they do so, not from the surface of the "active layer," but from the surface of the support metal. I have experimented with but one Planté battery, which, by the way, was the first storage-battery that I ever made. This battery was charged to its greatest possible capacity many times, and also discharged suddenly, but the active layer has not peeled from the non-oxidized portion of the lead plate. There has been at times a falling of fine particles of peroxide, but no peeling such as you get in pasted batteries.

The sooner storage electricians recognize that the greater the attraction of the molecules of a secondary electrode for each other, the more durable will the electrode be, the better for all concerned. Just as soon as storage electricians recognize the fact that the quality of a storage-battery is to be judged, not by the amount of peroxide the electrodes contain, but by the degree of attraction which exists between the molecules of the active layer, their experiments will be more fruitful, and the pasted plates of to-day will be no more. The problem is not how to store oxygen, but how to increase the affinity of each molecule of an oxide for its neighbor. Hoping that these remarks will set the readers of *Science* a-thinking, and that they may have some weight towards convincing them that all that is necessary in a good storage-cell is molecular affinity, I close my communication with great faith in the future of storage electricity.

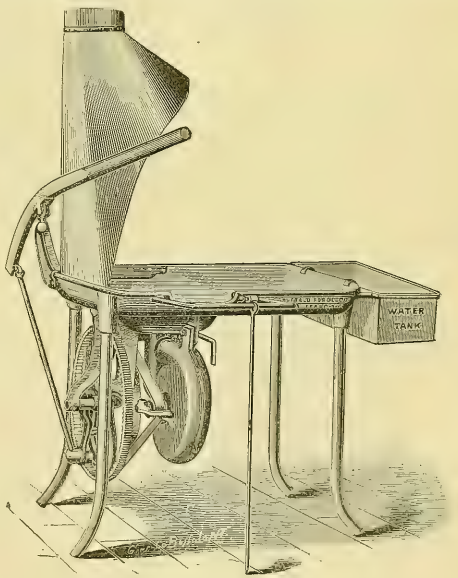
N. B. ALDRICH.

Fall River, Mass., March 18.

INDUSTRIAL NOTES.

Buffalo Blacksmith's Forge.

FEW progressive blacksmiths or metal-workers who look into the matter fail to acknowledge the superiority of the modern portable forge over the bellows and stationary blast-forge. By



A NEW BLACKSMITH'S PORTABLE FORGE.

the use of an improved portable forge, heat is produced more quickly and with less labor and cost. The portable forge also takes less space, while, so far as durability and reliability are concerned, a comparison between the two is much to the disadvantage of the old style. The first cost of the brick forge is greater, and subsequent repairs and occasional movings make a considerable item of expense, while repairs are seldom required on an improved portable forge; and it may be moved from one part of the shop to another with little trouble.

In the accompanying engraving is shown the latest pattern of improved portable blacksmith forge, made by the Buffalo Forge Company. The distinguishing features of this forge are, easy lever and swivel movements; steady powerful blast for heavy work, and even, light blast for light work; no dead centre to overcome in starting; all of which are important factors in the successful working of a forge. The bearings, which are of hardened steel and of more than ordinary length, deserve comment also. By referring to the illustration, which shows the No. 0 size, it will be seen that the forge has a large fan-case, 14 inches in diameter, which affords a maximum blast with a minimum expenditure of power. A point of importance is that the blast continues some little time after a stroke is made, sufficient to allow the operator to work upon the iron quite a while before it ceases.

This forge is also arranged for belt attachment, for general use in large shops where power is used. When run by belt, a cut-off for the blast is provided, which permits of the fire being regulated to any required degree.

The A. B. C. Electric Motor.

One of the latest additions to the long list of small electric motors now in the market is shown in Fig. 1. It is made by the A. B. C. Motor Company of this city, and embodies some of the ideas of Mr. Brown of that company.

The A. B. C. motor is designed so as to obtain, with a small expenditure of current, a maximum amount of magnetism, and to produce a machine that will do its work at a high rate of efficiency over a wide range of power, and at a moderate and constant speed under all loads. The field-magnets are laminated, permitting the use of sheet iron, a form in which soft, pure iron can be obtained of uniform quality. The several laminated sections, as shown in Fig. 2, are bound together, not by means of bolts passing through them in the usual manner, but by an arrangement of rods fitting into the notches shown, which are formed by the die in the outer edges of the plates. By means of this construction any irregularity caused by inexactness in the separate punching of holes is rendered impossible. The field-magnet has but one coil, and consequently no yoke is necessary in its construction. The field-magnet is ample in cross-section, and as short as possible, the entire space between the limbs being filled by the coil and the armature. This form of construction gives a magnetic circuit of very low resistance.

The armature is thoroughly insulated, and can be removed very quickly if necessary. The brushes, being at the top, can

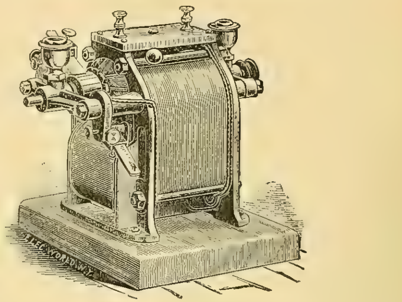


Fig. 1.

also be readily inspected; and, the armature being elevated, it is not necessary to place the motor on a special base when required for fan purposes. The mechanical construction of the

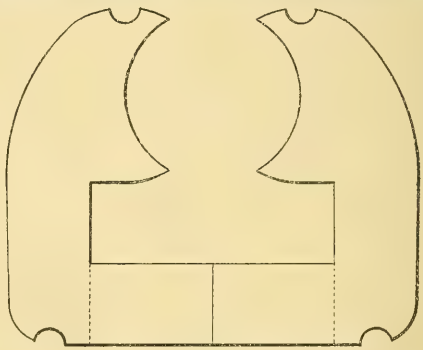


Fig. 2.

motor throughout has been carefully attended to, and all the details of the motor have been well worked out.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

March 18.—Henry Lee Reynolds, Caddoan Migrations Archæologically Considered; L. R. Klemm, Has Every One a Natural Calling? W. J. Hoffman, Mythology of the Menomini Indians.

Biological Society, Washington.

March 22.—D. W. Prentiss, Change in the Color of Human Hair; Change in the Color of Plumage in Birds, and in the Fur of Mammals (with specimens); G. Brown Goode, The Colors of Fishes; C. V. Riley, The Colors of Insects.

New York Academy of Sciences.

March 24.—W. W. Newell, The Study of Folk-Lore.

March 31.—C. F. Chandler, Volts and Amperes, and What they Mean.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

To correspond with colleges, seminaries and other schools where cabinets of fossils and minerals are being collected. I have an extensive private collection of fossils from every geological period, and minerals illustrating the common and many of the rare forms. This collection is in duplicate, and the duplicates are for exchange or sale. Every thing is scientifically classified. W. A. Bronnell, professor of geology, 905 University Ave., Syracuse, N.Y.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Corresp ndence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn

I wish to exchange or purchase well-fixed or hardened vertebrate embryos for sectioning. Desire specially reptilian embryos, but will be glad to secure any material that I do not possess. Thomas G. Lee, M.D., Histological Laboratory, Yale University, New Haven, Conn.

Wanted—Books and journals, American or foreign, relating to Photography—exchange or purchase. C. W, Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmola patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes.etc.,wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886.) for scientific books – those published in the *International Scientific Series* preferred.—James H. Stoller, Schenectady, N.Y.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A METALLURGICAL CHEMIST desires an engagement with a steel works, iron works, or blast furnace Has had nine years' experience in all branches of steel and iron work, and can furnish highest references and testimonials from former employers Address CHEMIST, 4,420 Chestnut St., Philadelphia, Pa.

A WILLIAMS SENIOR who has had two and one-half years' work in chemical laboratory, and one year in a biological laboratory, desires position as teacher of natural science and lesser mathematics, desires a position as instructor in these branches, or as assistant to some chemist. References as to ability and character. E. E. Towne, Box 74, Williamstown, Mass.

A REGULARLY graduated physician in his 32d year, who has been in active practice for eight years, excepting the time he was interne in a hospital and taking a post-graduate course, and who has done considerable work both in literature and science, more particularly connected with medicine, being now engaged in editorial writing for one of the first-class medical monthlies, wishes to learn of a town, not particular as to the size or location, where, in addition to practising his profession, he may become connected with a school or other institution as teacher of elementary and advanced physiology, chemistry, and hygiene, one or all; or would accept position with an older physician who is engaged in literary or scienific work, as an assistant, either in his practice, or as amanuensis or secretary, or in any capacity requiring knowledge of medicine and cognate branches; or would accept a position as librarian, having had experience as acting librarian while at college. Can furnish unexceptionable references as to ability and character, and, if the position offers opportunities for advancement, will accept for a time a nominal salary. Is married, but has no family beside his wife. Address Dr. W., care of *Science.*

WANTED. A Harvard Senior who has made a specialty of chemistry, and has had some experience in teaching and in analysis, would like to secure an appointment for the fall. Best of references given. Address, J., Harvard College, Cambridge, Mass.

CHEMIST (30) wants situation at once; Ph.D., and for three years Demonstrator of Chemistry, Leipzig University. Practical experience in technical branch of the subject. X., 13, Worcester Place, Oxford.

A YOUNG MAN aged nineteen, who is a graduate of the Exeter High School, wants a situation with some Manufacturing Chemist or in Laboratory of some Analytical or Private Chemist; must be chance where he can have access to books in evening. Is willing to work; has good knowledge of General Chemistry. Sam. L. Hills, South Lee, N.H.

A SUBSCRIBER of SCIENCE would be grateful for any information on the following points: 1. As to the kind of wax used in the preparation of embryological and anatomical models; 2. How it can be made and manipulated: 3. References to any literature on the subject. Wm. Patten, Grand Forks, North Dakota.

WANTED—Books upon American Archæology. My publication, "Fort Ancient," in exchange. First-class standard works only. Warren K. Moorehead, Smithsonian Institution, Washington, D. C.

A YOUNG MAN desires, about the 1st of July, a position as laboratory assistant, or as instructor in chemistry, physics, and lesser mathematics. References as to ability and character. 44 P.M.A. Address R. L. Porter, Penn. Mil. Acad., Chester, Pa.

SCIENCE

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THE COLOR OF FISHES.

THE skin of a fish, upon the structure of which its color depends, consists of two layers,—the outer, or epidermis, delicate, transparent, and not supplied with blood-vessels; the inner, the corium or dermis, laminated and elastic, varying in thickness in different species and in different parts of the body, and permeated by blood-vessels and nerves. Between the skin and the underlying muscles is a layer of loose connective tissue, often loaded with fat, especially in the mackerels and salmonoids and in the herring tribe. In the menhaden this layer is thick, hard, and blubber-like.

The scales are modifications of the dermis, and are ordinarily thin, transparent, horny plates, with rounded quadrangular outlines, which are partially embedded in folds or pockets in the dermis, and covered by the epidermis, through which, however, their tips protrude. The scales are usually

SECTION OF THE SKIN OF A FISH.
a, epidermis; *b*, scales; *c*, dermis.

imbricated, overlapping each other like the shingles on a roof, but are sometimes separated and embedded, and partly hidden in the skin, as in the eel.

In fishes which live near the bottom and among the rocks, such as the sea-bass, red snapper, sheephead, and perch, the scales are usually thick, hard, closely imbricated, and deeply set in their sheaths, forming an impermeable coat-of-mail.

In fishes which live in the mud, such as the tautog, the burbot, and the carp, the scales are usually covered by thick layers of epidermis and mucus.

In fishes which swim free and far from shore, such as the herrings and the lake white-fishes, the scales are attached merely by a small area of their rims, and, being but slightly covered with epidermis, are easily rubbed off. Scales thus removed are in many fishes easily renewed.

The smooth polished surface of the closely set scales offers little resistance to the motion of the fish as it glides swiftly through the water.

The exposed surface of the ordinary fish-scale is usually covered with a thin silvery coating, which derives its brilliant metallic lustre from the presence of numerous crystals of a combination of guanin and lime. This coating may readily be loosened and rubbed off, and in one European fish, the bleak or ablette, a member of the carp family, the crystals are sufficiently abundant to become the source of the metallic pigment known in the arts as *essence d'Orient*, or argentine, which is used to impart a nacreous lustre to the glass globules sold under the name of "Roman pearls." When the silvery coating is absent, scales are lustreless and transparent, as in the smelt, the abdominal cavity of which, however, has a brilliant silvery lining composed of the same substance.

CRYSTALS FROM THE SILVERY COATING OF A FISH-SCALE (MAGNIFIED 600 TIMES).

The colors of fishes are very varied, and often exceedingly brilliant and beautiful. "Aucune classe d'animaux n'a été aussi favorisée à cet égard," says Lacépède; "aucune n'a reçu une parure plus élégante, plus variée, plus riche; et que ceux qui ont vu, par exemple, des zées, des chétodons, des spares, nager pres de la surface; d'une eau tranquille et réfléchir les rayons d'un soleil brillant, disent, si jamais l'éclat des plumes du pœon et du colibri, la vivacité du diamant, la splendeur de l'or, le reflet des pierres precieux, ont été mêlés à plus de feu, et ont renvoyé a l'œil de l'observateur des images plus parfaites de cet arc merveilleusement colorie dont l'astre du jour fait souvent le plus bel ornament des cieux."

The colors are often due to a simple arrangement of pigment cells, placed at different depths in the skin; but those changeable and brilliant hues which constitute the greatest beauty of fishes are dependent, as Pouchet and others have shown, upon two very dissimilar causes.

One of these, which may be well observed in the scales of the herring, shad, or mackerel, is a true iridescence, similar to that seen in the pearl or in antique glass, and due to the refraction of the rays of light as they glance off the surfaces of thin plates or ridges in the scales. This is called "lamellar coloring." There are certain bodies called "iridocytes" (rainbow plates) embedded in the epidermis which have an important function, it is said, in this iridescent play of colors.

The coloration is, however, chiefly dependent on the arrangement of the pigment-cells, or chromatophores, which lie in the lower strata of the epidermis. These are black, yellow, and red; the latter, according to Pouchet, being capable of dimorphic changes into blue and green. The combinations of the various-hued chromatophores with the metallic crystals of silver, the white of the bony scale-plates showing through the epidermis, and the iridocytes already referred to, produce the coloration of every kind of fish.

An embryonic fish is colorless; but the pigment-cells of black, yellow, and red soon begin to appear, as is shown in Alexander Agassiz's beautiful plates of the early stages of flounders and other species, published in the "Bulletin of the Museum of Comparative Zoölogy." When the black pigment predominates, the color is sombre, as in the adult tautog, *Tautoga onitis*. A slight admixture of yellow gives the bronze-like hue of the eel, and a little more of the same results in the brighter green of the black-bass, the blue-fish, and the cunner. In all of these there is a sprinkling also of red, giving the warmer brownish greens so often seen in these species. Red pigments intermixed with black give the dingy browns of the carp, the sculpins, and some of the cat-fishes. When the yellow and red outnumber the black cells, there result the tawny colors of the sand-dabs, the sun-fishes,

the cusks, and the ling, and of some varieties of the cod. Red chromatophores alone cause the brilliant scarlet of the red snapper and the rose-fish, and, when these are interspersed with black, the deeper colors of the mangrove snapper and the ruddy variety of the sea-raven. When the chromatophores begin to segregate into separate groups according to color, the result is the formation of bands, stripes, spots, and shadings infinite in their possibilities of mutation and combination, and quite beyond the power of words to describe.

The entire absence of chromatophores results in albinism. I have already called attention to the curious albino haddocks occasionally taken on our coast. Sometimes these are of a light golden color, and are in what Günther calls a state of "incipient albinism," the dark pigments having changed into yellow. This has been observed also in flounders, carps, and eels, and in the gold-fish, which in its native haunts in China is a dull green. The golden orfe and the golden ide have become permanent in a state of domestication. The silver-fish, a form of gold-fish, is an example of still more complete albinism; and a combination of the two conditions is very common in the breeding-ponds of the United States Fish Commission.

The blind-fish of Mammoth Cave, *Amblyopsis spelæus*, is an illustration of permanent adaptive albinism; and in the abysses of the sea, where the light is very scanty, many fishes appear to remain permanently in this condition.

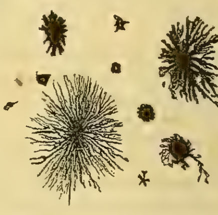
Adaptive coloration seems to be possible in quite another way, through the secretion of pigment-cells, which permanently change the color of the fish to make it harmonize with that of the bottom upon which it lives. On certain ledges along the New England coast the rocks are covered with dense growths of scarlet and crimson seaweeds. The cod-fish, the cunner, the sea-raven, the rock-eel, and the wry-mouth, which inhabit these brilliant groves, are all colored to match their surroundings; the cod, which is naturally lightest in color, being most brilliant in its scarlet hues, while the others, whose skins have a larger original supply of black, have deeper tints of dark red and ruddy brown. These changes must be due to the secretion of a special supply of red chromatophores. It has occurred to me that the material for the pigmentary secretion is probably derived indirectly from the algæ, for, though the species referred to do not feed upon these plants, they devour in immense quantities the invertebrate animals inhabiting the same region, many of which are likewise deeply tinged with red. Possibly the blacks and greens which prevail among the inhabitants of other colored bottoms are likewise dependent upon coloring-matter which is absorbed with the food. Günther believes that the pink color in the flesh of the salmon is due to the absorption of the coloring-matter of the crustaceans they feed upon. Spoonbills and flamingoes lose the brilliant pink tints of their feathers after long confinement in menageries, and it is customary for European zoölogical gardens to send them to the garden at Rotterdam to be recolored. It is not known how this is done, but it is supposed that they are fed upon some red-hued crustacean there obtainable.

The brilliant coloration of many kinds of fishes during the breeding-season may possibly have a relation to sexual selection; indeed, this can scarcely be doubted by any one who has observed the peacocking moments of male fishes. It has also a physiological significance which it is not difficult to comprehend. The increased brilliancy is usually most manifest in those parts of the body which lie close to the reproductive organs, in the belly, which is often flushed and vivid in color, in the ventral fins, and in less degree in the sides of the body and the posterior and lower parts of the head. The entire vascular system is in a condition of extreme activity at this time, as is evident from the manner in which outgrowths of the head and teguments are so rapidly developed. Every pigment-cell is receiving an unusual supply of blood, and its more abundant nutrition is, in part at least, the cause of its brilliancy.

If an abundant supply of blood results in an increase in brilliancy, its withdrawal from the teguments, on the other hand, causes an immediate decrease. I have often watched the large brightly striped "groupers," *Epinephelus striatus*, confined in the crystal fish-pools in Bermuda. When one of these had swallowed a large morsel of food, its color became almost instantly lighter and duller. This was evidently the result of the rush of blood to the stomach, to take part in the work of digestion: in like manner a man's face often becomes paler after he has eaten a hearty dinner.

The dulness and pallor in the color of fishes after death are due to the absence of living blood from the chromatophores. If, however, a fish not long dead is placed in the sun, its color will soon become almost as deep and bright as in life. In a few seconds it fades again, and cannot again be brightened.

This phenomenon leads to the consideration of another peculiarity in the arrangement of the pigment-cells, which renders rapid changes in hue possible in certain species. In these the pigments are associated with oily matter, and are arranged *areolæ*, which favor their approach toward or retreat from the surface of the skin. The accompanying diagram, drawn by Professor Benecke, shows how they may sometimes show as small, irregular spots upon the skin, and soon after become conspicuous star-shaped markings with far-reaching arms. Such changes may be effected by stimulation of various kinds, and even by the reflex action of the nerves under the influence of impressions of color received by the eye of the fish.



CHROMATOPHORES VARIOUSLY EXPANDED.

Every angler knows that trout inhabiting stagnant pools or dark bottoms are deep-colored, while those from deep, sunny waters are brighter. The same is true of many other fishes. I have often seen the common flat-fish change its color to that of the gravel and sand in which it was trying to hide, the hue varying as rapidly as that of the landscape when the sunlight is suddenly cut off by a passing cloud.

These changes of color are directly connected with the impressions of color received by the eye, and brought about by the reflex action of the nervous system. In no other way can changes such as those already referred to in flounders be accounted for. I have seen the tropical squid in Bermuda change color rapidly, and at will, while being pursued. This was evidently through the influence of emotion or fear, since it can hardly be supposed that there was definite purpose in the act; which, however, seemed at first sight to be intended to baffle its pursuers.

Pouchet experimented with young turbots, and found that if their eyes were blinded they did not change, thus proving that the color-cells were under the control of the

nervous system. Day records that young hybrid salmon raised at Howietoun, in which vision was more or less deficient, were observed to be generally lighter in color than their fellows.

The fishes of the sea are more often brilliant than those of the river or the lake. Warmth and light are favorable to brightness and variety of hue. The fishes of circumpolar regions, and those living at considerable depths, are therefore usually sombre, though occasionally they have iridescent scales or plates of great brilliancy.

In temperate regions, as along the coasts of the United States, sombre tones are most common, but in summer many sunny-hued strangers come up from the south.

In the tropical seas, however, the greatest beauty is to be found; and in some groups, such as the parrot-fishes and the wrasses, the most bizarre and astounding combinations of masses of brilliant color. Harsh and inharmonious as they seem, however, when imitated by the brush, they are never unpleasing in the living creatures. The West Indian fauna has many wonderful fishes,—such as the angel-fish, *Holacanthus ciliaris;* and the Spanish lady, *Bodianus rufus*,—but the utmost possibilities of beauty are to be found only in the Southern Pacific and the Indian Oceans.

As Count Lacépède has so eloquently shown in the passage already quoted, no class of animals has been so richly endowed with color as the fishes, except it may be the insects; and the effect of brilliancy in a fish is much greater on account of its larger size. Birds appear at a disadvantage in comparison, because, except in the metallic patches on the throats of the humming bird and a few similar instances, the surfaces of their feathers are not so well adapted to display as the broad burnished sides of fishes, kept constantly moist and lustrous by contact with water.

The beauty of fishes can only be known to those who have had the good fortune to see them swimming at ease, bathed in the limpidest of water and the brightest of sunshine. Aquaria are always dark and gloomy, and their glass walls seem more prison-like than the bars of a menagerie-cage. Museum preparations do not tell of the vanished beauty even so well as the lifeless bodies of the fishes themselves, and every angler knows how suddenly the dead fish loses its attractions of texture and color. This change has been well described by Dr. Badham in the following lines:—

"While blazing breast of humming-bird and Io's stiffened wing
Are bright as when they first came forth new-painted in the spring,
While speckled snake and spotted pard their markings still display,
Though he who once embalmed them both himself be turned to clay,
On fish a different fate attends; nor reach they long the shore
Ere fade their hues like rainbow tints, and soon their beauty's o'er.
The eye that late in ocean's flood was large and round and full
Becomes on land a sunken orb, glaucomatous and dull;
The gills, like mushrooms, soon begin to turn from pink to black:
The blood congeals in stasis thick, the scales upturn and crack;
And those fair forms a Veronese, in art's meridian power,
With every varied tint at hand, and in his happiest hour,
Could ne'er in equal beauty deck, and bid the canvas live,
Are now so colorless and cold, a Rembrandt's touch might give."

G. Brown Goode.

NATURAL HISTORY GARDEN AND AQUARIA FOR BOSTON.

At the meeting of the council of the Boston Society of Natural History previous to that held on Wednesday last, it was voted to recommend to the society, at its meeting of April 2, a resolution to the effect, that, in pursuance of the policy recorded in the vote of March 28, 1888, and adhering to the conditions therein required, the society authorizes the council, as soon as one-third of the final sum required for the establishment of its natural history garden and aquaria has been raised, to proceed with the establishment of the aquarium at City Point, in accordance with the plans laid down in the letter to the park commissioners of Dec. 31, 1889, which has received their approval. These plans will be best understood from this letter, which is in substance as follows:—

The Society of Natural History have been earnestly and constantly engaged in work upon matters connected with the foundation of natural-history gardens, since the receipt of the last letter of the commissioners, dated Dec. 30, 1887, and have finally concluded to offer the following as plans of what they deem to be best, hoping, if these are accepted, to follow up this first step very rapidly, so as to bring the matter speedily before the public. They propose to designate all the collections of living animals under their charge as the "Natural History Gardens," and to establish under this title three different divisions,—one to be called the "Marine Aquarium;" a second, the "Fresh Water Aquarium;" and the third, the "New England Zoölogical Garden;" these to be situated on grounds and to have buildings such as may be mutually agreed upon by the commissioners and by the society, in accordance with the provisions of the letter of the commissioners above referred to.

In compliance with the request of the park commissioners to present a statement of the proposed policy of the society in regard to the exhibits at the places designated by them,—namely, at City Point, near Jamaica Pond, and at Franklin Park,—the council offer for consideration the following general statement, and the outline of their plans with reference to each of the three divisions.

The attention of the commissioners is invited at the outset to the scientific and educational character of the plan of the Natural History Gardens. The three divisions of this department of the society's work, when regarded as a whole, form a connected series of exhibitions, which will, it is hoped, illustrate, more completely than has ever been done before, the relations of organisms to the four great regions of their distribution,—the sea, the fresh water, the land, and the air. The principle underlying the whole, and to which each part, however small, has been made to contribute, is the illustration of the relations of plants and animals to their surroundings. The council believe that a full exposition of the laws governing these correlations is the fittest use they can make of the opportunities offered by the commissioners, and the most valuable contribution which they and the commissioners acting together can bring to the cause of public education.

I. Marine Aquarium.

In the maps of the proposed Marine Park the lands and ponds assigned for the use of the society are admirably suited for the purposes of a large aquarial garden; and the council desire to express their satisfaction with these indications of the intentions of the commissioners, for they confirm the council in the opinion that it will be practicable to found a marine aquarium at this place which will be of unique excellence as an instrument of popular interest and education.

1. A collection of living organisms arranged and exhibited for the illustration of natural laws has a fuller effect if the minds of the students and visitors have been prepared by previous study, or, in place of this, if they have at hand a brief explanation of the general structure and relation of animals and plants to each other and to their surroundings.

The society propose to supply this explanation by means of an epitome collection, which, with a printed guide, shall explain the structure and relations of the more important subdivisions of animals and plants, the general adaptations of the structure of organisms to an aquatic existence, and the fact that under ordinary conditions, however diverse, the organisms retain their typical structures. This collection would consist of two classes of objects,—(*a*) a series of representative forms, including the principal types of animals and plants; (*b*) such general dissections and other anatomical preparations of selected types, accompanied by diagrams, as may enable the observer to grasp the fundamental points of the structure, physiology, and correlations of the animal

kingdom, but with special reference to those living forms which constitute the whole aquarial exhibit. These collections, being an introduction to the larger display, should occupy one room, serving also as the vestibule or entrance-hall in the main building.

2. The correlations between certain structures and parts in animals, and their habits and natural surroundings, can be illustrated by placing plants and animals that live on muddy, sandy, gravelly, or rocky parts of our own shores in separate aquaria, properly arranged and furnished. The suitability of organisms to the work they have to do could be illustrated in this and other ways, and clear ideas of one of the fundamental laws of organic modifications presented to intelligent visitors and students.

3. The extraordinary modifications which have taken place in the structure of the descendants of air-breathing land animals, in order to fit them for life in the sea, would be illustrated in the aquaria and also in the salt water ponds. These would be used for such seals, cetacea, and other marine animals as are either too large to be accommodated in tanks in the buildings, or which can be most appropriately exhibited in such enclosures. Adaptations equally fitting and instructive are found in birds which live upon the sea or its borders; and examples of these forms would be shown in the same ponds, or in appropriate places upon their margins.

4. It is well known that the distribution of plants and animals is limited more, perhaps, by temperature than by any other single cause. It is practicable to illustrate this great law of distribution with suitably constructed and properly arranged aquaria, stocked and kept supplied with animals and plants taken at moderate depths upon our own coasts. The problems connected with obtaining and handling animals gathered at great depths present difficulties with which no garden should attempt to cope until it is completely organized.

5. Faunal collections would compose the greater bulk of the marine aquaria. It is intended to group these together in such a way as to represent the association of the forms in their respective habitats. No attempt, of course, would here be made toward systematic grouping, but very dissimilar forms would be associated together, bringing prominently into view the geographical distribution of types. In one room of suitable size aquaria would be devoted solely to the marine plants and animals of the North Atlantic, from Cape Cod northward. As a part of this collection a series of aquaria would be maintained for the exhibition of the commoner plants and animals occurring on the coast of Massachusetts. These forms could be permanently supplied, and, being named and described in a proper guide book, would be of great interest to all persons living on the seashore. The fauna south of Cape Cod is in large part easy of acquisition, and could also be well represented in separate series of aquaria. The fauna south of Cape Hatteras and that of the western coasts of the United States, and other faunas, could also be exhibited, as opportunities presented themselves, either to a limited degree or more or less extensively, if the future progress and success of this division warranted the extension.

II. Fresh Water Aquarium.

It is obvious that an epitome collection is as desirable for the explanation of the relations of fresh-water plants and animals as of the marine.

1. The society would therefore form an epitome collection similar to that planned above for the Marine Aquarium; but this would necessarily differ in the details of its composition, fresh-water plants and animals being used instead of marine types. The adaptations of the structures of organisms to an aquatic existence would be exhibited by means of preparations of the gills, etc., as in the corresponding marine collection; but special adaptations to a fresh-water existence—such as the mode of reproduction of sponges, bryozoa, and some crustaceans by means of winter buds; the effects of desiccation upon some of these, and their mode of transportation from pond to pond; the contrasted structures of corresponding fresh-water and marine shrimps; the peculiarities of the batrachians, showing the transitions from a purely aquatic to a terrestrial type; and similar classes of facts—would be prominently illustrated. The fresh-water faunas of the globe are all secondary, or derived mainly from the marine faunas. This can also be approximately demonstrated in the epitome collection by placing side by side a certain number of marine and fresh-water animals in series or in pairs, including occasionally some fossils, in order to compare the existing *Amia*, gar pikes, etc., with their marine but now extinct ancestors.

2. Some of the most important results of research bearing upon the evolution of organisms have been attained by means of experimentation, and it is of the greatest importance for educational purposes that illustrations of such facts should be made accessible to teachers and students. The council would therefore aim at the repetition of some of these experimental observations, and make permanent exhibitions of the results. For example: a series of aquaria could be maintained, showing the gradual modification of the brine shrimp in passing from a saturated solution of salt, through ordinary salt and brackish waters, to a final lodgement in purely fresh water, where it becomes transformed into a well-known fresh-water type of crustacean; another series repeating Semper's experiments upon the snail, *Lymnœa stagnalis;* and still others showing the results of experimentation upon the development of the axolotl, salamanders, etc. This department would also include aquaria for the exhibition of the animals and plants now living in mineral or hot springs, the Caspian and Dead Seas, and other anomalous and more or less isolated positions, such as caves and subterranean rivers.

3. Fresh-water plants and animals are not wholly derived from the sea: many of them are modified descendants of terrestrial organisms that have changed their habitat and become suited to an aquatic existence. Some of the ponds would be used to exhibit this important fact, since in them the larger air-breathing animals that live on or in the fresh waters—such as the swimming and wading birds; the batrachians (frogs, salamanders, etc.); the reptiles (snakes, turtles, and alligators); beavers, muskrats, and possibly larger representatives of the mammalia from the tropics, such as the hippopotamus—could be confined. Some of these ponds would also be devoted to the exhibition of the *Liliaceæ* and other plants, which, although originally truly terrestrial and flowering plants, have become more or less modified and fitted for aquatic life. The huge leaves and flowers of the *Victoria regia*, and the lovely color of many of these annuals floating upon the glassy surface of the water, and framed in a shore growth of rushes and grasses, would form pictures of rare beauty and attractiveness.

4. Insects, although as a whole purely terrestrial and aerial, contain a number of groups that pass either a portion or the whole of their lives in water. An insectary would therefore be established, furnished with aquaria, placed in the midst of suitable plants, and surrounded by ample cages of netting for the confinement and display of the adults after they have passed through their transformations and have begun to fly. This part of the exhibit could be made exceedingly instructive by means of a printed guide, explaining the transformations of the insects shown in the aquaria and cages.

5. The fauna of our own fresh waters is apt to strike one at first as uninteresting: but it contains sponges, especially interesting to the public on account of their effect on the water-supply; many microscopical plants that can be cultivated in masses, so as to be seen by the unassisted eye; large bryozoa, such as *Pectinatella*, growing in heads like a brain-coral; bivalves and snails of respectable size; several interesting species of batrachians; and many fishes of remarkable structure and habits. The council would therefore bring together a series of aquaria exhibiting the animals of the fauna of New England and eastern Canada, and also keep in view the idea of explaining their more obvious relations to the water-supply of our cities. The fauna of the inland waters of the western and southern parts of North America is accessible, and should be shown, in so far as the more prominent forms are concerned, in a separate series of aquaria. Opportunities will perhaps be offered in the future for the acquisition of the larger and more interesting organisms of other faunas. These can be exhibited, provided the future success of this division justifies an extension of the plan.

III. New England Zoölogical Gardens.

The grounds at Franklin Park assigned by the commissioners for the use of the society are suited only to the third division of the Natural History Gardens,— the higher vertebrates or the larger terrestrial and aerial animals; and here, better perhaps than anywhere else, would it be possible to carry out one of the favorite projects of the supporters of the society, namely, such exhibitions as would familiarize the observer with the animals of New England. For in Long Crouch Woods is to be had not only a characteristic fragment of New England scenery and rock structure, but, by the limitations of the surface and of the territory, it would be impossible to make there any extensive display of foreign forms.

1. The council would exhibit fully the animals of the north temperate zone of the New World, limiting this zone to about eight or ten degrees of latitude on the parallels of New England, and thus display those which one might see at any point within the northern United States. All these animals could be cared for in such a place at the minimum expense, for their habits in a wild state have accustomed them to brave all the severities and vicissitudes of our climate. It being easier to obtain and to maintain the animals of this zone which are nearest home, it would follow that the great bulk of the collection at all times would be made up of animals characteristic of New England. But as thus one of the prime features of life upon the globe is necessarily touched upon,— its geographical distribution,— so may the lesson be made far more telling if to this assemblage be added just those animals (and no others) which in other faunas specially represent animals indigenous to New England. Thus, to instance one or two points, the council would exhibit side by side with the Rocky Mountain goat the chamois, structurally allied, adapted for and dwelling in similar mountain regions, characteristic of the Old as our own is of the New World; beside the cougar, or American panther, they would display the jaguar of South America; beside the black, the brown bear; while to correspond with the opossum, they would seek a relative, not in the more nearly allied marsupials of South America, but in the distinctive home of marsupials, among the strange forms which occur in Australia. As it would not be necessary to seek this counterpart for each animal, but in many cases only one for an entire series, as with the mice, hares, foxes, and so on, it will be seen that the collection would not be very largely increased, while its increase would be strictly limited, and its educational value greatly enhanced. It might be desirable to extend the collection in one or two instances; but in these only in the case of great groups, not represented in our own fauna, such as the ornithorhynchus of New Holland, and one, possibly two (or even three), of the quadrumana. Under such restrictions, which seem to be absolutely required by the extent to which the grounds at this point are limited, there would be a coherency and meaning to the collection which it would be difficult to find duplicated elsewhere, and it would be a means of exhibiting the characteristic features of the New England fauna and its relationships not easily accomplished in any other way.

The principal difficulty in carrying out even this limited plan is the insufficient surface suitable for such an exhibition. This is nowhere more manifestly true than as regards the ruminants; for within the limits of Long Crouch Woods itself it would be entirely impossible to display in any pleasing or profitable manner those largest forms among our quadrupeds which excite, perhaps, greater interest than any other,— the bison, moose, elk, caribou, deer. For this purpose it is absolutely essential that more ground be had, at least so far as a range is concerned. And this it is hoped the commissioners will grant whenever needed, perhaps in the ground which has been set apart as a deer-park, in which it would be quite possible, by lines of wire fence practically invisible, to separate such bands as could not be brought into a common enclosure.

2. What has been said thus far relates principally to the terrestrial animals. Another mode of exhibition for the freer-moving, aerial creatures may be advantageously pursued. Thus it might be possible in a series of outdoor aviaries, sufficiently large to enclose good-sized trees, to bring together at their proper periods the characteristic summer or winter birds, so that one might see for himself what was the avifauna of New England at any given time. In others might be placed, as a permanent exhibition, such of the native breeding birds as would bear association, where they might find room enough, and suitable places, for all purposes of nesting and bringing up their young. The headlong flight of some birds might prevent their exhibition here. Similar aviaries for the exhibition of birds found in our north temperate zone west of New England should be placed side by side with those of New England itself; while the exhibition of foreign birds for comparative purposes, limited in the same way as those of the less freely moving vertebrates, would be more naturally disposed in the mode common in foreign gardens.

3. Long Crouch Woods, then, would be *par excellence* a New England exhibit; and such a display would naturally lose much of its interest in the winter time. If, however, there could be combined with this a winter garden situated in Sargent's Field, adjoining, cost alone would prevent it from becoming so attractive as to make it a constant place of resort at all times, and particularly during the colder months of the year. Here, in a large but simple structure of glass and iron, handsome rather in its proportions than through decorative attachments, warmed so as to have a very constant but not too high temperature throughout the winter, one would walk upon the unfrozen ground in a garden where varied and luxuriant vegetable forms would enable him to imagine himself in the midst of the tropics. The loftier vegetation, like the bamboos and certain palms, could be grouped in a higher central portion; while miniature ponds and fountains, reached by winding walks, would everywhere afford special nooks for aquatic or spray-loving plants. This could be enlivened still further with a very few of the more brilliant-plumaged birds and songsters in aviaries, aquatic birds on the ponds, and with here and there an enclosure containing some small creature, specially pleasing by its form or attractive by its habits,— a gazelle, a jerboa, perhaps a spider-monkey; a chameleon, a Surinam toad, or a garter-snake. The possibilities of such a scheme are fascinating; and the structure should be so arranged and situated that extensive additions could be made to it, and that it could be approached directly by conveyance to the door. An ordinary greenhouse would, of course, be necessary as an adjunct of the winter garden, for forcing plants for ornamental purposes.

4. An insectary should be built; and, both for economic reasons in construction and heating and for the convenient proximity of the necessary food-plants, it should be an annex to the greenhouse. Colonies of striking and curious insects, especially the social insects, undergoing their transformations, might be exhibited in a small, single-storied structure of glass and iron, like an ordinary conservatory, with no more flooring than would be required for passageways between the plants and shrubs. Such a collection would be inexpensive and attractive, and, without in any way curtailing its public use, would afford ample opportunity for scientific experimentation of an important kind. Pedigree breeding, for instance, or breeding in constant temperatures, whether high, low, or average, might here be carried on upon a large scale. Indeed, the opportunities are so great that the choice of subjects would be difficult, so many would claim attention; and it would be quite possible to display a changing round of attractive and instructive sights from week to week throughout the year.

The educational use that can be made of these three different divisions of the Natural History Gardens, forming one connected whole,—one in principle, but varying in details to suit the special needs of each division, and the adaptability of the separate locations,—will undoubtedly meet the requirements of the present, and also give the necessary freedom for enlargement or modification needed by future generations. It will be seen, also, that the New England element enters into each division in varying proportions, as circumstances permit, and to the greatest degree where the objects concerned are more commonly known, being most developed among the higher animals, with which, from their size and their relations to man, the public is more familiar.

The difficulties which surround the whole project,—in many

respects so novel as to offer no precedents, wholly new to those on whom the burden of the execution of the plan must fall,—as well as the great expense of the undertaking, have been subjects of long and thorough consideration by the council. These difficulties account for the delay in replying to the last communication of the commissioners. Their deliberations have finally brought the council to the assured conviction that it would be neither feasible nor wise to attempt to begin the three proposed divisions at the same time; and yet it is obvious that the work of the society in building up the department of Natural History Gardens should not be delayed. Although the sites proposed for the Marine Aquarium and the Fresh Water Aquarium will not be ready for occupation for some time, nevertheless it is the unanimous opinion of the council that the undertaking should begin with the Marine Aquarium. The proposed site of this division, the less proportionate expenditure for installation and maintenance, and its general interest to the public, combine to make it likely that it can be made a financial success, and thus contribute to the foundation and maintenance of the other departments

In order to meet these difficulties and make a beginning without unnecessary delay, the council suggest the propriety of starting a temporary marine aquarium on grounds already under the control of the commissioners, and therefore respectfully inquire of the park commissioners whether the establishment of a temporary aquarium at the Marine Park in South Boston would meet with their approval; and, if so, what part of the grounds and water-front now at their disposal could be allowed the society for that purpose.

The pumps, piping, and specimens would of course be serviceable for removal to the buildings and grounds of the permanent establishment; and, if thought advisable, it might be practicable to construct even the temporary building so that it could be taken down and rebuilt in another place, or easily removed to a new site.

A temporary garden of respectable proportions would require only a limited sum for buildings and machinery, and would probably prove remunerative; the society could also begin operations sooner, if a limited sum devoted to such uses could be asked for; and they could thus effectively start the work of exciting public interest in favor of their plans for the establishment of a fresh-water aquarium and a New England zoölogical garden, and probably advance with surer steps toward the establishment of these two divisions of the Natural History Gardens.

In view of these considerations, the council of the Boston Society of Natural History ask the approval of the park commissioners to the following proposition: namely, that they shall be allowed to begin operations as soon as they have raised a third part, more or less, as may be needed, of the proposed sum of two hundred thousand dollars, for the purpose of erecting and equipping a building for a temporary aquarium at Marine Park, on land to be granted by the commissioners of parks; said sum to be ultimately incorporated with the two hundred thousand dollars to be raised by the society for the establishment of the Natural History Gardens, but for the present, and as long as the temporary aquarium exists, to be considered as belonging to an independent foundation.

Little has been said about buildings in this communication, because it has been considered essential first to settle what the council as scientific men and the commissioners in their official capacity, both being equally interested in the cause of public education, would deem it best to do; and, second, because in all such undertakings the true basis should be sought in the exposition and teaching of principles. As will be seen, however, by all those who have followed the history of this undertaking, the plans have been made with due consideration of the advantages offered by the localities proposed for the three divisions; and their unique character and extent are fully justified by the unequalled opportunities offered by the commissioners for the founding of these great institutions, devoted to the entertainment and instruction of the people in the system of parks under their jurisdiction.

We hope to publish next week some account of the action taken by the Boston Society of Natural History at its meeting on April 2.

STAMMERING.

In the *Provincial Medical Journal* of Feb. 1, 1890, is an anonymous letter from a physician, himself a victim to this unpleasant habit, which contains so many points of practical interest that portions of it are here reproduced from the *Medical Analectic*.

"Having lately received several circulars from different professors who advertise their secret methods for the cure of stammering, I have thought that a personal experience might be of interest and value. I shall not attempt a learned physiological analysis of the nerve-centres and nerves involved in the different muscles, and sets of muscles, in stammering, but rather aim at a simple statement.

"Since twenty years of age, I have been, though not wholly, yet fairly free from the trouble. In my earliest remembrance of speech, and all through my boyhood, I was a terrible stammerer. I have only heard of two epileptics in my family,—one a woman, a first-cousin; the other a boy, a second-cousin,—both on the father's side.

"The occasions on which I have stammered for thirty years past, and yet stammer, are about as follows: from habit acquired in travel, and in India, and to save the legs of the maid, I prefer to go out of my room, and call to the maid for what I may want. For two years I had a favorite maid called Mary. It was in vain for me to attempt to call out 'Mary!' My lips would compress, the upper teeth seizing the flesh inside the under lip. The word would not come without extreme and painful effort. But there was one way towards perfect relief: I always called 'O Mary!' i.e., I placed a vowel-breathing before the consonant, and thus unlocked the complex and inharmonious co-ordination of brain, nerve, and muscle involved in the production of *m*. In reading a lecture before a public audience, a terrible word is 'method.' Within the last ten years my upper teeth have made wounds inside the under lip in getting out this word. I naturally avoided the ridicule of inserting a vowel-sound before an audience. Another occasion on which I am still constantly bothered is in saying 'good-morning,' as I am shown out of a front-door by master or maid: something unduly glues my tongue over the *g* in 'good.' I get over this difficulty by bringing into operation another mental act, and the action of a different set of muscles, by the act of lifting my hat. I can say 'good-morning' without stammering while in the very act of lifting my hat. Here the same principle is involved as in putting a vowel before *m*: spasm of certain muscles is relieved by diverting nerve-energy to other channels and other muscles. Again: if I feel that I am about to stammer in any word, I try to substitute another word. Often in public reading, if I avoid the difficult word by some substitution, the same difficult word may recur many times, and I can speak it with little or no difficulty.

"If I am reading a lecture in public which is legibly written, and if I have previously read it aloud to myself, I shall stammer little or not at all: in other words, I do not stammer when the nervous system is calm. Similarly, if, speaking in a public discussion, I confine my mind to one simple point at a time, I do not stammer; but if the mind, in its active tumultuousness, sees too much or too widely the other possible relatives of the subject, and a fear of want of clearness comes over the mind, then my speech is full of stammering.

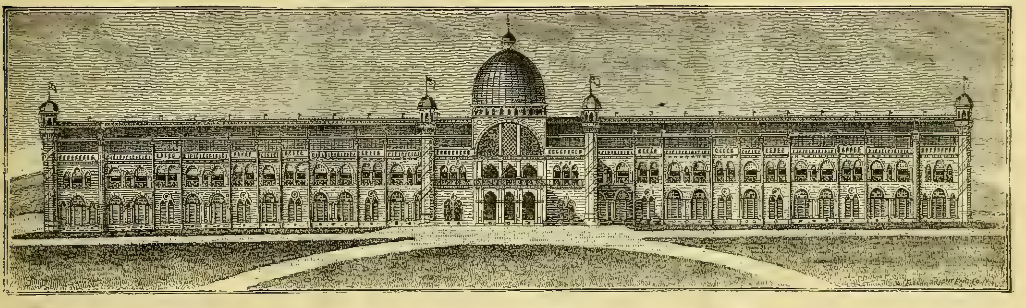
"The points which have seemed to me important toward avoiding stammering are to seek nervous calmness. If this be not attainable by the will, the sufferer can do something to divert the *præ* or present spasms; such as drawing in the breath, always keeping the lungs well filled with air in speaking, walking up and down the room, moving other parts of the body by an act of will, taking up a book or ornament, etc. I have made it a strict rule never to seek to force myself to say the difficult words, but stop and use another word or substitute some other words immediately preceding the difficult one. The sufferer should read aloud when alone both poetry and prose. Stammerers rarely stammer in reading poetry aloud when alone: the mind and nerves by poetry are induced into harmonic rhythm

just as they are by dance-music, and irregular action is prevented. The words which the stammerer finds most difficult when in society, he will find easy enough, especially in poetry, when reading aloud in his chamber. I do not think that he should practise on these words except when alone and in the most calm way: he needs rather to read naturally as it comes, to forget that he stammers, and, by practice of natural reading and speaking aloud when alone, to educate the just co-ordination of the nerves, etc. I found it best to walk to and fro in my chamber while reading aloud."

JAMAICA INTERNATIONAL EXHIBITION, 1891.

WE again would call attention to the international exhibition which will be held in the Island of Jamaica in January, 1891, under the auspices of the Government of Jamaica. The exhibition building, shown in the illustration, is 511 feet long, with a transept 174 feet in length. The breadth across nave and aisle is 81 feet, and the height is 59 feet

In view of the very considerable and increasing trade between the United States and the West Indies, the committee have appropriated a large space for American exhibits, and consider this an opportunity which those who are interested in introducing American manufactures and extending the export trade of the United States should not fail to take advantage of. No charge will be made for space in the exhibition buildings, nor will duties be levied on any of the exhibits unless sold in the island. The geographical position of the island and the salubrity of the climate will undoubtedly attract a large number of visitors from the neighboring islands and South and Central America, as well as from the United States. There is constant and regular communication by steam between New York and Jamaica, and the island is also connected with the United States by cable. In addition to the present accommodations for visitors, a large hotel has been recently erected and opened near the exhibition grounds, under American management. The railroad system of the island, which has been recently taken over by an American company, is rapidly being extended. The regulations of the committee, and full information as to the mode of shipment, rates of freight, and marking of exhibits, and all other particulars as to the scope and object of the exhibition, will be furnished by the secretary to the committee for the United States, Thomas Amor, 280 Broadway, New York.



JAMAICA INTERNATIONAL EXHIBITION BUILDING.

NOTES AND NEWS.

THE next annual meeting of the American Society of Microscopists will be held in Louisville, Ky., Aug. 12 to 15 inclusive. There is such activity on the part of the officers of the society, and such interest has been shown by many Southern microscopists, that a large meeting is quite assured. An interesting programme will be perfected and a pleasant entertainment provided, so that those who attend may combine relaxation with profitable work.

— The following notes on icebergs and field-ice in the North Atlantic have been prepared principally from information obtained by Ensign Hugh Rodman, U.S.N., during his recent trip to Halifax and St. John's. By January the body of the ice interfered seriously with transatlantic navigation, and its general southern limit was found in latitude 45° north, longitude 48° 30′ west. By February it had reached latitude 42° 30′ north, longitude 49° 30′ west, and at present it is in latitude 41° 30′ north, from 50° to 56° west. This extreme southern position, in January, is about two months in advance of the average. The Dundee whalers that passed last summer in Greenland waters reported, on their arrival home in October and November, a very open season in the Arctic, with more bergs than had been seen in previous years. By August and September these bergs had reached the coast of Labrador, and were seen in great numbers in their regular southerly drift in the Arctic current. This would account for their appearance near the transatlantic routes in December and January. The past winter has been the most severe, both as to temperatures and winds, that has been experienced for years in Labrador and Newfoundland. Ice in the Gulf of St. Lawrence has rendered navigation in those waters impossible, and the outflow to the southward through Cabot Strait has sent large fields of heavy ice in almost a continuous stream to the southward and westward since January. Much of this ice is four or five feet in thickness, rough, rafted, and closely packed. Field-ice, especially when rough, is more affected by wind than by current, while with bergs the reverse is the case. From this it is evident that the drift of the bergs could have been foretold some months ago, had early reports been received; while the drift of field-ice can best be predicted by telegraphic or other reports that come in promptly to a central office, where weather-charts are at hand to indicate the force and direction of the wind. Following the ice made on the Labrador and Newfoundland coasts comes the Arctic field-ice, heavier and more dangerous than the former, and its arrival is daily anticipated. The quantity of field-ice to the southward of 44° north will probably grow less from this time on, though vessels entering the fields should keep a sharp lookout for heavy, deep-blue, low-floating pieces of ice, called "growlers," that appear as fragments of bergs, or the advance pieces of Arctic ice: these mingle with the coast-fields at this time, and are especially dangerous, as they are hard to distinguish. Through the exertions of the Hydrographic Office, co-operation has been effected with the lighthouse service of Newfoundland, from which monthly reports of ice and weather will hereafter be obtained; with the sealing fleet, which will probably first sight Arctic field-ice; with a number of whalers who spend each summer in the Arctic; and with the Labrador and Newfoundland fishing-fleet. From these sources, and with a hearty co-operation of masters of vessels sighting ice at sea, there seems to be no reason why, in future, the position of the ice cannot be predicted by the Hydrographic Office with still greater accuracy than hitherto.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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MENTAL SCIENCE.

The Time-Sense.

A great deal of experiment and discussion has been expended upon the means by which we estimate time-intervals. Different observers have obtained quite opposite results, and the entire problem seems to become more complex as study is expended upon it. The usual form of experiment consists in reproducing various intervals, as produced by the beats of a metronome or otherwise, as accurately as possible under different conditions. The difference between the true interval and the average of the reproduced intervals is then calculated, and measures the constant error; while the average deviations of the several reproductions from their mean measures the variable error. The intervals thus tested were usually very brief ones, rarely being as long as a minute. On the other hand, we have an idea of time from the relative filling-out of the interval with mental experiences. A time during which much has happened seems long: one during which little has happened seems short. The latter may be regarded as a truly mental mode of estimating intervals; but it will be readily seen that it is only roughly approximate in character, and is not applicable to such small intervals as those usually experimented upon. What, then, is the means by which we gain our notions of the duration of these short artificial time lengths; such, for instance, as we employ in music and other rhythmical occupations? This is the problem that Dr. Münsterberg has recently studied in quite an original way.[1] His reflections upon the matter led him to the opinion that for these brief intervals we have no time-sense in the strict sense of the word, but that our estimates depend upon the feelings of tension, of arrest or delay, of ordinary physiological functions; and according as the end of the interval comes upon the rise or the fall of this tension-wave will a time-interval change its character. It is rather difficult to more accurately specify the subjective feelings which one experiences in waiting for intervals or in following them, but one factor most readily observed is the variation in breathing. We have all had some experience in the change of the breathing-rate under different emotions. Breathing, too, being one of the most constant bodily rhythms, it is not improbable that this affects our notions of time. To test this, Dr. Münsterberg arranged his apparatus in the usual way, first giving an interval varying from 6 to 60 seconds, and then having the subject mark off an interval equal to it: the average error in so doing was 10.7 per cent. He now had the experiments so arranged that the second sound, closing the original interval, came at the same respiratory phase as the first or opening sound of the interval: then the error was only 2.9 per cent. In this series the sound closing the original interval was at the same time the sound opening the reproduced interval. In a following series of experiments each interval had a separate opening and closing sound. When no attention was paid as to the concurrence in the respiratory phase of the opening and closing sounds, the error was 24.0 per cent, while when this was taken into account the error was only 5.3 per cent. In a third series the attention was purposely withdrawn from the respiratory and tension feelings, and the time judgments became utterly confused. While these experiments are too few to be taken as at all decisive, they certainly suggest a very interesting field of research, and, furthermore, open out some possibility of explaining the various results of different observers.

Visual Space Measurements.

The sense that above all others gives us our knowledge of extension in all the dimensions of space is the sense of vision; but, as we approach the problem more carefully, we see that there are several modes of perceiving sensations of length by the eyes. There is, first, the passive impression of a length upon the retina, which is analogous to the impression on the skin when an object, such as the edge of a ruler, is in contact with it. In both cases it is very essential to the notion of extension thus formed on what part of the skin or the retina the image is impressed. There are finely and coarsely sensitive portions of both skin and retina; and the general law is, that the same amount of objective stimulation will give a more extended sensory effect upon the more finely sensitive surface. The centre of the eye is by far the most sensitive portion, and hence we habitually turn the eyes so that the object to be seen falls upon it; and it is the space-sense of this portion of the eye that is usually tested. We have, again, the perception of space from the muscular effort needed to move the eyes so that the beginning and end of the length shall successively fall upon the fovea or central spot. In both these cases we must, to complete our estimate of length, take into account the distance of the object from the eyes; for size and distance are inversely dependent upon each other, and each becomes inferrible only when the other is known. Again, we have two eyes, which we ordinarily use together, but which we can use separately. The distances judged may be varied to an equal extent; they may be of any stated length within ordinary limits,—may be complete continuous lines, a series of points, or simple terminal points marking off a distance between them; they may be horizontally, vertically, or diagonally arranged; they may be symmetrically or asymmetrically situated with reference to the central axis of the eyes; and so on. It is evident, then, that we exercise our power of estimating distances by the eye in a large number of complex ways, and that to introduce system into the problem of how these estimates are made it is necessary to test the space-sense of the eye under different and definite conditions. This Dr. Münsterberg[1] has recently attempted by the following method. Two small squares of cardboard are seen on a green ground with a

[1] H. Münsterberg, Beiträge zur Experimentellen Psychologie, Heft 2.

distance varying by 10 millimetres, from 10 to 200 millimetres. and the attempt is then made to set another pair of squares at an equal distance apart under the most varying conditions, the average constant error and the average variable errors being carefully calculated in each case. Of the very many points arising from the 20,000 observations thus made, only a few can be here noticed. A striking result is, that no difference, however slight, in the method of viewing the lengths, is without its effect upon the accuracy with which a distance can be reproduced All the variations above noticed were tried, and showed a difference in the accuracy of reproduction, though of course some of the variations have much less effect than others. Quite a constant result with Dr. Münsterberg is an overestimation of distances on the left, and an underestimation of distances on the right. This he explains as due to the constant practice, in reading and writing, of moving the eyes from left to right. This results in making this movement easier, and, according to the general law, the movement made with more effort will seem the longer. If, then, the eye is forced to start at the middle of the length, and move towards each side, the space on the left will seem larger than that on the right. When the distances are reproduced by each eye separately, distances on the right are overestimated by the right eye, and on the left by the left eye. This is probably due to the greater ease of each eye to direct the gaze towards the common field of vision. If an interval elapses between the sight of the standard length and its reproduction, the accuracy is much diminished, and the lengths are generally overestimated, especially the smaller ones. If the original and the reproduced lines occupy the same positions, the error is least. Broken lines seem too long, as is the usual illusion. Vertical distances are overestimated as compared with horizontal ones; but this only when the vertical is above the horizontal, and the eye is free to move. All this refers to the constant error. Regarding the variable error, which measures the uniformity of the reproductions, it is very much larger when the eyes are fixed than when they move freely. This is due to the increased accuracy of the muscle-sense over the retinal sense of space, as well as to other causes. The law holding in many other kinds of sensations, that the error depends for its absolute size upon the length reproduced, seems to hold of space-sensations, but is probably a law of the motor adjustments rather than of the retinal sensibility. These selected points must suffice to indicate the scope of this very extended and critical research.

HEALTH MATTERS.

Insanity in Australian Aborigines.

IN a paper read before the Intercolonial Medical Congress of Australasia, Dr. Morton Manning, the inspector-general of the insane in New South Wales, gave a most interesting account of the cases of insanity found to have occurred among the aborigines of Australia. Mental disease would appear to have been a very rare affection while they were in their primitive and uncivilized condition, and the manner in which they dealt with the few cases which did arise was of the most drastic nature. "If the lunatic was violent or aggressive, he was promptly slaughtered; if melancholy, he was allowed, if so disposed, to commit suicide; if demented and helpless, he was allowed to die; and only when quiet and peaceable, and when his erroneous ideas did not result in offensive acts, was he allowed to continue in the tribe." In the course of time, as the aborigines were brought more into contact with civilization and its attendant vices, insanity increased rapidly in proportion to the number of the population; and Dr. Manning states that since 1868, 18 aborigines had been admitted into the asylums of New South Wales, from a population which has never during that time exceeded 2,500, and is now less than half that number. In the census year 1881 the proportion of the aboriginal insane to the aboriginal population of New South Wales was 2.83 per thousand, a proportion in excess of that for the general population; and at the close of 1887 it was upwards of 5 per thousand. The causes of insanity in the 32 cases of aborigines admitted into the asylums of Queensland and New South Wales were in a considerable proportion of the cases due to drink. The prevailing type of the malady was mania, passing rapidly into dementia. All the melancholic cases originated in jail. Three were epileptics. No case of general paralysis, or any thing like it, was seen. There were 20 deaths; and in several cases the only cause which could be assigned was marasmus,—a gradual wasting without tubercular or other manifest ailment. The average duration of life was much shorter than in Europeans; the confinement, though tempered by many unaccustomed comforts, being apparently the great factor in shortening life.

Dietary for the Nervous System.

The nervous tissue requires for its constitution, says the *Dietetic Gazette* for January, the chemical constituents of the albuminoids and fats, together with phosphorus: hence the chief alimentary substance is the albuminoids (provisional formula $C_{72}H_{112}O_{22}N_{18}S$) contained in milk, eggs, cereals, the juices of vegetables, and the muscular substance of meat. Water should be freely indulged in by neurotic types of constitution almost *ad libitum*. Among the meats most suitable are, in their order, beef, mutton, lamb, and pork, and the brains of animals. Fish is not so valuable as reputed, but may be employed to vary the diet. Oysters, on the other hand, are extremely useful as nerve reconstructives. Among vegetables, wheat stands at the head of the list, containing, as it does, fatty matters and phosphoric acid. Rice, corn, oat-meal, barley, and sweet-potatoes are better than onions, carrots, beets, turnips, etc. Fruits are useful as adjuvants because of the sugars they contain.

Removal of Warts by Electrolysis.

Dr. Patrzek of Oppeln describes, according to the *Weekly Medical Review*, his method for removing warts by electricity. The wart is first thoroughly moistened with a warm solution of salt. Both needles are then thrust through it just above the surface of the skin, and the current turned on, one element after another being added until pain is felt. Five cells are sufficient. With most cases two sittings of five minutes each are sufficient to destroy the growth, which gradually dries up and falls away, leaving a surface at first slightly reddened, but which later assumes the appearance of normal skin.

The Dangers of Hypnotism.

At Nuremberg a case of some public interest was tried in the police court, says the London *Lancet*. A commercial traveller while in a restaurant told the waitress to look steadily at the white of his eye, and hypnotized her. On a second occasion he repeated the experiment; but this time the sleep was so profound that a medical man had to be called, who had the utmost difficulty in rousing the girl. The commercial traveller was accordingly summoned to appear before the magistrates, and the severe sentence of eight days' imprisonment was passed on him, which will probably be efficient in checking similar performances in that region. In France the practice of hypnotizing people for amusement seems to be very common, and unpleasant consequences are frequently reported. At a supper-party in Paris one of the company hypnotized a girl, and was unable to rouse her. She was consequently taken to the house of a medical man, and after a time she recovered consciousness. The whole party were taken into custody by the police, and were not released until next day. Even when hypnotism has been practised by competent medical men for remedial purposes, unpleasant accidents and ulterior consequences have again and again occurred; so much so, that an order has been issued by the French Government, prohibiting surgeons in the army and navy from practising it. It ought to be distinctly understood, both by the profession and the public, that hypnotism is not devoid of danger at the time, and not infrequently has permanently impaired the moral and emotional control of patients. A medical man is bound, before recommending hypnotism for a patient, to weigh the question as carefully as he would that of the advisability of administering an anæsthetic.

Yellow-Fever at Key West.

The history of yellow-fever in Key West (being the most exposed point in the United States) dates from a very early period. The frequent occurrence of epidemics of this disease, the recurrence of isolated cases between epidemic periods, its recent reappearance in October, 1889, and during the month of January, 1890, point, in the opinion of Dr. J. L. Posey of the United States Marine Hospital Service, to but one rational conclusion,—that the disease has finally become endemic in Key West.

BOOK-REVIEWS.

Physiognomy and Expression. By Paolo Mantegazza. (Contemporary Science Series.) New York. Scribner. 12°. $1.25.

The author of this work, who has published others on related topics, remarks in his preface that he "takes up the study of expression at the point where Darwin left it, and modestly claims to have gone a step further." He begins by sketching the history of the study, giving, as it seems to us, altogether too much prominence to the astrologists and other fanciful writers, but assigning the highest place to Darwin. His own work is divided into two parts, the first treating briefly of the anatomy of the face and the various features, while the second and much larger part deals with expression strictly so called. In this second part we find a great wealth of facts relating to the outward signs of various emotions, evidently collected with great care, and showing great keenness of observation; and, so far as our own experience and knowledge enables us to judge, these statements of fact are for the most part correct. They are also well classified and arranged; and, as a description of expression in its various phases, the work can be well recommended. We look in vain, however, for any attempt at explaining the modes of expression. The author quotes Darwin's theories, which, with some modifications, he accepts; but he makes almost no application of them. He also announces what he calls a law of expression, "according to which expression is the clearer and more characteristic in proportion as it is provoked by a more powerful, by a better defined emotion," which would seem to be a truism. But in the main Signor Mantegazza's work is purely descriptive, and lacking in those philosophical qualities that we find in Sir Charles Bell and in Darwin. As a storehouse of facts it will be useful; but for further light on the theory of expression we shall have to wait for some deeper thinker.

AMONG THE PUBLISHERS.

Among the more important articles in *Harper's Magazine* for April are "A Suit of Clothes," being one of a series of papers on great American industries, by R. R. Bowker; and "Three Indian Campaigns," by Gen. Wesley Merritt, U. S. A. These articles are handsomely illustrated. There is also a well-written and interesting article, by Richard Wheatley, descriptive of the New York Maritime Exchange.

—The Forest and Stream Publishing Company have in press "Trout and Salmon Fishing," by one of New England's best-known anglers; also a new edition of Grinnell's "Pawnee Hero Stories and Folk-Tales."

—Messrs. D. Appleton & Co. published last week "Studies in Hegel's Philosophy of Religion," with an appendix on "Christian Unity in America," by Dr. J. M. Sterrett; and "The Spiritual Sense of Dante's 'Divina Commedia,'" by W. T. Harris, LL.D.

— Messrs. Ginn & Co. announce to be ready in May "Wentworth's School Algebra." The necessity of having new plates for the author's "Elements of Algebra" has given him an opportunity to write a new book, with fresh and interesting problems, and with definitions, illustrations, and arrangements of the subject-matter like those in his "College Algebra." The work is written for high schools and academies, and is a thorough and practical treatment of the principles of algebra up to and including the binomial theorem.

—Porter & Coates have published "Life and Works of the Earl of Beaconsfield," by Judge F. Carroll Brewster. Every work of Disraeli has been sketched so as to afford condensation of plots, characters, and noteworthy passages. They have also ready, by the same author, "Molière in Outline," being a translation of all important parts of Molière's works, with notes, abridged from Van Laun and others, to which are added the arguments of the play.

— The prospect is that the exploration and conquest of Africa will be the problem of the twentieth century. Already nearly every nation has its Stanley. France has hers in the person of M. Trivier, whom she prefers, however, to call her Livingstone. An article on this "French Livingstone" by Henry Fouquier has the post of honor in *The Transatlantic* of April 1. The peaceful method employed by Trivier in his recent two years' journey across Africa is contrasted by the writer with the warlike and bloody methods of Baker, Emin Pacha, and Stanley. Following this article Caliban (Emile Bergerat) ridicules the anti-Jewish crusade, Enrico Panzacchi critically sketches the decadent school of writers, and there are extracts from the new volume of Edmond de Goncourt's "Memoirs," accounts of new novels by Zola and Tolstoï, and an interview with Louise Michel regarding her operetta, "In the Moon."

—Dr. Martineau's forthcoming book, "The Seat of Authority in Religion," will be published almost immediately by Longmans, Green, & Co. The work is addressed, not to philosophers or scholars, but to educated persons interested in the results of modern knowledge.

—"Old Friends," Mr. Andrew Lang's new book, to be issued here at once by the Longmans, is not unlike his "Letters to Dead Authors." It describes the meetings of the characters of one novelist with those of another. For example, Dugald Dalgetty tells of his duel with one of the "Three Musketeers," Barry Lyndon describes his playing cards with Allan Stuart Breck (from "Kidnapped"), and Trollope's Mrs. Proudie sets forth Becky Sharp's assault on the bishop.

— The April number of *College and School* (Utica, N.Y.) is a "Gen. Spinner number," containing two portraits of the ex-treasurer, with his famous signature appended. The general himself contributes the last article from his pen to appear in print, — an interesting reminiscence of his school-days in the Mohawk valley, where, as he says, he was "educated to ignorance." Three pages of the manuscript are reproduced in facsimile. Another facsimile reproduction is a translation, by the general, of a German poem, "*Ich bin nicht einsam wen allein.*" In his article, "The Watch-Dog of the Treasury," A. G. Richmond relates an incident of the Breckenridge attack upon Washington, which strikingly illustrates the foresight of the man who was the guardian of the country's treasure. "Spinner, the Student," is an account of the formation of the general's lifelong habit of reading. L. L. Merry, in his "Recollections of Gen. Spinner," narrates in a familiar way some things which only an old friend would be likely to know. L. R. Tuttle, ex-assistant treasurer of the United States, tells how he tried to persuade the general to let Mr. L. D. Ingersoll write a memoir of his life, while Louis Lombard has a word to say about the general's remarkable memory and his garretful of note-books The number is eight pages larger than usual, and contains, besides the Spinner papers, Mr. William H. Hayne's "Editor's Library Table," and the usual departments of college news, literary notes, and book-reviews.

— Messrs. Ginn & Co. announce as published last month "Sidney's Defence of Poesy," edited by Albert S. Cook, professor in Yale University. Sir Philip Sidney's "Defence of Poesy," in which, says Taine, "we meet with genuine imagination, a sincere and serious tone, a grand commanding style, all the passion and elevation which he carries in his heart and puts into his verse," has not hitherto been accessible to the school and college student in a handy and readable edition, notwithstanding the existence of one or two literal reprints of the earliest copies. The attempt is here made, by modernizing the spelling and punctua-

tion, and by providing an introduction and a copious body of notes, to enable any intelligent reader to draw profit and delight from this masterpiece of poetical philosophy. This volume will furnish an admirable introduction to a general course in poetry, or to the poetry of the Elizabethan age in particular. As one of the best specimens of the earlier Elizabethan prose, it will be useful to the student of English prose in its historical development; and as the first annotated edition of the "Defence of Poesy," in a critical text formed by the collation of the two earliest copies, it will be indispensable to libraries, public and private.

—George L. English, Edwin C. Atkinson, and William Niven, dealers in minerals, having on April 1 entered into a partnership, the business of each will be carried on by the new firm under the name of George L. English & Co., at the old stands, 1512 Chestnut Street, Philadelphia, and 739 and 741 Broadway, New York. With enlarged facilities and experience, they hope to give even more careful attention to the wishes of customers in the future than in the past.

—Messrs. Ginn & Co. announce to be published in May, "Reference Handbook of English History for Readers, Students, and Teachers," by W. H. Gurney. This work is intended as a constant companion and assistant to the reader or student of English history, affording him a rapid and easy method of placing his persons and dates before him in accurate relationship to each other, and helping him to draw them out of the maze of confusion and contradiction in which we find them in nearly all our great histories. It identifies enery prominent man from the time of the Confessor to Victoria, giving the date of his death, to whom married, and the number and names of his children. Unless the student becomes thoroughly acquainted with the characters about whom he is reading, the reading of history is apt to be confusing, uninteresting, and conflicting. The materials for this work have been drawn from Dugdale, Freeman, Palgrave, Longman, Sanford, and Townsend, and many other valuable works, the whole passed through a critical examination and comparison, in which the impossible has been rejected and the reliable retained. It saves the reader hours of study, and makes his work a pleasure.

—The Appletons have published, in their series of History Primers, the "History of Egypt," by F. C. H. Wendel. The work gives evidence of careful and conscientious study, and it is also plain in style. It has, however, the common fault of short histories,—an excessive amount of detail; the mass of petty facts and of proper names making the work confusing. It has also a more serious fault, in that it treats almost exclusively of the kings and their doings, with hardly any reference to the people. There is an account on pp. 100, 101, of a strike of laborers employed on certain government works, due to the non-payment of their wages, and there are brief references here and there to commercial enterprises; but in the main the condition and occupations of the people are ignored. The introductory chapter, which treats of the hieroglyphic writing, the Egyptian religion, and some other matters, is the most interesting and instructive part of the book; and it is a pity that the rest of it was not written on a similar plan.

—The corporation of Harvard University has authorized the publication of two monographs, which it is hoped may form the beginning of a series. The first number, to be ready in April, will be "A History of the Veto Power in the United States," by Edward Campbell Mason, A.B., instructor in political economy. Mr. Mason's work will include a chapter on English and Colonial vetoes, and a chapter on State vetoes. The body of the work is a systematic discussion of all the presidential vetoes, arranged by subject, and based on a study of the records of Congress. Then follows an investigation of the constitutional questions which have arisen out of the use of the veto power. An appendix contains a chronological list of presidential vetoes, with complete references to the journals of the two Houses, and a bibliography of the subject. In an introduction the editor, Professor Hart, will discuss the veto in modern constitutions. The second number of the series will be "An Introduction to the Study of Federal Governments," by Albert Bushnell Hart, Ph.D., assistant professor of history. This monograph will contain an historical introduction, with brief sketches of the rise and institutions of the principal federal governments which have existed from the establishment of the Greek federations to the present day. To each sketch will be appended a brief, critical bibliography. Then will follow a parallel arrangement of the texts, in English, of the four most important federal constitutions,—those of Canada, Germany, Switzerland, and the United States. There will be an appendix containing a list of special authorities on federal government, and of references to discussions in more general works. The monographs will be published by Ginn & Co., Boston.

—Our readers should remember that the only uniform edition ever published of the complete works of Walter Bagehot, in five volumes, 2,700 pages, is published by The Travelers Insurance Company, Hartford, Conn., at $5 for the set, all charges paid. The publication is supposed to be an advertising scheme of the insurance company, but how is not so evident to the layman. Meanwhile it would be a good plan for all who value Bagehot's writings to secure a set, as they are certainly cheap. There is nothing objectionable in their make-up or appearance.

—Volume VI. (1890) of *The American Journal of Archæology and of the History of the Fine Arts* will contain among its articles of interest the following: "Hittite Sculptures" and "Oriental Antiquities," by Dr. William Hayes Ward of New York; "Antiquities of Phrygia," by Professor William M. Ramsay of Aberdeen, Scotland; "Terra-cottas in American Collections," by Salomon Reinach, Museum of Saint-Germain, France; "Reminiscences of Egypt in Doric Architecture," by Professor Allan Marquand of Princeton; "Three Heads of Zeus, Hades, and Poseidon, of the Hellenistic Period," by Professor Adolph Michaelis of Strassburg; "Excavations and Discoveries made by the American School of Archæology at Anthedon and Thisbe, in Bœotia, Greece," by Professor F. B. Tarbell of Harvard University and Dr. J. C. Rolfe of Columbia College; "Greek Sculptured Crowns and Crown-Inscriptions" and "Distribution of Hellenic Temples," by Dr. George B. Hussey of Princeton; "Norms in Greek Architecture," by Professor Marquand and Dr. Hussey; "The Recently discovered Early Christian Palace under SS. Giovanni e Paolo, at Rome," by Padre Germano of the Order of Passionists; "The Lost Mosaics of Rome from the Fourth to the Ninth Century," by Eugene Müntz of the Beaux-Arts, Paris; "Cistercian Monuments as the Earliest Gothic Constructions in Italy," "Roman Artists of the Middle Ages," "Christian Mosaics," and "Tombs of the Popes at Viterbo," by Professor A. L. Frothingham, jun., of Princeton. Being the organ of the Archæological Institute of America, and the medium of direct communication from the American School at Athens, this work has an increasing popularity among general readers as well as specialists.

—The United States Bureau of Education has issued two circulars of information that may interest some of our readers. One is "The History of Federal and State Aid to Higher Education in the United States," by Frank W. Blackmar, giving an account of the various grants of money and other valuables in aid of universities and other higher institutions since the first settlement of the country. The work bears the marks of careful study and preparation, and will be useful to educational specialists; but the style is so unattractive that we fear the book will not have many readers. The other circular referred to is the "Proceedings of the Department of Superintendence of the National Educational Association" in Washington last spring, and contains much interesting matter. One of the leading topics discussed was manual training, both sides of the controversy being represented, and some important points elucidated. Perhaps the ablest paper was that of Dr. William T. Harris on "The Psychology of Manual Training." The author expressed the wish not to take part on either side of the pending controversy, but sought to ascertain what manual training could and could not do for the development of the mind. His conclusion was that though manual work may to some extent train the hand and the eye, yet the essential part of intellectual education is the training of the reflective faculties, to which manual work can contribute little or nothing. Most of the speakers and essayists were in favor of special industrial schools in places where there was sufficient de-

mand for them, but against the adoption of manual training as a part of the general educational course. At the close of the discussion one of the members moved that a committee of the association be instructed to define the term "manual training," which would certainly seem to be a proper and even necessary thing to do, if there is ever to be an agreement about the expediency of such training. But the motion raised a perfect storm of opposition, so that the chairman had to interpose a few remarks to prevent an acrimonious dispute. Another important subject treated was that of examinations, especially the examination of teachers, which was recognized as at once a work of great importance and of great difficulty. Candidates for the position of teacher are now often examined by persons with no real fitness for the task, and some remedy for this evil is undoubtedly necessary. Besides these topics, the assembled superintendents discussed the training of teachers, the duties of principals, and other themes that need not be specified here.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Heat and Ventilation.

IN your issue of Feb. 28 is a notice of the Timby system of heating and ventilation, which, you say, "is now attracting universal attention, especially in New England." It is to be hoped that New England will not miss the delicate touch of flattery perhaps unconsciously given her in this quotation, and that your columns are open to any voice of intelligent response which may come back from her.

The attention of which you speak is not stated to be that of competent engineers, nor that of others better qualified than "ex-mayors" to judge of the merits of the described system. It is not defined as that of either scientific sanction or condemnation.

But the appearance of the article in *Science*, and without unfavorable comment, would seem to the popular mind to lend a quasi-scientific approval to the enterprise, as it doubtless has afforded gratification to its promoters.

The art of ventilation has suffered much injury at the hands of many whose ingenuity has not been the well-trained servant of a sound scientific knowledge. The field is a fertile one for the culture of schemes and methods more visionary than practicable, and more gratifying to inventors than profitable to users. To protect the public against imposition, to save the popular mind from discouragement through repeated and costly failures, to expose and weed out the worthless methods from the good, and to establish popular faith by evidence of actual or possible success in any worthy undertaking, is a legitimate and laudable service for any man or journal capable of rendering it.

To this end it would afford satisfaction to see in your columns a thoroughly trustworthy discussion of the applicability of the Timby system to the actual necessities of good ventilation and heating. With a view to eliciting contributions to such a discussion, the following propositions are submitted: —

First, The mechanical part of the problem is beset with insuperable difficulties of various sorts, some of which are closely akin to those belonging to the long ago demonstrated impracticable scheme of ventilating a city's sewers by a centrally located system of pneumatic exhausters.

In the company's pamphlet, and under the head of "Plan of Introduction," the statement is made that it is proposed to heat and ventilate a town of 50,000 inhabitants by means of one centrally located plant.

The first essential in ventilation is an adequate air volume, and the second is an effective use of it. If the dermal and thoracic excretions are to be diluted to one in two hundred, — a proportion of diluent which for the pelvic excretions would be considered far too small to fit them for potable or edible use, — the air-supply for such a town should be 150,000,000 cubic feet per hour; and for the sweetening of the 2,000 buildings of 50,000 cubic feet capacity each, in which the inhabitants may, for the purposes of computation, be supposed to compactly live, the air-supply should reach at least that quantity. Let it be reduced to 100,000,000, and, for the sake of simplifying the mechanical problem, let the houses be ranged along two intersecting streets, 500 houses to each half-street, and let the ventilating plant be located at the point of intersection. Let the houses stand in compact block form, and average, with alley and cross-street spaces, forty feet frontage. Let each of the main air-conduits be six feet in diameter, and the central supply-shaft twelve feet. The velocity of air-flow through the main conduits would be nearly 15,000 linear feet per minute, and the theoretical power required to propel the air would be about 125,000 horse-power, 4,000 being required to give the air its initial motion, and the balance to overcome the resistance of friction. This computation takes no account of the further work required for moving the air through leads to the 2,000 buildings, and through the ramifying conduits for its distribution to their several floors and rooms.

The above computations are qualified as theoretical, since it is assumed that the efficiency of the motile machinery employed is unity instead of the one-third or one-fourth usually available in such mechanism. It would be interesting and instructive to examine a description of the apparatus it is proposed to use for the propulsion of such large volumes of air under the high pressure demanded. To effect the pressure by blowers, the velocity of their blade tips would have to exceed that of a rifle-shot, and a twenty-foot diameter fan must make the quite impossible performance of 1,800 revolutions per minute.

Let the question be simplified to that of supplying air to two such buildings as the newer ones of the Massachusetts Institute of Technology, they monopolizing an entire main, and being located at its extremity. The theoretical horse-power required would be some 345, against a present actual mean of 15 or so, for the supply of 5,600,000 cubic feet of air an hour.

Second, The method proposed for warming the air supplied through the mains by means of a hot-water pipe with return bend, as shown in the cut reproduced by *Science*, and described in the company's pamphlet, is defective.

The pamphlet states that the pressure within the pipe is not to exceed five pounds, and that the heat-loss in the water is not to exceed five per cent. The statement, though somewhat ambiguous, may reasonably be made to mean that the water starting with a temperature of 227° will return to the heater cooled through 12°.

If the sole aim of this warming of the air were to raise it to the temperature of comfort, say 70°, before supplying it to the buildings, and the matter of heating the buildings were excluded from consideration, the volume of water to be moved through the pipe would, on a day of average winter temperature, be nearly 200,000 gallons an hour, or a flow rate of nearly five miles an hour through a fourteen-inch pipe.

For extreme weather this quantity must be more than doubled, and, if the heating of the buildings is to be included, the duty of the heating system must be quadrupled.

A study of the mechanical part of this heating problem is not here presented.

Presumably the small fraction of the exhaust steam from the air and hot-water propelling engines required for heating purposes would be utilized. Enough would still remain for the comfortable heating of some halfscore of adjacent towns of rival size.

A description of the arrangement of the proposed pipe or other heating surface, so that cumulative heating effect should be avoided, and a uniform temperature maintained throughout the mains, would interest many of your readers.

Third, The required inequalities of temperature in the air-supply to various buildings, and to the various parts of the same building, cannot be furnished from one supply source maintained at a fixed temperature.

For the shady or the windward side of a dwelling whose air is "changed" but once an hour, the air-supply temperature may need to be in some weathers 190° or 200°; and on the sunny or the leeward side, or in the sleeping or sick room, twenty to thirty de-

grees lower; and at the same time the air supplied to a theatre, hall, or church must have a temperature of from 60° to 80°. Hence the impossibility of meeting all requirements of both heating and ventilation with air from one supply source at a fixed temperature. S. H. Woodbridge.

Boston, March 20.

Sound-English.

In your review of my "Sound-English, a Language for the World," in your issue of March 21, you make some statements to which, I am sure, your well-known fairness will allow me to offer a correction.

You say that I propose "to introduce at first five new letters, to be followed by six more at a later time," and that you "gravely doubt if any system can be brought into use that contains new letters; and, if new letters are to be introduced, there are other systems that have quite as good a claim to be adopted" as mine.

Now, the fact is that I do not introduce a single new letter. I distinctly state it as my idea of the "requirements of a phonetic alphabet" (see p. 21) that "the present equipment of any printing-office must suffice, without the necessity of casting new types or even employing diacritical marks," and that "all the leading type-writers now in use must be adapted or easily adaptable to the new system without destroying their usefulness in writing the present spelling." My whole system is worked out in conformity with this principle. It is the principal claim I make for its superiority over other systems. If you will kindly turn to the "specimen page" from Macaulay's "History," on p. 51, you will not find a single sign which could not be set up to-day in any village newspaper-office between Maine and Calfornia.

To distinguish *a* in *at* from *a* in *ask*, I propose a slight alteration in the type, which may be effected with a penknife; but this is a trifling matter, so much the more as we do not require any distinction between the two sounds in ordinary reading-matter.

I do not know of any perfectly phonetic system of spelling in which the same result is attained, if we except Mr. Ellis's "Glossic;" but, then, he employs vowel digraphs, while I do not employ a single vowel digraph, excepting, of course, the three regular diphthongal sounds *ou*, *oi*, and *ai* (in *aisle*).

I do propose five very simple alterations for the script; and I say, further, that in course of time, when "Sound-English" will be firmly established, type-founders will provide us with more appropriate forms to designate some of the sounds; and then, merely for the purpose of offering a complete system, I venture to suggest what these forms ought to be. But I am far from advocating their immediate introduction.

As for the expediency of designating the long vowels by full-faced type, and in script by shading, it is, of course, a matter of opinion. You think it an insurmountable obstacle; for, as you say, "who will take the trouble, in rapid writing, to shade now and then a letter more heavily than the rest?" Now, in the first place, "the rest" are not shaded at all in my system. In the second place, do not many systems of stenography distinguish sonant from surd consonants by shading? And do not stenographers write rapidly?

In conclusion, I beg to call attention to the fact that I employ full-faced type and shading not only for the long vowels, but also for designating the accent,— a feature which I think to be as important as it is original; for I do not know of any system of spelling, in any language, in which the accent is thus designated, symbolically, without employing a special sign.

I hope you will not consider this as a fault-finding review of your review, coming from an author who cannot bear adverse criticism. It is intended only as a courteous request for permission to lay my own statement of the facts before the select circle of thinkers who subscribe for your excellent journal.

A. Knoflach.

New York, March 28.

Do the Barclayan Descriptive Terms occasion Obscurity?

In the *American Naturalist* for October, 1889, p. 923, the notice of Stowell's cranial nerve studies concludes with the remark that "the adoption of the Wilderian adjectives and adverbs renders them somewhat pedantic and obscure." The title of this communication attributes to Barclay, the anatomical preceptor of Richard Owen, the exact descriptive terms which have been employed by many writers, and which I merely adopted in 1880 at the Boston meeting of the American Association for the Advancement of Science. The charge of pedantry is not new; but, as that is a matter of custom and taste, it may be overlooked. Since, however, the very purpose of the Barclayan toponymy was to eliminate the obscurity which lurks in every anatomical treatise or paper known to me in which those or equally exact descriptive terms are not used, I am anxious for specifications on this head, and trust they may be presented in response to this letter.

Burt G. Wilder.

Ithaca, N.Y., March 29.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

March 29.—Marcus Baker, Obituary Notice of Edward B. Lefavour; O. H. Tittmann, Note on the Length of Kater's Pendulum; William Eimbeck, A New Method of determining Astronomical Differences of Longitude; Herman Holerith, Exhibition of a New Electrical Tabulating Machine.

Natural Science Association of Staten Island.

March 13.—Mr. L. P. Gratacap exhibited specimens of quartz geodes and limonite concretions, from the iron-mines near Four Corners; Mr. Arthur Hollick showed specimens of *Anemone hepatica*, L., the common liverwort, collected in full bloom at Prince's Bay on Feb. 16. The following objects were shown: a cannon-ball, presumably a relic of Revolutionary times, presented by Mr. S. N. Havens; a stone axe and arrow-head, presented by Mr. M. T. Merrill, which had been dredged from the bottom of the Kills near Linoleumville. The articles were incrusted with barnacles and bryozoöns.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

A large number of plants from Maine, Connecticut, Indiana and Illinois for exchange. Southern and western exchanges preferred. Address, enclosing lists, L. N. Johnson, 223 Chicago Ave., Evanston, Ill.

For Exchange—Fourteen volumes Encyclopedia Britannica (Stoddard's ninth edition), bound in leather—part in original wrappers, all as new—can arrange to furnish volumes required to complete set, and six volumes "American Naturalist" in numbers. Want small screw-cutting foot lathe and testing galvanometer and rheostat. For particulars address A. B. Campbell, McKean Co., Bradford, Pa.

To correspond with colleges, seminaries and other schools where cabinets of fossils and minerals are being collected. I have an extensive private collection of fossils from every geological period, and minerals illustrating the common and many of the rare forms. This collection is in duplicate, and the duplicates are for exchange or sale. Every thing is scientifically classified. W. A. Bronnell, professor of geology, 905 University Ave., Syracuse, N.Y.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

I wish to exchange or purchase well-fixed or hardened vertebrate embryos for sectioning. Desire specially reptilian embryos, but will be glad to secure any material that I do not possess. Thomas G. Lee, M.D., Histological Laboratory, Yale University, New Haven, Conn.

Wanted—Books and journals, American or foreign, relating to Photography—exchange or purchase. C. W. Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection.—F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

A few duplicates of *Murex radix*, *M. ramosus*, *M. brandaris*, *Cassis rufa*, *Harpa ventricosa*, *Oliva triatula*, *O. reticularis*, *Chlorostoma funebrale*, *Cypræa caput serpentis*, *C. lynx*, *Lottia gigantea*, *Acmæa patina*, *Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application.—Curator Museum, Polytechnic Society, Louisville, Ky.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

AN experienced College Professor, with considerable ability in advertising educational institutions, now employed, is open to an engagement. Has built up two schools by advertising. Now is just the time to begin work for September opening. "William," 348 East 20th St., New York.

WANTED by a Cornell University graduate a position as Chemist in some Manufacturing establishment. References given. T. B.

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A WILLIAMS SENIOR who has had two and one-half years' work in chemical laboratory, and one year in a biological laboratory, desires position as teacher of natural science and lesser mathematics, desires a position as instructor in these branches, or as assistant to some chemist. References as to ability and character. E. E. Towne, Box 74, Williamstown, Mass.

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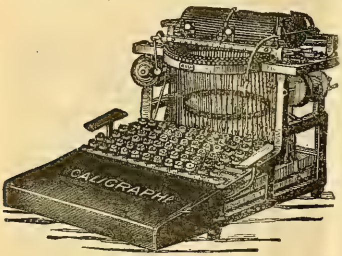

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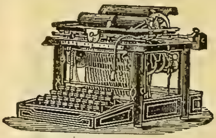

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A SHORTHAND TYPE-WRITER.

A VERY ingenious piece of mechanism, intended to lighten the labor of the shorthand reporter, is shown in the illustration on this page. It is the invention of Mr. G. K. Anderson of Boston, and is known as the shorthand type-writer. As its name indicates, it is an adaptation of the principle of the type-writer to an instrument for recording, in legible characters, the words of a speaker as fast as they may be uttered. It is claimed by its inventor that an operator of ordinary dexterity and intelligence will be able to write from dictation, with this instrument, at the rate of a hundred words per minute after only five or six weeks' practice. It is also claimed that from two hundred to two hundred and fifty words may be printed on this machine with the same number of strokes required to print forty or fifty on an ordinary type-writer.

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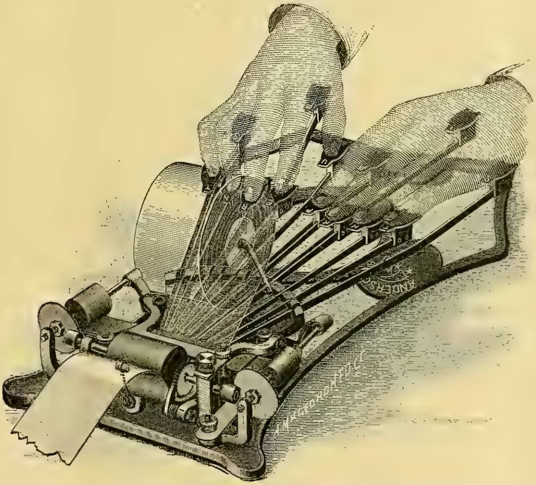

THE ANDERSON SHORTHAND TYPE-WRITER.

SALADS.

AT the fortnightly meeting of the Royal Horticultural Society recently, M. Henri de Vilmorin, president of the Botanical Society of France, delivered a lecture on salads, mentioning that in England the people neither eat nor grow so many plants for salad as in France. He dwelt, says *Nature*, upon the nutritive value of salads due to the potash salts, which, though present in vegetables generally, are eliminated in the process of cooking. He then enumerated the various plants which are used in salads in France; namely, the leaves of lettuce, corn-salad, common chiccory, barbe de capucin, curled and Batavian endives, dandelion in its several forms of green, blanched, and half-blanched, water-cresses, purslane in small quantities, blanched salsify-tops of a pleasant nutty flavor, witloof or Brussels chiccory, the roots of celeriac, rampion, and radish, the bulbs of stachys, the stalks of celery, the flowers of nasturtium and yucca, the fruit of capsicum and tomato, and, in the south of France, rocket, picridium, and Spanish onions. Various herbs are added to a French salad to flavor or garnish it, such as chervil, chives, shallot, and borage flowers. In addition, many boiled vegetables are dressed with vinegar and oil. M. de Vilmorin then showed specimens of dandelion, barbe de capucin, and witloof, both varieties of chiccory, which he recommended to the notice of English gardeners as most useful and palatable. He mentioned that from a ton to a ton and a half of witloof is daily carried to the Paris market from Brussels, where it is grown in the greatest perfection. Specimens of English salads grown in the month of March, and consisting of corn-salad, lettuce, and blanched chiccory, were sent from the Marquis of Salisbury's gardens at Hatfield. Among the other exhibits was a quaint orchid (*Cœlogyne pandurata*), a native of Borneo, sent from Kew Gardens. The flower is bright green, like the color of forced lilac-leaves, with a dull jet-black blotch and lines on the lip.

FOODS AND FOOD ADULTERANTS.

THERE is hardly any subject with which we come into such daily and constant contact as that of food, about which there is so much ignorance and prejudice; and it is the purpose here to discuss the nature, properties, and some of the chief adulterants of the principal food-products in regard to their healthfulness and composition from a chemical standpoint.

There has been a large amount of information published in periodicals, official reports, general and monograph volumes, written in English, French, German, and other languages;[1] which, however, has not found its way to the general public, who, as a rule, have a feeling of uncertainty and insecurity on the subject of most food-products. When people hear that a certain food is adulterated, or is a food substitute, there is immediately a prejudice excited against the article, which it takes time and familiarity to allay, because they imagine that any substance used as an adulterant of, or a substitute for, a food-product, is to be avoided as being injurious to health. A moment's reflection ought to show that it would be directly contrary to the food-manufacturer's interest to add to, or substitute any thing for, a food-product which would cause injurious symptoms, as in that case his means of gain would be cut off by the refusal of consumers to buy his product. It is true that the unscrupulous manufacturer or dealer does not hesitate to cheat his customer in the interest of his own pecuniary profit and gain, but he does not want to poison him. Where, through carelessness or ignorance, injurious substances, such as the arsenic, copper, aniline, and other metallic and organic poisonous salts sometimes used for artificial colors, are added to foods, their presence is promptly revealed by the dangerous symptoms which they call forth in the consumer. About a year ago the case of the Philadelphia bakers, who added chromate of lead to color some of their cakes, and thus caused the death of several persons, and serious illness in nearly every one who ate any of these products, will be recalled by many.

Prejudice about Foods.

How much this nearly universal prejudice arises from misleading and sensational articles and advertisements in the daily newspapers, it would be hard to say. That a large proportion of the articles suitable for food, and produced in all countries, is wasted annually because of this prejudice, is undoubtedly true.

We do not object to eating a *live* oyster, but prefer all our other meats *dead*, and undergoing putrefaction to a slight extent, in order to get rid of the "toughness," as it is generally called, produced by the *rigor mortis*. Some people like to let the putrefaction proceed further until the meat is "gamy." The Texan cowboy eats goat's meat in preference to that of the cattle and sheep he is herding. Young puppies, rats, and birds' nests are considered delicacies by the Chinese. Frogs' legs and snails are among the highest priced dishes served at Delmonico's. Except the bones and hide, every part of an animal slaughtered for food is eaten by most civilized nations,—the brain; tongue; blood in the shape of black pudding and sausages; the liver; heart; lungs; stomach as tripe; the pancreas, thyroid, and sublingual glands, which are called sweetbreads, and considered a great delicacy; the feet in the way of jellies, and pickled; the intestines as sausage covering, etc. In the markets of Paris there is a steady demand for horse-flesh as food. The Arabs and other nomadic tribes prefer mare's or camel's to cow's milk. Many people would as soon eat a snake as an eel, yet the latter commands a higher price than most fish in many parts of the world. Lobsters, which are the scavengers of the sea, are eaten by people who would not touch pork. The Eskimo, who eats blubber and other solid fats, and the native of the tropics, who "butters" his bread with a liquid vegetable oil, have the same object in view; viz., to supply a concentrated form of fuel. The squirrel is considered a great delicacy in many parts of this country, but is not eaten in England. The vain efforts of Professor Riley some years ago to induce the starving people of Kansas to eat the food they had at their doors,—grasshoppers, sorghum and millet seeds, and squirrels,—himself setting them the example, will be recalled by many.

Our bodies are like a furnace, and require fuel and air to sustain the heat of combustion by the constant renewal of fresh material and the elimination of the waste products. The form, whether solid or liquid, of animal or vegetable origin, in which we supply this fuel, depends largely on local circumstances, climate, education, etc.; and, as long as the food employed goes to furnish the proper amount of fuel material for the maintenance of the body temperature, life is sustained.

The extent of the consumption of any new food will evidently depend on how it fulfils this requirement as a fuel, and by its pleasing appearance, its palatability, its capacity to appease hunger, its wholesomeness, and its relative cheapness, attracts public attention. If the new food is a manufactured product, its cheapness will depend upon the possibility of its production on a large scale from relatively cheap materials.

Classification of Foods.

Foods may conveniently be divided into two large divisions,—the first and chiefest, that which the Germans call *Nahrungsmittel*, in which the article of food supplies material for the renewing of some structure or the maintenance of some vital process, the nutrients; and the second, well expressed by the German *Genussmittel*, in which the food increases the vital actions to a much greater degree than the amount of nutritive value which it supplies would lead one to suppose, the stimulants.

These two divisions can again be subdivided into five different classes, according as they supply moisture, nitrogenous material, fats, carbohydrates, and mineral salts. A combination of all five in certain proportions will supply the whole wants of the body, or, in other words, make a perfect food. It is not essential that one food should supply all these wants, although this is eminently the case in regard to young infants, where the mother's or other milk contains the proper proportions of all five classes; but it is essential that it should supply one or more of these materials, so that, by judicious combinations of a variety of different foods, the proper amount of nourishment may be supplied.

This classification could be extended much further, into simple, compound, easily digested, economical, agreeable, flesh-forming and heat-forming, sweet, acid, etc.

Chemical Composition of the Human Body.

Before proceeding further, let us see what is the chemical composition of a human body, so that we may have some idea of what kind of material the food consists which is to support or increase its vital action.

An interesting collection will be found in some cases in

[1] In the report of the Commissioner of Internal Revenue for 1888, pp. xi–xxiii, will be found a short bibliography of the leading publications, prepared by the writer.

the United States National Museum at Washington, showing the approximate weights of the chemical elements found in the body of a man five feet eight inches high, weighing one hundred and forty-eight pounds (Table I.). It is obvious that the composition of the bodies of different persons will vary with age, size, sex, stoutness, etc.; so that the figures given in the following table can only be considered typical.

Table I.—Chemical Composition of the Human Body (calculated by Professor W. O. Atwater).

Elements.	Pounds.	Per Cent.	Compounds.	Pounds.	Per Cent.
Oxygen	92.40	62.4	Water	90.0	60.6
Carbon	31.30	21.2	Proteine	26.6	18.2
Hydrogen	14.60	9.9	Fats	23.0	15.5
Nitrogen	4.60	3.1	Carbohydrates	0.1	0.1
Calcium	2.80	1.9	Mineral matters	8.3	5.6
Phosphorus	1.40	0.9			
Potassium	.34				
Sulphur	.24				
Chlorine	.12				
Sodium	.12	0.6			
Magnesium	.04				
Iron	.02				
Fluorine	.02				
Total	148.00	100.0	Total	148.0	100.0

We find in the above table, that, when the innumerable organic and inorganic compounds of which our bodies are composed are reduced to the simple form of their chemical elements, they can be divided into three groups: first, gases (oxygen, hydrogen, nitrogen, chlorine, and fluorine,—five); second, solids, non-metals (carbon, phosphorus, and sulphur, —three); and, third, solids, metals (iron, calcium, magnesium, potassium, and sodium,—five). Besides these thirteen elements, minute quantities of a few others, as silicon, manganese, and copper, are found in the body.

The principal materials of which the body is composed may be briefly stated as follows. The flesh (muscles) consists of water, fat, inosite, fibrine, albumen, myosin, gelatine, certain extractives, and salts of lime, magnesia, potash, soda, iron, and phosphorus. Blood is in composition very similar in its elements to that of flesh. Bone, of which about 30 per cent is mineral matter composed of salts of lime, magnesia, potash, soda, and phosphorus, contains cartilage, gelatine, and fat. Cartilage consists of collagen and other gelatinoids, with salts of soda, potash, lime, magnesia, iron, phosphorus, and sulphur. The brain, nerves, and spinal cord contain substances called protagon, cerebrin, etc., consisting of nitrogenized and phosphorized fats, also water, and mineral salts. The liver is formed of water, fat, glycogen, and albuminoids, besides salts of potash, soda, lime, iron, and phosphorus. The lungs consist of gelatinoids and albuminoids, fibrine, various fatty and organic acids, cholestrin, and salts of soda and iron, and water.

Chemical Composition of Different Foods.

It will seem strange to many that substances seemingly as dissimilar as flesh and wheat should contain the same class of chemical elements; yet in both we find water and mineral salts, nitrogenous materials, fats, and carbohydrates, as Table II. shows.

Proteine.

The most important class of food-material is that containing nitrogen, which is usually present in the form of albuminoids; i.e., organic substances very similar in chemical composition to albumen or "white of egg," or in the form of gelatinoids, i.e., organic substances similar to gelatine in chemical composition; and it is customary for chemists to call both by the generic name of "proteine." Lean meat, the curd of milk, and the gluten of wheat, consist principally of proteine compounds. The "extractives," as chemists call the organic compounds, containing nitrogen, which are extracted from flesh by treatment with water,—beef-tea, extract of beef, etc.,—are interesting, in that they act as stimulants, like alcohol, and are not nutrients. The other two organic classes of foods, which, however, do not contain nitrogen, are the fats and the carbohydrates.

Fats.

The fats contain the chemical elements, carbon, hydrogen, and oxygen, and are known as the glycerides of the fatty

Table II.—Average Chemical Composition of Different Food-Materials.[1]

Food-Material.	In the Original Substance.					In the Dried Substance.			
	Water.	Proteine.[2]	Fat.	Carbohydrates[3]	Ash.	Proteine[2]	Fat.	Carbohydrates[3]	Ash.
Ox, flesh, very fat	53.05	16.75	29.28	—	0.92	35.68	62.37	—	1.95
" " medium fat	73.03	20.96	5.41	0.46	1.14	77.59	20.03	0.16	4.22
" " lean	76.37	20.71	1.74	—	1.18	87.65	7.16	—	5.19
" fat, heart	65.66	19.61	13.75	0.10	0.88	57.10	40.04	0.30	2.56
" lungs	81.03	12.37	2.46	0.21	3.93	65.21	12.97	1.10	20.72
" liver	71.39	19.72	5.55	1.69	1.65	68.92	19.40	5.91	5.77
Cow, flesh, fat	70.96	19.86	7.70	0.41	1.07	68.40	26.52	1.39	3.69
" " lean	76.35	20.54	1.78	0.01	1.32	86.84	7.53	0.05	5.58
Calf, " fat	72.31	18.88	7.41	0.07	1.33	68.17	26.76	0.27	4.80
" " lean	78.84	19.86	0.82	—	0.50	93.86	3.88	—	2.26
Mutton, " very fat	53.31	16.62	28.61	0.54	0.93	35.60	61.28	1.13	1.99
" " medium fat	75.99	17.11	5.77	—	1.33	71.26	23.20	—	5.54
Hog, " fat	47.40	14.54	37.34	—	0.72	27.64	70.98	—	1.38
" " lean	72.57	20.25	6.81	—	1.10	73.83	24.83	—	1.34
Horse "	74.27	21.71	2.55	0.46	1.01	84.39	9.91	1.77	3.93
Blood	80.82	18.12	0.18	0.03	0.85	94.48	0.94	0.15	4.43
Salmon	64.29	21.60	12.72	—	1.39	60.48	35.63	—	3.89
Mackerel	71.20	19.36	8.08	—	1.36	67.23	28.05	—	4.72
Shad	70.44	18.76	9.45	—	1.35	63.47	31.97	—	4.56
Oysters, flesh	80.52	9.04	2.04	6.44	1.96	46.41	10.47	43.05	10.07
" liquor	95.76	1.42	0.03	0.70	2.09	33.49	0.71	16.51	49.29
" flesh and liquor	87.30	5.95	1.15	3.57	2.03	46.85	9.06	28.11	15.98
Woman's milk	87.41	2.29	3.78	6.21	0.31	18.19	30.02	49.33	2.46
Cow's "	87.17	3.55	3.69	4.88	0.71	27.67	28.74	38.06	5.53
Goat's "	85.71	4.29	4.78	4.46	0.76	30.02	33.45	31.21	5.32
Sheep's "	80.82	6.52	6.86	4.91	0.89	34.00	35.77	25.59	4.64
Butter	13.59	0.74	84.39	0.62	0.66	0.86	97.64	0.74	0.76
Oleomargarine	10.57	—	85.82	1.14	2.47	—	95.95	0.73	3.32
Cheese, full cream	38.00	25.35	30.25	1.43	4.97	40.89	48.79	2.30	8.02
" whole milk	39.79	29.67	23.92	1.79	4.73	49.23	39.68	3.24	7.85
" skimmed milk	46.00	34.06	11.65	3.42	4.87	63.08	21.58	6.32	9.02

[1] König's Chemie der menschlichen Nahrungs- und Genussmittel (Berlin, 1889), vol. i. p. 1100 *et seq.*
[2] Nitrogenous substances. [3] Nitrogen free substances.

Table II.—Continued.

FOOD-MATERIAL.	In the Original Substance. Water.	Proteine.[1]	Fat.[2]	Sugar.[2]	Dextrine.[2]	Starch.[2]	Crude Fibre.	Ash.	In the Dried Substance. Proteine.[1]	Fat.[2]	Sugar.[2]	Dextrine.[2]	Starch.[2]	Crude Fibre.	Ash.
Wheat, kernel	13.37	12.04	1.85	3.25	2.54	62.86	2.31	1.78	13.89	2.13	3.87	2.93	72.46	2.67	2 05
Chaff	13.37	11.84	1.85	0.98	1.74	65.52	2.65	2.07	13.66	2.13	1.13	1.98	75.65	3.06	2.39
Rye	13.37	10.81	1.77	1.87	4.57	63.77	1.78	2.06	12.47	2.04	2.16	5.27	73.63	2 05	2 38
Barley	14.05	9.66	1.93	1.23	3.75	62.01	4.95	2.42	11.23	2.24	1.43	4.36	72.17	5.76	2.81
Oat	12.11	10.66	4.99	1.72	1.89	54.76	10.58	3.29	12.13	5.68	1.96	2.15	63 30	12 04	3.74
Maize, corn	13.35	9.45	4.29	2.29	2.06	64.98	2.29	1.29	10.90	4.95	2.64	2 38	75 00	2.64	1.49
Rice, hulled	12.58	6.73	0.88	0.15	0.77	77.56	0.51	0.82	7.70	1.01	0.17	0.88	88.72	0.58	0.94
Buckwheat	14.12	11.32	2.61		54.86		14.32	2.77	13.18	3.04		63 88		16 68	3.22
Wheaten flour, fine	13.37	10.21	0.94	2.35	3.06	69.30	0.29	0.48	11.79	1.08	2.71	3.53	80 01	0.33	0.55
" " coarse	12.81	12.06	1.36	1.86	4.19	65.88	0.98	0.96	13.83	1.56	2.13	4.69	75.57	1.12	1.10
" grits	13.05	9.43	0.94		75.92		0.21	0.40	10.84	1.08		87.38		0.24	0.46
Rye-flour	13.71	11.57	2.08	3.89	7.16	58.66	1.59	1.44	13.41	2.41	4.51	8.30	68.06	1.84	1.67
Barley-flour	14.83	11.38	1.53	3.11	6.52	61.60	0.45	0.59	13.36	1.80	3.65	7.65	73.82	0.53	0.69
Oatmeal	9.65	13.44	5.92	2.26	3.08	61.67	1.86	2.12	14.88	6.55	2.51	2.41	69.24	2.06	2.35
Cornmeal	14.21	9.65	3.80	3.56	3.36	62.63	1.46	1.33	11.21	4.42	4.14	3 90	72.81	1.97	1.55
Rice flour	12.82	6.91	0.67		78.84		0.18	0.58	7.93	0.77		90.42		0.21	0.67
Buckwheat-flour	13.51	8.87	1.56	1.06	2.95	70.30	0.67	1.14	10.25	1.80	1.23	3.41	81.25	0.78	1.28
Wheaten bread, fine	35.59	7.06	0.46	4.02	52.56		0.32	1.09	10.95	0.71	6.24	79.91		0 50	1.69
" " coarse	40.45	6.15	0.44	2.08	49.04		0.62	1.22	9.71	0.69	2.28	84.41		0.98	1.93
" biscuit	13.28	8.55	0.98	1.82	73.28		0.59	1.50	9.86	1.13	2.10	84.50		0.68	1.73
Rye bread	42.27	6.11	0.43	2.31	46.95		0.49	1.46	10.58	0.74	4.00	81.30		0.85	2.53
Oat biscuit	13.04	8.39	6.03	4.09	60.12		5.28	3.05	9.65	6.93	4.70	69.14		6.07	3.51
Potato	74.98	2.08	0.15	0.28	20.73		0.69	1.09	8.31	0.60	1.12	82.85		2.76	4.36
Sweet-potato	82.52	1.78	0.14		14.04		0.64	0.88	9.12	0.72		82.37		3.28	4.51
Swedish turnip	87.80	1.54	0.21	2.71	5.51		1.32	0.91	12.62	0.25	3 24	81.22		1.58	1.09
Turnip	90.78	1.18	0.22		5.89		1.13	0.80	12.80	2.39		74.90		1 23	8.68
Beet	87.50	1.34	0.14	7.22	1.68		0.98	1.14	10.72	1.12	57.76	13.44		7.84	9.12
Sugar-beet	82.25	1.27	0.12	12.52	1.88		1.14	0.82	7.22	0.68	71.16	9.80		6.48	4.66
Carrot, large variety	86.79	1.23	0.30	6.71	2.46		1.49	1.02	9.31	2.27	50.79	18.63		11.28	7.72
" small "	88.84	1.07	0.21	1.58	6.59		0.98	0.73	9.59	1.88	14.16	59.05		8.78	6.54

[1] Nitrogenous substances. [2] Nitrogen free substances.

acids. The fats, of which there are many kinds, both animal and vegetable, may be said to be mixtures of three typical forms,—the solid variety, stearine, found in almost every animal and vegetable fat; the semi-solid form, palmitin, found especially in palm-oil, whence its name; and the liquid, oleine, found in olive-oil, human fat, etc.

Carbohydrates.

The carbohydrates contain the same chemical elements as the fats, but in different proportions, and are represented by sugar and starch in the vegetable, and by liver-sugar, glycogen, and muscle-sugar, inosite, in the animal kingdom.

The average composition of these three organic classes of foods may be given as follows:—

	Carbon. Per Cent.	Hydrogen. Per Cent.	Oxygen. Per Cent.	Nitrogen. Per Cent.	Total.
Proteine	53.0	7.0	24.0	16.0	100
Fats	76.5	12.0	11.5	None	100
Carbohydrates	44.0	6.0	50.0	None	100

Water.

Water, which forms nearly two-thirds of our bodies, is so important a constituent of both animals and plants, that we find it in large quantities disseminated throughout their structures.

Mineral Matters.

The mineral matters contained in both our bodies and foods are present in small quantities only.

Dietary.

It is fortunate that nature has provided these great varieties of food, so that man can make a selection suitable to his age, occupation, health, and other conditions of life. The subject of what are the proper proportions and kinds of food suitable to an economical and healthful diet covers too large a field for this series of articles; but it may be stated that people generally eat more than is requisite for the maintenance of their bodies in a state of perfect health.

The following table by Professor W. O. Atwater shows, in the form of debit and credit account, the daily income and expenditure of a man doing a moderate amount of work:—

Table III.—Assumed Daily Income and Expenditure of the Body of an Average Man doing a Moderate Amount of Muscular Labor.

Income. Materials.		Weights.[1] Ounces.	Grams.	Outgo. Materials.		Weights. Ounces.	Grams.
Nutrients of food.	Proteine	4.2	118	From digested food and inhaled oxygen. Respiratory products excreted through lungs and skin.	Carbonic acid	38.8	1,100
	Fats	2.0	56		Water	12.7	361
	Carbohydrates	17.6	500	Excreted by kidneys.	Urea, etc.	1.2	34
	Mineral matters	0.8	24		Mineral matters	0.7	20
Water of food and drink		71.4	2,024	Water otherwise excreted		71.4	2,024
Oxygen of inhaled air		30.2	855	Undigested matters (water free)		1.4	38
Total		126.2	3,577	Total		126.2	3,577

[1] One pound avoirdupois, 453.6 grams; one ounce, 28.35 grams.

Various standards for daily dietaries for a man doing a moderate amount of work have been proposed by various authors, and the reader interested in such matters is referred to the last (third) edition of Dr. I. König's "Zusammensetzung der menschlichen Nahrungs und Genussmittel" (Berlin, 1889) for much information on the subject.

Below will be found a table,[1] prepared by Professor C. A. Meinert, giving the composition (in grams[2]) of the daily rations of the different European armies:—

Table IV.—Composition of the Rations of European Armies.

	Proteine.	Fat.	Carbo-hydrates.	Price.[1] Pfennig.	In the Daily Food as Meat, Raw.	In the Daily Food as Bread.
I. Imperial German Army						
Ordinary peace ration	107	22	489	33.4	150	750
Major " "	135	27	533	45 4	250	750
Ordinary field ration.						
Meat and bread	133	35	471	63.1	375	750
Pork " "	78	146	471	43 1	170[2]	750
Meat and biscuit	150	35	471	71 1	375	500[3]
Pork " "	97	146	471	51 1	170[2]	500[3]
Maximum ration	192	45	678	85 0	500	1000
II. Austria-Hungarian Army.						
In peace	100	51	474	40 0	187	900
In war.						
Meat	146	47	645	?	280	900
Pork	109	135	645	?	170[2]	{714 meal {100 bis 't
III. French Army.						
In peace.	130	29	542	43	300	1000
In war						
Bread	139	31	574	48	312	1000
Biscuit	168	31	574	52	312	750[3]
Navy	136	44	478	46	330	750[3]
IV. Italian Army.						
In peace	127	45	613	57	300	918
In war	113	38	613	48	200	918
V. English Army.						
In peace	108	48	452	60	340	680
Navy						
Fresh meat	141	417		—	—	—
Salt "	165	535		—	—	—

[1] One mark equals 100 pfennigs, equal to 24 cents, [2] Pork, [3] Biscuit,

Digestibility of Foods.

The digestibility of foods is an important part of this subject, and it is to German chemists that we owe the greater part of our knowledge. The number of reliable investigations and experiments is very small, about sixty altogether, and the results obtained are tabulated in Table V.

Experiments in the digestibility of different cattle-foods have long been a subject of investigation by the different agricultural experiment stations in Europe, and the data obtained have been made use of in various ways, e.g., in quickly fattening cattle for the market.

The general method pursued consists in analyzing and weighing both the food consumed and the excreta; the latter representing the undigested materials, and the difference the amount digested. No trouble is found in feeding an ox or a horse on a diet of hay and water for a long period; but when a human being is taken for experiment, no matter how simple or palatable the food-material may be, it very soon becomes repugnant to him, the digestive functions are disturbed, and the accuracy of the experiment impaired. This is especially true where a diet of fat is tried.

Instead of the living subject, resort has been made to artificial digestion, when the food-material has been placed in a suitable vessel with a solution containing pepsin, and subjected, with occasional agitation, to the action of heat, at body temperature, for twenty-four hours, portions being taken out at different intervals and subjected to microscopical and chemical examination.

Table V.—Proportions of Nutrients Digested and not Digested from Food-Materials by Healthy Men (calculated by Professor Atwater).[1]

	Proteine. Total	Proteine. Undigestible.	Fats. Total.	Fats. Undigestible.	Carbohydrates. Total.	Carbohydrates. Undigestible.	Mineral Matters.	Water.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Beef.								
Round	23.0	0.0	9.0	0.9	0.0	0.0	1.3	66.7
Sirloin	2 .0	0.0	19.0	1.9	0 0	0.0	1.0	60.0
Pork, very fat	3.0	0.0	80.5	6.0	–	–	6.5	10.0
Haddock	17.1	0.0	0.3	–	0.0	0.0	1.2	81.4
Mackerel	18.8	0.0	8.2	0.8	0.0	0.0	1.4	71.6
Hen's eggs	13 4	0.0	11.8	2.4	0.7	0.0	1.0	73.1
Cow's milk	3.4	0.0	3.7	0.1	4.8	0.0	0.7	87.4
Cheese, whole milk	27.1	0.0	35.5	0.9	2.3	0.0	3.9	31.2
Butter	1.0	–	87.5	1.7	0.5	–	2.0	9.0
Oleomargarine	0.4	–	87.2	3.3	0.0	–	2 1	10.3
Sugar	0 3	–	–	–	96.7	0.0	0.8	2.2
Wheat-flour.								
Very fine	8.9	1.3	1.0	–	75.2	0.8	0.3	14 6
Medium	11.6	2.1	0.8	–	72.2	1.8	0.4	15.0
Coarse, whole wheat	10.9	2.7	1.8	–	71.7	5.3	1.2	14.4
Wheat-bread, average	8.9	1.2	1.9	–	55.5	0.6	1.0	32.7
Black bread	6.1	1.6	–	–	48.6	5.3	1.5	43.8
Pease	22.9	3.2	1.8	–	57.8	2.1	2.5	15.0
Corn-meal	9.1	1.2	3.8	–	71.0	2.3	1.6	14.5
Rice	7.4	1.2	0.4	–	79.4	0.7	0.4	12.4
Potatoes	2.0	0.5	0.2	–	21.3	1.6	1.0	75.5
Turnips	1.0	0.3	0.2	–	6.9	1.3	0.7	91.2

[1] Century, vol. xxxiv. p. 736.

From experiments made by Herr Jensen[1] in the laboratory of the University of Tübingen, it appears that raw meat is much sooner digested than cooked meat. The raw beef was digested in two hours; the boiled, "half done," was digested in two and a half hours; the boiled, "well done," was digested in three hours; the roasted, "half done," was digested in three hours; the roasted, "well done," was digested in four hours.

In regard to the relative digestibility of butter and oleomargarine, the only actual comparative tests on record are

[1] From König's Chemie der menschlichen Nahrungs- und Genussmittel (Berlin, 1889), p. 156.

[2] One gram equals 15.4 Troy grains; one ounce avoirdupois equals 28.35 grams.

[1] Century, xxxiv. p. 739.

a series made for three days on a man and a boy, by Professor A. Mayer, in Holland.[1] In these from 97.7 to 98.4 per cent of the fat of the butter, and from 96.1 to 96.3 per cent of the fat of the oleomargarine, were digested. The average difference was 1.6 per cent in favor of the butter. This proportion is so inconsiderable that in healthy persons it is of little or no importance. The slight difference in the chemical nature of the two fats would naturally lead to the same conclusion, as there is always a larger proportion of soluble glycerides in butter than in oleomargarine.

Dr. R. D. Clark made a series of artificial digestion experiments for the New York State Dairy Commission,[2] comparing oleomargarine with butter and other fats, including beef and mutton suet, and lard, cottonseed, sesame, and cod-liver oils. It was found from these tests that cod-liver oil exhibited the most perfect state of emulsion, after which came genuine butter, then "oleo" and lard oil, there being frequently no appreciative difference between them. The other animal fats and vegetable oils followed.

For healthy persons the difference between the genuine and artificial butter in digestibility was found to be nearly inappreciable. Cod-liver oil, which is the most readily digested of all the fats, cannot always be tolerated by invalids.

The difference between the digestibility of a piece of cold roast meat and oleomargarine would seem to be in favor of the latter, as the greater part of the more solid fats have been taken out of the latter in the process of manufacture; so that it more readily melts in the mouth and stomach, and from its fine state of division is readily emulsified.

Cooking.

Cooking, as far as animal food is concerned, has the effect of making it more pleasing to the taste, but is unnecessary; whereas with certain vegetables, especially those composed principally of starch, as grain and potatoes, it is required to fit them for use. The proper preparation of food is one that has not received the attention it demands. A badly cooked meal is more apt to disorganize the system than to prove nutritious and beneficial. The general teaching of cookery in our schools, both public and private, to girls would undoubtedly result in much improvement in this regard.

There is in boiling and frying foods a very simple problem in physics, which most people ignore; viz., that of latent heat. When a piece of meat, a vegetable, or other article of food, which is at the ordinary temperature, 60° to 75° F., is placed in boiling water or fat, the temperature of the solution is lowered proportionately to the mass and temperature of the article introduced; and it is not until the mass has absorbed more heat from the fire that the solution again comes to the boil. If care is taken, either by introducing the food in small quantities at a time into the boiling solution, so that very little lowering of the temperature takes place, or by a preliminary heating of the food before adding it to the solution, and in every case allowing the solution to boil before introducing any fresh material, the soddenness of improperly boiled or fried foods will be avoided.

Food-Products and their Chief Adulterants.

The great majority of substances used for food adulterants or substitutes consist of cheap and harmless substances, which are not injurious to health, as the following list of those most commonly met with in the principal food-products will show. This list has been compiled from the reports of the State boards of health, the returns of the British Inland Revenue Department, the reports of the British Local Government Board, and those of the Paris Municipal Laboratory.

[1] Landwirthsch. Versuchsstationen, 29, p. 215.

[2] Second Annual Report of the New York State Dairy Commissioner.

Table VI. — Food-Products and their Chief Adulterants.

FOOD-PRODUCT.	ADULTERANTS.
Milk	Water, removal of cream, addition of oleo-oil or lard to skimmed milk.
Butter	Water, salt, foreign fats, artificial coloring-matter.
Cheese	Lard, oleo-oil, cottonseed-oil.
Olive-oil[1]	Cottonseed and other vegetable oils.
Beer	Artificial glucose, malt and hop substitutes, sodium bicarbonate, salt, antiseptics.
Sirup	Artificial glucose.
Honey	Artificial glucose, cane-sugar.
Confectionery	Artificial glucose, starch, artificial essences, poisonous pigments, terra alba, gypsum.
Wines, liquors	Water, spirits, artificial coloring-matter, fictitious imitations, aromatic ethers, burnt sugar, antiseptics.
Vinegar	Water, other mineral or organic acid.
Flour, bread	Other meals, alum.
Baker's chemicals[1]	Starch, alum.
Spices[1]	Flour, starches of various kinds, turmeric.
Cocoa and chocolate	Sugar, starch, flour.
Coffee[1]	Chiccory, peas, beans, rye, corn, wheat, coloring-matter.
Tea	Exhausted tea-leaves, foreign leaves, tannin, indigo, Prussian blue, turmeric, gypsum, soapstone, sand.
Canned goods[1]	Metallic poisons.
Pickles	Salts of copper.

[1] For list of adulterated brands see Report of the Commissioner of Internal Revenue, 1889, pp. 181–184.

EDGAR RICHARDS.

NOTES AND NEWS.

EARLY this month there will be at the New York Academy of Medicine a joint discussion upon the pneumonias of this winter, by representatives of New York, Boston, and Philadelphia. Provost Pepper of the University of Pennsylvania has been appointed to represent Philadelphia. It is hoped that the discussion will lead to some positive conclusions as to the most effective method of dealing with *La Grippe*.

—At the meeting, on April 7, of the New York Academy of Sciences, Mr. George F. Kunz presented a paper on a remarkable find of meteorites in Kiowa County, Kan.

—The American Academy of Political and Social Science, organized in Philadelphia in December last, has met with unexpected success. It has already over three hundred members, though its working organization is scarcely two months old. Its membership list embraces many of the leading thinkers and workers in the economic and social field in this country and Canada. The first volume of its proceedings will appear early in June.

—At a meeting of the board of trustees of the University of Pennsylvania, held April 1, 1890, Dr. Hobart Amory Hare was elected clinical professor of the diseases of children, to succeed Dr. Louis Starr, resigned. Dr. Hare is a graduate of the University of Pennsylvania, 1884. He is a descendant of the distinguished Dr. Robert Hare, one of the early professors of the university. He has done much important original work, is a teacher of remarkable excellence, and, since his graduation in 1884, has won eight prizes for various essays, etc.

—The third national industrial exhibition of Japan opened at Tokio on April 1, and will continue until July 31. The directors of the exhibition have given special facilities for foreigners visiting their country, having made arrangements with railroad and steamboat lines for transportation all over the empire at a considerable reduction from the usual rates. These arrangements have been made by Mr. Iwamura Michitoshi, vice-president of the exhibition. Special tickets have been issued, entitling the bearer, on his arrival in Japan, to a passport which will enable him to travel through the empire. The exhibition includes a display of Japanese products and manufactures, art works, curios, etc.

—The St. Petersburg Academy of Sciences has issued the report for 1889, which was read at the annual meeting on Jan. 12. The report contains, according to *Nature*, a valuable analysis of the scientific work done by the members during the year. In mathematics, Professor Tchebysheff's applications of simple fractions to the investigation of the approximate value of the

square root, and M. Ishmenetsky's work on the integration of symmetrical differential equations, are especially worthy of note. In astronomy are to be noticed O. A. Backlund's researches on the influence of temperature upon refraction. In physics, M. Khwolson made an attempt at a mathematical investigation of the extremely complicated laws of dispersion of light in milk-colored glasses. The exploration of earth magnetism has made marked progress, both as regards the theory of diurnal variations and the measurement of magnetical elements in Caucasia and Siberia. Besides theoretical work in meteorology, the Central Physical Observatory has extended its system of weather-forecasts. Much interesting work has been accomplished in geology, Baron Toll having brought out the first volume of the geological part of the work of the expedition to the New Siberia Islands. In the botanical department the chief event was the publication of two parts of Professor Maximowicz's description of the plants brought from Central Asia by Prjevalsky, as well as the flora of western China, as represented in the valuable collections brought by M. Potanin. Highly interesting work was done in zoölogy by Professor Famintzyn.

— When the sun sets in the sea, a curious appearance, as of a bluish-green flame, is sometimes observed. This has been thought to be due to the light passing through the crests of waves. But Professor Sohncke, as we learn from *Nature*, considers this view disproved by such an observation as that recently made by Professor Lange at a watering-place on the Baltic. Shortly before sunset, the disk was divided in two by a thin strip of cloud; and, just as the upper part disappeared under the cloud, the blue flame was observed. Thus the cause appears to be in the air, not in the sea. It is a case of atmospheric refraction. And as a planet, seen near the horizon with a good telescope, appears drawn out into a spectrum, with the more refracted blue-violet end higher than the red, so the last visible part of the sun furnishes the blue-violet end of a spectrum. But it would be interesting, Herr Sohncke remarks, to determine more precisely the conditions of this not very frequent phenomenon. Perhaps it requires merely great transparency of air, as only in this case would the last ray be able to give a spectrum sufficiently intense in its blue region.

—Recently Lord Reay, the governor of Bombay, laid the foundation-stone at Poona of a bacteriological laboratory which is to be annexed to the College of Science in that town. Dr. Cooke, the principal of the college, to whose efforts the establishment of the laboratory is due, stated that it was originally intended that the study of the diseases of the lower animals in Poona should be directed to check the losses from anthrax in cattle by the introduction into India of protective inoculation. With this object, we learn from *Nature*, two Bengal students at the Cirencester Agricultural College underwent a course of study in M. Pasteur's laboratory in Paris. One of these gentlemen devoted his attention entirely to sericulture; the other studied M. Pasteur's system of vaccination against anthrax. He returned to India, and has since conducted some experiments on cattle in Calcutta. Subsequently Mr. Cooper, of the veterinary service, was deputed to M. Pasteur's institute for instruction in the system of inoculation against anthrax. While in Paris, Mr. Cooper submitted a report, and explained that for the work in question a special laboratory would be required. At the same time he advocated the adoption of artificial gas for the culture-stoves and glass-blowing, and for the purpose of obtaining the high temperature required for sterilizing vessels, instruments, etc. Subsequent inquiry showed that anthrax is not the only contagious disease of a fatal nature with which the Indian cattle-owner has to contend. He has also to take into account rinderpest, tuberculosis, pleuro-pneumonia, and, in a minor degree, foot-and-mouth disease. It was therefore evident that if an institution was established for the preparation of an anthrax vaccine, its value would be greatly enhanced if diseases other than anthrax could receive attention. The main objects of the Poona Laboratory, therefore, are (*a*) the preparation of anthrax vaccine for despatch to districts where anthrax prevails; (*b*) The conduct of experiments in rinderpest with a view to the discovery of the pathogenic micro-organism of the malady, its cultivation in broth and other media, and attenuation, so as to provide a vaccine that shall give immunity to animals in rinderpest-infected districts; (*c*) experimental research into the epizootic diseases generally of the ox and the horse; (*d*) the instruction of trained native veterinarians in a proper method of performing vaccination and of the precautions necessary to avoid risk of septic infection.

—A paper on forestry in India and the colonies was read recently by Dr. W. Schlich before the Royal Colonial Institute. He said, as given in *Nature*, that for seven hundred years a gradual destruction of forests of India had gone on. Under British rule, the process had been hastened by the extension of cultivated and pasture land, and by the laying-down of railways. After a time difficulty was experienced in meeting demands for timber, and in the early part of the century a timber agency was established on the west coast, while in 1873 a teak plantation on a large scale was made at Nilambur. Through the energy of a few officials, the matter was kept before the public; and in 1882, the Forests Department of Madras was entirely re-organized. Several acts were passed to provide for the management of the forests under the protection of the state, and a competent staff of officers was provided, to be re-enforced from time to time by those educated at Cooper's Hill College. Under the charge of the department were some 55,000,000 acres of forest-lands, and the figures relating to the cost of the work done were very satisfactory. Dr. Schlich then gave an account of the action of the Australian colonies with regard to the regulation of wooded lands by the state, contending that in no case had sufficient steps been taken to insure a lasting and continuous supply of timber.

—A preliminary report of the committee on anatomical nomenclature was accepted Dec. 28, 1889, by the Association of American Anatomists, without dissent. In this report the committee recommended (1) that the adjectives "dorsal" and "ventral" be employed in place of "posterior" and "anterior" as commonly used in human anatomy, and in place of "upper" and "lower" as sometimes used in comparative anatomy; (2) that the cornua of the spinal cord, and the spinal nerve-roots, be designated as "dorsal" and "ventral" rather than as "posterior" and "anterior;" (3) that the costiferous vertebræ be called "thoracic" rather than "dorsal;" (4) that the *hippocampus minor* be called "calcar;" the *hippocampus major*, "hippocampus;" the *pons Varolii*, "pons;" the *insula Reilii*, "insula;" *pia mater* and *dura mater*, respectively "pia" and "dura." The committee, consisting of Joseph Leidy (chairman), Harrison Allen, Frank Baker, Thomas B. Stowell, Burt G. Wilder, and Thomas Dwight, desire frank and full expressions of opinion from scientific and medical journals, and from any who are interested in the subject. At the 1889 meeting of the American Association for the Advancement of Science, a report of that association's committee on anatomical nomenclature, with special reference to the brain, was made, to the effect that during the year some of the members of the committee have given to the subject intrusted to them as much time as their regular duties would permit. They agree upon one point; viz., the advantages, other things being equal, of mononyms (single-word terms) over polyonyms (terms consisting of two or more words). Before making specific recommendations or presenting a final report, the committee thought it advisable that they and other anatomists should have an opportunity of discussing at leisure the simplified nomenclature employed in certain treatises published during the winter. The treatises referred to in the above report are Leidy's "Human Anatomy," and the following articles in Wood's "Reference Handbook of the Medical Sciences," Vol. VIII.: by E. C. Spitzka, "Spinal Cord" and "Histology of the Brain;" W. Browning, "Vessels of the Brain;" S. H. Gage and B. G. Wilder, "Anatomical Terminology;" B. G. Wilder, "Anatomy of the Brain," "Malformations of the Brain," and "Methods of Dissection, etc." The members of the committee are Burt G. Wilder (chairman), Harrison Allen, Frank Baker, Henry F. Osborn, and T. B. Stowell.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

HAS EVERY ONE A NATURAL CALLING?[1]

IT is not a rare occurrence to hear of a person that he has "missed his calling." People mean that his natural faculties and endowments are better fitted for other kinds of work than the one in which he is engaged. Here, then, we meet with the presumption that the person in question is especially well qualified for a particular occupation. Upon this presumption is based the meaning of the word "calling." He who is called to perform a certain kind of work or to fill an office is given credit for the qualifications it requires.

But let me ask, is there any such thing as a natural calling for every one? that is to say, is there in man a combination of faculties which qualifies him for a certain kind of activity, and for no other? Is he predestined, if I may use the term, to his calling, by the peculiar mixture of natural gifts he possesses?

The Germans are apt to answer this affirmatively. They maintain that every one is particularly well equipped by Mother Nature for one kind of activity, but that it is difficult to discover for which one, and that many persons fail in discovering it, choosing a field of occupation for which Nature has not intended them. In many cases their chosen profession or occupation is not the right one, which is illustrated in numerous cases. In truth, the fact that many pursue a calling in which they are not successful seems to indicate the strength of the argument. Yea, "to miss one's calling" was a proverb long before Bismarck characterized the journalists as men who had missed theirs.

In America we are apt to answer the question in the negative, and just as emphatically. The American will grant only in rare cases that a man may have a natural calling. Generally it is asserted that every one has the calling to earn his livelihood; and, as to the different kinds of human activity, our reverence for the self-made man prompts us to believe that every one is capable of doing any thing, provided he takes hold of it with pleasure and good-will.

Here, then, we have two opposite opinions, — on the one side, the German idea, that every one is equipped, that is, called for, a special kind of work, which idea has been developed in the most ideal manner, and defended by the ablest arguments; on the other side, the American idea, that every one may be or is prepared for or called to many, if not to all kinds of work. Which of the two ideas is correct, — either or neither of them? If neither, which one comes nearer the truth?

In order to answer these queries understandingly, it will be well to inquire into the origin of the two diametrically opposed ideas.

The Germans are an old nation, with a history and national culture of more than a thousand years. When first appearing upon the historic stage, they were divided into ranks, — in high and low nobility, free-born retainers, and serfs or servants, among whom were again distinguished body-servants and servants of the estate. When through war and strife, particularly in consequence of hostile invasions, it was found necessary for many to leave their isolated abodes, crowd together in cities, and live securely side by side behind ramparts, palisades, and town-walls, the social status of former times could not be retained. It was hard to give up privileges, for he who is in possession shuns the change; and it is proven in history that it is easier to yield an inborn right than to relinquish a privilege (a private right). But necessity knows no laws. The privileges of the free-born were disregarded in towns where all had to live together, side by side, and the will of the majority became law. The cities were populated, and soon became the very backbone of resistance to oppression and transgression of princes and nobles. In due course of time, inequalities vanished, and the citizens acquired equal rights, though not until after hard struggle and civil strife.

Even noblemen found it necessary to resort to some occupation where every one was obliged to make a living; and so we see families of great repute and noble name become merchants, armorers, etc. And just as among the Romans some trades were despised, we see in the cities of Germany that some occupations became honored, others despised and detested. The patriarchal government of those times soon regulated every thing, even the number of masters in each trade. Guilds sprang into existence, originally for the protection of their members, afterward for the exclusion of outsiders. Soon the guilds were sharply defined, and formed communities within the community. Even within the narrow confines of a guild numerous grades and subdivisions were established. There were tailor, carpenter, weaver, cobbler guilds, etc. Joiners and carpenters were not permitted to confound each other's work, any more than could nail-makers and blacksmiths, bricklayers and stonemasons. The cobbler who made men's boots and shoes was prohibited from making ladies' shoes: that was meddling with some one else's trade.

These guilds have a history of eight hundred years. Their pernicious influence upon culture and civilization is a matter of history, and need not be stated here; but it must be mentioned that they fostered the idea of seclusion and separation. They gave rise to the idea of a predestined calling for every one; and this idea became so predominant, that the accident of birth decided not only nationality and religion, but also the calling of the child; and to a limited extent this is still the case in our times.

In this country we ridicule the idea. Here the new-born child is not placed face to face with such an idea. He breathes the free air of a country which enjoys political and social liberty, as well as liberty of trade. In Germany the child seems to inherit the germ of the idea that his destiny is preconceived, and he inhales, figuratively speaking, an atmosphere which is fitted to develop this germ. A child of German parentage in America may inherit

[1] Paper read before the Anthropological Society in Washington, March 18, based on Professor Rohrbach's treatise on this question, by L. R. K.

the same tendency, but this tendency dies away under the influence of the unfavorable circumstances surrounding the child. Every thing here is opposed to it: the currents of American thought admit of no such presumption. The inherited tendency finds no nourishment whatever, and dies out.

That the guilds should have fostered the idea of predestination is evident. That the son should adopt the business of the father, in which he had grown up, the peculiarities of which he had known from early childhood, was something so self-evident, that the custom became an established rule.

Just consider this: the father's shop was ready for him to step into, material and goods were stored up, resources for this particular business and a market were found, custom was secured; in short, the father had warmed the nest so nicely, that the son would have been a fool to fly away into insecure circumstances to fight the hard battle for subsistence.

To all this came another powerful motive: liberty of trade, and the right to settle in any part of the country, are of very recent origin in Germany. Not only the guilds proved obstacles to the freest development of the nation's resources, but also the great number of independent and often antagonistic states and principalities and their governments. Though, through the peace at Muenster and Osnabrück at the close of the thirty years' war, two hundred of these petty states were wiped out of existence, there still remained more than three hundred and fifty of them up to the beginning of the nineteenth century; and every little fatherland had its own government and boundary posts. Not even the right to change one's domicile within these posts was readily granted. It was considered rank heresy, and an outrage upon time-honored custom, to speak of leaving; it was high treason to leave; and so the son staid where his cradle had stood. Of course, he spent a few years in travelling as journeyman, plying his trade under renowned masters; but soon he returned to the old nest.

This exclusiveness was particularly strict within the walls of the cities. Since their inhabitants had, by natural increase, filled the towns to overflowing, the city government prohibited outsiders from settling in town. The elders of the guild determined upon a certain number of masters who could ply their trade: no others were permitted to open a shop, lest competition might play havoc with their bread and butter. Even the sons of masters had to wait for the death of their fathers before they could start in business or become masters. As the number of inhabitants was literally limited by town-walls, so was the number of tradesmen by harsh, arbitrary rules. No wonder that hundreds, thousands, and hundred-thousands packed up and left, never to return.

To our own century it was reserved to remove the tyranny of guilds in Germany; and liberty of trade and settlement has only been secured by law during the last fifty years. This could never have happened if the cities had not first broken their choking neck-ring, — the town-walls, — and levelled their ramparts. It was a sequence of the marvellous change in warfare inaugurated by Napoleon I. Thus we see a beneficial sequence following the terrific influence of war. Such imposing armies as were massed together (1,300,000 soldiers went to Russia under command of Napoleon) made a mockery of town-walls and ramparts, built and thrown up before gunpowder was invented; and they were soon torn down and levelled by the citizens. After the restless little man Napoleon was safely stowed away as a prisoner on the Island of St. Helena, a time of peace of more than fifty years followed; and, lo! all the many buds broke open, and out of musty streets, and from behind mouldy town-walls, sprang an exuberantly blooming life in every domain of human exertion. Now additions from outside were welcomed in town. The cities swelled. The band that had checked their growth was torn asunder.

However, a state of things such as I have indicated had existed for more than eight hundred years, and had developed a certain mode of thinking and acting; had ripened certain deep-rooted prejudices; had imprinted upon life in Germany an almost indelible stamp; in fact, it had nurtured the idea of a natural calling for every one; and it need not be wondered at that there is still a strong current of thought in Germany which directs, or misdirects, the destiny and future of many a child.

Now turn to the Union. Here the people began, about two hundred years ago, where the Germans stand now. Here we never had town-walls, never any guilds, no limitation as to number and grade of practitioners of trade. Here we had no hostile neighboring nations lurking about to invade our territory and take us unawares. Free and unmolested, the people built their houses, towns, and cities, — built them upon the virgin soil under God's free heavens, without fear of sieges and scaling-ladders. Every one was permitted to come, and he was welcome to build; and if he thought he could earn his daily bread, he could do so without fearing any arbitrary limitations by guild regulations. Competition has ever been absolutely free in this country. The liberty of trade, like political liberty, has its own regulator. Trades and industries are governed by the steady force of the law of supply and demand, and the sleepless instinct of gain prompts us to heed that law.

The American farmer-boys of "ye olden time" (and they were greatly in the majority) were raised in a most excellent school, that of necessity. The great distances between the farm and the centres of trade made them lend a hand at almost every trade. They learned to repair shoes, wagons, and implements, to shoe horses, ply the carpenter's and joiner's trade, etc. They were not exclusively farmers. The idea that a man is predestined for one kind of labor, and for no other, never occurred to them.

The peculiarly advantageous circumstances of the New World for gaining wealth; constant immigration of skilled laborers from all civilized nations; a restlessness, which became permanent, caused by a constant westward movement of the people; the hope to enrich one's self still more quickly elsewhere, — these motives stirred all the powers of the nation into a mad whirl. A constant shoving and pressing, an unceasing roaming about and seeking luck, became the ruling passion of the people. The idea of taking root in a community rarely prompts any one here. Is he not the citizen of a country the extent of which is so great that it takes him six months to cross it on foot from east to west? Compare with such magnitude some small German principalities through which one could pass on foot conveniently in a day.

Now, when the American does not like one place, or if he fails to catch luck or to secure a fortune in one occupation, he simply turns to another; and so he changes readily from professions to trades or to farming, as circumstances seem to favor the one or the other. Since the people have never known town-walls or guilds, they do not entertain the idea that a man should devote his life to one thing exclusively. It is not at all astonishing to see a man shift from book-keeping to cigar-making, from farming to practising law or medicine, from working in a machine shop to doing this glorious country inestimable service as policeman or legislator.

We must not for a moment entertain the idea that this is conducive to great mischief. It is not: I rather think this freedom more beneficial than the humiliating bondage to which, according to the German usage, a man is condemned who has "missed his calling," and has to abide by the consequences of his folly. Let me repeat, liberty always has a regulator in itself. Free choice of occupation follows laws which are as unerring as the law of gravitation. No guild regulation could ever compete with them in effectiveness. Nature's law of the "survival of the fittest," though terribly cruel, is very effective.

And now we come back to our question, Is every person predestined for a calling? Approach the question regardless of preconceived notions, and you will have to consider that every one has his own peculiar face, his own form; each of his limbs or hands is peculiarly shaped, and cannot be duplicated by that of any other human being. His senses and faculties are in their combination so wonderfully and peculiarly arranged, that there may, perhaps, be found a similarity, but never an exact duplicate. This proves, if any thing, that no two men can be exactly alike in faculties, qualifications, tendencies, and accomplishments, so as to feel at any time, and under all circumstances, exactly the same impulse for action. Every one will move in a direction differing from that of all other men. Evidently, then, the peculiar mixture of which every individual consists tends toward confirming the belief that every one has a calling; that is, every person

must be specially well fitted for one kind of work, and for no other as well.

That would seem to settle the question, but it does so only ap parently. The child is a "soft and yielding being." Plant-like, he accommodates himself to influences which play upon him. His aptitudes grow exuberantly on the one side, and become crippled on the other, as friendly or hostile influences prevail. A symmetrically shaped plant will become twisted and distorted if placed against a wall. It depends upon the treatment of the gardener, whether a tree will spend its energy in producing leaves or fruit. A boy six years old may have a talent for art, his sense of form and color may be very pronounced; yet after five years he may be found to have apparently lost that faculty, and developed in a direction which makes the observer prophesy that the boy will become a great lawyer. And, again, after some years he may be found to have developed great skill in manual occupation, having apparently pressed into the background his liking of art and literature.

These are no hypothetical cases. Every observant educator will have come to the conclusion ere this, that it is utterly unfruitful and perilous to fore-ordain a pupil's future. This being the case, it seems to me wise to follow the advice of eminent men; to wit, develop harmoniously all the talents that manifest themselves in the child, and leave the choice of occupation or calling to the developed and ripe judgment of the youth. Do not make this choice irrevocable. Give every one the greatest possible freedom for changing his profession, or occupation, or calling (or give it whatever name you will), if he comes to the conclusion that he missed it in his first choice. A human being who has had the chance and manifold opportunities for testing his natural gifts, and is permitted to exert himself in many directions, will certainly find his natural calling, and achieve great success. Let there be no arbitrary rules, no guild regulations, but let us maintain that liberty of action which has made this nation what it is, the greatest, noblest, most talented, most energetic, most successful, and therefore happiest, nation on the face of the earth.

HINDU ARITHMETIC.

EUROPEANS who have resided in India have frequently expressed astonishment at the rapidity with which arithmetical calculations are mentally made by very small Indian boys. Some account, therefore, of the Indian method of teaching arithmetic, which is believed to be superior to the English methods, is given by Frederic Pincott, M.R.A.S., in the April number of *Knowledge*, and will probably be interesting to our readers.

The arithmetical system of Europe was revolutionized by India when the so-called Arabic figures which we daily use were borrowed by Arab traders to the Malabar coast, and by them introduced into Europe. It was Indian intelligence which devised the method of changing the values of the numeral symbols according to their positions. This ingenious conception rapidly superseded the older methods, and gave enormously increased facility to arithmetical computations as compared with the Greek and Roman and the older Arabic methods.

In order to explain the present Indian system of arithmetic, it is necessary to premise that the *Pândhes*, or schoolmasters, employ a number of terms unknown to English teachers. These terms have been invented for the purpose of facilitating calculation, and the astonishing results achieved cannot be understood without comprehending the terms employed. The strangeness of the names of the figures and fractions arrests the attention of every student of Hindî. Few attempt to master the fractions; and there are some who, after many years' residence in India, cannot repeat even the numbers from one to a hundred.

Indians use monosyllables similar to ours, from 1 to 10; but from that point the words are built on the model of "1 and 10," "2 and 10," "3 and 10," etc.,[1] up to "8 and 10;" but the word for 19 means "minus 20." After 20 the same method is continued; "21" being impossible, the form is invariably "1 and 20," "2 and 20," up to "minus 30," "30," "1 and 30," and so on. This method of nomenclature goes back to remote antiquity, for the old Sanscrit language presents the same peculiarity.[1] The object of this nomenclature is to facilitate computation; for, in reckoning, the mind has to deal with the even tens, the simplest of all figures to multiply. Thus the question, "9 times 19," is not a simple one to an English child; but the Indian boy would be asked, "9 minus-twenties." In an instant he knows that he has only to deduct 9 minus quantities from 9 twenties, and the answer 171 comes before the English boy has fully realized the question. The formidable difficulty of the 9 is thus completely got rid of by a mere improvement in nomenclature.

Another advantage that the Indian boy has is the use of short, mostly monosyllabic, terms for every ascent in the decimal scale; thus such lumbering expressions as "one hundred thousand" are unknown to him, the simple word *lâkh* conveying the idea fully to his mind. So, also, "one thousand millions" is *arb;* "one hundred thousand millions" is *kharb;* and so on. The advantages of this terseness must be at once apparent.

It is, however, with respect to fractional numbers that the advantage of the Indian system of nomenclature becomes most conspicuous, when once understood. They employ a large number of terms, which are given below.[2]

These terms are *prefixed* when used in combination with whole numbers, the object being to present the special modification to the mind before the number itself is named. Complicated as this nomenclature appears at first sight, its difficulties disappear when brought to the test of practice. It is the outcome of centuries of practical experience, and the thoughtful application of means to an end. It will be sufficient to illustrate the use of these words, and the extraordinary arithmetical facilities they afford, if the use of *paune* is explained, that is, ¾, that being the fraction which the English child has most trouble with. The Indian boy knows no such expression as "two and three-quarters;" in fact, the term "three-quarters" in combination with whole numbers has no existence in his language. His teacher resorts to the same device as has been explained when speaking of the figure 9: he employs a term which implies "minus." By this process 2¾ becomes *paune tîn*, that is, "minus 3," or "a quarter less 3;" and in the same way 3¾ is *paune châr*, that is, "minus 4;" and so on.

Precisely the same plan is adopted with reference to the term *sawâ*, which implies "one-quarter more:" thus 3¼ is *sawâ tin* = "plus 3;" 4¼ is *sawâ châr* = "plus 4;" etc. It will now be seen that the *whole* numbers form centres of triplets, having a minus modification on one side, and a plus modification on the other. This peculiar nomenclature will be clearly apprehended by the following arrangement: —

2¾	paune-tin	—3	3¾	paune-châr	—4	4¾	paune-pânch	—5
3	tin	3	4	châr	4	5	pânch	5
3¼	sawâ-tin	+3	4¼	sawâ-châr	+4	5¼	sawâ-pânch	+5

In multiplying these fractions, therefore, the Indian boy has to deal with only the minus and plus quantities. A simple instance will illustrate this. "7 times 99¾" would be a puzzle to an English child, both on account of its lumbering phraseology, and the defective arithmetical process he is taught to employ. The Indian boy would be asked, "*Sât paune-sau?*"—three words meaning "seven minus-hundreds?" The very form of the question tells him that he has only to deduct 7 quarters from 700, and he instantly answers 698¼. Equal facility is found with any similar question, such as "5 times 14¾?" The Indian boy is asked, "Pânch paune-pandrah?" i.e., "5 minus-fifteens?" As the words are uttered, he knows that he has only to deduct 5 quarters from 5 fifteens; and he answers at once, "Paune chau-hattrah," i.e., "a quarter less four-and-seventy" (73¾).

So much for the machinery with which the Indian boy works. The more it is understood, the more it will be appreciated. It is undoubtedly strange to our preconceptions; but it would be a

[1] This is also the original meaning of the English words "eleven," "twelve," etc., up to "nineteen."

[1] In the ancient language there was also an optional form in conformity with the English method.

[2] Pâ,o = ¼; âdh = ½; paun = ¾; paune = —¼ (¼ less than any number to which it is prefixed); sawâ = 1¼ (¼ more than any number to which it is prefixed); sârhe = + ½ (½ more than any number to which it is prefixed); derh = 1½ (a number + half itself); pawannâ = 1¾; arhâ,î = 2½ (twice and a half times any number); hûnthâ = 3½; dhaunchâ = 4½; pahûnchâ = 5½.

real blessing to our country if corresponding suitable terms were invented, and this admirable system were introduced into all our schools.

Some Europeans have sought to account for the surprising results attained by Indian children, by attributing them to special mental development due to ages of oral construction. It is perfectly true that Indians rely more on their memories than on artificial reminders, and no one can come into contact with the people without being struck by their capacity for remembering. It is well known that many of the ablest men the country has produced could neither read nor write; but they hardly missed those accomplishments, for their minds were frequently stored with more information, which was more ready to their command, than that possessed by the majority of book-students. It is well known that Ranjît Singh could neither read nor write, but he knew all that was going on in every part of a kingdom as large as France. He was an able financier, and knew at all times accurately the contents of all his treasuries, the capacities of his large and varied provinces, the natures of all tenures, the relative power of his neighbors, the strength and weakness of the English, and was in all respects a first-class administrator. We commit the mistake of thinking that the means to knowledge is knowledge itself. This induces us to give all the honor and prizes to reading and writing, and leads us to despise people, whatever their real attainments may be, who have not acquired the knack of putting their information on paper. It ought to modify our opinion on this point to reflect that the architectural triumphs of India were nearly all built by men who could neither read nor write. Another illustration of dependence upon memory instead of paper can be found in the Indian druggist, who will have hundreds of jars, one above another, from floor to ceiling, not one of them marked by label or ticket, yet he never hesitates in placing his hand on the right vessel whenever a drug is required. The same, to us, phenomenal power of memory is shown by the ordinary washermen, who go round to houses with their donkeys, and collect the clothes, some from one house, some from another. These they convey to the river and wash, and, in returning with the huge pile, never fail to deliver each particular article to its rightful owner.

The Indian boy's first task is necessarily to commit to memory the names of the figures from 1 to 100. He is next taught that there are nineteen places for figures, and their names. These correspond to our units, tens, hundreds, etc.; but the monosyllabic curtness in the names of the higher numbers is his distinct advantage.

What we call the multiplication table then begins. In England the multiplier remains constant, and the multiplicand changes: thus children repeat, "twice one, two; twice two, four; twice three, six;" etc. In India the boy is taught to say, "one two, two; two twos, four; three twos, six;" etc.; his multiplier changing, while the multiplicand remains fixed. Another peculiarity is this: he begins at 1, not at 2; and this furnishes him with a series of most useful collective numbers. Here, again, the English language lacks terms to translate the first table, but an idea may be gained from the following attempt: one unity, one; one couplet, two; one triplet, three; one quadrat, four; one pentad, five; etc.

These names for aggregates, as distinguished from mere numerals, are of much value to the boy in the subsequent processes, and give him another distinct advantage.

In learning these tables the boy is not carried beyond 10; that is, he goes no further than "two tens, twenty," "three tens, thirty," etc.; but to make up for that forbearance he is carried on in this process of multiplying figure by figure not only to 12, or up to 20, but he goes on through the thirties, and does not make his first halt until he gets to "ten forties, four hundred." In achieving this result something more than mere memory is brought into play, for he is taught to assist his memory by reference from one table to another; thus the first half of the six table is contained in the three table, etc.

A short supplementary table is next taught, beginning at 11×11 to 20×11, and then proceeding to 11×12 to 20×12, and so on up to 20×20. This method reduces considerably the tax on the memory; for one-half of the table is obviously the same as the other half, and therefore only half calls for special effort.

The boy has now committed to memory the multiplication of every figure from 1×1 to 20×20, and in addition he knows the multiplication of every figure up to 40 by the ten "digits." It will be observed that both tables end at 400 (10×40 and 20×20); in fact, 4 is the most important factor in Hindu arithmetic, all figures and fractions being built upon multiples and fractions of it.

At this point, instead of practising on imaginary sums in the hope of learning arithmetic empirically, the Indian lad immediately proceeds to tables of fractions, the first being the multiplication of every figure from 1 to 100 by ¾. Here, again, ¾ would be the last fraction we should attempt; but in India it is the first, and, by the superior system of nomenclature there in use, it is a very easy affair. The boy, knowing the multiplication of the whole numbers, is taught to deduct the half of the half (¼), and the thing is done. Memory is assisted by observing that every multiple of 4 is a whole number, and that the number below it will always be a *sawâ* of the next lower figure, and the number above it always a *paune* of the next higher figure. Thus in answer to the question $\frac{3}{4} \times 36$, the Indian boy says mentally, 18, 9, 27; he also knows that 36 is the ninth multiple of 4, and by immediately deducting 9 can get his 27 that way also. Knowing, also, that 36 is a multiple of a 4 yielding 27, he knows that 35 will yield *sawâ chhabbîs* (26¼), and that 37 will yield *paune athâ,îs* (—28=27¾). In this way three-fourths of the table is a matter of logical necessity, resting on the elementary table previously acquired.

In the next table the boy is taught to multiply every figure from 1 to 100 by 1¼. This, of course, is precisely the reverse of the last: the ¼ is ascertained and added, instead of being deducted. Here, again, the multiples of 4 are whole numbers; but the figures preceding result this time in a *paune*, and those next following in a *sawâ*. This table also costs but little effort when thus taught.

The next table teaches the boy to multiply from 1 to 100 by 1½, and of course means simply adding half the multiplier to the figure itself.

The next step, multiplying from 1 to 100 by 1¾, is achieved by simply adding three-quarters of the multiplier to the multiplier itself. The "three-quarters" table has been already acquired by the boy, and he has therefore only to add any given multiplier to it. Thus, if asked, "What is 27 times 1¾?" he knows that 27 *paunes* are 20¼: he has therefore only to add this to the 27 itself to get 47¼ as the instant answer.

The boy is next exercised in multiplying 1 to 100 by 2½, and he is taught to do this by adding half the multiplier to the "twice-times" table.

Then follow similar tables multiplying by 3½, 4½, and 5½; and the results are arrived at instantaneously by adding to the "three-times," "four-times," and "five-times" tables half the multiplier in every case.

In all these tables the rapidity and simplicity is in great part due to the terms employed. The boy is not asked to "multiply seventeen by three and a half," or "What is three and a half times seventeen?" or puzzled by any other form of clumsy verbosity. The terms he uses allow him to be asked "*sattrah hûnthe*" ("seventeen three-and-a-halfs"). His elementary table has taught him that $17 \times 3 = 51$, and he knows that he has only to add half 17 to that, and the sum is done.

The final task of the Indian boy is a money table, which deals with a coinage which may be thus summarized: 16 *damrî* = 1 *takâ*; 16 *take* = 1 *ânâ*; 16 *âne* = 1 *rûpî*.

There is a small coin called *dâm*, three of which make 1 *damrî*; and therefore 48 make 1 *takâ*, and 96 = *ânâ*, 4^2 being still the unit. The table imparts a familiarity in combining these coins together.

This completes an Indian boy's most elementary course of arithmetic; and a little reflection on the great facility for computation which Indian children show, and the simplicity of the means by which it is effected, ought to make us rather ashamed than boastful of our own defective methods.

HEALTH MATTERS.

The Influence of Cold on Pneumonic Infection.

DR. G. LIPARI of Palermo, in his recent experiments on the infectious nature of fibrinous pneumonia, essentially confirms what is known of Fraenkel's pneumonococcus, and has also succeeded in proving the influence of cold as a factor in the origin of fibrinous pneumonia. According to the *Lancet*, the endo-tracheal injection of pneumonic sputa or pleuritic exudation of animals which had died from pneumonococci gave a negative result; but when the author, before or after the endo-tracheal injection, exposed the animals to cold, the result was very different. Of eight animals so treated, six died with clearly established pneumonic infiltration. The author supposes that the cold paralyzes the ciliated ephithelium of the bronchi, and at the same time causes the mucous membrane to swell, both of which pathological processes favor the descent of the infectious material into the alveoli. These experiments were doubtless undertaken with a view to harmonize the old and new teaching upon the origin of this prevalent disease.

A Long Fall.

A remarkable fall of a miner down 100 metres of shaft (say, 333 feet) without being killed is recorded by M. Reumeaux in the *Bulletin de l'Industrie Minérale*. Working with his brother in a gallery which issued on the shaft, he forgot the direction in which he was pushing a truck: so it went over, and he after it, falling into some mud with about three inches of water. As stated in *Nature*, he seems neither to have struck any of the wood *débris*, nor the sides of the shaft, and he showed no contusions when he was helped out by his brother after about ten minutes. He could not, however, recall any of his impressions during the fall. The velocity on reaching the bottom would be about 140 feet, and time of fall 4.12 seconds; but it is thought he must have taken longer. It appears strange that he should have escaped simple suffocation and loss of consciousness during a time sufficient for the water to have drowned him.

Tight Collars and Vision.

The influence of tight collars in impeding the circulation in the head by pressing on the jugular veins is well-known to military surgeons with the troops in India, says the London *Lancet;* but the bad effects of such pressure in cooler climates have been demonstrated by the observations of Professor Förster of Breslau, who states that three hundred cases have come under his notice in which the eyesight has been affected by the disturbance of the circulation caused by wearing collars that were too small. A large number of these cases were probably subjects of myopia.

The Treatment of Phthisis by Carbonic Acid.

It is said that lime-burners enjoy a certain degree of immunity from phthisis, not because they take in more carbonic acid, but because its diffusion when expired is impeded. Again, the course of phthisis is often seen to be arrested in pregnancy, and this has been ascribed to the increased amount of carbonic acid in the maternal blood. Chronic heart-disease, by causing chronic hyperæmia of the lungs, also affords a kind of immunity against phthisis. Lastly, in emphysema there is also permanent dyspnœa in more or less degree, and the blood is overcharged with carbonic acid. Acting on these ideas, Dr. Hugo Weber (*Berliner klinische Wochenschrift*) proposes to administer carbonic acid by the stomach, in the form of effervescing powders. Ten cases are reported in which decided improvement was noted after this treatment, which certainly merits further trial, especially as it can be carried out at the patients' own homes. According to Ebstein's theory of diabetes, the increased proneness to phthisis which that disease entails is due to the defective development of carbonic acid, this being not only the final product of tissue oxidation, but a body which exerts a regulatory restraining influence on the destruction of glycogen and albuminoids. Bergeon, Dujardin-Beaumetz, and others, have used in phthisis gaseous injections *per rectum* of hydrofluoric acid, copiously diluted with carbonic acid, and the good results they met with are claimed by Dr. Weber as due to the diluent.

BOOK-REVIEWS.

Numbers Universalized: An Advanced Algebra. Part II. By DAVID M. SENSENIG. New York, Appleton. 12°.

THE volume forming the first part of this work was noticed in these columns last August. The work as a whole embraces all algebraic subjects usually taught in the preparatory and scientific schools and colleges of this country. The object in dividing the work into two parts is to accommodate all kinds and grades of schools sufficiently advanced to adopt its use. The work may be had bound either in one or two volumes, as may seem desirable to the teacher.

AMONG THE PUBLISHERS.

THE three latest issues of the *Modern Science Essayist*, Nos. 22, 23, and 24, are devoted to "The Evolution of the State," by John A. Taylor; "The Evolution of Law," by Rufus Sheldon; and "Evolution of Medical Science," by Robert G. Eccles, M.D.

—Two useful and convenient little pocket volumes just published by E. & F. N. Spon of London and New York are "Tables and Memoranda for Engineers," by J. T. Hurst (tenth edition), and "Practical Electrical Notes and Definitions," by W. Perren Maycock. The first-named volume, which is of vest-pocket size, contains memoranda for excavators, brick-layers, masons, carpenters, plasterers, iron-workers, plumbers, painters and glaziers, and others, besides tables on every subject connected with engineering. The other volume is intended to be a *vade-mecum* for all persons even remotely interested in electrical engineering. It treats, briefly but clearly, of wires and lightning-conductors; electrical circuits, units, and Ohm's law; magnets, batteries, bells, indicators, switches, and alarms; electric light and dynamos; the telegraph and telephone; the electrical transmission of power, electric motors, and telpherage. It also contains rules and regulations to be observed in the fitting-up of electrical installations, all diagrams necessary to make its subjects clear, and is provided with a very full index.

—"Giordano Bruno: Philosopher and Martyr," is the title of a pamphlet containing two addresses before the Contemporary Club of Philadelphia, and published by David McKay of that city. The first is by Daniel G. Brinton, and treats more particularly of Bruno's life, martyrdom, and character, though with some notice also of his philosophy. The second, by Thomas Davidson, is devoted almost exclusively to Bruno's doctrines, their nature, their history, and their present significance. Both authors show too strong a tendency to read their own opinions into Bruno's works, or at least to find anticipations of them even in his casual utterances, — a common fault in philosophical writers, at the present day, when treating of earlier thinkers. Bruno's philosophy is too vague and mystical to be identified with any of those now prevalent, though it has points of contact with several of them. Besides, what is most interesting in Bruno is not his philosophy, nor yet his personal character, which was not of the best, but his spirit of independent thought and his heroic resistance to ecclesiastical tyranny. For these he will be remembered and honored, whatever the defects of his character or his creed.

—The leading article in *Garden and Forest* last week is on the sugar-maple, and it is illustrated by a striking picture of one of these trees. The number also contains an illustration of *Syringa Pekinensis* (the so-called weeping lilac), with a description of this new shrub; while Dr. Maxwell T. Masters, the distinguished editor of the *Gardeners' Chronicle*, London, writes instructively on sports, and Professor Budd of the Iowa Agricultural College discusses hardy trees and shrubs. "Chrysanthemums," "Plants for Easter Decoration," "The Spring

Garden," "Faults in Grafting," and "The Longevity of the Elm," are titles of a few of the remaining articles.

—The University of Pennsylvania is about to begin the issue of a series of monographs representing work done in the fields of philosophy, psychology, and ethics. The first number is announced for April, and is a work on "Sameness and Identity," by Professor Fullerton. Following this number will be a series of studies from the laboratory of experimental psychology, and an edition of Descartes' "Meditations," with Latin and English texts, and philosophical commentary. The series will be published by the University of Pennsylvania Press, under the editorship of Professors Fullerton and Cattell. Dr. E. J. James, professor in the Wharton School of Finance and Economy, is preparing for the American Economic Association a paper on the "Canal Question in the United States." He will show how great a mistake the American people have committed in allowing its canal system to fall into decay. He is warmly in favor of the construction of a new system which shall unite the great water-ways of the West to the Atlantic seaboard at various points. Dr. Simon N. Patten, professor in the Wharton School of Finance and Economy, has in press a book entitled "The Economic Basis of Protection." He "re-examines the whole question of free trade *versus* protection in the light of modern economic theories, and shows how the free-trade theories are inconsistent with the best results of late economic thought."

Publications received at Editor's Office, March 24–April 5.

ALLEN, W. F. Ancient History for Colleges and High Schools. Part II. A Short History of the Roman People. Boston, Ginn. 370 p. 12°. $1.10.
BRINTON, D. G., and DAVIDSON, T. Giordano Bruno: Philosopher and Martyr. Two Addresses. Philadelphia, David McKay. 68 p. 12°.
CROSBY, H. The Seven Churches of Asia; or, Worldliness in the Church. London and New York, Funk & Wagnalls. 168 p. 16°. 75 cents.
GOULD, G. M. A New Medical Dictionary. Philadelphia, Blakiston. 519 p. 8°. $3.25.
HOLMES, O. W. Poems and Prose Passages from the Works of. Compiled by Josephine E. Hodgdon. Boston and New York, Houghton, Mifflin, & Co. 107 p. 12°. 30 cents.
MACARTHUR, R. S. The Calvary Pulpit. Christ, and him Crucified. London and New York, Funk & Wagnalls. 294 p. 12°. $1.
SUTTON, J. B. Evolution and Disease. New York, Scribner & Welford. 285 p. 12°. $1.25.
SWEET, H. A Primer of Phonetics. Oxford, Clarendon Pr. 113 p. 16°. (New York, Macmillan, 90 cents.)
WHITTIER, J. G., Poems and Prose Passages from the Works of. Compiled by Josephine E. Hodgdon. Boston and New York, Houghton, Mifflin, & Co. 112 p. 12°. 30 cents.
YOUNG, L. Simple Elements of Navigation. New York, Wiley. 226 p. 16°.

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A WILLIAMS SENIOR who has had two and one-half years' work in chemical laboratory, and one year in a biological laboratory, desires position as teacher of natural science and lesser mathematics, desires a position as instructor in these branches, or as assistant to some chemist. References as to ability and character. E. E. Towne, Box 74, Williamstown, Mass.

A REGULARLY graduated physician in his 32d year, who has been in active practice for eight years, excepting the time he was interne in a hospital and taking a post-graduate course, and who has done considerable work both in literature and science, more particularly connected with medicine, being now engaged in editorial writing for one of the first-class medical monthlies, wishes to learn of a town, not particular as to the size or location, where, in addition to practising his profession, he may become connected with a school or other institution as teacher of elementary and advanced physiology, chemistry, and hygiene, one or all; or would accept position with an older physician who is engaged in literary or scienific work, as an assistant, either in his practice, or as amanuensis or secretary, or in any capacity requiring knowledge of medicine and cognate branches; or would accept a position as librarian, having had experience as acting librarian while at college. Can furnish unexceptionable references as to ability and character, and, if the position offers opportunities for advancement, will accept for a time a nominal salary. Is married, but has no family beside his wife. Address Dr. W., care of *Science.*

WANTED—Books upon American Archæology. My publication, "Fort Ancient," in exchange. First-class standard works only. Warren K. Moorehead, Smithsonian Institution, Washington, D. C.

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I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn

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CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

April 1. — J. M. Gregory, Recent Find in Switzerland of Skeletons and Arms of the Old Roman Period; Garrick Mallery, The Origin and History of Salutations.

Women's Anthropological Society of America, Washington, D.C.

March 29. — Mrs. Anna H. Barus, Modern Socialism.

Appalachian Mountain Club, Boston.

April 9. — S. H. Scudder and others, The New Map of the Country about Boston; W. O. Crosby, Description of Mohegan Rock, Conn., and Comparison of it with the Madison Bowlder, New Hampshire (with lantern views of both); R. B. Lawrence, Account of the Winter Excursion to Randolph (with lantern views of the mountains and club hut).

American Academy of Arts and Sciences, Boston.

April 9. — J. Walter Fewkes, The Use of the Phonograph in the Preservation of the Languages of the American Indians, with Demonstrations.

Engineers' Club, St. Louis.

April 2. — Thomas Long, The Erection of Some Recent Large Bridges; Mr. Frank Nicholson, The Pemberton Concentrator (read by Mr. Arthur Thacher).

Royal Meteorological Society, London.

March 19. — G. M. Whipple, A Brief Notice respecting Photography in Relation to Meteorological Work; W. Marriott, Application of Photography to Meteorological Phenomena. After the reading of the papers the meeting was adjourned to allow the fellows to inspect the exhibition of instruments, etc., illustrating the application of photography to meteorology. Not only were specimens or drawings of nearly every photographic meteorological instrument, and records from the same, shown, but also a most valuable and interesting collection of photographs of clouds and other meteorological phenomena. The photographs of clouds taken by Mons. P. Garnier of Boulogne-sur-Seine were exceptionally fine. A number of new meteorological instruments were also shown, as well as an ingenious working model devised by Mr. A. W. Clayden for showing the connection between the monsoons and the currents of the Arabian Sea and the Bay of Bengal. The exhibition remained open till Friday, March 21.

SCIENCE

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A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 376.

NEW YORK, APRIL 18, 1890.

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THE SUPPRESSION OF CONSUMPTION.

WE have in consumption to deal with a disease that causes upwards of 60,000 deaths every year in the United Kingdom; and it is estimated, on the basis of three invalids for each death, that about 200,000 persons suffer from it within that period. This disease pervades all ranks of society, from the mansion of the rich to the cottage of the poor, and it attacks in its course childhood, youth, maturity, and old age. Can we suppress consumption,—a disease that has so wide an area of distribution, and that possesses such a fatal character? I have come, after due and careful investigation of the subject, to the conclusion that we can. The issue here raised is of immense importance. It is a question of life or death for hundreds of thousands; and I earnestly request careful consideration of the evidence I shall adduce in support of the case, which, I say, not only completely justifies, but also necessitates, the conclusion that we now have it in our power to suppress consumption. And I would at once note the fact that there is no essential reason why that should not be accomplished. Man is not born to die from this disease, and, in fact, from four-fifths to six-sevenths of the race do not. We have unquestionable evidence that consumption has been completely recovered from, that a considerable reduction in its amount has been effected in some cases (for example, among prisoners), that it has been arrested for longer or shorter periods, and that persons with the signs of the disease have been able to completely escape from it:[1] consequently we must sooner or later ascertain the means by which that has been effected, and then we shall apply that knowledge to the prevention and cure of this disease.

What is the cause of consumption, and how does it operate in the production of the disease? The authorities have from time to time propounded theories that were said to give satisfactory information on these points. I take as examples of these theories the following:[2] climate, a certain height above the sea-level, cold, change of temperature, impure air, night air, carbonic acid, bad or insufficient food or clothing, dyspepsia, the non-assimilation of fat, diathesis, disease of the nerve-centre, cough, catarrh, bronchitis, pneumonia, pleurisy, dampness of the soil, inheritance, the *Bacillus tuberculosis*, etc., and ask, Does any one of them afford adequate information on these points? Submit them to critical examination, and the answer to this question is an emphatic negative;[1] for they either have no foundation in fact, or have for their basis conditions that, on the one hand, occupy so wide an area of distribution that they include within their sphere of action a large number of persons who have never shown any signs of the disease, and, on the other, are so limited in the field of the disease that they are only found associated with a greater or less number of its cases, and consequently can afford no adequate explanation of its cause and mode of operation. So obviously, indeed, is this the fact, that I shall only note a few of them in passing, and then examine in detail the important, because it is popular, theory of Koch.

Is consumption limited to, or even more prevalent in, any particular climate? No: the disease is co-extensive with the civilized world. Truly, consumption is more prevalent below than above certain altitudes, but within the same limits the vast majority of the human race is living free from the disease. Further, while on the one hand consumption is found at high altitudes, as in Madrid and in certain cities in South America, on the other it is unknown in certain tribes inhabiting districts below the sea-level in Asia. To cold and change of temperature has generally been assigned an important place. That is an error; for in cold climates, as in Canada, Sweden, and such places, as well as in the classes most exposed to cold, there is little consumption, and in the severe winter of 1854–55 more men died from it in the barracks at home than in the camp before Sevastopol; and a similar argument may be held with regard to the causal influence of change of temperature.

The majority of those who breathe impure air, night air, or who have bad or insufficient food or clothing, etc., do not get consumption; and the same fact holds good for the diseases that are alleged to produce it. What an appalling amount of consumption there would be if every one who had a cough, or who caught a cold, became consumptive! Dampness of the soil is another alleged cause of this disease, but in the cases cited in proof of that theory drainage was not the only factor that was present. We know that as parts of Lincolnshire get drained, ague disappears, and consumption takes its place; and we have the same fact in America and in Switzerland.[2] There was the least consumption in the most wet department of France. Consumption

[1] Sydenham, Walshe, Laennec, Heitler, Roger and Boudet, Ewart, Friend, Fuentes, Blake, Herman Weber, Cruveilhier, Pollock, Austin Flint, Fuller, Stokes, etc.

[2] Williams, Fuchs, Murrhy, Bouilland, Scot-Allison, Briquet, Boyle, Baudeloque, Bucheteau, Shephard, MacCormac, Ruchle, Herard and Cornil, Bouchardat, Bennett, Hutchinson, Brakenridge, Dobel, Lebert, Lugol, Allbut, Roberts, Memeyer, Clark, Williams, Broussais, Grisolle, Buchannan, Bowditch, Thompson, Cotton, Roberts, Koch, etc.

[1] Louis, Hanot (Jaccond's Dictionary), Andrew, Pollock, Ziemssen.

[2] Haviland, Kelly, Green (U.S.A.), Damaschind.

is comparatively rare in pure wet, undrained districts, and a majority of consumptive patients have not been subjected to the influence of dampness of the soil. The theory of the inheritance of consumption is still generally accepted, although no evidence has been adduced in its support. At birth the child of consumptive parentage has the same type of chest, the same proportion of chest-girth to height, as that possessed by children of healthy parents, and there are no means of distinguishing the lungs of the one from those of the other. The fact that some of the children of consumptive parents subsequently themselves suffer from this disease is not evidence that consumption was transmitted from the parents to those children. A large number of children, even where both parents have died from consumption, remain absolutely free from it.[1] Is it so unreasonable to expect the conditions that produced the disease in the parents will later on repeat the process in those of the children that are submitted to their action, that we must resort to a pure hypothesis for an explanation of those facts? The theory is only alleged to account for a small part of the cases of consumption, and we cannot accept an hypothesis where we already have a reasonable explanation of the subject.

I pass now to the theory that the *Bacillus tuberculosis* is the cause of consumption, and I ask, What evidence is there to prove this theory? Koch[2] experimentally introduced the bacillus into a number of animals, some of which were invariably attacked by consumption, others had a greater or less liability to it, and the remainder were totally free from the disease. We have to examine the successful experiments. They were made upon animals that were most liable to "spontaneous" consumption, and their value rests upon the fact that the animals that were not inoculated were found healthy. Now, Koch himself noted, that, if these animals were kept too long before they were inoculated, they also became diseased. So there was only a difference of time between the inoculated and non-inoculated animals that became consumptive, and consequently the value of the so-called "control" evidence entirely disappears.

What produced consumption in the non-inoculated animals? According to the theory, the inhalation or other introduction of the bacillus. Just so; but where is there any evidence of that? The previous experiments do not prove that the bacillus can produce consumption, and to offer that explanation is to assume the precise point the experiments were intended to prove.[3] Further, these animals were subjected to the conditions of confinement. What effect did those conditions produce on the animals? Koch ignored them and their effects, and by so much vitiated his conclusion, even if that conclusion had been otherwise established. The bacillus, its containing medium, or the changes effected, were evidently powerfully irritant; and it would indeed be surprising if, when introduced into animals so liable to consumption and subjected to the conditions of confinement, the disease were not both more rapidly manifested and of a more extensive character. Therefore Koch's experiments do not in any way warrant the inference he has drawn from them; and once again a great discovery has had its true import temporarily overshadowed by a misinterpretation of its real significance.

[1] Thompson.

[2] Report of Koch's Experiments (British Medical Journal), Watson, Cheyne, Spina (*Sutler*).

[3] Cadeal and Malet's Experiments (British Medical Journal), Brown-Sequard's Experiments (Lancet).

How does this theory accord with the known facts of the case? Tubercles in various stages, young and adult, are found in which there are no bacilli, while in the same specimen caseous tubercles may be present containing bacilli.[1] There are cases of consumption in which the bacillus is absent both during life and *post-mortem*.[2] The physicians, clinical clerks, nurses, *post-mortem* room attendants, and those who clean the wards of consumptive hospitals, are not attacked by the disease.[3] Patients suffering from bronchitis, pneumonia, etc., occupy beds adjoining consumptive patients for long periods, but they do not become consumptive. The friends of patients who regularly visit them in these institutions do not get it. Some wards at Brompton had their ventilating-shafts stopped, but no attack of consumption followed either in the patients suffering from other chest complaints or in the attendants.[4] These institutions are not centres from and around which the disease spreads. Yet here are the most favorable conditions for its rapid and unquestionable propagation; and we have only to substitute small-pox, scarlet-fever, or any of the infectious diseases for consumption in the above conditions to realize what must happen if it were an infectious disease. And so widely is this bacillus distributed, so tenacious is it of life, and so constantly are we, especially when suffering from respiratory diseases, exposed to its action, that on the assumption of its potency it is impossible to account for the comparative smallness of the number of consumptives.

We pass from these contradictory and most unsatisfactory theories to the consideration of one that is both in strict accord with and capable of affording an adequate explanation of all the known facts of the case. The theory my investigations have led me to hold may be stated as follows: that consumption is the direct result of the reduction of the breathing surface of the lungs below a certain point in proportion to the remainder of the body, and is solely produced by conditions that tend to reduce the breathing capacity.

I have experimentally produced consumption by these conditions. On one occasion I took a well-developed chest, and gradually submitted it to conditions that tend to reduce the breathing capacity, and at the same time, so far as possible, placed impediments to the performance of compensatory action by other organs. At first there was a reduction of the chest-girth, a wasting of the muscles, a loss of the range of extension, the well-known change in shape, and increased frequency of breathing. This was soon associated with catarrh, pain in the chest, steady loss of weight, and hectic; and the process was continued until I was satisfied that consumption was well established. Then I induced compensatory action by other organs, and submitted the lungs to conditions that tended to develop them. This was followed by great relief in the chest symptoms, which eventually completely disappeared, by a restoration of the general health, a return to the normal weight, a change in the

[1] Klein. [2] Spina, Sir Andrew Clark.

[3] Pollock, Cotton Andrew. [4] Pollock.

shape of the chest in an opposite direction; and I continued the process till the chest had regained its full development and there was sound health. Each step in the experiments was carefully verified, the same sequence of events was invariably observed, and I have both traced the presence of these conditions and watched their progress in many cases of consumption.

We can at any time watch the direct production of consumption by the constant inhalation of small particles of various substances in strong healthy men who have been brought up in the country, and we know the disease has been produced in this way for generations. Masons, builders, wool and cotton manufacturers, quarrymen, cutlers, file-makers, earthenware manufacturers, etc., supply a large contingent to the mortality from consumption.[1] Occupations that are carried on in small, crowded, or badly ventilated rooms, where the respiratory functions are impeded, or those in which there is a long-continued cramped position of the chest, have long been notorious for the production of consumption. We have examples of this in the case of Manchester warehousemen, drapers, tailors, shoemakers, watchmakers, printers, clerks, and students.[2]

The army supplies us with a practical demonstration of the direct production of consumption by such conditions. Each recruit is specially examined with reference to consumption, and three months after he has entered the army he is again examined, when, if any indication of the disease be found, he is at once dismissed the service. These men are placed under the supervision of skilled medical officers; their food, clothing, and home are assured them; they are in the prime of life; and any illness they may have is at once attended to. Yet, notwithstanding this doubly certified freedom from consumption, and these great advantages, the loss to the army from this disease is much higher than that of the worst district in England. During the six years 1880–85 there were, on an average, 1,330 admissions into hospital, 263 deaths, 215 invalids sent home from abroad, and 474 invalids discharged the service. Army medical authorities[3] are agreed in attributing this "generated" disease to the conditions of army life; and of these they attach most importance to the large amount of time spent in impure barrack air, compression of the chest by clothing, etc., alcoholism, sentry go, and specific disease, or, in other words, to conditions that tend to reduce the breathing capacity.

We have in confinement[4] another practical demonstration of the direct production of consumption by conditions that tend to reduce the breathing capacity. Prisoners, orphans, and the insane formerly suffered terribly from this disease. At one time the mortality of the white prisoners of New York from consumption was three times that of the population, and the mortality of the black was double that of the white prisoner.

In the so-called "inherited" consumption there is yet another sad example of the direct production of the disease by such conditions. Look, on the one hand, at the conditions under which these children are brought up from birth, at the early age at which the disease appears, at its greater frequency in the daughters of consumptive mothers, and, on the other, at the plain evidence of the effect of these conditions that is seen in the arrested or retarded development of their chests.

Strong healthy countrywomen, who were accustomed to work in the fields, went to Paris, wore stays for the first time, and furnished the majority of Louis' patients. Tall men, who in proportion to their height are small-chested, and narrow-chested men, are notorious for their great liability to the disease. The association between repeated injury to the lungs by certain diseases and consumption has attracted the attention of most observers. We know that our cities are the chief centres of consumption, that the main tendency of city life is to reduce the breathing capacity, and that men who have been brought up in the country supply the majority of its victims. We also know that in the country such tendencies dominate the sphere occupied by the women who are liable to this disease, and that the female mortality exceeds that of the male.

Further, we have the same relationship between these conditions and consumption in the animals under our control. Many investigators have produced consumption in animals by strict confinement.[1] Wild animals kept in the great national menageries, cows stabled in cellars under ground in large cities, and our own domestic pets, alike become its victims. And where is there a case of consumption, experimental or not, in which such conditions were absent?

I have carefully sought in vain for the record of such a case. Now, if the interpretation that has been placed upon these facts is true, then we shall find ample evidence of the action of those conditions in the disease itself. They tend to reduce the breathing capacity: consequently their effect must be a progressive reduction of the breathing surface of the lungs, and that is precisely what we have. Long before we get the so-called signs of the disease, we have a progressively lessening chest capacity, that goes[2] on to the end. I have shown, I trust not too briefly, that conditions that tend to reduce the breathing capacity can and do produce consumption, and that they are the dominant factors of, and co-extensive with, the field occupied by this disease. Let us now glance at the dominant conditions of the field in which consumption is unknown: for there are still places in Asia, Africa, and America in which there is no consumption; and in some of these the inhabitants have no word for the disease, and do not know what it means. Travellers inform us that these people spend the whole of their lives in active exercise in the open air, that they hold themselves erect, bearing the weight of their shoulders on the spine, and that their chests are broad, deep, and freely movable. And there is no record of consumption being found in animals in their wild state.

But this area of freedom from consumption is being steadily diminished by the introduction of civilization,—that is, of conditions that tend to reduce the breathing capacity,—and that is invariably speedily followed by the first appearance

[1] Lombard.
[2] Supplement to Registrar-General's Report, 1870–80.
[3] Parkes, Aitken, Welch.
[4] Taennec, Cruveilhier, Peter.

[1] De Musey, D'Arboval, Rayer, Bricheteau.
[2] Hutchinson, Stokes, Ransome, Graham, Balfour.

of the disease. The native races of America were free from consumption till they came in contact with Europeans, and began to adopt their habits and mode of life; and the amount of this disease actually present in the American Indians has recently been shown to correspond with the extent of their civilization.[1] So, also, were the South Sea Islanders, the Maories, the New Britons, and the natives of the African coast. The same process is now marking the progress of civilization among the natives in the interior of Africa, Asia, America, and New Britain. We have the same sequence of events in the great mortality of the dark races that settle in our cities and large towns; and in civilized countries the classes that were formerly free from consumption, for example, mountaineers and our own Highlanders, are now being attacked by the disease, as the direct result of a corresponding change in their habits and surroundings.

What is the mode of operation of the conditions that tend to reduce the breathing capacity in the production of consumption? In a true state of health the lungs have a sufficient breathing surface, not only to perform their ordinary functions, but also to meet within certain limits any extra demand that may be made upon them. When they are subjected to conditions that tend to reduce the breathing capacity, they lose this power of adjustment to their external conditions, and subsequently become unable to effect the whole amount of those interchanges that constitute their ordinary function. That part of those interchanges that is not effected by the lungs, being necessary to meet the ordinary requirements of the body, will be at once added to the work normally performed by one or more of the other organs; and, so long as this compensatory work is accomplished without causing a disturbance of their functions, a temporary adjustment will have been effected, and there will be no obvious disturbance of the general health. But unfortunately these conditions continue in active operation, there is progressively increasing reduction of the breathing capacity, and consequently there comes a time when this compensatory work is not effectively performed by other organs, and there is either a greater pressure of work thrown on the lungs, or over-activity of one or more of the other organs, indicated by some mode of disturbance of the general health.[2] The imperative demand for the effecting of these interchanges causes in the parts least able to meet it, as a rule the apices, the phenomena of irritation, which is, as we know from the experimental production of tubercles by irritation,[3] manifested by tubercular change. Each point of these morphological changes produces a further reduction of the lung capacity, and by so much becomes an addition to the forces that increase the inequality between the amount of lung available and the amount of work it has to perform; and so there is more irritation of the lungs, and more work thrown on the other organs, disturbing their functions and deranging the general health. Further, as the foci of morphological change multiply by reason of the progressive increase of the conditions that produce them, there is increased pressure and lessened supply of nutrition, accompanied by local congestion; so that they become deprived of nutrition, necropsis takes place, and eventually cavities are formed. Hence there is more and more work thrown on the other organs, causing increasing disturbance of their functions, and consequently more and more disturbance of the general health, till first one organ and then another becomes so greatly deranged that the so-called complications of the disease are produced; and this process goes on till at last neither lungs nor the other organs are together able to effect those interchanges without which life cannot continue.

Glance for a moment at the course of consumption when viewed in the light of this interpretation of its nature. Instead of its "uncertain and mysterious" advent, its "protean" forms and "chameleon" changes, we now see before us a perfectly natural succession of events, whose *raison d'être* order of sequence and relationship to each other can be laid down with exactitude. We have, in the first place, the lowered or arrested vital capacity progressively decreasing, associated with a progressive decrease or arrest of the size and extent of movement of the chest, the wasted or non-developed muscles, the sloping shoulders, and the changing shape of the thorax. At a certain point in this course there appear occasional, and then frequent, indications of increased activity of one or more of the other organs; there is increasing liability to "catch colds," and increasing difficulty in getting rid of them; and there are signs of the derangement of the general health and increasing weakness, accompanied by indications of lung irritation and implication. This may be followed by a period of rest; there has been a temporary adjustment between the work to be done and the work effected; and in common parlance the patient has been "patched up," if he is under treatment. Then the area of lung implication spreads, the signs of lung irritation become more marked and troublesome, the general functions are greatly deranged, the appetite fails, the body-weight seriously decreases, hectic is present, and the patient's rest is disturbed. This also may be followed by a period of rest, a balance having been effected between the work now required and that accomplished. And these periods of attack and rest go on, the attacks increasing and the rests disappearing, until so much destruction has been effected that the body is no longer able to resist the disease, and death terminates this unequal combat.

Whatever condition of man's habits, mode of life, and surroundings has a tendency to reduce the breathing capacity is a potential cause of consumption; and it is an active cause in its production, unless and until its action is counteracted or compensated. It is evident that we have not to deal with the mere temporary or accidental presence of such conditions, but with those only that have a continuous or permanent character. We may consider these conditions from the point of view of whether their tendency is expressed by disuse of the lungs or by their forcible compression or injury. The most important place in the former must be assigned to the rapidly decreasing amount of muscular exertion we require to make in order to supply ourselves with those things that are necessary for our daily wants, owing to the increasing facilities for obtaining them afforded us by means of machinery and railways. This

[1] Rush (Philadelphia), Science (New York).

[2] Pollock, Hanot (Jaccond's Dictionary), Ruehle (Ziemssen's), etc.

[3] Wilson-Fox, Sanderson, Simon, Cohnheim, Frankel, etc.

lessened demand for muscular exertion to obtain our necessaries creates an inability and distaste for exertion to obtain those things that are not necessary; and, as there is a consensus of opinion on that point, it comes to be considered "not the correct thing" to perform any of those acts that require such exertion. Who carries any thing that he can have sent, or walks when he can ride? Who does not now ride in a closed carriage in preference to performing the journey on horseback? An obvious effect of this change is to increase the time spent in houses, manufactories, and offices, and consequently to greatly decrease that spent in the open air. Not only does man spend much more time in his habitation, but also those habitations have materially altered in character. Our sleeping apartments are no longer open to a thatched roof, our doors and windows are made to fit more accurately, and for the wide, open fireplace of our fathers we have substituted the modern grate, which appears to be kept closed on every possible occasion. In a word, the resources of civilization have been used to obtain as much difference as possible between the air in which we now pass the greater portion of our lives and that we have to breathe when out of doors. Whatsoever part of the twenty-four hours is spent in a house is so much time during which the movement of the lungs is impeded, for while there we are generally either sitting down or reclining; and both positions tend to reduce the breathing capacity, the latter more than the former. Also, as there is little muscular exertion in the house, there is a lessened production of heat, for which artificial heat is substituted; hence the great difference between the temperature of the rooms and that of the external air, the great sensitiveness to a lower temperature, and the fear of catching cold This fear of cold leads to active measures being taken to prevent cold air entering the rooms, and consequently to bad ventilation. And this hyper-sensitiveness to cold tends either to keep us in-doors during the colder months of the year and on those days during which the temperature is lower than usual, or to induce us to so overload the body with clothes when we do go out that free movement of the lungs is impeded.

The habit of stooping, whether brought about by the shape of the chairs (they are admirably adapted for that purpose), by the habit of assuming a so-called easy position, by muscular disuse and consequent weakness, or by poring over books from the nursery through the whole course of modern education, tends to materially reduce the breathing capacity. Very efficacious in the production of chest reduction is the universal custom of both sexes to have their clothes made to exactly fit the body at a period of rest, and thereby effectively preventing any but the most limited movement. Does not this custom effectually check any tendency to movements that would necessitate more than ordinary, tranquil breathing? And have we not enforced this habit by penalizing its breach as indicating a want of *savoir vivre?* Fashion dictates the size and shape of our clothes, and our bodies have to and do conform thereto. A beautiful example of this is seen in the hideous distortion of the lower part of the chest produced by wearing a corset, that never, never is tight. The compression thus produced is one of the most powerful causes of consumption in young girls and women; and obviously whatever produces either forcible compression of the chest or direct injury to the lungs is a cause of consumption. And when we look at the position such conditions hold in civilization, at the advances that are being made by man's increasing knowledge of the operations of nature, and his application of that knowledge to his own purposes, and at the progressive increase of such tendencies, then we see that in consumption we have one of the processes by which an adjustment is being made between the body and the work it has to perform under the changing conditions of advancing civilization, by the removal of those who have a body in excess of that work, and that the survival of the so-called fittest is thereby effected.[1] G. W. HAMBLETON.

[To be continued.]

HEALTH MATTERS.

Cookery of the Poor.

A FACULTY of social science has, it is stated, been instituted at the University of Brussels; and Professor Berger, a Belgian authority in chemistry, has given a course of lectures on alimentary chemistry. In the first of them he came to the academic conclusion that it was possible to determine with precision the quantity of nutritive elements indispensable for the reparation of the power of a working-man, and consequently the amount of money necessary for purchasing this quantity, and that therefore, when the other primary wants of a working-man were determined in the same way, the minimum of salary could be fixed with scientific accuracy. Questions of taste, digestibility, and prejudice are, however, apt to be ignored in calculations of this kind; so that, although of value as a basis of information, they are far from having the practical use which their authors ascribe to them. The knowledge of the housewife and of the cook, and a familiar acquaintance with the habits and surroundings and tastes of the laboring classes, are necessary to give reality to such calculations. An excellent example of what may be done in this way is furnished in the able and interesting chapters on the subject in the popular little handbook of domestic economy issued by Messrs. Cassell & Co., and largely used in board schools, entitled "The Making of the Home," written by Mrs. Barnett, of St. Jude's, Whitechapel. The same subject is treated with great technical knowledge and power of sympathetic feeling for the poor in her chapter on "Our National Defences," in the joint essays by herself and the Rev. S. A. Barnett, in the well-known collection of essays entitled "Practicable Socialism." The subject is one in which medical men, skilled as they are in the physiology of food, and accustomed to deal with the poor both in family life and in public institutions, might give great aid. That which the working-classes greatly need is instruction in the art of braising, or slowly stewing at a low heat, combinations of meat-scraps and of vegetables. Any thing more toothsome and nutritious than the vintagers' *pot au feu*, which, says a correspondent of the *British Medical Journal*, "I lately tasted in the Medoc during the gathering of the grapes, cannot well be imagined. It was so delicious that a supply of it was ordered into the château for mid-day lunch, and it was voted by acclamation worthy of a *cordon bleu*. It was made with leg of beef, onions, carrots, cabbage, and the like, and poured smoking into bowls over slices of thin bread. What a lesson it conveyed to our managers of soup-kitchens, and what a meal for our harvesters!"

Schmerz-Freude ("Pain-Joy").

The Berlin correspondent of the *Therapeutic Gazette* states that Professor Leyden presented to his class at Charité a young lady affected with "schmerz-freude." "It is a pity I cannot translate that name for you, for 'pain-joy' would convey no meaning to you. The patient, as the professor explained, belonged to that class of hysterical women who not only experienced no pain during an operation, but, on the contrary, had a morbid desire to

[1] Pritchard, Lamarck, Darwin, Spencer.

have otherwise most painful operations performed on them without an anæsthetic. The patient in question had, during a paroxysm of hysteria, fractured her lower jaw and injured the facial artery. The injury proved a most serious one, and necessitated the ligation of the facial and carotid arteries, and finally the removal of part of the lower jaw. The patient insisted upon having all three operations performed without an anæsthetic, and told the operator that she had derived great pleasure from the operation."

Action of Caffeine.

The Paris correspondent of the *Boston Medical and Surgical Journal* reports that at the meeting of the Academy of Medicine in March, Professor Germain Sée read a paper on the researches he had undertaken in conjunction with Dr. Lapicque, his *chef de laboratoire*, on the action of caffeine on the motor and respiratory functions in a normal state and in a state of inanition, the conclusions of which may be summed up as follows: 1. Caffeine in small and repeated doses, about sixty centigrams per day, which may be prescribed with advantage to soldiers on the march, facilitates muscular work in augmenting the activity, not directly of the muscle itself, but of the motor nervous system, cerebral as well as medullary. The consequence of this double action is to diminish the sensation of effort, and to avert fatigue, which constitutes a nervous and at the same time a chemical phenomenon. 2. Caffeine prevents breathlessness and palpitations consecutive to effort, which is of great importance. 3. It thus immediately communicates to a man who gives himself up to violent and prolonged exercise the aid that he requires. 4. In producing this excitation of the cerebro-spinal motor system, on which depends the augmentation of the muscular tonicity, the caffeine augments the waste of the carbon of the organism, and particularly of the muscles, but it does not restrain the nitrogenous waste. It therefore is not, in the strict sense of the word, a means of saving (*moyen d'épargne*). 5. A saving action in general can take place in the higher animals in a complete manner to prevent the injurious effects of fasting, only in a condition impossible to realize; namely, inaction or immobility, more or less absolute where there is little expenditure without work. With caffeine, we observe just the reverse, that is to say, an intense work, which we will obtain only at the expense of the wear and tear of the organism. The animal machine can work only in consuming combustible matters, and it is precisely in promoting this combustion that caffeine permits muscular work even during fasting. 6. Caffeine has not, as is generally believed, the marvellous property of replacing food: it only replaces the general tonic excitation which the ingestion of food produces. If it be admitted that it is the direct and instantaneous action of the aliments which stimulate the stomach and the nervous system, and that their alimentary value is primarily nothing, one might substitute one stimulant for another. Caffeine, far from sparing the reserves, will place a fasting man in a position to undertake his work only by attacking these reserves, the destruction of which it hastens by the excitation of the nervous system, and, by its medium, that of the muscles. The organism will then soon use up its nutritive supply, and the caffeine will not prevent it. It is, nevertheless, of incontestable but temporary utility for the physical forces.

NOTES AND NEWS.

A NUMBER of Chicago "lady medicals" are said to have organized a committee for the purpose of securing an international congress of women physicians in 1892.

—One of the latest additions to the University of Pennsylvania is the establishment of an archæological museum. In addition to the American specimens, the museum contains a fine collection of flints, bronze implements, and pottery from Europe, as well as objects from Asia, Africa, and the South Sea Islands.

—Dr. Rothrock, professor of botany at the University of Pennsylvania, is preparing for the establishment of a museum which promises to be of unusual industrial importance. The new collection, to be called the "Museum of Economic Botany," will consist of specimens of all kinds of woods, vegetable fibres, grains and drugs, arranged so as to illustrate the processes of manufacture from the raw product, and the various uses to which each material may be put.

—A study of the figures presented in the 1890 edition of George P. Rowell & Co.'s "American Newspaper Directory" reveals some interesting facts pertaining to the business of newspaper publishing. This volume, which was issued April 1, and is the acknowledged authority on newspaper statistics, estimates the total number of papers now published in the United States and Canada at 17,760. Of these, 812 are Canadian publications. This is a net increase, since last year, of 629 in the United States and 24 in the Dominion of Canada.

— In the course of some excavations lately made at Ludwigshafen, on the Rhine, the tibia and two teeth of a mammoth, and the jaw of a stag, were found. The skeleton of another "antediluvian" animal, *Nature* states, was discovered in the limestone near Oberhildesheim. The researches are being continued.

— According to a French journal, the number of foreign students now studying in Paris is about 1,000, of whom 729 (107 of them women) are studying medicine, and 182 law. Literature has 66 (including 9 women), science 60, and pharmacy 23. It is remarkable, says *Nature*, that Russia furnishes the largest contingent of the foreign medical students, viz., 150; America coming next with 139. We find no mention of England. The foreign element is, on the above estimate, about one-tenth of the whole.

—At a meeting of the Société Chimique de Paris in March a paper by M. Meslans was presented by M. Moissan, announcing the isolation of fluoroform (CHF_3), the fluorine analogue of chloroform ($CHCl_3$). A brief abstract of this preliminary communication will be found in the *Chemiker Zeitung* for March 26. During the course of the work recently published concerning propyl and isopropyl fluorides, we learn from *Nature*, M. Meslans had occasion to study the action of silver fluoride upon iodoform. The result of this action was found to vary according to the conditions of experiment, liquid products being obtained under certain conditions, and gaseous products under others. The end result, however, was always the production of a gas, which turns out to be fluoroform. Chloroform, as is well known, is readily attacked by a warm alcoholic solution of potash, potassium chloride and potassium formate being produced: $CHCl_3 + 4KOH = H.COOK + 3KCl + 2H_2O$. It is interesting to learn that fluoroform behaves in precisely the same manner, for the gas is decomposed by either aqueous or alcoholic potash with formation of fluoride and formate of potassium. On being heated to redness in a glass tube, fluoroform is also decomposed, with production of gaseous silicon tetrafluoride and a deposit of carbon. The gas is only very slightly absorbed by water, but it dissolves readily in chloroform or alcohol. Fluoroform has also been prepared by substituting chloroform or bromoform for the iodoform used in the first experiments.

—The superiority of the highways of Europe over those of the United States is one of the first things which attracts the attention of the traveller from this country. In Europe the roads are under the supervision of officials who are thoroughly trained for their work. In the United States road-engineering is committed to the control of citizens not particularly interested in this imposed task, and with no special training for their duties. The results are evident. Our public roads are a disgrace to the people. To assist in remedying this condition of affairs in Ohio, by disseminating information on the subject of roads, and proper ideas with regard to their construction and management, Case School of Applied Science, Cleveland, will give, free of charge, instruction in road-engineering sufficient to qualify a man of ordinary intelligence to properly locate and manage a highway. The instruction will consist of lectures on the following topics: location and construction of roads; keeping up and repairing roads; ditching and drainage; road-making machinery; improvement of the surface of roads, including the use of gravel, broken stone, plank, paving, etc.; highway structures, including retaining walls, culverts, bridges, etc.; cost of earthwork and mechanical structures; highway administration; and laws relating to highways. For those who desire it, instruction will be given in the use of instruments employed in road-engineering,—the compass, transit, and

level,—and in drawing plats, plans, and profiles. Besides the instruction given by the professors of Case School, practising engineers of wide experience will give lectures on special topics connected with road-making. The only preparation needed for the course of instruction is a common English education, such as is given in the district schools of Ohio. The lectures will begin the first Monday in February, 1891, and will continue four weeks. There will be no charge of any kind made by Case School.

—There is an ample demand for the increased use of soap in India; for at present, after allowing for local manufacture, it may be said of the people of India that soap is to them an unknown luxury, the consumption being at the rate of less than a shilling's worth for every hundred inhabitants a year. The imports of soap have, it is true, more than doubled during the last six years, and the trade is steadily increasing from year to year. It is not any thing like a large trade even now: for the largest quantity yet imported, that of the year ending April, 1889, reached only 74,000 hundredweight, the value of which was $511,445. The bulk of this was from England, the other European states supplying only a little over 3,000 hundredweight. The soap-factories at Bombay, Jeypore, and Meerut are doing well, and increasing their out-turn, and the local demand will most probably now go on increasing from year to year. The soap manufactured by these companies is much liked by the natives, and particularly that variety called "vegetable" soap is in much request. Hindoos of the orthodox type would not touch a soap made of tallow or animal fat, as it is against the principles of their religion to do so. Such men and women in general, therefore, did not use soap at all, and contented themselves by cleaning their hands with simple earth, or the soap-nuts of species of *Sapindus* and the legumes of *Acacia concinna*. Since the production of the vegetable soap, the objection to the introduction of that article in the native Hindoo household is overcome, and soap is beginning to replace the primitive clay and vegetable substances used. About 8,000 hundredweight of native-made soap is now exported annually. The imports of soap of all kinds into British India have been as follows in the last six years: 1883–84, 34,447 hundredweight; 1884–85, 38,075; 1885–86, 49,804; 1886–87, 59,016; 1887–88, 6',139; 1888–89, 74,072. The imports since this have, however, been declining. Of 500,000 hundredweight of soap exported from England in 1888, 75,275 hundredweight went to India.

—The problem whether kangaroos can be acclimatized in England appears to have been solved at Tring Park by a very simple process. Hitherto it seems to have been assumed that the only chance of keeping kangaroos in that climate is to rear them on the principle which, to use a vulgar colloquialism, is known as "coddling." They have accordingly been kept and tended in pens or small enclosures, as we see them in Regent's Park. At Tring Park, however, according to the interesting account of Mr. Walter Rothschild, they have simply been turned loose in the park and woods, and the experiment has proved remarkably successful. Fifteen years since, the late Baron de Rothschild endeavored to breed kangaroos; but the male and young one were unfortunately poisoned by eating laurel,—a danger which English kangaroo-breeders will do well to note. Of late, however, the experiment has been renewed with success. They are found, we are told, to breed freely, and there are now to be seen in Tring Park twenty-eight or thirty native kangaroos, including the red and black species, Bennett's wallaby, the black wallaby, and the larger macropius, generally known as "the giant kangaroo."

—In respect to a statement alleging that the Australian Government had refused to allow M. Pasteur the reward of £20,000 offered to the person who should suggest the best plan for the destruction of the rabbits that infest that colony, M. Pasteur is reported to have said that this was not so, for the simple reason that he had never sought it, and that, owing to circumstances over which he had no control, he could not claim such a reward. He had sent M. Loir, his nephew, and another of his assistants, to Australia in order to try the experiments which he had made in his laboratory on a more extended scale. The assistants returned to France after a few months, discouraged. According to M. Pasteur, says the *British Medical Journal*, they were not allowed by the commission appointed by the Australian Government to make any important experiments. This commission permitted the assistants to inoculate a few rabbits, and the experiments were successful enough to warrant a further extension of the authorization; but all sorts of delays and adjournments were caused, until the assistants abandoned all hope of being able to carry out the purpose for which they had undertaken the voyage to Australia.

—Ten million young whitefish from the govermnent fish-hatchery on Lester River, Minnesota, have been placed in Lake Superior this spring, and it is intended to place fifteen million more there at once. About one-fourth of these will probably survive, maturing in four years, if the illegal work of the net-fisherman can be prevented.

—At the meeting of the Royal Society of Edinburgh on Feb. 28, Dr. John Berry Haycraft communicated the results of some recent investigations on voluntary muscular contraction. Dr. Haycraft's observations are interesting both to physiologists and to physicists. Where a muscle is stimulated by an electrical shock, all the fibres of the nerve receive the same stimulus, and all the fibres of the muscle to which the nerve passes contract together, and in the same way. This is not the case when a muscle contracts on receiving a natural nerve stimulation, starting either as a result of volition or of reflex action. The central nervous system seems unable to affect all the fibres of a muscle, through the numerous nerve-fibres passing to it, in such a manner that they all shall contract exactly in the same way. The reason for supposing this to be the case is the fact, observed by the author, that fascicular movements are always present within a muscle during a voluntary or a reflex contraction, so that tracings taken from different parts of the same muscle invariably differ from each other. The experiments were conducted, *Nature* states, both upon the human masseter and the gastrocnemius muscle of the frog. These fascicular movements occurring within it, will prevent any muscle from pulling with perfect steadiness on any lever or other registering apparatus; and the tracings taken by means of such apparatus will show oscillatory waves, often very rhythmical in their appearance. Many observers have concluded from an examination of these tracings that they indicate that the central nervous system discharges impulses into the muscle at a rate corresponding with that of the oscillations observed. Thus some observers find twenty, others ten, oscillations per second in the muscle curve, and they consider that the nervous system discharges into the muscle at these rates. The author finds that the fascicular movements just described as occurring within the muscle itself account fully for the oscillations seen, the irregular aperiodic movements of the muscle compounding themselves with the period of oscillation proper to the registering apparatus itself; for, by varying the instruments used, the resultant curves may be varied at will, slow oscillations appearing when using instruments of slow period, quick oscillations when using instruments of quick period. The author suggests that these fascicular movements probably account for the production of the muscle sound, which Helmholtz long ago pointed out was chiefly an ear-resonance sound. This, of course, could readily be evoked by any slow aperiodic movement, and the fascicular movements within the muscle must, at any rate, assist in producing it. These fascicular movements may, perhaps, account for the results obtained by Lovén with the capillary electrometer, for it is more probable that he wa registering the period of his own instrument than that th muscles were twitching at the slow rate of eight times p second. If these conclusions are correct, there remains litt to be said in support of the theory generally accepted, that th nervous system normally discharges nerve impulses into th muscles like shots quickly fired from a revolver. It may b that this is the case, but the subject requires more extended investigation before any definite conclusions can be arrived at.

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CONTENTS:

We have received the prospectus of Barnard College, the institution founded last year in New York to enable women to receive collegiate instruction from the professors of Columbia College. The two corporations are distinct; but Columbia furnishes the teachers for the women's college, and confers the degrees upon its graduates. The new college was named after the late President Barnard of Columbia, in gratitude for his efforts in behalf of the higher education of women. The pamphlet now before us contains the requirements for admission to the Barnard, together with the courses of study during the freshman and sophomore years. The requirements for admission consist of the elements of Greek, Latin, and mathematics, with English grammar and composition and some history and geography. The studies of the first two years are in the same departments, with the addition of chemistry and botany and the French and German languages. It will be seen, therefore, that the founders of the new institution are no innovators, but have adopted the course of study usually pursued by young men. The studies thus far announced seem rather too largely technical, but probably those of the junior and senior years will be less so. Several post-graduate courses are also provided, with opportunity to obtain the degrees of master of arts, doctor of philosophy, doctor of letters, and doctor of science. On the whole, the programme promises well, and every friend of humanity will wish the new college God speed.

THE MARINE BIOLOGICAL LABORATORY.

The third session (1890) of the Marine Biological Laboratory will be held this summer. The corps of instructors consists of Dr. C. O. Whitman, director, professor of zoölogy, Clark University, editor of the *Journal of Morphology;* Howard Ayers, Ph.D., director of The Lake Laboratory, Milwaukee; E. G. Gardiner, Ph.D., instructor in zoölogy, Massachusetts Institute of Technology; I. Playfair McMurrich, Ph.D., docent in zoölogy, Clark University; J. S. Kingsley, Sc.D., professor of zoölogy, University of Nebraska; H. C. Bumpus, M.A., fellow in zoölogy, Clark University; W. M. Rankin, Ph.D., Princeton College; W. A. Setchell, B A., assistant in botany, Harvard University; Takano Ryoiche, artist; G. W. Fitz, laboratory assistant.

In addition to the regular courses of instruction in zoölogy, botany, and microscopical technique, consisting of lectures and laboratory work under the direct and constant supervision of the instructors, there will be two or more courses of lectures on special subjects by members of the staff. One such course of six lectures will be given by Dr. McMurrich on the *Hydrozoa*. Similar courses on the *Crustacea* and echinoderms will be given by Professor Kingsley and Dr. Rankin. There will also be ten or more evening lectures on biological subjects of general interest. The first of these will be given by Dr. Whitman on July 9. Among those who may contribute these lectures and take part in the discussions upon them may be mentioned, in addition to the instructors above named, the following: Professors E. B. Wilson of Bryn Mawr, C. S. Minot of Harvard Medical School, W. T. Sedgwick of the Massachusetts Institute of Technology, S. F. Clarke of Williams College; Dr. G. Baur, recently of Yale University; Dr. Henry Orr, recently of the Universities of Jena and Princeton; Dr. C. H. Eigenmann, recently of the University of Indiana; Professor W. A. Locy of Lake Forest University; and William M. Wheeler of Milwaukee.

The laboratory is located on the coast at Wood's Holl, Massachusetts near the laboratories of the United States Fish Commission. It has already been found necessary to add to it this year a library, a lecture-room, and six more private laboratories. The building consists of two stories; the lower for the use of students receiving instruction, the upper exclusively for investigators. The laboratory has aquaria supplied with running sea-water, boats, collecting apparatus, and dredges; it will also be supplied with alcohol and other re-agents, glassware, and a limited number of microtomes and microscopes. By the munificence of friends the library will be provided henceforth not only with the ordinary text-books and works of reference, but also with the more important journals of zoölogy and botany, some of them in complete series. If the necessary funds can be obtained, the laboratory will also be provided with a steam-launch, and in any event there will be opportunities for collecting material for study and investigation.

The laboratory for investigators will be open from June 2 to Aug. 30. It will be fully equipped with aquaria, glassware, re-agents, etc., but microscopes and microtomes will not be provided. In this department there are fourteen private laboratories supplied with aquaria, running water, etc., for the exclusive use of investigators who are invited to carry on their researches here free of charge. Those who are prepared to begin original work, but require supervision, special suggestions, criticism, or extended instruction in technique, may occupy tables in the general laboratory for investigators, paying for the privilege a fee of fifty dollars. The number of such tables is limited to ten. Applicants for them should state precisely what they have done in preparation for original work, and whether they can bring a complete outfit; viz., microscope, microtome, camera-lucida, etc. Special attention is invited to the opportunities offered to the holders of these tables, as it is believed that they are somewhat unusual.

The laboratory for students will be opened on Wednesday, July 9, for regular courses of seven weeks in marine zoölogy and botany, and microscopical technique. Opportunities will be given for collecting and preparing material for use in the class-room and for special lines of study. Hand-lenses, dissecting-instruments, drawing-materials, etc., may be bought at cost in the lab-

oratory. It is desired that students owning microscopes or microtomes should bring them, and applicants for admission should state whether this requirement can be complied with. The fee for workers in this department is twenty-five dollars, payable in advance. The number of students will be limited to thirty, and preference will be given to teachers or others already qualified. By permission of the director, students may begin their individual work as early as June 15 without extra charge, but the regular courses of instruction will not begin before July 9. Applications for places in either department should be addressed to Miss A. D. Phillips, secretary, 23 Marlborough Street, Boston.

The Marine Biological Laboratory is intended to continue and enlarge the work of the laboratory at Annisquam, carried on for six years by the Woman's Education Association, with the co-operation of the Boston Society of Natural History. The annual reports of the trustees, containing an account of its organization and work, may be obtained from the secretary.

BOOK-REVIEWS.

The Anatomy of the Frog. By Dr. ALEXANDER ECKER. Tr. by George Haslam, M.D. Oxford, Clarendon Pr.; London, Henry Froude; New York, Macmillan & Co.

THIS volume is No. II. of the "Translations of Foreign Biological Memoirs." The first part of Ecker's "Anatomie des Frosches" appeared in 1864, and the second part sixteen years later. This was the groundwork on which Dr. Haslam prepared his "Anatomy," adding many facts which he deduced from his own personal investigations, and in general bringing the book up to date by including the results of recent researches. It may seem to many rather peculiar that so much labor should have been expended on the study of the minute anatomy of so insignificant a creature as the frog; but when it is remembered that for many reasons the frog has for years been studied by scientific men to elucidate intricate physiological problems, and that to-day no animal is more commonly found in physiological laboratories than the frog, this peculiarity will cease to exist. It would be interesting, did our space permit, to review the intimate relations which the frog has sustained to important discoveries. Swammerdam, more than two hundred years ago, called attention to the advantages which the frog possessed as an aid to scientific study. It was from accidentally observing the contractions of the muscles of the denuded hind-legs of a frog that Galvani was led to abandon all other occupations and investigate the phenomena which were the basis of Galvanism.

Our knowledge of the capillary circulation of the blood rests upon Leeuwenhoek's observations of the web of the foot of this animal, and the gills and tail of its tadpole; and to-day the frog affords almost the only material for the investigation of the excitability of nerve and its associated electromotive changes. Histology is also deeply indebted to the frog for its present status. The structure of nerve-fibres, their origins and terminations, and the structure of muscular fibres, have all been studied more in the frog than in any other creature. These and many more reasons might be given in justification of devoting so much time and labor to the preparation of a book of such size on such a restricted subject. As a book of reference, the volume is invaluable to every biological student. It is very complete in all its parts, besides being admirably printed and illustrated. Taken as a whole, it might well serve as a model to all publishers. The paper and the type are especially worthy of commendation.

Practical Electricity in Medicine and Surgery. By G. A. LIEBIG, Jun., Ph.D., and GEORGE H. ROHÉ, M.D. Philadelphia and London, F. A. Davis. 8°. $2.

ELECTRICITY is becoming more and more each day an important adjunct to both the physician and the surgeon in their battle with disease. Whereas a few years ago no one but a specialist was expected to know any thing about the practical application of electricity in medicine, to-day many physicians in general practice, and laying no claim to being specialists, have in their offices the appliances necessary for the treatment of disease by electricity. Drs. Liebig and Rohé have therefore, in issuing this book, supplied a guide in a comparatively new field, to those who have up to this time failed to find in the literature of the subject all that was necessary to enable them intelligently to make a practical use of so important an agent as electricity.

This volume is divided into three parts. In Part I. the various forms of electrical and magnetic apparatus are described which are likely to be of use to the physician, together with the best arrangements of cells for any given work, the construction and use of galvanometers, the theory of the chemical action taking place in the storage-cell, and the best methods of caring for batteries. The electric motor, the telephone, and the phonograph are also here described. Part II. describes the effects of electric current upon the body in health and disease. Part III. treats of the application of electricity to the treatment of disease.

The work is a most valuable contribution to the elucidation of a most intricate subject, and coming just at this time, when there is such a general interest in the manifold applications of electricity, must receive a cordial welcome not only from members of the medical profession, but also from scientists generally.

Notes on American Schools and Training Colleges. By J. G. FITCH. New York, Macmillan & Co. 16°. 60 cents.

THIS little book, reprinted from a report to the English Education Department, contains the observations made by the author after a visit to the schools of this country. Mr. Fitch's opinion of American public schools is in the main very favorable; and the criticisms he makes on particular points, together with his occasional comparisons between our schools and the English, ought to be useful to American educators. The chief excellence that he notes in our school system is the enthusiasm shown, not only by teachers, but by the public as well; while the chief defect, in his opinion, is the excessive minuteness with which the lessons and the mode of teaching them are prescribed, so that nothing is left to the spontaneity and originality of the teacher. He dwells upon this topic at considerable length, remarking that "text-books and certain accepted formulas appeared to dominate the work of the classes too much," and adding that English teachers would find such minute regulations an intolerable restraint. He maintains at the same time that the English elementary schools give as good an education as those of this country. With regard to training-colleges, or, as we call them, normal schools, Mr. Fitch thinks we are as yet but poorly equipped, the number of such institutions being far too small for the work required. He notes, however, that certain other modes of training supply to some extent the place of normal schools; and he dwells with special interest on the teachers' associations and reading-circles, which he regards as admirable features of our educational system. As he came here to study the public schools, he has very little to say about the colleges and universities, what he does say relating almost exclusively to the worthlessness in general of American college degrees, — a matter that has been much discussed among ourselves, and as to which the author's remarks are not a whit too strong. We commend the book to the notice of American educators.

Practical Electrics: A Universal Handy-Book on Everyday Electrical Matters. New York and London, Spon. 8°. 75 cents.

THIS practical volume is a reproduction of a series of papers on electrical subjects which originally appeared in the third series of "Workshop Receipts." It is intended mainly for that large and rapidly growing class of scientific amateurs and conscientious artisans who, through inclination or necessity, are led into the field of electrical practice without having time or opportunity to make a thorough study of the subject. In other words, it contains a fund of information of an eminently useful and practical character, though not what

may be looked for in more complete treatises on the subject. To those having electric bells, telephones, or electric lights in their houses, and who are not practical electricians, the volume will be found a convenient reference-book, containing many valuable suggestions.

Among the subjects discussed in the book are electrical connections, alarms, batteries, bells, carbons; induction, intensity, and resistance coils; dynamo-electric machinery; fire risks; electrical measurements; microphones; electric motors; phonographs; photophones; accumulators; and telephones. A sufficient number of illustrations are introduced to make clear every point touched upon.

AMONG THE PUBLISHERS.

A NEW book by Dr. J. G. Fitch, entitled "Notes on American Schools and Training Colleges," has been issued recently by the Macmillans. The well-known "Lectures on Teaching," by the same author, has passed through many editions, having been adopted for use by the Teachers' Reading Circles throughout the country.

—Ward, Lock, & Co. will publish early in May Lane's "Manners and Customs of the Modern Egyptians."

—The J. B. Lippincott Company have in press "Economic Basis of Protection," by Professor Simon N. Patten of the University of Pennsylvania.

—Macmillan & Co. will publish at once a timely book on the silver question, to be entitled "Silver in Europe," by S. Dana Horton, a delegate of the United States to the International Monetary Conference held in Europe in 1878 and 1881.

— D. C. Heath & Co. of Boston issued last week "Deutsche Literaturgeschichte," Vol. I., by Professor Carla Wenckebach of Wellesley College. The purpose of this work, which is to be in three volumes, is to offer students a history, in the German language, of the growth of German literature.

—Pictures of fifteen representative houses built through the agency of building and loan associations will appear in W. A. Linn's article in the May *Scribner*, with the story of how each one was built told by the owner. Brooklyn, Rochester, Pittsburgh, Reading (Penn.), Cincinnati, St. Paul, New Orleans, and San Francisco are among the cities represented.

—De Wolfe, Fiske, & Co. have published "Lake Champlain and its Shores," by W. H. H. Murray, a narrative of the traditions and history of Lake Champlain, with a description of yachting, camping, and fishing. Mr. Murray's chapter on the great national park is included in the volume.

—Professors Lewis M. Haupt and Edmund J. James, of the University of Pennsylvania, have just completed a monograph on "Canals and their Economic Relation to Transportation." The former deals with the technical side of the question, while the latter discusses its economic aspects.

—Clarence Deming has found, in the manuscript diary of William Brisbane of South Carolina, some pen-pictures of the First Napoleon, as he appeared to Mr. Brisband when he visited Paris in 1804. The most interesting of these, describing the coronation procession, the presentation of colors on the Champ de Mars, etc., will be published in *Scribner's* for May.

—*The Annals of Gynæcology*, formerly published in Boston, has been enlarged and a new department added, the name being changed to *Annals of Gynæcology and Pædiatry*. The latter department is under the editorship of Dr. Louis Starr of Philadelphia, formerly professor of diseases of children at the University of Pennsylvania. The journal appeals with more than ordinary interest to the mass of the profession, in that it deals exclusively with the diseases of women and children. It is now published by the University of Pennsylvania Press.

— The leading article in *Garden and Forest* for last week is dedicated to the memory of Dr. George Thurber, in whose recent death America has lost her most accomplished horticultural writer. Professor Beal, in the same number, writes of the methods of botanical study; Mr. Sereno Watson describes a new amaryllis, which is also figured; Secretary Williams discusses the best grapes for home use; and much timely horticultural matter is given, including a description of the Easter flowers in New York. Besides the plant portrait, there is a view of The Parterre, Fontainebleau, with explanatory text.

—In the article on Millet in *Scribner's* for May, T. H. Bartlett tells of the meetings in Millet's house in Barbizon of "the most illustrious company of artists that ever sat around a table together,"—Corot, Daumier, Barye, Rousseau, and Diaz. The following anecdote is related: "At all these gatherings, when Diaz was present, there was an accustomed break in the ceremony. He had a wooden leg, and hated, above all things, talk on art; and whenever the moment of exhausted patience came, he would pound the table with his hands, imitate a trumpet with his mouth, bring the end of his stump up against the under side of the table with a fearful thump, and cry out like a wild man, 'Thunder of all the Gods, give us peace! Can't you content yourself by making art all day without gabbling about it all night? Close up!' For each and every one he had some special designation: of Rousseau, whenever he began to speak, 'Oh, there! Rousseau is going to unscrew his chair.' When his own opinion was sought, he would always reply, 'Oh, yes! oh, yes!' no matter what the question was or subject discussed. As they did not 'close up,' Diaz would get up and leave in high indignation, hearing as he passed out of the room this comforting assurance, 'Blessed is the door that hides you.'"

—The opening article of *The Chautauquan* for May is by the English historian, Edward A. Freeman, and is the first of a two part paper on "The Making of Italy;" James A. Harrison, LL D, of Washington and Lee University, takes "The Archæological Club in Italy" through the period of the renaissance in architecture and sculpture; Bella H. Stillman continues her studies of "Life in Modern Italy;" Professor Adolfo Bartoli contributes a paper on "Italian Literature;" Professor Henry A. Beers of Yale University takes for his theme Browning's drama of "King Victor and King Charles;" Principal James Donaldson, LL.D., of the University of St. Andrews, Scotland, writes on "Roman Morals;" the "Map Quiz" this month is on the present Kingdom of Italy; Albert Shaw, Ph.D, contributes a study of "The Servian Kingdom;" some facts about color-blindness will be found in the article by Professor Edward L. Nichols of Cornell University; Arabella B. Buckley considers the moral teachings of science; John R. Spears writes of "The American Navy;" a sketch of the life of Salmon P. Chase is given by his private secretary, Eugene L. Didier; "Woman's Work in Archæology" is a translation from the *Deutsche Rundschau;* Thomas Bertrand Bronson of Michigan Military Academy gives the status of the present political parties in Germany; an interesting paper on "The Literature of the Irish," by John Hull, follows; and J. W. Hamilton, D.D., asks and answers some questions about the faith-cure.

—The long-promised article by Henry George appears in the April *New Review*. The same number contains a timely paper on "The Fall of Prince Bismarck."

—E & F. N. Spon have just published "A Practical Treatise on the Manufacture of Vinegar and Acetates, Cider and Fruit-Wines," edited from various sources by William T. Brannt. It is an octavo volume of 479 pages, illustrated by 79 engravings. Besides the subjects mentioned in the title, it treats of the preservation of fruits and vegetables by canning and evaporation; the preparation of fruit-butters, jellies, marmalades, catchups, pickles, mustards, etc.

—In *The Ladies' Home Journal* for April, "How to Act before the Camera" is told by A. Bogardus, the pioneer of New York photographers; Henry Ward Beecher's love for gems and rare stones is told by himself in several unpublished letters; and Mrs. Moses P. Handy has a timely article on "How to Move Easily and Well."

—Messrs. Ginn & Co. announce to be published next month "The Nine Worlds: Stories from Norse Mythology," by Mary E.

Publications received at Editor's Office, April 7-12.

CASPAR'S Directory of the American Book, News and Stationery Trade. 2 vols. Milwaukee, Wis. C. N. Caspar. 1434 p. 8°. $12.
EIMER, G. H. Organic Evolution as the Result of the Inheritance of Acquired Characters according to the Laws of Organic Growth. Tr. by J. T. Cunningham. London and New York, Macmillan. 435 p. 8°. $3.25.
FITCH, J. G. Notes on American Schools and Training Colleges. London and New York, Macmillan. 133 p. 16°. 60 cents.
KIMBALL, A. L. The Physical Properties of Gases. Boston and New York, Houghton, Mifflin, & Co. 238 p. 12°. $1.25.
LUBBOCK, J. Scientific Lectures. 2d ed. London and New York, Macmillan. 228 p. 8°. $2.50.
NEW HAMPSHIRE State Board of Health, Eighth Annual Report of the, for the Eighteen Months ending Oct 31, 1889. Manchester, State. 366 p. 8°.
SLINGO, W., and BROOKER, A. Electrical Engineering. London and New York, Longmans, Green, & Co. 631 p. 12°. $3.50.
ZOE. A Biological Journal. Vol. I. No. 1. March, 1890. m. San Francisco, Zoe Publ. Co. 32 p. 8°. $2 per year.

Litchfield. This book tells in a simple way the story of the old Norse gods, and is calculated to awaken an interest in the religion of our Teutonic ancestors. It is based chiefly upon the Eddas. The introductory chapter gives a clear idea of the relative position of the "Nine Worlds" of the mythology, and tells in a few words the relation of the gods and giants to objects in nature. The book is suited to children of any age, and will possess equal interest for general readers.

—Longmans, Green, & Co. will shortly publish, both in London and New York, "The House of the Wolf," a romance by Stanley J. Weyman. It tells the perils and bravery of three young brothers in the fortnight before and after the massacre of St. Bartholomew's Day.

—Messrs. Ginn & Co. announce to be ready in May or June "Elements of the Calculus; Method of Rates," by A. S. Hardy, professor of mathematics in Dartmouth College. This text-book is based upon the method of rates. The object of the differential calculus is the measurement and comparison of rates of change when the change is not uniform. Whether a quantity is or is not changing uniformly, however, its rate at any instant is determined essentially in the same manner: viz., by letting it change at the rate it had at the instant in question, and observing what this change is. It is this change which the calculus enables us to determine, however complicated the law of variation may be. From the author's experience in presenting the calculus to beginners, the method of rates gives the student a more intelligent, that is, a less mechanical, grasp of the problems within its scope than any other. No comparison has been made between this method and those of limits and of infinitesimals. This larger view of the calculus is for special or advanced students, for which this work is not intended; the space and time which would be required by such general comparison being devoted to the applications of the method adopted.

—The February number (No. 45) of the Riverside Literature Series (published quarterly during the school year 1889-90 at 15 cents a single number, by Houghton, Mifflin, & Co., Boston) contains "The Lays of Ancient Rome," by Thomas Babington Macaulay, with the author's introductions and historical notes. The old Latin literature of the Romans had entirely disappeared, and the stories and legends about the early history of Rome were incorporated into the writings of the later historians without any written authority for them. These "Lays of Ancient Rome" were writtn by Macaulay as an attempt to show how these legends and stories about the early history of Rome would have been sung by the old ballad-mongers, as they wandered from village to village, and repeated to an eager crowd of listeners these old songs which all knew so well and yet always loved to hear. The lays have always been liked by children on account of their life, movement, and romantic incidents, and in this new form the publishers hope that they will gain a still greater and more widespread popularity.

—The University of Pennsylvania has published a translation of "The Federal Constitution of Switzerland," by Professor Edmund J. James. The Constitution of Germany had previously been issued in the same series, so that American political students now have the means of comparing those two important federal governments with our own. The principal difference between the Swiss Constitution and ours is in the executive authority, which in Switzerland is vested in a Federal Council of seven members chosen by the two houses of the national legislature. All executive orders are issued in the name of the council, and, though there is a president of the council, he is nothing but a moderator, with no more authority or dignity than any other member. The present Constitution went into effect in May, 1874, and gives to the central government much greater authority than it had before. Nevertheless, there are strong local and democratic elements in the government still, as a perusal of this pamphlet will show.

—Professor John Fiske will open *The Popular Science Monthly* for May with an account of the life of Edward L. Youmans, including the story of his association with Herbert Spencer. Professor Fiske was a warm friend of the late Professor Youmans, and describes his fruitful labors in popularizing science and the evolution philosophy in America with sympathetic appreciation. Herbert Spencer has decided to publish the opening chapters of one of the uncompleted parts of his system of philosophy, dealing with morality. Three of these chapters, treating respectively of "Animal Ethics," "Sub-human Justice," and "Human Justice," will be printed in the same number under the general title "On Justice." "Sumptuary Laws and their Social Influence" will be discussed by Dr. William A. Hammond. Dr. Hammond shows the absurd failures of laws against fine dress, costly food, and smoking, in Rome, France, Turkey, and England, and against the selling and drinking of alcoholic liquors in some of the United States. A careful comparison of secondary school programmes, French and American, will also appear in the May number. The author, Mr. George W. Beaman, maintains, that, if our high and preparatory schools are to compare well with those of France, the pupils must not only do more work, but they must also work on more distinctly specialized lines.

LETTERS TO THE EDITOR.

Anemometry.

It is generally known that quite recently there have been two independent series of investigations of the relation of cup motion in the Robinson anemometer to wind travel,—the one in England, with an arm twenty-nine feet long, upon which the anemometer was whirled in the open air; and the other in this country, with arms of twenty-eight and thirty-five feet and used in a large closed court. It has been charged that the experiments in this country were modelled after those in England; but this is not the fact, for the experiments in Washington were nearly completed before a word had come over regarding the others. A good proof of this is found in the fact that Professor Marvin was so successful in refining the apparatus and in using electrical contacts, that it required only a few hours to show that no experiments of value could be tried in the open air, while this has been learned in England only after many months. In the January number of the *Quarterly Journal of the Royal Meteorological Society* there has appeared a second series of experiments tried in England, which are quite interesting and in many respects novel.

The earlier results showed that at low velocities there were very great irregularities, though these practically disappeared at fifteen miles per hour. In the open air the free wind would undoubtedly equal a slow motion of the whirler; and as has been shown, under these conditions, the factor would be made twenty-five per cent too small. If we add to this the effect of irregularities from whirls in the air and in the experiments, nearly all the difficulty would be accounted for.

To account for these irregularities, it has been suggested that in the open air the more or less intermittent action of the wind would tend to continually accelerate or retard the cups; and, since they have a momentum, this would tend to carry them faster than the wind during the retard, so that there would be a gain in the total movement recorded by the cups over the motion of the whirler and the free wind. This view loses sight of the very important consideration that during a rising wind the cups would lag behind, and presumably just the amount of the acceleraton during a falling wind. This point could only be settled by experiment, and the following facts seem to show that this supposed effect is either inappreciable or just the contrary to what is desired.

1. The weight of a very light set of cups was increased fourfold, and in the open air there was no change in the result.

2. Two sets of cups, which were exactly alike except that one was eight times as heavy as the other, were compared side by side. It was found that in light winds the lighter cups gave two to four per cent more wind, and that they were alike in higher winds.

3. Professor Marvin increased the moment of inertia two to

three times in a set of cups, and found that the lighter gave more than ten per cent more wind at five miles per hour, while there was no difference between the light and heavy cups in higher winds.

4. In the more recent trials in England, an anemometer was placed, with its axis horizontal, on the arm of a whirler, and the whirler rotated once and then suddenly stopped: the anemometer cups (supposedly from their momentum) continued to revolve. This experiment was certainly most remarkable. It is a little difficult to see what other result was to be expected. If any thing was to be learned, it could only be by stopping the cups at exactly the moment the whirler was stopped. This certainly does not elucidate in any way whatsoever the supposed inertia effect in an intermittent wind.

5. The crucial test in the English trials was made when the whirler was given an intermittent motion or one simulating a natural wind. The anemometer was placed on the end of the arm, and the velocity of the whirler was changed quite rapidly, ranging back and forth between forty and ten miles per hour,—a far greater fluctuation than can occur in the free air. Here, then, above all things else, we ought to get an inertia effect; but it was found that there was no difference in the record of the anemometer between the uniform and intermittent motion. The evidence seems to be overwhelming that the supposed momentum or inertia effect is purely imaginary.

We cannot sympathize with the feeling aroused in England by these experiments; namely, that the Robinson anemometer is untrustworthy. Undoubtedly the Kew instrument, with its 12-inch cups and 24-inch arms, is exceedingly clumsy, and should be discarded as soon as possible; but the experiments in this country have shown that with 4-inch cups and 6.72-inch arms the results are all that could be asked near ten miles per hour, and during about eighty per cent of our winds. It has also been demonstrated that an anemometer can be constructed which will give very good results over a large range of wind velocity. It is very certain that the Robinson anemometer is far ahead of any instrument that requires a vane. In the English trials a vane anemometer or air-meter gave much more uniform results than any other instrument in the open air, but this was simply because the effect of the natural wind would be almost exactly counterbalanced on opposite sides of the whirl. In portions of the whirl where the wind would tend to accelerate the motion, the much more rapid whirler motion would tend to keep the vane normal to the arm; and, even if the vane had any influence, it would tend to turn the anemometer at an angle with the arm in such a way as to make it lose the proper speed which it would have in its normal position.

It seems probable that the anemometer problem has nearly reached its solution. What are now needed most of all are experiments with an anemometer, as light as practicable, and which will present a slightly greater proportional resistance to the higher winds than to the lighter, and possibly cause fewer whirls around the cups. H. A. HAZEN.

Washington, April 11.

Supposed Aboriginal Fish-Weirs in Naaman's Creek, near Claymont, Del.

THE copy of my letter published by the Rev. Mr. Peet in Vol. XII. of the *American Antiquarian*, March, 1890, No. 2, is correct in some respects, and incorrect in others. So far, Mr. Peet has failed to prove that I ever used the word "pile-dwellings," or "river-dwellings." My denial is quite as good as his assertion in this respect, until the original letter be produced, and proven to be mine. I have already given a true version of this letter in a former communication to *Science*, and sufficient reasons for the use of the terms "pile-structures." "pile-ends" or "log-ends," and "stations." They are sufficiently clear explanations for any one to understand without danger of an erroneous impression. No repetition of this explanation is therefore necessary. I call Mr. Peet's particular attention to this assertion.

In the reproduction of my letter, published on p. 118, *American Antiquarian*, March, 1890, I desire to correct the following error: "The numerous suggestions that the pile-structures were fish-weirs is untenable," should read "the numerous suggestions that the pile-structures were fish-weirs is tenable;" and if my

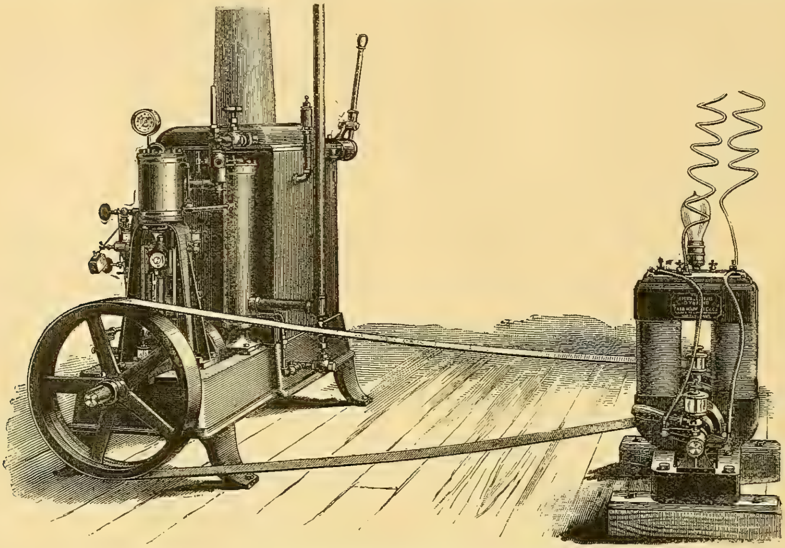
letter in Mr. Peet's possession gives any other sense, it has been tampered with by some one desiring to make mischief. The remarks that I make at the end of this letter (written several years ago, and now for the first time published by Mr. Peet) show that I was opposed to theorizing upon the subject, and used the term "pile-structures" throughout the letter. Reasons for use of these terms, let me repeat, have been referred to, as above stated. In regard to the quotations from the Peabody Museum reports, I have to say that its editor was perfectly free to express his opinions upon the subject, whether he accepted my fish-weir theory or not. So far, I have not yet made any definite report upon the subject, from lack of time to work the material up. There is no manuscript in the hands of the Peabody Museum, upon pile-dwellings or river-dwellings in North America, awaiting publication, as has been asserted. HILBORNE T. CRESSON.

Philadelphia, April 11.

INDUSTRIAL NOTES.

Automatic Oil-burning Steam-Engine for Electric Lighting.

THE compact electric-lighting plant shown in the illustration has been found to work satisfactorily in places where a comparatively small number of lights are required, and where the expense of operation must be reduced to a minimum. One such plant has been for some months furnishing light in a church at Fitchburg, Mass. Power is furnished by a Shipman automatic



A COMPACT ELECTRIC-LIGHTING PLANT.

oil-burning engine, which was illustrated and described in these columns about a year ago. The dynamo furnishes current for fifteen 32-candle-power incandescent lamps, six 25-candle-power lamps, and five 16-candle-power lamps. The fuel being oil, supplied automatically as required, and the water-supply, steam-pressure, and speed being automatically regulated, the plant requires scarcely any attention other than to start and stop it, and is said to give entire satisfaction.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

A large number of plants from Maine, Connecticut, Indiana and Illinois for exchange. Southern and western exchanges preferred. Address, enclosing lists, L. N. Johnson, 223 Chicago Ave., Evanston, Ill.

For Exchange—Fourteen volumes Encyclopedia Britannica (Stoddard's ninth edition), bound in leather—part in original wrappers, all as new—can arrange to furnish volumes required to complete set, and six volumes "American Naturalist" in numbers. Want small screw-cutting foot lathe and testing galvanometer and rheostat. For particulars address A. B. Campbell, McKean Co., Bradford, Pa.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

April 12.—J. R. Eastman, The Progress of Meteoric Astronomy; B. G. Wilder, Comparative Anatomy of the Simian and Human Brain.

Woman's Anthropological Society of America, Washington.

April 12.—Clara Bliss Hinds, Some Studies in Child-Life.

Biological Society, Washington.

April 19.—W. H. Dall, Exhibition of Original Drawings of the Fur Seal and Steller's Sea Cow, executed by a Member of Bering's Expedition of 1742; C. Hart Merriam, Historical Review of the Faunal and Flora Divisions that have been proposed for North America; Joseph F. James, On Variation, with Special Reference to Certain Paleozoic Genera; B. T. Galloway, Observations on the Flora of Missouri; C. L. Hopkins, Characteris ic Vegetation of the Cliff-Dwellers Cañon near Flag Staff, Arizona.

Boston Society of Natural History.

April 16.—N. S. Shaler, Climatal Conditions of Salt Deposits; Frank Leverett, Glacial Studies bearing on the Antiquity of Man; M. H. Saville, Sanborn Bowlder near Rockport, Mass.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED—One or two persons with some means interested in Archæology to accompany a reliable antiquarian to Southern Ohio for four months' work in the mounds. The specimens found to be shared equally. For terms address W. K. M., Box 148, Smithsonian Institute, Washington, D. C.

WANTED—Position to teach Sciences or Mathematics by a Smith College graduate who was also a student at the Mass. Institute of Technology. Nine years' experience. Address T. H., care of SCIENCE.

A YOUNG LADY, graduate of Boston University, also of special course at the Massachusetts Institute of Technology, desires a position to teach Chemistry, Physics and Mathematics. Two years' experience. References given. Address Miss B. L., Warren, Mass.

A YOUNG MAN aged 19, a graduate of Eastman College, wants to serve an apprenticeship with some Manufacturing Electrical Laboratory where he can have access to books in evening. Is willing to work. The best of references given. C. F. BENEDICT, P. O. Box 84, Westbury, Wayne Co, N.Y.

AN experienced College Professor, with considerable ability in advertising educational institutions, now employed, is open to an engagement. Has built up two schools by advertising. Now is just the time to begin work for September opening. "William," 348 East 20th St., New York.

WANTED by a Cornell University graduate a position as Chemist in some Manufacturing establishment. References given. T. B.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR. VOL. XV. No. 377. | NEW YORK, APRIL 25, 1890. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

THE SUPPRESSION OF CONSUMPTION.

THE first step in the practical suppression of consumption is to take those measures that are necessary to reduce its production to insignificant proportions; that is, we must secure the effective prevention of the disease. We shall attain this object by seeing that, on the one hand, we have or obtain such an amount of lung surface as is adequate not only to perform the ordinary work that is demanded of it, but also to meet, within certain limits, any extra demand that may be made upon it, and, on the other, by so arranging our habits, mode of life, and surroundings, that their tendency as a whole is to develop the lungs. What amount of lung capacity is necessary to conform to the above requirements? Hutchinson's so-called standard of vital capacity is too low. The lungs of a man having a chest-girth ranging between Brent's "medium" and "maximum" standards, with an extent of movement of four inches and upwards, would give the required amount of lung surface. I give these standards in the following table:—

Height. Ft. In.	Medium. Inches.	Maximum. Inches.
5 1	34.56	40.66
5 2	35.01	41.33
5 3	35.70	42.00
5 4	36.26	42.66
5 5	36.83	43.33
5 6	37.40	44.00
5 7	37.96	44.66
5 8	38.53	45.33
5 9	39.10	46.00
5 10	39.66	46.66
5 11	40.23	47.33
6 0	40.80	48.00

It will be found, on examination, that many of us do not possess the standard of chest development; and if we would be certain of absolute freedom from the possibility of an attack of the disease, then we should deliberately set to work to obtain this development. There is no difficulty whatever in doing that, for the size and shape of the chest depend upon the conditions to which it is subjected.[1] To develop the chest we must avoid those conditions that tend to disuse of the lungs, to their compression or injury, and introduce others that markedly tend to develop the lungs. If possible, the residence should be situated in the country, in a healthy suburb, or in a wide, open street. The rooms, and especially that used as the sleeping apartment, should be lofty, capacious, well lighted by windows that open, and ventilated by direct and continuous free communication with the external air, summer and winter, night and day. Gradually lower the temperature of the rooms till there is not nearly so much difference between it and that of the external air as that to which we are now accustomed. Great care should be taken about the clothing of the body. It is essential that the clothes should be made so loose that they offer no impediment to the full and free movement of the chest. When ordering clothes, be sure the measurement is taken at a full inspiration, and see that they are quite easy even then. Don't use braces, corsets, or respirators: they tend to impede the respiratory movement. Wool manufactured in such a way that it is elastic and permits free ventilation should be worn next the skin; and the under-linen should be frequently changed, so that no impediment is offered to its emanations. A sponge-bath should be taken every day. Low-heeled boots, wide, broad toes, should be worn, so that walking exercise may be taken in comfort. Spend as much time as possible, and that daily, in some form or other of active exercise in the open air. Carefully avoid the habit of stooping: throw the shoulders back, the chest forward, and get into the habit of holding the body erect at all times. Breathe through the nose, and take half a dozen deep inspirations, followed by full expiration, several times daily. Go in for gymnastics, giving special attention to the development of the muscles of the chest, swimming, singing, and athletics, and get gradually acclimatized to the external air, wind, and rain. Don't overload the body with clothes; and maintain the temperature in the natural way, by increased muscular exertion. Get the chest-girth and vital capacity taken at regular periods, and record them, so that you may know what progress you are making; and do not relax these efforts for a day until the chest-girth at the nipple line is higher than Brent's medium standard.

The members of consumptive families and those who bear the marks of threatened disease—a narrow chest and faulty carriage of the body, associated with some indication or other of deranged health—should make it the first business of their lives to carry out the above directions. Till that has been accomplished, it is worse than useless—it is certain disease—for them to engage in sedentary, chest-constricting, or dust-inhaling occupations. Those who are engaged in such occupations, or who are unavoidably submitted to surroundings that tend to reduce the breathing capacity, should most scrupulously devote sufficient time daily to one or other mode of developing the lungs, in order to counteract their effects. And I need not point out that considerations of self-interest, of humanity, and of public policy, alike de-

[1] "What is Consumption?" (1886); "The Experimental Production of Chest-Types in Man," British Association, 1887, Statistics; "Physical Development;" The Illustrated Medical News, Nov. 9, 1889.

mand that a practical effort should now be made to reduce the compression of the chest, the inhalations of small particles, and confinement, especially in rooms under ground, to a minimum in those trades.

At birth the child has a proportion of chest girth to height that slightly exceeds that of the maximum standard. I have suggested the birth standard as the true standard of health; but under the present system of bringing up children, they are, from the moment of birth right through the whole course of modern education, submitted to conditions that tend to reduce the breathing capacity; so that for a height of 51.84 inches there is a chest-girth of 26.10 inches, instead of one of 35.18 inches, or a loss, in about ten years, of nearly nine inches. And when there is consumption in the family, extra care is taken of the children; that is, these conditions are pushed to an extreme limit, and the so-called inherited consumption is the direct result. Here you have the best standard of chest-girth. Is it too much to ask that the conditions of the child's surroundings as a whole shall be so arranged that it may be retained? Look at the poor, puny chests we meet with, and at the reports of the registrar-general, and then we shall see the grave responsibility that lies upon us for producing such a change, and permitting it to continue.

I have pointed out the means by which we can develop the lungs to the required standard, and in so doing have shown how that development is to be retained, and consumption be effectually prevented. These measures are very simple; and in one form or other, and at some period or other within the twenty-four hours, they are within the reach of all. But they effect a complete change in our habits, mode of life, and surroundings; and a change of this nature must be slowly, gradually, and cautiously effected. I warn you against stretching the lungs (that is not development), against violent or sudden exertion and exhaustion. Uninterruptedly, step by step, acclimatize the bodies to the new conditions, and then they will lead us safely and surely to complete protection from consumption.

How can we reduce the mortality from consumption to insignificant proportions, and so complete the measures that are necessary to secure the practical suppression of the disease? This is the state with which we have to deal. The lungs are being progressively destroyed by a process of irritation[1] caused by more work being thrown on them than they are able to effect;[2] and this inability has been produced by their having been, and still being, subject to conditions that tend to reduce their capacity;[3] and, further, during the progress of these events, the other organs have become involved by attempting to perform compensatory work, with the result that the general health is more or less seriously compromised. Consequently, in order to adequately deal with this state of things, we must treat consumption upon the following principles: to establish an equilibrium between the amount of interchange required to be effected and that effected; to enable the other organs of the body to perform their ordinary functions; to restore to the lungs their power of adjustment to their external conditions; and to obtain the above without producing indications of friction: that is, in other words, we must arrest this process of irritation, restore the general health, and develop the lungs to the required amount, in order to secure complete recovery from consumption. A little consideration will make it evident, that, to carry out the first principle of treatment, we shall have to take measures from two distinct points of view. On the one hand, the conditions that impede the effecting of these interchanges must be, as far as that is possible, removed, and those that have an opposite tendency substituted; and, on the other, any deficiency that may remain must be made good by the compensatory action of one or more of the other organs. For this purpose we shall, in the first place, put the patient under conditions of habitation, habits, and surroundings that tend individually and collectively to promote these interchanges. The consumptive patient must be sent as soon as possible to live in a house the sanitary condition of which has been ascertained to be good, situated on an elevation, either in the country or at the seaside, where the air is pure and free from dust. Each room must communicate continuously and directly with the external air. Sunlight should be freely admitted; the windows constantly kept open, night and day; and the temperature, as recorded by a maximum and minimum thermometer, gradually lowered till there is not so great a difference between it and the external air as that we still find in the rooms of consumptive patients. The patient's clothes must be warm, not too heavy, and made so loose that they can offer no restraint to the free movement of the chest. Wool manufactured in such a way that it is elastic, permits free ventilation of the skin, and is not too heavy, should be worn next the body; that used during the day must not be worn at night, and the under-linen should be frequently changed. As much time as possible must be spent in the open air. If the patient is unable to walk, he should ride or drive in an open carriage till he has gained sufficient strength to enable him to do this. Sitting in a position that tends to impede the movement of the thorax must be carefully and constantly avoided, and the patient should be gradually induced to throw the weight of the shoulders on the spine till he both sits and walks with the body erect. If any deficiency remain,—and that, as well as its amount, will depend upon the extent of the disease,—we shall have to obtain compensation for it by measures that increase the activity of the functions of the skin, or the kidneys, or the alimentary canal. To increase the functional activity of the skin, we shall direct the patient to be bathed or sponged with warm water, medicated or not, as frequently as may be found desirable, once daily in any case; and, if necessary, we shall increase that activity by prescribing diaphoretics. If the action of the skin obtained by the above measures be not sufficient for the purpose, or if it be already performing its share of this compensatory work, then we shall increase the activity of the kidneys by suitable diuretics, and attend to the functions of the alimentary canal. Now, the above measures, thoroughly and carefully carried out, will, if the

[1] Tanner, Aitken, Wilson-Fox, Waldenburg, Schottelius, Roberts, Lombard, Marcet, Sanderson, Simon, Cohnheim, Frankel, Rindfleisch, Niemeyer, Powell, Ewart.

[2] Gautier, Peter, and the French School.

[3] Graham Balfour, Gintrac, Hanot (Jaccoud), Hutchinson, Fabino, Wintrich, Hecht, Schnievogt, Waldenburg, Ransome, Stokes, Frieund, Aitken.

disease be not too extensive, effect an equilibrium between the work required to be effected and the work effected, and we shall have obtained an arrest of the disease.

The first step towards enabling the other organs of the body to perform their ordinary functions has been already taken by removing that which was the primary cause of their derangement; viz., the presence in those organs of substances that interfered with their normal work, and altered, to a greater or less extent, the state of their nutrition and that of the body as a whole. We shall supplement that, where necessary, by appropriate means to secure the relief of any organ that may have become involved by its compensatory action, and to obtain the normal functional activity of the others, so that the body may be placed in a fit state for the reception and assimilation of suitable food. The nature and quantity of the food, and the time for its administration, must be carefully regulated according to the requirements of the case, but care must be taken not to give it too frequently or in too large quantities. I attach much importance to the careful cultivation of the appetite, so that the patient may be tempted to eat, and to the careful avoidance of any dish or article of food to which the patient has taken a dislike. Good new milk alone, or made up in various ways, cream, butter, olive-oil, marrow (I have found great benefit from a preparation of marrow and malt immediately after the meal), hot bacon with its fat, eggs, good beef-tea, soups, fish, fowl, cutlets, fillets, etc., with a suitable supply of vegetables and fruit, must be freely drawn upon for the patient's food. And we may add to this a good bitter beer, stout, or a good, sound claret, or wine, when we are sure we can get them.

No attempt whatever should be made to apply the third principle of treatment until the disease has been some time arrested, as shown by a progressive decrease of the symptoms of lung irritation, an increase in the area of breathing, increased vital capacity, extent of movement and girth, a nearly normal temperature, a steady improvement of the general health, and increased weight. Then the following measures may be gradually adopted and steadily increased, great care being taken to avoid either strain (the lungs must not be stretched) or over exertion, the state of the general functions and temperature being carefully watched. We place the patient under conditions that progressively make increasing demands for the use of the lungs, such as slight ascents on the neighboring hills, slowly performed at first, and then gradually increasing both the elevation and the time occupied in such exercise. Deep breathing is to be regularly practised, commencing with three or four full inspirations, followed by deep expirations, in succession, and increasing both their number and extent. I have found the careful and regular use of a spirometer very beneficial, and much regret that, as in the case of thermometers, no one as yet supplies them at such a price as will enable the general public to purchase them. Then the muscles of the chest must be fully developed, and the patient should take part in such exercises as will insure their full use. And this process of lung development will not be complete until the patient's vital capacity exceeds Hutchinson's so-called standard of health.

And we shall attain the object of the fourth principle of treatment by carefully selecting appropriate measures to effect each purpose we have in view (and the medicines must be prescribed precisely on the same principle; for instance, if we desire to increase the functions of the skin, a diaphoretic is prescribed, and its use stopped when we desire such action to cease), by using them at the right time and to the right extent, and by carefully watching their effects, so that if there be any indication of friction we may at once effect the necessary modification, or adopt some other means to attain the same object.

Under this system of treatment, the chest symptoms are immediately relieved; pain, cough, and expectoration speedily disappear; the area of breathing, the vital capacity, the chest-girth, and extent of movement, progressively increase. The temperature tends towards that of health, the general state improves, the weight increases, and there is a feeling of health and strength. In fact, so real is this, that it has been the source of one of the chief difficulties of treatment, by tempting the patient to do something beyond his strength, or to neglect some of the directions given him, till he finds himself promptly pulled up by a cessation of his improvement. Soon, in those cases in which the disease is not extensive, there is a complete arrest of the disease, no chest symptoms, a good state of the general health, a fair weight, normal temperature, a good breathing capacity, and eventually the patient makes a complete recovery. By this I mean he has the appearance and possession of sound health, natural breathing from base to apex, a well-formed and fully developed chest, and a good range of movement and vital capacity.

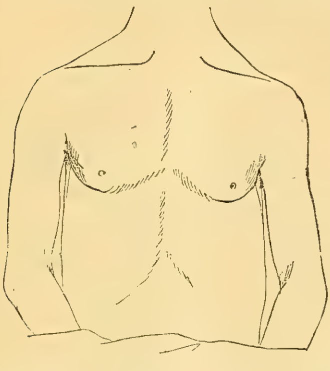
I have based this statement on the results I have invariably obtained in my experiments, and in the practical treatment of the cases of which the following notes appeared in the *Lancet* of Nov. 26, 1887, and Dec. 8, 1888, and in the *Illustrated Medical News* of Oct. 26, 1889:—

"Case I.—In April, 1883, I saw H. O. M. E., a married lady, in conjunction with the gentleman who had attended her. We found the usual signs of phthisis of the right lung. Family history good; height 5 feet 2 inches; vital capacity 85 cubic inches. I accompanied the patient to Hastings, and saw that she was carefully treated on the principles I advocated in that paper.[1] June 13, much improved; vital capacity 130 cubic inches. June 21, improvement continues; now able to walk a mile or two; vital capacity 162 cubic inches. June 29, able to walk four miles; vital capacity 167 cubic inches. The patient was unfortunately obliged to return to town. The improvement stopped, and after a few weeks she began to lose ground. In September the patient went to the Isle of Wight, the vital capacity then being only 161½ cubic inches. Oct. 9, very much improved; vital capacity 195 cubic inches. She continued in the south, and was gradually accustomed to walk many miles daily; no chest symptoms. Nov. 4, patient's appearance that of a lady in good health; vital capacity 201½ cubic inches. Nov. 25, continues well; vital capacity 222½ cubic inches. Dec. 11, patient has recovered; angles of scapulæ lie flat on back,

[1] "The Scientific Treatment of Consumption," Manchester Meeting of the British Association.

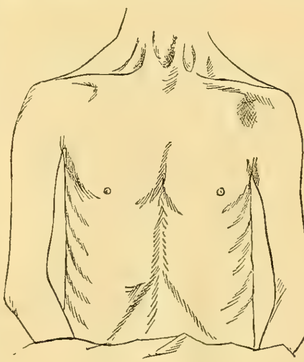
chest freely movable, and vital capacity 226 cubic inches, or 44 cubic inches above the so-called standard of health. Since that date the patient has had two children, there has been no relapse, and in September last her vital capacity was 220 cubic inches.

"Case II.—L. J. F. was said to have disease of the right lung by family doctor. The patient's father and uncles had died of consumption. I found the disease very limited, and the case a most favorable one to treat. Height 5 feet 6 inches; chest-girth at third rib 30 inches; extent of movement $\frac{1}{2}$ inch; girth at ensiform cartilage 29 inches, extent of movement $1\frac{1}{4}$ inches. Treated on the same principles, the patient steadily and rapidly improved in condition. Two months later the chest-girth at the third rib was $32\frac{1}{8}$ inches, extent of movement $1\frac{5}{8}$ inches; girth at ensiform cartilage 30 inches, extent of movement 3 inches. Two months after the above, the patient had practically recovered. There was a further gain of half an inch in girth; no depression above or below clavicles; angles of scapulæ flat, and weight 9 stones 5 pounds. The patient continues well.



"Case III.—This was a servant, with disease of both lungs. The patient was sent home to the country apparently recovered, and desired no further attendance. I have since lost sight of her.

"Case IV. is that of myself. It will be fully understood that I only refer to it to complete the *prima facie* case I have established in support of this method of treating the disease. My mother, her three brothers, and two sisters died of phthisis. In physical appearance I was a well-marked example of the so-called 'inherited' disease. Height 5 feet $9\frac{1}{2}$ inches; vital capacity considerably below the so-called standard; was always subject to winter cough; broke down while attending hospital in 1873, and was advised to leave at once, in the middle of the session. There was no doubt about the nature of the disease. Since that time I have gained about five inches in chest-girth, and for ten years have been free from any sign, symptom, or appearance of the disease.



"I shall be obliged if you will enable me to state that those patients continue well, notwithstanding the severity of last winter, and that their remarkable increase of chest-girth and range of expansion has been retained. Since then, I am sorry to say, I have only had an opportunity of applying those principles of treatment in two cases.

"The first case was an acute attack, temperature over 102°, in a case of long-standing and very extensive disease of both lungs. Under treatment, the temperature became nearly normal, cough and expectoration nearly disappeared, breathing became easy, the chest-girth increased, and in about six weeks the patient returned to work. A short time since, I heard that the patient was fairly well, and still able to continue at work; and, had there been a home placed under conditions suitable for treatment, I think this case would permanently recover, notwithstanding the extent of the disease.

"In the other case there was extensive disease of the right, with commencing disease of the left lung, and hectic. The patient could not leave his business, but carried out the directions so carefully that cough and hectic disappeared; the appetite was good, weight increased, and there was no difficulty in breathing on exertion. In fact, he felt and looked so well that he spent a day at Wimbledon, got thoroughly wet through in the camp, and remained in his wet clothes. That brought on an acute attack, and his temperature rose to over 103°. Under treatment, this was rapidly recovered from, and in three weeks he was fit to go, and went, to the Highlands. During the attack the patient lost eight pounds in weight; the heart was displaced to the right; and the chest-girth at ensiform cartilage was, on expiration $27\frac{1}{2}$ inches, and on inspiration $28\frac{1}{8}$ inches. The patient has no trouble with cough; the color is healthy; temperature nearly normal; weight has increased 12 pounds; heart has gone back; chest-girth at ensiform cartilage is, on expiration 28 inches, on inspiration $30\frac{1}{2}$ inches; and there is no difficulty in breathing or cough when the patient runs."

"The cases previously reported continue well. Of the two cases which were noted in the *Lancet* of Dec. 1, 1888, one (Case 5), I understand, continues at work, and the other (Case 6) has had a most instructive record. This patient went through the winter very well, and I did not see him till the 29th of May, when, as the direct result of recent overwork in his business, I found he had materially lost ground, but unfortunately he could not leave town. A sharp attack of hæmoptysis came on on the 29th of June, and I was sent for. The temperature rapidly rose to 103°, but was promptly reduced, the hemorrhage arrested, and in a few days the patient was up. He left for the Highlands on the 19th of July, when his chest-girth was, on inspiration $30\frac{5}{8}$ inches, and on expiration $30\frac{1}{4}$ inches, the extent of movement being only $\frac{3}{8}$ of an inch. I next saw him on Oct. 3, his chest-girth being, on inspiration 32 inches, expiration 30 inches, showing an increase of 2 inches. This was associated with a considerable improvement in the local and

general state, weight 9 stones 4 pounds, and I am well satisfied with his progress.

"Case VII.—On May 21 first saw this patient. Father and his brothers had died from consumption. Occupation dust-inhaling; liable to colds, slight cough, hectic, frequent diarrhœa, voice changed, and face pale; height 5 feet $5\frac{1}{4}$ inches; chest girth at ensiform cartilage, on inspiration $27\frac{1}{2}$ inches, expiration 25 inches. Commencing disease of right lung. June 26, appetite fair; air entering more freely; chest-girth, on inspiration $28\frac{1}{2}$ inches, expiration 26 inches. July 24, looks very well, sleeps well, appetite good, no cough, voice natural, temperature normal, air entering freely everywhere, good movement; chest-girth, on inspiration $29\frac{3}{4}$ inches, expiration 27 inches, showing an increase of $2\frac{1}{4}$ inches. The patient has practically recovered. Still well.

"Case VIII.—Patient's mother's family consumptive. Dust-inhaling occupation. Has had cold upon cold, pale, appetite bad, fingers clubbed, pain over middle of third right rib, cough troublesome; temperature 99.1°. Disease of both lungs. Height 5 feet $9\frac{1}{4}$ inches; chest-girth, on inspiration $36\frac{1}{4}$ inches, expiration $33\frac{1}{4}$ inches. June 18, says he is first-class, looks better, appetite good; no cough, no pain in chest; air entering freely, more movement, apices higher; and chest-girth, on inspiration $37\frac{3}{4}$ inches, expiration 35 inches. July 17, sleeps well, eats well, and looks well. Temperature normal; weight 10 stones 9 pounds; no pain, no cough, no expectoration; air freely entering everywhere; and chest-girth, on inspiration 38 inches, expiration $34\frac{3}{4}$ inches, being an increase of $1\frac{3}{4}$ inches. Patient has nearly recovered, and returned to work. Continues well.

"Case IX.—This patient has been getting thin, feels weak, pale, and appetite capricious. Occupation in a basement partly lighted by gas always. Commencing disease of left lung, breathing generally feeble, and very little movement. Temperature 96.6°; height 5 feet 8 inches; chest-girth, on inspiration 35 inches, expiration 32 inches. Aug. 29, says he feels quite well, and looks it; air entering freely everywhere, movement good; chest-girth, on inspiration $37\frac{1}{4}$ inches, expiration $32\frac{1}{4}$ inches, showing an increase of $2\frac{1}{4}$ inches; temperature normal; weight 10 stones 3 pounds. This patient is practically well. Still well.

"Case X.—Patient has been losing weight for about twelve months, appetite very bad, cough very troublesome, hectic, perspiration at night; temperature 99.4°; height 5 feet 5 inches; chest-girth at ensiform cartilage, on inspiration $26\frac{1}{2}$ inches, expiration $25\frac{1}{4}$ inches; very little movement, very little air entering; disease of both lungs. Sept. 18, has been to Hastings. Looks well, sleeps well, cough only occasional when exposed to cold, appetite wonderfully good, voice greatly improved, air entering freely, fair general movement; chest-girth, on inspiration $29\frac{1}{2}$ inches, expiration $26\frac{3}{4}$ inches, showing an increase of 3 inches. Making splendid progress.

"Case XI.—Saw this patient on the 10th of July. Dissease of both lungs. Temperature 99°; expectoration colored, cough very troublesome, had been losing weight; chest-girth, on inspiration 26 inches, expiration $24\frac{3}{4}$ inches. Sent to Hastings. Sept. 29, looks very much better, little cough, appetite good, steadily putting on flesh, air freely entering, movement good; and chest-girth, on inspiration $28\frac{1}{4}$ inches, expiration $25\frac{1}{4}$ inches, being an increase of $2\frac{1}{4}$ inches. This patient is making most satisfactory progress.

"Case XII.—Patient has extensive disease of both lungs. Hæmoptysis six years ago, and from time to time up to date. Has tried Madeira, Torquay, etc. Height 5 feet $7\frac{5}{8}$ inches; chest-girth, on inspiration 25 inches, expiration $25\frac{1}{4}$ inches. Sept. 27, decidedly better, breathing much easier, more air entering generally, moist sounds clearing up; chest-girth, on inspiration $27\frac{1}{2}$ inches, expiration $26\frac{5}{8}$ inches, showing an increase of $2\frac{1}{4}$ inches. Going to Hastings. There is a little hope for this patient."

Further, the literature of consumption supplies us with a mass of evidence that clearly and unquestionably points to the accuracy of the above results. In the first place, an examination of the circumstances in which the numerous recorded cases of arrest, whether for a longer or shorter period, have taken place, shows that conditions that tend to obtain compensatory action by one or more of the other organs, those that tend to develop the lungs, or both associated together, were always present. Formerly arrests were sometimes obtained by the induction of an artificial skin-disease, by the use of counter-irritants, by bathing and sponging, and by preparations acting on the skin, kidneys, and digestive tract. Patients sent to hilly districts in the country, to the seaside, to warmer climates, where more time was spent out of doors, or to the mountains, have obtained an arrest of the disease, and similar results have followed the taking-up of the trade of testing wind-instruments or practising various methods of inhalation.[1]

Not only have such conditions been invariably present where a temporary arrest has been effected, but they also, and especially those that tend to develop the lungs, have always been for a long time present in all the cases in which a complete cure has been obtained.[2] We know that men have completely recovered after following an occupation in the open air for many years, after long residence in mountainous districts, after many years spent in constant travelling, and after leading an active life on the borders of civilization in all parts of the world. Such are the thousands of happy results that have been so correctly described by Walshe as "Nature's cures." But there was a physician who could, and did, cure consumption by a definite method of treatment, as distinguished from the accidental nature of the recoveries above referred to, and that was Sydenham. He ordered his patients to continuously ride on horseback till they got well. This exercise was to be taken in the country, where the air was good; the riding was to be increased from seven to one hundred and fifty miles a day; and the patients were only to stop for food for themselves and horses, and not to remain more than one night in a place. And of this method of treatment he said, "I have put very many upon this exercise, and I can truly say I have missed the cure of very few."

[1] Ruehle (Ziemssen), Meckel, Powell, Ewart, Hanot (Jaccoud), Hirtz, Magnus Huss, Blake, Roger and Boudet, Heitler, Laennec, Cotton, Clark.

[2] Frieund, Case in Royal Infirmary, Edinburgh (Lauder-Brunton), Cruveilhier, De Mussy, Fuentes, Harrhy, Stokes, Ewart, Herman-Weber, Andrew, Austin Flint, Fuller, MacCormac, Germain Sée, Hastings, etc.

We are now in a position to state the case that has been laid before us. We have seen that the accepted theories of consumption must be rejected, because they either have no foundation in fact, or they do not accord with and are incapable of affording an adequate explanation of all the known facts of the case; and that Koch's theory falls within these categories. A new theory—that consumption is the direct result of the reduction of the breathing surface of the lungs below a certain point in proportion to the remainder of the body, and is solely produced by conditions that tend to reduce the breathing capacity—has been brought before us, and the following evidence adduced in its support:—

1. Consumption has been experimentally produced by conditions that tend to reduce the breathing capacity. Koch's successful experiments were directly produced by those conditions.

2. We can at any time watch the direct production of consumption by these conditions in the dust-inhaling trades.

3. The trades and occupations that directly compress the thorax, or impede the respiratory functions, are notorious for their production of consumption.

4. A large amount of consumption is produced in the army every year by those conditions.

5. Consumption has been repeatedly produced by confinement, both in man and in animals.

6. The children of consumptive parents who become diseased have been carefully brought up under such conditions.

7. Consumption bears the mark of the effects of the progressive action of such conditions from its commencement to its termination.

8. There is no recorded case of consumption, experimental or not, in which those conditions were absent.

9. Where such conditions are absent, there is no consumption in man or animal.

10. Upon their introduction, consumption immediately appears, both among men and in animals.

11. The disease presents a perfectly natural series of events when viewed in this light.

12. Its presence in our midst is due to the changes in our habits, mode of life and surroundings, that are being effected by the progressive advances of civilization.

13. Consumption has been prevented by the removal or counteraction of those conditions. The immunity of mountaineers is due to their capacious lungs.

14. The disease has been frequently arrested for a longer or shorter period by the accidental or deliberate adoption of measures that tended to compensate for or counteract those conditions.

15. And both the experimental and the practical application of measures that tend to compensate for and counteract those conditions have invariably been followed by the arrest and subsequent complete recovery from consumption, where the disease was not too extensive; and the same process has obtained in the thousands of cases of cure by nature and by Sydenham. Therefore this theory is founded on fact, and is both in strict accord with and capable of affording an adequate explanation of all the known facts of the case. And consequently we now have it in our power to secure, with absolute certainty, the prevention of and recovery from consumption. I have laid down the principles that must guide us in carrying out this work, and now it only remains for me to point out the directions in which we must move, in order to secure the general application of this knowledge, and the consequent practical suppression of consumption. The State loses the services of a large number of men every year from consumption in the army and in the various departments of the civil service. That not only represents a considerable financial loss, but in the case of the army it also constitutes a serious source of danger to the State. The trades and occupations that produce so much consumption should be the subject of careful inquiry to ascertain how this production can be reduced to a minimum. That this inquiry is urgently called for, is evident from the following statistics, taken from the supplement to the "Registrar-General's Report," which show, that, out of a thousand deaths among various classes, there were from phthisis,[1] among Cornish miners, 690; earthenware-manufacturers, 473; printers, 461; file-makers, 433; cutlers, etc., 371; brewers, etc., 334; stone-quarriers, etc., 308; drapers, etc., 301; publicans, etc., 295; tailors, 285; cotton-manufacturers, etc., 272; wool-manufacturers, 257; shoemakers, 254; builders, etc, 252; carpenters, etc., 204; hosiery-manufacturers, 168; laborers (agriculture), 122; gardeners, 121; fishermen, 108; farmers, etc., 103

Physical education should be made a necessary part of our system of national education. We look to the government for action in the above directions, and their serious and immediate attention should be given to them. Life-assurance companies and sick-benefit societies can co-operate most materially in the prevention of consumption, and save their members considerable sums of money annually by insisting upon their members having or obtaining the required amount of lung development. And every available opportunity should be taken of placing before workingmen's clubs and societies the immense importance of physical development.

It is of great importance that the consumptive patient should be placed under treatment as soon as possible, and that it be uninterruptedly continued until the recovery is complete. For this purpose we require hospitals and institutions placed in the most favorable conditions in the country and at the seaside, and I am sure the means will be gladly found for opening these institutions when once their necessity and immense importance have been realized. With such institutions, so placed, and this system of treatment thoroughly and continuously carried out, I am certain we shall have reduced the mortality from consumption to truly insignificant proportions before the next century has escaped from its infancy. And I have the right to express a clear and emphatic opinion on this subject; for I myself and my patients have unquestionably completely recovered from the disease. A great, a splendid, a noble victory over this disease lies in the hands of the profession. Shall we let doubt stand between us and its practical achievement?

G. W. HAMBLETON.

[1] The disease is very rare among gypsies.

NOTES AND NEWS.

DR. DIXON, professor of hygiene at the University of Pennsylvania, has been making some experiments with air and dust obtained in street-cars. He has found in them the germs of many diseases, contagious and otherwise. Better ventilation and more effective cleansing are sorely needed.

—Mr. Allan V. Garrat has tendered his resignation as secretary and treasurer of The National Electric Light Association, to take effect June 15, 1890.

—The directorate of the railway intended to connect Hudson Bay with the Canadian railway system has been recently reorganized, and, it is expected, will be able to carry the undertaking to completion. The length of the railway is to be 350 miles, starting from North Bay, off the Canadian Pacific Railway at Lake Nipissing, thence to Moose Factory, a port on James Bay, the southern prolongation of Hudson Bay. This, it is expected, will become an important feeder to the railways already built, passing as it does through one of the richest pine regions in the Dominion, containing forests of red and white pine, spruce, and tamarac of gigantic proportions. The country traversed is also said to be rich in minerals, such as galena, copper, nickel, and iron.

—M. Georges Rolland, an eminent French engineer, recently read a paper before the Académie des Sciences, in which he insists upon the necessity of constructing a railway across the Sahara. M. Rolland says that it is time for France to make up her mind as to the part which she intends taking in the economic conquest of the interior of Africa. In his paper he defines what are the regions of the western and central Soudan upon which French commerce could reasonably reckon, his conclusion being that nothing durable or really useful could be effected in the Soudan without the assistance of Algeria; while, in order to take any effective action in Algeria, that colony would need to be connected with the Soudan by means of a railway crossing the Sahara.

—A club of students, under the charge of four experienced tutors, will be formed at Seal Harbor, Mount Desert, Me., for study and tuition during the summer of 1890. The object of the club will be to prepare students for the college entrance examinations in the fall, and also to assist any who have fallen behind in their studies in making up their deficiencies. The club will be under the charge of Louis L. Hooper (Harvard '89), assistant in physics in Harvard College, who was at the head of a similar club successfully carried on last summer at North Edgecomb, Me. He will be assisted by L. H. Dow in ancient languages, N. R. George, jun., in mathematics and physics, and J. B. Scott in modern languages, all of whom hold very high rank in the present senior class of Harvard College. They have specialized in their several departments, and are experienced tutors. As each student will receive separate and individual instruction in all his studies, his peculiar needs can be met, and rapid and thorough progress can be made. Although the club is organized principally for study, there will be ample opportunity for exercise and recreation. A tennis court and row-boats have been secured, and, as is well known, the neighborhood offers remarkable advantages in the way of excursions and mountain-climbing. For further particulars, address Louis L. Hooper, Harvard University, Cambridge, Mass.

—At a regular meeting of the Washington Chemical Society, April 11, Dr. Thomas Taylor of the United States Department of Agriculture exhibited a new flash-light intended to take the place of several kinds which have of late proved highly dangerous in practice. The composition of Dr. Taylor's new flash-light consists largely of charcoal made from the silky down of the milk-weed,—a form of carbon which he prefers to all others, because of its freedom from ash. A few grains of this new composition placed on tissue-paper and lighted by a punk-match produced a prompt and blinding flash, while it was observed that the paper on which the powder rested was not even scorched. The flash being instantaneous, the heat is not sufficient to ignite the most inflammable material on which the powder may rest. Dr. Taylor demonstrated this by using, with the same paper for a base, an inferior flash-light, which set fire to the paper at once. This is owing to the comparatively slow combustion of the chemicals used in the inferior grade. Dr. Taylor said that the powder of his new flash-light will not explode either by concussion or friction.

—On Monday evening, April 21, at the meeting of the section of mineralogy of the New York Academy of Sciences with the New York Mineralogical Club, Mr. George F. Kunz spoke on the subjects of "The Minerals exhibited at the Paris Exposition of 1889" and "A Remarkable Group of Meteorites from Kiowa County, Kan.;" and Dr. Joseph H. Hunt exhibited a collection of specimens from Paterson, N.J., consisting of zeolites and quartz pseudomorphs after zeolites. Mr. Kunz also exhibited a new and undescribed meteoric iron from Colfax, Rutherford County, N.C., and spoke on the asteriation in calcite as observed by putting a light through transparent cleavages, on the native antimony from Kern County, Cal., and on the pallasites and meteoric iron from Kiowa County, Kan.

—The following is a complete list of the papers read before the National Academy of Sciences, at its April meeting, 1890: "The Effects of the Inhalation of Nitrogen, Nitrous Oxide, Oxygen, and Carbonic Acid upon the Circulation, with Special Reference to the Nitrous Oxides, Anæsthesia, and Asphyxia," by H. C. Wood; "On the Application of Interference Methods to Astronomical Measurements," by A. A. Michelson; "Physiognomy of the American Tertiary Hemiptera," by S. H. Scudder; "Totality of the Eclipse of 1889, Dec. 22," by D. P. Todd; "The Budding of Salpa considered in Relation to the Question of the Inheritance of Acquired Characters," by W. K. Brooks; "Recent Advances towards a Knowledge of the Fishes of the Great Oceanic Depths," by G. Brown Goode and Tarleton H. Bean; "A System of Classification of Variable Stars," by S. C. Chandler; "On the Spectrum of Metals," by H. A. Rowland; "On the Cheapest Light," by S. P. Langley; "On the Relation of Secular Disintegration to Certain Crystalline and Transitional Schists" and "On the Structure of the Green Mountains," by R. Pumpelly; "The Interrelationships of the Ichthyopsida," "The Notacanthoid Fishes as Representatives of a Peculiar Order," and "The Halosauroid Fishes Typical of a Special Order," by Theo. Gill; "Researches on the Double Halides" and "Researches on the Sulphinides," by Ira Remsen.

—The faculty of the Wharton School of Finance and Economy, at the University of Pennsylvania, have been steadily developing during the past months a library, which, now that it has reached very large dimensions, is making its importance felt. The foundation was laid by the great collection of the late Stephen Colwell, comprising between seven and eight thousand volumes, and including nearly every important book on the subjects of finance and political economy in the English, French, and Italian languages published before 1860. This was supplemented by the bequest of the library of the late Henry C. Carey, which embraces many later works and pamphlets, and is especially rich in statistical literature, European government reports, and the like. Some time since, in addition, a collection of about three thousand English pamphlets on financial and economical subjects, formerly the property of Mr. McCalmot of London, was obtained, covering the period from the close of the seventeenth century to our own time, and bound in chronological order. Professor Bastable of Dublin has pronounced this to be better than the similar collection of the British Museum. It is necessary, of course, in order to keep pace with the times, to buy the best of the new books within the scope of the Wharton School. An annual fund has accordingly been provided for this purpose; and a number of works, several of them fresh from the author's hands, which were selected by Professor James while abroad last summer, have lately arrived at the university. A department of the library of especial interest is that pertaining to municipal government. It is hoped that all documents pertaining to this subject for cities of over fifty thousand inhabitants may be obtained. The co-operation of all municipal officers is urgently requested, and the receipt of any documents, however trifling, will be gratefully acknowledged.

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CONTENTS:

All the States of South and Middle America have of late years shown great solicitude about the condition of the national education, but none more so than the Argentine Republic. Dr. J. B. Zubiar has just published a little pamphlet entitled "Quelques mots sur l'Instruction dans la République Argentine" (Paris). He is inspector of the national schools and training-colleges, and was his country's delegate at the last Paris exhibition and at the pedagogical congress held on that occasion. The object of his pamphlet is to show to the civilized world what progress the Argentine Republic has made since it succeeded in shaking off the clerical government of Spain, which had for three centuries held it down. The following facts need no comment. In 1810 the only places where teaching went on were a theological college and a few schools kept by priests, who taught the young idea how to shoot chiefly by means of the cane. In 1888, after fifty years of independence, there are for the forty million inhabitants two universities with three faculties each, 15 colleges, 34 training-colleges with 758 professors and 11,365 pupils, 2,263 elementary schools with 4,744 teachers and 175,239 pupils (which gives an average of 34 to each class only), and, besides, 831 private elementary schools with 1,094 teachers and 33,723 pupils,—altogether 3,227 schools with 254,608 pupils. In commenting on this report, the *Journal of Education*, London, states that the great impulse to education was given by the law of 1789, and ever since the work has rapidly extended. In one year, 1887–88, there was an increase of 109 schools, with 1,000 teachers and 27,158 pupils.

MENTAL SCIENCE.

A Study of Movements in Young Children.

Modern science attaches great importance to the study of beginnings, and such study is quite as promising and interesting in the field of mental as of physical facts. The origin and growth of human faculty as exemplified in the development of the child claims an especial importance on account of its very general and educational interest. Quite a number of child biographies have been written from this point of view, and the period has now come when special studies of particular lines of development and acquisition of faculty are made. A recent study by M. Binet (*Revue Philosophique*, March, 1890) deals with the following four points: the co-ordination of movements in walking, the bilateral character of movements, automatism in movements, and re-action times.

The study of how children learn to walk has been confined mainly to determining the age at which independent locomotion begins: this in the average of a number of infants was found to be at about eighteen months. It varies considerably with the health and growth of the child, and also with the degree of attention the child gives to the learning of it. M. Binet tells of two sisters, the elder of whom learned to walk at twelve months by carefully and persistently leaning on one chair, feeling the way to the next, and so on; while the younger, who was stronger and had every opportunity of learning quickly, made very intense but irregular efforts to walk, and did not succeed until her fifteenth month. This difference of character has been maintained, the elder being calm, serious, and not easily distracted, while the younger is exuberant, easily distracted, and volatile. The origin of the tentative movements resulting in walking, Preyer regards as instinctively inherited, and in this opinion M. Binet concurs. The latter observed in an infant only three weeks old alternate movements of the legs when the child was held with the legs free to move, and the soles of the feet were in contact with any substance. Repeated experiments showed that if the child were held with its feet above the ground, no such alternating movements of the legs occurred, but as soon as the feet touched the floor these movements were reflexly excited. This seems to indicate that the movements of walking are instinctive; it also indicates that the fact of walking being a power which the child acquires somewhat late does not interfere with its instinctive character.

If one observes the spontaneous, explosive movements of the arms and legs of infants a few weeks old, one will notice a great preponderance of bilateral movements; the two arms or the two legs moving together, or, if not quite together, alternating so rapidly as to amount to the same thing. The contrast in this respect between the infant and a child of two or three years is very marked. Of 57 movements made by an infant one week old, only 13 were unilateral, 25 were bilateral, and 23 of the rapidly alternating kind. This tendency towards bilateral movements can be observed in older children. Rubber tubes were placed in the hands of a three-and-a-half-year-old child with the request that at a given signal she should press only one of the tubes. The record showed very frequently that both were pressed, and other irregularities occurred. In connection with these movements, M. Binet's attention was called to the expression of fear in the child when not securely held. This was very evident by its crying, which ceased as soon as the child was securely held. This occurred before the child had had a fall, and so would suggest a sort of instinctive fear of falling,—a fear which does not exist with regard to fire, for instance.

Recent researches have attached great importance to the phenomena of automatism, or the subconscious reception of sensation, and execution of appropriate movements. In a single child such automatism was evident during the first six months of life. If the child's hand were open, a light pressure on the thumb sufficed to make it close, and when closed a stroking of the back of the hand opened it. This succeeded as well whether the child was awake or asleep, whether the child directed its attention to the hand or not. The same automatic faculty comes to the front in many ways. If a child's interest is held towards a certain point,

one may slip a key or other object into a child's hand and have it held until the hand opens and the key falls, evidently without the child's knowing it. The ease with which a child may be distracted is well known. A crying child is appeased by drawing its attention away from the source of trouble. The case is cited of a child much put out by being presented to strangers, but who at once stopped crying when a match was lit. As soon as the match went out, the crying recommenced, and so on, for several minutes. We here see an alternation of the mental view that would be regarded as abnormal in the adult. The contrast between this and the elaborate means necessary to gain mental diversion in adult life is certainly striking.

The time of mental acts can be studied in children old enough to understand what is asked of them. Ordinary observation shows that children are slow in responding to a stimulus. Actual measurements were taken by having children press upon a tube as soon as they heard a sound. The average adult time for this re-action is .14 of a second. Children from four to seven years old require over half a second to do the same thing. The times, too, are irregular, from a minimum of one-fifth of a second to a maximum of a second or more, indicating an irregularity in the power to fix the attention upon so artificial a task. When the time was measured, the curve of contraction was also written. This in the adult is a quick, sudden stroke, occupying about .34 of a second. In three of the children the movement occupied over half again as much time, and in one child was as long as two seconds. This suggested a test of the maximum number of pressures a child and an adult could make in a given time. The adult makes 18 (in an extreme case 27) in 4 seconds, while the children averaged only 9 pressures in the same time. We have thus indicated in a variety of ways the gradual development of human faculty, as well as the unconscious education we pass through in childhood, and the means of educationally utilizing it.

The Sensations of Movement

We are getting to appreciate more and more how much of mental life is founded upon the information obtained through the contraction of muscles. The exact determination of how this knowledge is obtained becomes correspondingly important. A recent study by M. Bloch sheds interesting light on some phases of this question (*Revue Scientifique*, March 8, 1890). It is to be observed at the outset that we have no direct knowledge of the muscular changes produced in the muscles themselves when they contract. When we close the hand, all the sensation is in the hand itself, while the muscles whose contraction brings on the movement are farther up in the fore-arm. It is, then, from the sensations of compression of the skin and the movement of joints that we obtain our notions of movement. There are indeed certain secondary associative contractions of muscles, coming a slight fraction of a second after the contraction of the muscle we innervate, that seem to tell us of the realization of the intended contraction. While thus ignorant of the means of muscular contraction, we can direct its extent and direction. We can set the vocal chords to sing a certain note, but in many cases these adjustments are simply a series of tentative attempts, and even then liable to some considerable errors. For the motions of the arms this was tested in the following way. The two leaves of a screen standing at about an angle of eighty degrees to each other had their sides covered with ruled paper, and the general problem was for the observer in a definite position in front of the screen to find with the two arms corresponding places upon the two leaves of the screen. The movements of the two hands were most nearly alike when the movements were nearest to the body and near the line of the eyes, although the eyes in these experiments were of course closed. The difference in position of the two hands is about 1 centimetre in this region; this when the two hands are moved together. If the one hand is placed, and the other is to find a corresponding position, then the task is much more uncertain, and the error larger; the error being 5 centimetres, where it was but 1 centimetre before. If this process depends upon the contraction of muscles, then the error should be larger if the one arm is moved passively by an assistant, while the other arm finds the position in which the first was placed. An actual test showed that under such conditions the process is quite as exact as before. This independence between the perception of the position of our limbs and the muscular contraction was further shown by placing the wrist of one hand through a ring suspended by a rubber band from the top of the screen. To find a place low down on the screen, the hand must pull against the rubber band, and this should make all the adjustments too high; but no such effect occurs. Again, if a weight of 2 kilograms be attached to either wrist, it does not change the accuracy of the adjustments. Another kind of muscular sensation was tested by taking a number of leaves of a book in between the thumb and forefinger of one hand, and finding with the other an equal number of leaves. This error for a small number of leaves was about one fifteenth the number of leaves, but for a larger number this ratio decreased. It makes some difference whether the right or the left hand is the judging hand; and for M. Bloch, who is left-handed, the left hand feels lengths as larger than equal lengths in the right hand.

We also have no definite knowledge of the precise time of a muscular contraction. If we attempt to beat time with a metronome by the rhythmical contraction of a muscle, we imagine that we begin the motion as the metronome beats; but in fact it is the end of the movement that coincides with the beat of the metronome, the real contraction preceding it by a considerable fraction of a second. More curiously still, if an impulse is sent out at the same time to a muscle near the brain (say, the muscles moving the jaws) and to muscles far away (say, those moving the foot), the impulse will reach the foot later. If, now, we keep time with a metronome by alternately contracting the jaw and the foot, then we really begin the movement of the foot earlier than that of the jaw, so that the close of the movements shall coincide with the sound.

The intensity of muscular sensations, M. Bloch subjected to only a very rough test. After many unsatisfactory modes of testing, he used a form of balance, on the short arm of which was suspended a constant weight, and along the long arm of which the finger moved, keeping the beam horizontal. The finger was placed in a certain position, and then moved as little one way or the other as was necessary to tell that the pressure had changed. From this the ratio of pressures at the two positions was calculated, and found to be about 1:4.3. In this both the muscle sense and the pressure-sense are used. To rule out the former, a brace was placed above the beam, so that the weight pressed against the finger, but the latter need not support it. The ratio thus determined was 1:3. The pressure-sense was eliminated by wrapping thread around the finger, and then the sensibility was determined to be 1:2.5, so that both these senses contribute to the common result.

BOOK-REVIEWS.

A Primer of Phonetics. By HENRY SWEET, M.A. New York, Macmillan. 16°. 90 cents.

THIS work makes use of "Visible Speech" to teach the elements of phonetics, and to denote the analysis of English, French, and German sounds. All the details of "Visible Speech"—its organic and phonetic classifications, its terminology, and even its symbolic notation—are borrowed in wholesale, in a way that, however flattering to the author of the system, cannot be satisfactory to its students: for Mr. Sweet has made "a few modifications" of the symbols; and, notwithstanding that these have been repudiated by the author of "Visible Speech" as not in harmony with the fundamental principles of his system, they are here incorporated with it, without any indications to distinguish the innovations from the original parts of the scheme. The "Visible Speech" notations should at least have been shown in comparison with the substitutions, so that a student might use the one or the other, as his preference might dictate. Without the symbols themselves, the objectionable character of the "modifications" cannot be made clear; but the ground of the objections will be understood from the statement that the mutual relations of the

sounds of *p b m, t d n, k g ng*,—depicted in the "Visible Speech" symbols,—are entirely *in*visible in the substituted symbols for the sounds of *m n ng*. So, also, for the symbols of *s sh th*, —which form a related series in "Visible Speech,"—the "modifications" depart altogether from the original plan of symbolization by substituting a set of merely arbitrary forms.

In some few points Mr. Sweet disputes the correctness of the "Visible Speech" analysis; for example, in the sound of *ah*, the "low back wide" vowel which Mr. Sweet says should be the "mid back wide." Such difference of opinion is of course legitimate, but each opinion should be attributed to its proper author. In the preface to this book Mr. Sweet says, "I feel convinced that the path of progress lies through the 'Visble Speech' analysis, and that the first duty of the very few who have a practical command of it is to do what they can to spread the knowledge of it." Yet in the above case Mr. Sweet gives his own analysis only, and makes no reference to its divergence from that originally made, and still upheld, by the author of "Visible Speech." The same procedure is further manifested in the introduction of symbols for the teeth, turned in different directions—as, surely, never teeth were turned—to represent the sounds of *th* and *f*. In reference to these symbols, Mr. Bell says, in his "Lectures on Phonetics," "The symmetry of the system has been deformed in republications which have been made without leave asked or given. One emendator, it seems, had supposed the system wanting in symbols for the teeth, and accordingly he actually provided it with a set. 'Visible Speech' was certainly not born with teeth; or, rather, teeth being in the mouth, their presence is implied as a matter of course, and requires no symbolizing—as they are not in the habit of shifting their root-fast positions. The teeth, like the hard palate, are only passively employed; and it will be time enough to call in dental aid when the teeth are shown to be the active agents in forming any oral sound."

In spite of this protest, Mr. Sweet brings in his symbols for the teeth, without a word to show that they form no part of the original system. This is altogether indefensible. "Visible Speech," as we learn from the inaugural volume, cost its author the labor of twenty years: and, although its inventor might be scientifically glad to see his system superseded by a better, no person can look with equanimity on wanton interference with so elaborate a plan. All that Mr. Sweet has to say in his "Primer" might have been said —if not better said—within the limits of the symbolism that has not, we are told, been found wanting in means to discriminate the phonetics of any language. Mr. Sweet's "modifications" cannot be accepted as legitimate; far less can they be considered as improvements: but the chief objection to them is that they are mixed up with the true "Visible Speech," as if they formed part of the system. In it, yet not of it, they misrepresent it, and mislead the learner.

Simple Elements of Navigation. By LUCIEN YOUNG. New York, Wiley. 16°.

To the yachtsman who annually, and about this time of year, goes down to the sea in a schooner, or a sloop, or a cutter, or perchance in a steam or naphtha launch, this little pocket-volume will prove invaluable; and to the naval apprentice, the petty officer, or the ambitious able seaman, it will be of greater immediate assistance on the road to promotion than more pretentious works intended for the use of accomplished mathematicians and experienced navigators. The treatise is not intended to take the place of any other work, for we know of no other of similar scope; nor does it aim to supply any real or imaginary deficiency in previous works on the subject. It is put forth as a compendium or epitome of the simple elements of navigation, containing every thing necessary to enable a man of ordinary intelligence, with a little "seafaring education," to navigate a vessel to any port in the world; but it does not aim to supplant more comprehensive works on navigation. All complicated mathematical formulas are omitted, and also all calculations not readily and easily comprehended and performed. About one-half the volume is of necessity given to the tables of difference of latitude and departure; refraction, dip, and parallax; declination of the sun; equation of time; sines, tangents, and secants; etc.; without which no work of the kind is complete.

But, good as the book is, it has serious defects, which we hope to see remedied in later editions. These defects, however, while marring the literary value of the work, do not interfere with its value for the main purpose the author had in view. They arise from the attempt to condense into a few pages matter which, from its nature, does not readily lend itself to condensation. As a consequence, there are many sentences in the book which must be carefully studied, read over and over again, before the meaning is apparent. To the author, of course, familiar with the subject, all is clear; but to the student, to whom navigation may be "all Greek," the translation into plain English of puzzling obscurities, produced by ultra-condensation, may be a distasteful task. Then there are occasional lapses in grammar and in diction, which would not be so noticeable were they not in so noticeable a work. As a whole, the treatise is a good one, the need of such a work was felt, and we have no doubt that it will have a cordial reception.

A Century of Electricity. By T. C. MENDENHALL. Boston and New York, Houghton, Mifflin, & Co., 1890. 12°. $1.25.

THIS is a second edition, with additions, of this book, which was first published in 1886,—with additions, we note, as the progress of electrical science, which has been made mostly in the last hundred years, did not cease four years ago, but has made further strides Many of these advances have been in the applications of electricity to the production of light, and, in a broad way, to the transmission of power. Four years ago electrical appliances were popping up on every side, each putting forth a claim to great usefulness and to perfection. This activity in a new industrial field gave rise to the inevitable fever of speculation, which could but result in great disappointments, as the incompleteness of the novel inventions as they then stood was shown by experience. Then, again, the use of so powerful an agent in methods most crude led to disasters to human life and property, that aroused hostility to the new force. Our author traces all this matter of history, and shows how even the much talked of alternating currents have been gradually made more amenable to human wants, and records the general settling-down to really useful work of the electrical industries.

But it is on the side of theory also that enormous advances have been made recently in electrical science. Many know that a connection between electricity and light was suspected a dozen or twenty years ago by Clerk Maxwell. Now, in his additions, Professor Mendenhall records the experiments of Hertz, which show the suspicion of twenty years back to be true.

Many are interested in the display of electrical energy on every hand, and yet know little of how it has come to pass that there are electric cars, electric lights, electric printing-presses. For these Mendenhall's "Century of Electricity" is intended, and that they may rely upon it is shown by the fact that in two years only two errors have been pointed out in the text; and one of these dates back to Faraday himself, who overlooked a misstatement of one of the laws he discovered in his own publication of them,—an error which was inadvertently copied.

The Elements of Laboratory Work: A Course of Natural Science. By A. G. EARL. London and New York, Longmans. 12°.

THE author is a late scholar of Christ's College, Oxford, and now science master at Tonbridge School. The book is for use in laboratory work, and presupposes a fairly well stocked room for the instruction of beginners in physical science. The field of work is somewhat more limited than is frequently the case with books of this class, experiments on the physical and to some extent on the chemical properties of matter being made most prominent. Electrical measurements, which lend themselves admirably to higher laboratory work in physics, are but sparingly referred to. For ourselves, we do not approve of the minuteness with which the primary facts in regard to matter are supposed to be observed by the student using Earl's methods, but we are

aware that all teachers do not agree with us in this; but we do not hesitate in saying that to this, even now, new method of study "The Elements of Laboratory Work" is an addition, and that those who have such work in charge will find the experiments and exercises full of suggestions.

AMONG THE PUBLISHERS.

"HINTS on How to Travel" is the title of a handsomely illustrated little guide and information book just published by H. D. Newson & Co., 852 Broadway, this city.

—"The Growth of Yale Athletics," by Walter Camp, illustrated by instantaneous photographs taken on the campus; "Path of the Cyclone," seventeen views of the ruins in Louisville; "Mississippi Floods," breaks in the levees, river scenes, as pictured from the government vessel,—are published in *Illustrated American* No 9, for the week ending April 19.

—In the May number of the *New England Magazine* there will be a full-page portrait of George Kennan, which appears in connection with a poem on the recent Russian atrocities.

—"The Better Day" (New York, Funk & Wagnalls) is the title of the new periodical, the organ of the Better Day Reading Circles. It is a journal of temperance education, to extend the work begun by the course of scientific temperance instruction in the public schools.

—Encouraged by the success of the "Historiettes Modernes," by Professor C. Fontaine, Washington, D.C., the publishers, D. C. Heath & Co. (Boston) issued on the 21st a second volume by the same author, and edited on the same plan. The stories are short, pure, interesting, and of recent appearance in France, and the notes are full and suggestive.

—Two American honeysuckles which have often been confounded are admirably figured in last week's *Garden and Forest.* They are *Lonicera flava* and *Lonicera Sullivantii*, and the portraits will serve to facilitate their identification. Some sound advice about planting new places is given in the leading editorial article, and the great nurseries of the Messrs. Veitch & Sons, near London, are described. Besides the usual variety of seasonable horticultural matter, the number contains a review of Dr. Heinrich Mayr's important work on the forests of North America.

—Roberts Brothers have ready "London of To-Day," by Charles Eyre Pascoe, an illustrated handbook for the season of 1890.

—An article in *Lippincott's Monthly Magazine* for May of timely interest is "Subsidies and Shipping," by Henry W. Raymond. Mr. Raymond points out that all nations who are leaders in commerce grant subsidies to their shipping, and argues that in order to compete successfully with foreign nations we must adopt their methods.

—Charles Scribner's Sons have ready "The Wife of the First Consul," translated from the French of St. Amand by T. S. Perry, and have in press two more books by the same author,—"Marie Antoinette and the End of the Ancient Régime" and "The Happy Days of the Empress Louise." A revised edition has been prepared of Lafayette C. Loomis's "Index Guide to Travel and Art Study in Europe."

—Little, Brown, & Co. will publish next month "The Influence of Sea Power upon History," by Capt. A. T. Mahan, U.S.N., with twenty-five charts illustrative of great naval battles. The object of the work is an examination of the general history of Europe and America, and exemplification of the great determining influence of the maritime strength upon great issues,—a point which many historians have either overlooked or touched upon superficially. The period embraced is from 1660 to the end of the American Revolution.

—Messrs. Ginn & Co. announce for publication May 1, "Common School Music Charts," by W. S. Tilden, teacher of music in the State Normal School, Framingham, and author of "A Common School Song Reader." These charts are designed

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Publications received at Editor's Office, April 14-19.

CANADA Geological and Natural History Survey. Plan of the Asbestus Areas in the Townships of Thetford, Coleraine, Wolfestown & Ireland. Ottawa, Geol. Surv. f°.
——Geological Map of the Province of New Brunswick. Ottawa, Geol. Surv. f°.
DAVIS, E. H. The Fourth Reading-Book. Philadelphia, Lippincott. 448 p. 12°. 80 cents.
HEROIC Ballads. With Poems of War and Patriotism. Ed. with notes by D. H. M. Boston, Ginn. 319 p. 12°. 50 cents.
MENDENHALL, T. C. A Century of Electricity. 2d ed. Boston and New York, Houghton, Mifflin, & Co. 243 p. 12°. $1.25.
SWEDENBORG, E. Angelic Wisdom concerning the Divine Love and the Divine Wisdom. New York, Amer. Swedenborg Publ. Co. 375 p. 24°.
U. S. COAST AND GEODETIC SURVEY. Annual Change of the Magnetic Declination for the Epoch January, 1890. Washington, Government. f°.
——Isogonic Chart of the United States for the Epoch 1890. Washington, Government. f°.
——Magnetic Meridians of the United States for January, 1890. Washington, Government. f°.
WARD, R. H. Plant Organization. 2d ed. Boston, Ginn. 31 p. 8°. 85 cents.

to furnish at moderate cost a brief course in note-reading for the smaller village and country schools, in which a full graded course cannot well be followed.

— Dr. Francis Warner (physician to the London Hospital, etc.) has prepared for publication his lectures on "The Growth of Intellectual Faculty," delivered for the Teachers' Training Syndicate, in Cambridge, during the Lent term in 1888 and 1889. The author insists on the necessity of observing physical facts, their causes and effects, when considering mental and moral questions, and has worked out a system of observing pupils in school. Special attention is given to such states as "attention," nervousness, sleep, fidgetiness, disobedience, lying, headache, low development, etc. Observations made in schools are largely referred to, and the notes of many cases are given. The book, which is illustrated with diagrams, will be issued shortly by Macmillan & Co.

—A year or two ago, a series of articles was published in *The Forum*, entitled "How I Was Educated." The contributors were presidents of universities and colleges, other prominent educators, and men of letters. These autobiographical papers were collected and printed in a separate volume, and now belong to the standard educational literature of the United States. A new series of articles will appear forthwith on an analogous question; viz., "What were the influences—the persons, the circumstances, the books—that have operated most to form the character and occupation of a number of notable scholars and men of letters and science?" The contributors to this series will include eight or ten of the foremost men of letters, men of science, teachers, and statesmen, American and foreign.

—Dr. E. N. Sneath, lecturer on the history of philosophy at Yale, has been inspiring the preparation of a series of small volumes of selections from the leading philosophers from Descartes down, so arranged as to present an outline of their systems. Each volume will contain a biographical sketch of the author, a statement of the historical position of the system, and a bibliography. Those so far arranged for are "Descartes," by Professor Ladd of Yale; "Spinoza," by Professor Fullerton of the University of Pennsylvania; "Locke," by Professor Russell of Williams; "Berkeley," by Ex-President Porter of Yale; "Hume," by Dr. Sneath of Yale; and "Hegel," by Professor Royce of Harvard. Kant, Comte, and Spencer will certainly be added to the series, and others if encouragement is received. The publishers will be Henry Holt & Co.

— Mr. D. C. Thomson, author of "The Life and Works of Thomas Bewick" and "The Life of H. K. Browne, 'Phiz,'" has had in preparation for the past three years an important work on the Barbizon School of Painters. This volume will be similar in size (quarto) and character to the "Life of Bewick" and the "Life of 'Phiz,'" and will be illustrated with numerous plates and wood-engravings. The work will supply a complete biographical and critical account of the group of five celebrated French painters known as the Barbizon School, —Theodore Rousseau, Jean François Millet, Narcisse Virgilio Diaz, Charles François D'Aubigny, and Jean Baptiste Camille Corot. Such a publication necessarily demands excellent illustrations; and many representations will be given of pictures, drawings, and portraits, in various methods of reproduction, — etching, photogravure, wood-engraving, etc. It is proposed to publish the volume by subscription, which should be forwarded to Scribner & Welford, New York, without delay.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Psychrometer.

THERE have recently appeared two quite extended investigations on the use of the psychrometer (wet and dry bulb thermometers) in determining the moisture-contents of the air. The first is a comparison with the condensing hygrometer, made by Professor S. A. Hill of Allahabad, India, published in the *Journal of the Asiatic Society of Bengal* (vol. vii., 1888). Recent investigations in this country have shown the entire uselessness of trying to obtain refined results with an unventilated psychrometer, and we note that a partial neglect of this precaution has led to wrong inferences in this paper. The experiments with the Regnault apparatus revealed the same difficulties, with the plate, fumes of ether, etc., that have been noted by others. The comparisons were made with artificial ventilation, as well as in a breeze and in still air, at pressures ranging from 20.6 to 29.4 inches. There were twenty-seven observations; and of these, four had an artificial ventilation. The method of ventilation is not given, but we may assume that it was sufficient to give good readings. The following are the results:—

Pressure.	Dry Bulb.	Wet Bulb.	Dew Point.	
			Regnault.	Hazen Table.
23.55	71.4	49.5	19.9	19.5
23.50	60.3	52.1	45.7	45.0
25.80	86.8	62.1	43.6	43.8
23.51	69.3	59.6	52.6	52.7

The results given in the last two columns are most extraordinary. There is almost a perfect accordance between the dew-point observed at heights up to 6,500 feet and that computed for a height of 600 feet from the ventilated psychrometer. Without more information as to the accuracy of the condensing hygrometer and the sufficiency of the ventilation, it would be dangerous to argue upon these results; but the coincidence between them and those obtained in this country by the writer up to 3,000 feet is very remarkable. Professor Hill, by combining together all the ventilated and unventilated readings, obtains an exactly opposite result, but it is now known that unventilated psychrometer readings are worthless for careful comparison.

The second paper is by Dr. Haldane and M. S. Pembrey of Oxford, England. It is to be found in the *Philosophical Magazine*, April, 1890, pp. 306–331. In this paper an attempt is made to compare the unventilated psychrometer with determinations of moisture by chemical methods. The experimenters have given the chemical method an exhaustive study, and their results in that line are excellent. The comparisons with the psychrometer, twelve in number, are unsatisfactory and lead to erroneous conclusions for the reason already given. Five out of the total were made in so damp an air that they cannot help in the comparison. The other seven are as follows:—

Dry. (1)	Wet. (2)	Vapor Pressure in Millimetres Computed. Observed Chemical. (3)	Glaisher. (4)	Regnault. (5)	Hazen. (6)	Gl., H. & P. (7)	(6) — (3) (8)	(7) — (3) (9)
61.6	53.0	7.43	8.58	7.37	7.57	7.76	.14	.33
61.3	54.9	8.99	9.65	8.84	9.14	9.00	.15	.01
63.7	56.0	8.78	9.63	8.79	9.14	8.99	.36	.21
61.5	53.0	7.63	8.58	7.37	7.87	7.78	.24	.15
63.0	55.2	8.90	9.40	8.46	8.97	8.68	.07	—.22
64.1	57.0	10.00	10.18	9.45	9.83	9.52	—.17	—.48
64.6	57.4	10.23	10.49	9.60	10.03	9.67	—.20	—.56
Mean........		8.85	9.50	8.55	8.94	8.77	.09	—.08

In column (4) are given vapor pressures computed by Glaisher's Tables, as published in Guyot's Tables, 1884. It is very gratify-

ing to note that these have been materially modified recently, as shown by column (7) Formerly they were exceedingly unsatisfactory. It will be seen that the most satisfactory argument lies in columns (3) and (6); but since column (6) is for a ventilated psychrometer, and the readings used were unventilated, we must conclude that the chemical method for obtaining vapor pressure, as given by this investigation, does not agree with the condensing hygrometer. It is much to be regretted that comparisons were not instituted between the chemical method, the sling psychrometer, and the condensing hygrometer. This paper is a valuable addition to our knowledge of chemical methods, and narrows down the remaining unexplored field of research for measuring the moisture of the air. H A. HAZEN.

Washington, April 16.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

April 15.—S. V. Proudfit, A Collection of Stone Implements from the District of Columbia; Romyn Hitchcock, Among the Ainos of Yezo (illustrated with lantern).

American Folk-Lore Society, Boston.

April 18.—J. Walter Fewkes, Phonograph in the Preservation of the Folk-Lore of the American Indians; Passamaquoddy songs, tales, legends and conversations, were repeated by the phonograph.

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SCIENCE

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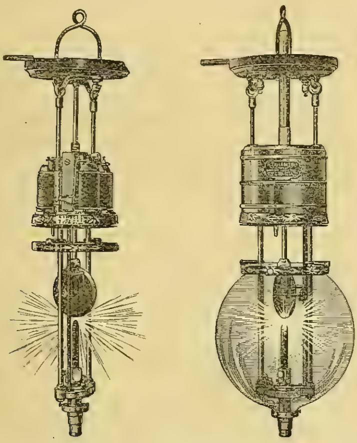
EIGHTH YEAR. VOL. XV. No. 378. | NEW YORK, MAY 2, 1890. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

A SUPERIOR ARC-LAMP.

MANY efforts have been made by trained electricians and other experimenters, both in the United States and in Europe, to apply the disk carbon to the electric arc-lamp, every one appreciating how much more brilliant and lasting a light would be where the disk carbon was used rather than the ordinary pencil carbon, provided that it could be controlled. Until the present, all efforts in this direction, so far as made public, have ended in complicated and clumsy contrivances altogether unsatisfactory, and too expensive for general purposes in lighting.

The invention, of which we present illustrations, has for its object to provide an arc-lamp that will burn about twice as long without re-trimming as the arc-lamp now in general use, at a cost of constructing and operating not greater than that of the ordinary arc-lamp.



THE RUSSELL DISK-CARBON ARC-LAMP.

It consists in the combination of a vertically moving and intermittently rotating carbon electrode in disk form, with a pencil-shaped carbon electrode, fixed and immovable, standing vertically in the bottom of the lamp-frame. Arc-lamps as heretofore made burn about eight hours, when the carbons will be consumed; and if longer service is required, they must be renewed.

This lamp will burn and give a full light for about eighteen hours, and it may be so constructed as to burn twenty four hours before renewing the carbons. The cost of the carbons is less than the cost of those ordinarily in use in proportion to the amount of carbon in them. The electric current is less than that required by other arc lamps, as the length of carbon resistance is two inches less. The pencil being stationary, the disk is made to revolve slowly by the vibrations of the armature and the ratchet arrangement shown in the sectional view, and thus made to burn evenly around the centre. The disk descends a little lower after each rotation than it was during the previous rotation, and so on until the disk is as nearly consumed as it may be. As the disk presents a greater surface of contact, a stronger and more steady light is secured; and over seventy per cent of the light is reflected below the disk, and not thrown above.

The lamp is provided with a device for arresting sparks, so that none can get outside the globe. It is known as the Russell electric lamp, and is attracting attention in Boston, where it is being introduced by the company controlling its manufacture.

ON THE USE OF THE PHONOGRAPH IN THE STUDY OF THE LANGUAGES OF AMERICAN INDIANS.

THE invention by Edison of the phonograph, and the improvements in its effectiveness which rapidly followed, naturally turned attention to the possibilities which it presents in the preservation of the languages of the aborigines of the United States. It was recognized independently by several persons, that, if the instrument could be brought to a certain stage of perfection, it would serve as a valuable means for this purpose; but no one, as far as the author knows, has published an account of experiments made to test its capabilities in this direction.

In order to determine its present value for this purpose, the author undertook a series of experiments,[1] taking for that purpose the language of the Passamaquoddy Indians, who are the purest blooded Indians now living in the confines of New England. The result of these experiments has fully justified his expectations, and convinced him that the instrument has now reached such a degree of perfection that it can be adopted by scientific students for that purpose. He believes that it is a most valuable auxiliary in linguistic researches, and that it should be used in the study of the fast disappearing languages of races, and in making record of those which are rapidly becoming extinct.

It is thought that phonetic methods of recording Indian languages are not all that might be desired for this purpose. Even with the assistance of the admirable system of letters and conventional signs which have been proposed for that purpose, there are many difficulties besetting the path of one who would accurately record the aboriginal languages, which are but imperfectly met by this method. There are inflections, gutturals, accents, and sounds in aboriginal dialects which elude the possibilities of phonetic methods of expression. It is desirable, also, to preserve songs, sacred and secular, which are rapidly becoming extinct. Their counting-out rhymes often have inflections which are imperfectly expressed by letters. The use of the phonograph among the Passamaquoddies has convinced me that the main characteristics of their language can be recorded and permanently preserved, either for study or demonstration, with this instrument.

On a visit to Calais, Me., undertaken in March, to make experiments on the value of the instrument in recording Indian languages, many cylinders full of records were taken. These embrace a large variety of subjects, such as it was thought would represent, in a general way, the main peculiarities of this branch of the Algonquin languages. The records taken may be roughly classed as follows: 1. Songs; 2. Folk-tales; 3. Pronunciation of

[1] The author read a paper on this subject before the American Folk-Lore Society at its last meeting in Boston on April 19. This paper will be published later. These experiments were carried on preparatory to taking the instrument for the same purpose among the Pueblo Indians of New Mexico. The work was done under the auspices of the Hemenway expedition.

words; 4. Passamaquoddy equivalents of English words; 5. Counting-out rhymes; 6. Imitations of sounds made by animals; 7. Ordinary conversations in the Indian language, in which two or more persons took part. These records were always accompanied by a statement on the cylinder of the subject, time and place, name of the Indian giving the testimony and that of the observer. This safeguard seemed necessary for future identification, as their labels might be displaced or lost, and by that means their value be impaired.

Among the songs[1] recorded are war-songs, a sacred song ("The Song of the Snake-Dance"), and several songs which form a part of ancient stories. It is said that in old times, as so often happens among primitive peoples, the folk-tales and legends were all sung. In many instances at the present time these stories have for the most part lost that character, and are simply narrations, although in many of them songs occur, and some still have a lyrical character. As an example of a story with songs in it, may be mentioned an interesting account of the adventures of Black Cat ("Pogump") and the Toad Woman ("Pookjinquess"), a story which is full of rude imagery, in which occurs a very old song with onomatopœic sounds. The so-called war-songs, which still survive in the memories of the old Indians, seem particularly desirable for preservation. One of these, a Mohawk war-song, the words of which were improvised, is of a most interesting character. The song sung at the celebration of the chief on the first night of the festivities was taken from the lips of the Indian who sung it the last time this event was celebrated.

Of sacred songs, the only one which was obtained is the song of the snake-dance, a little-known ceremony, which will be described in a forthcoming article in the *American Journal of Folk-Lore.* This dance, which has lost whatever sacred character it once had, has not been performed by the Passamaquoddies for five years, and the song was sung at that time by Noel Josephs, who sang it on the cylinder of the phonograph for me. All the listeners, of whom there were several, said that the song was very ancient. The words of the song as sung are as follows:—

"Way ho yāh ne, way ho yāh ne, way ho yāh ne, way ho—o—o,
Hew nayie hah, hew nayie hah, hew nayie hah."

These words are said to be archaic, which fact is regarded as additional evidence of the great age of the song itself, and were obtained by me from a study of the cylinder of the phonograph upon which it was recorded. When compared with the original, it shows how accurate the records are. The words of the song, which have been indicated by the spelling given above, were also derived from the phonograph. They were sent to Mrs. W. Wallace Brown of Calais, Me., who is one of the best students of the Passamaquoddy language known to me; and she writes me that she regards them as indicating the pronunciation as nearly as possible by phonetic methods.

The music of the "Snake-Dance" given below was written out by Mrs. H. E. Holt. Mrs. Holt had never heard the Indians sing the song, but was able from the record to write out the notes, from which a third person sang the song in the same way as the original recorder, Noel Josephs.

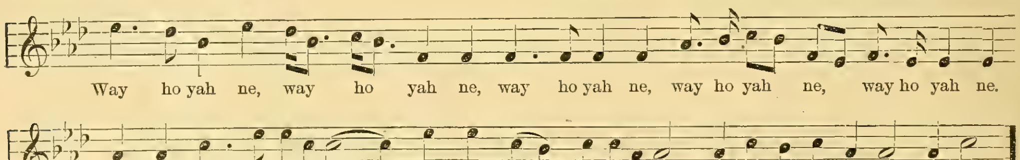
time to the music by a dance. The second is the song of the Indians who take part in forming the coil which represents the snake. Calls to those not taking part in the dance frequently occur in the second part of the song, but those are not indicated. On the same cylinder with the music of the "Snake-Dance" I was able to obtain in the Passamaquoddy language a record of the proclamation announcing the dance, and an invitation to the same.

The possibilities of the phonograph in these studies indicate one of the great advantages of this instrument. What specimens are to the naturalist in describing genera and species, or what sections are to the histologist in the study of cellular structure, the cylinders made on the phonograph are to the student of language. In the quiet of his study he can hear the song repeated over and over again as often as he wishes, and can, so to speak, analyze it, and in that way separate the constituent sounds. Moreover, these records on the cylinders can be submitted to specialists for study. The collector may not have a musical ear, as in my own case, and may not be able to write out the songs, no matter how many times they are repeated. He can in that case collect the records, and submit them at some favorable time to one who is able to catch the song and set it to music.

It is particularly desirable to record the songs of the Indians, for we may conclude that these are very ancient, and preserve their identity for a long time. This is true at least as regards those pertaining to sacred observances, which may be regarded as of great antiquity. Songs in sacred ceremonials are among the last of the religious observances to be modified or changed. Paraphernalia of sacred dances, or even the whole sacred character of the dance, may be lost; but the song would be the last to have its integrity impaired. Moreover, when a comparative study of songs of different peoples is desirable, the cylinders taken from one tribe may be carried among the Indians of another in order to compare records or to see if those taken are recognizable. This method of comparison renders possible an exactness in the comparative study of Indian songs which has never been possible before.

The records of the stories or folk-lore of the Indians which were taken can be studied in the same way as the songs. Although the cylinders remain as perpetual records of the stories, it is desirable to write out the Indian words and obtain an accurate translation. I have gone far enough in my work to see that this can be done with great precision with the phonograph, and that the instrument has great capabilities in this method of work.

The study of folk-lore can never stand on a scientific basis as far as Indian tales are concerned until we reduce to a minimum the errors of interpretation which may creep in through the translator. The tales are so full of imagery that the tendency to enlarge upon them is fascinating, and names of well-known authors who have succumbed to this influence might be mentioned. As long as there is a possibility that the hearer adds to or detracts from the story as he hears it, by so much is the value of a story for scientific comparison diminished. The phonograph records the story exactly as the Indian tells it; and although free translation of it may, and probably must, be made, to render the story comprehensible, we can always preserve the phonographic record



The first part of the song is sung by the conjurer, who goes about with a rattle while singing, searching for the snake, keeping

as a check on exaggeration, or as a reference in critical discussions of the subject-matter of the story. In this way the phonograph imparts to the study of folk-lore, as far as the aborigines are concerned, a scientific basis which it has not previously had, and makes it approximately accurate.

In order to determine the pronunciation of Passamaquoddy

[1] It would be desirable to apply the phonograph to the preservation of other songs which are rapidly becoming extinct. For instance, it is said that the old plantation melodies of the negroes are rapidly being replaced by other songs. These might be recorded on the phonograph for permanent preservation.

words, I took on the phonograph several cylinders, with the Indian equivalent of the English words. In doing this I made use of pages of the well-known schedules published by the Bureau of Ethnology at Washington, speaking the English word, and requesting the Indian to follow with the Passamaquoddy translation. This, of course, is only possible when the Indian has a knowledge of English, or is able to know by signs what is needed.

To obtain sentences, a conversation was recorded in Indian language between two Passamaquoddies. These cylinders reveal the general linguistic peculiarities, and when studied might be valuable adjuncts in the acquirement of the language.

It seems possible that the phonograph may be found to be of valuable assistance not only in the study of Indian, but also of all modern languages. A number of cylinders with records of sentences pronounced by a Frenchman or German with the proper accent might be found a valuable aid to a teacher of these languages who is not a native of the land the language of which he is teaching. Even proficient teachers might find it a help in their classrooms. For study of these languages without the aid of a teacher, a set of cylinders with the proper pronunciation might have a great value in training the ear to the correct pronunciation of the words and sentences of a foreign language, which are but imperfectly indicated by phonetic methods. By the use of the phonograph the teacher of modern languages might be relieved of the endless repetition of pronunciation of words in a foreign language which the pupil acquires with difficulty.

I have taken the following clipping from a daily paper: "Edison's phonograph has found a new application at the Milwaukee College, where it will be used as an assistant in teaching the French and other foreign languages. The phonograph, of course, never gets tired, and can be made to repeat the same sentence or the same word hundreds of times. In giving a lesson, the teacher reads it before the phonograph, at the same time addressing the pupils, and the lesson is reproduced whenever wanted." This would seem to indicate that the use of the phonograph in the teaching of modern languages had been put in practical test.

The necessity of work with the phonograph in preserving the languages of the aborigines of this continent is imperative. There are stories, rituals, songs, even the remnant of languages which once extended over great States, which are now known only to a few persons. These persons are in some instances old men and old women, with whose death they will disappear forever from the face of the earth if some record is not now made of them. Many have already been lost forever, even in the last twenty years, and some are fated to disappear in the next decade.

These rituals are in some instances the unwritten history of the tribe, and contain all that the Indians know of their history. The younger men among several tribes do not willingly take to the customs of their fathers. They are rapidly losing their former character. They have no desire to commit to memory the rituals of their ancestors. To learn their language, to live among them and study all that pertains to them from an intimate acquaintance, even membership in the tribe, is desirable, if earnest investigators can be found to undertake it; but this is not always possible. The phonograph renders it practicable for us to indelibly fix their languages, and preserve them for future time after they become extinct or their idiom is greatly modified or wholly changed.

The prime object of the above-mentioned experiments was simply to test the capabilities of the phonograph in recording aboriginal languages. That it could be used for that purpose was assured before I began by the knowledge that it records any language with precision; so that the experiments bearing on its capabilities in this direction might seem superfluous. Demonstration, however, gave weight to belief.

The expense at the present time for the use of the instrument is possibly a practical difficulty, which it is to be hoped may be lightened for those using the instrument for scientific purposes. Certainly no idea could show a more disinterested personal interest than a wish to permanently preserve the fast vanishing languages of the American Indians. It belongs to the realm of pure science, and the scientific student will probably be met in a similar liberal spirit by those who control the patents of the phonograph.

J. WALTER FEWKES.

FACTS ABOUT TORNADOES.

THERE is no subject in the whole science of meteorology of such absorbing interest as this of tornadoes. Its importance may be judged from the hundreds of pages that have been written upon it, from the universal attention paid it by newspapers through the length and breadth of the land, and from the fact that many insurance companies have taken the matter in hand, and are prepared to take tornado risks. It is easy to see that the interest in this topic must gradually increase as the tornado districts become more thickly populated, and as the facilities for spreading the news of disaster become greater. There is no doubt that in many instances losses from a tornado have been greatly exaggerated, and fears of devastation have been increased because pictures of the very worst tornadoes are the only ones that have been printed.

The most important thing for us to do is to establish the facts, and these will serve as a basis from which we may uproot false theories, and, if not now, at some time in the future, to build up a solid superstructure. It is to be noted that all studies on this question ultimately turn to the facts, either to support theories or to form them. We shall find the most diverse views in these discussions, and yet every one of them based upon facts. It is only because of a false or imperfect interpretation of what is observed that such antagonism can exist. A partial explanation of these conflicting views lies in the fact that the outburst of a tornado is accompanied by such terrifying manifestations, and observers are in such fear for their lives that they are totally unfitted to give an account of what they have seen. In many cases, also, there has been altogether too narrow a view taken of this phenomenon. We have been entirely absorbed in the immediate destruction, the demolition of houses, the twisting-off of trees, the distribution of *débris*, etc., and have neglected the atmospheric conditions which have led up to the disaster. All will agree that a thorough knowledge of all the circumstances attending these outbursts is indispensable, if we would learn the mechanism of a tornado, or if we ever attempt to guard against its devastation, or ever try to give warning so that others may protect themselves. We may enumerate some of the facts as follows:—

Quiescent State of the Atmosphere.

It is quite well known that tornadoes seldom occur singly, but many are formed over an extended region, five hundred or more miles in length and breadth, where the conditions are favorable for their development. In this region the air is remarkably quiet previous to the tornado. There is a general or wide-extended storm some two hundred or four hundred miles to the north-westward; and into this storm, which is usually intensified much above the average storms at that season, gentle southerly and south-easterly winds are blowing at a distance, which are freshened as the centre is approached. Tornadoes rarely occur in any but the hotter season, say from April to August; and in this season, even when there are thunder-storms, high winds are an exception.

Temperature.

The universal testimony is, that there is an exceedingly warm and sultry air. Even if the sky be overcast, and the

sun's direct rays be hidden, this same oppressive feeling is noted. This heat seems to have a special characteristic entirely unlike that from the ordinary bright sun's rays, and it has never been properly accounted for. The same heat is often felt just before a thunder-storm, and we may consider that the same cause is acting in both these cases.

Clouds.

The clouds have the general motion that they always have in the neighborhood of an extensive storm. This would seem an exceedingly important consideration, and would show that the conditions leading up to the tornado are the same as are present at innumerable times when there are no serious outbreaks. A beginning in a study of these conditions has already been made (*Journal of the Franklin Institute*, July, 1888, p. 48). In that investigation it was learned that near the centre of the general storm, the clouds moved mostly with the surface winds, from right to left, or counter-clockwise, and if they had any other direction it was simply a slight turning toward the east in the line of the general flow of the upper current. This fact was also ascertained by Hildebrandsson in Denmark, though the storms there may have slightly different characteristics from the proximity of the ocean. A score of tornado regions have shown this tendency. It will suffice to give here illustrations from three tornadoes which have been specially studied; and a fourth will be described later, in connection with the Louisville tornado.

Washington Court-House, O.

This place was visited Sept. 8, 1885. The general storm was central in southern Wisconsin, and the cloud-movements were as follows: from south-west at Dubuque, Davenport, Keokuk, Springfield (Ill.), Chicago, Indianapolis, Louisville, Nashville, Cincinnati, Columbus, and Sandusky; from south at Cairo, Toledo, Pittsburgh, and Erie; from south-east at Detroit, Cleveland, and Buffalo. In all this region there was not a single cloud-movement from the north-west or even west. On April 14, 1886, St. Cloud and Sauk Rapids, Minn., were injured by a tornado. The general storm was central in north west Dakota, and the cloud-motions were as follows: from south-west at North Platte, Des Moines, and Valentine; from south at Deadwood, Omaha, Leavenworth, Springfield (Mo.), Springfield (Ill.), Cairo, St. Louis, Dubuque, and La Crosse; from south-east at Bismarck, Moorhead, St. Vincent, and St. Paul. Here not only are there no west or north-west cloud-movements, but also in the immediate tornado region the movement is markedly from the south-east.

Mount Vernon, Ill.

This tornado occurred Feb. 19, 1888. The general storm was central in eastern Iowa, and clouds were moving as follows: from south-west at Keokuk, Memphis, and Louisville; from south at Springfield (Ill.), Chicago, Indianapolis, Toledo, St. Louis, Cairo, and Chattanooga; from south east at Milwaukee and Davenport.

This is an exceedingly important fact, as will be seen later on, and seems to be abundantly established.

Distribution of Tornadoes.

Rarely do these violent outbursts occur singly. In any region favorable for tornado development, two hundred to four hundred miles to the south-east of the centre of the general storm, we shall find, after the hottest part of the day, a line of tornadoes occurring one after the other, and moving almost invariably to the north-east. An hour or so later, another line will be found parallel to the first, and about fifty miles south-east of the first In some cases, as in the great Louisville tornado, there may be six or even more of these lines. They are entirely independent of each other, and very clear cut, there being no destruction between. The last line may not begin until 8.30 P.M., more than five hours after the hottest part of the day.

Velocity.

A marked feature of these outbursts is their most rapid translation across the earth for two hundred and sometimes three hundred miles. The speed is rarely under forty miles per hour, and there have been well-authenticated cases where it has reached over eighty miles per hour, notably in the Louisville tornado. It should be noted that the general storm, while travelling in the same direction, attains a velocity only half as great; for example, at Louisville it was thirty-eight miles per hour, which is very much above the average.

Thunder-Storms.

All through this region thunder-storms are very numerous, and are an invariable accompaniment. Sometimes vivid displays of lightning occur in the tornado, and undoubtedly these would be observed much oftener were not the beholder awe struck by the terror-inspiring phenomenon. A careful study of thunder-storms, occurring at any time, has shown that they have a velocity double that of the fostering general storm, and are always found within the region six hundred miles to the south-east. It has come to be generally admitted that tornadoes and thunder-storms are analogous phenomena, and that the former are an intensification of the latter. If this be true, we see at once what an enormous advance has been made. We do not need to wait for the full-fledged monster, whose very appearance drives away all thought save flight for safety, but we may study it in its gentler moods.

Lurid Sky.

Let us take a slightly closer view. Almost the first warning after the appearance of dark and threatening clouds in the west, as in a thunder-storm, is a peculiar lurid or greenish tinge in the sky from the south to the west. This "tornado-sky" is a characteristic feature, and it is believed that to those who have studied the phenomenon this will always serve as a warning for the more serious results which soon follow.

Two Clouds.

Many observers have seen very black clouds,—one to the west or north-west, and the other to the south-west,—which seem to rapidly advance, and, when they meet, to form the tornado. This is believed to be in the nature of a perspective effect, and the clouds to be an immediate accompaniment of the tornado. A full explanation of this phenomenon will be given later.

Cloud of Dust.

It is a very significant fact that in very many cases the funnel-cloud, which has a sharp outline and should be the

first thing seen at a long distance, is not seen till it is just upon the observer. This is due to an enormous cloud of dust directly in front of the tornado, rising oftentimes to a great height. Such a cloud of dust has often been seen in thunder-storms in regions never visited by the tornado. It is produced by a tremendous outrush of air from the tornado, and indicates almost conclusively that there is a plenum, and not a vacuum, at the centre. That this outrush of air could be produced by the fall of raindrops carrying air with them, has been proved impossible. The calculation showed that the heaviest rainfall that ever occurred could not produce a velocity greater than one-tenth of a mile per hour, which is practically inappreciable (see *American Meteorological Journal*, September, 1887, pp. 206–211).

Loud Roar.

As the tornado approaches, an indescribable roar is heard. It has been likened to the bellowing of a million mad bulls, the roar of ten thousand trains of cars, etc. This is certainly a most significant fact, and one that has not been sufficiently dwelt upon. The roar was analyzed by one observer, and was found to be precisely similar to a continuous roar or rumble of thunder. There is no question but that it is a marked electrical phenomenon, though just the manner of its production demands most careful investigation. Another explanation will be given under another heading.

The Tornado.

These warning sights and sounds are quickly followed by the funnel-cloud itself, like a great balloon sweeping its neck round and round with terrible fury, and destroying every thing in its path. It has been likened to an enormous elephant's trunk. It whirls with almost incredible velocity in its mad career, with a motion back and forth, sometimes leaving the earth a moment, then bounding back to continue its dire havoc. The whole destruction occupies but three or four minutes; but in that time the stanchest houses of brick or stone have been demolished, and sorrow and ruin have been spread all along its path.

Clearing Sky.

The exceedingly circumscribed nature of the tornado is shown by the blue sky or stars appearing a few minutes after it has passed. The wind turns to the south again, every thing quiets down, and no one would think that a terrible catastrophe had occurred, except for the devastation that is all about, and the cries of the unfortunates.

Width of Path.

The width of the destructive path has been given as high as a mile, but this is undoubtedly due to an erroneous estimation of the real track. There are always south-westerly indraughts which produce more or less destruction on the south side, but these should be carefully distinguished from the track proper or the region of greatest destruction. This may reach a thousand feet, though its width is rarely over two hundred or three hundred feet.

Distribution of Débris.

In the central line of the tornado all timbers and trees are strewed in the same direction, as though a mighty river had passed and left them behind. Where trees are not completely uprooted on either side of the path, they all lie with their tops inclined to the central line; that is, on the south side they are toppled toward the north-east, while on the north side toward the south-east. This appearance or action may be due to the indraughts, and should be carefully distinguished from the effect of the tornado proper. The same remark may be made as to the distribution of fences and light objects on either side of the path.

Velocity of the Destructive Wind.

This should not be confused with the onward motion of the tornado, which is comparatively slow. The whirling of the cloud is the cause of the great destruction. This has been estimated as high as a thousand miles per hour; but such a velocity as that is highly problematical, and is due to erroneous assumptions. Probably the most accurate measurement of this velocity ever made was at Wallingford, Conn., on Aug. 9, 1878. Here the tornado blew off monuments in a cemetery without chipping either the upper or lower stone. In one case the stone was 2×2×4 feet in dimensions, and would have required a velocity of about two hundred and sixty miles per hour to blow it off.

Direction of Whirl.

This has been reported again and again as from right to left, "counter-clockwise;" and this has caused a notable modification of the old theory that the whirl in a tornado may be either way. It is probable that this unanimity of opinion is due to other causes than careful observations. The determination of the direction of a whirl is practically impossible, unless the observer is within a very short distance, as any one may see for himself in the whirls of a dusty street. The only possible way to determine the direction of the whirl is to be near enough to see the actual motion of the leaves and twigs upon the ground. If one looks at the whirling column, he can learn nothing positive. This question is by no means settled yet, and there are reasons for thinking the old theory correct.

Air-Pressure.

Until very recently it has been assumed that there is a partial vacuum at the tornado centre. It is admitted that in a thunder-storm the pressure rather suddenly rises, nearly a tenth of an inch oftentimes; and, if the tornado is analogous, we may reason that the pressure rises in that. Professor Davis, in the *American Meteorological Journal* (February, 1890, p. 452), says that this fails to take account of the causes of increased pressure in thunder-storms, and of the decreased pressure in tornadoes. This seems a remarkable argument. Where does the severest thunder-storm and greatest increase of pressure leave off, and the tornado, with an absolutely reversed pressure, begin? The strongest argument that has ever been advanced has been the seeming bursting or exploding of houses in a tornado. This could have been occasioned by a sudden blow on any side of the house, whereby the pressure inside would be increased, and the walls thrown outward. This view was advanced some years ago, and has received a recent most remarkable confirmation in the report of a destructive storm at St. Louis, Jan. 12, 1890. The observer, a very intelligent man, writes, "In all cases of falling walls, it was noted that they fell outwards. In all cases of houses which at first sight appeared to have exploded, it was ascertained that immediately

before or at the time the walls gave way, the wind forced in some portion of the south wall, as a window or door, thus probably accounting for the outward pressure on other walls." The most important observation in connection with these exploded houses, however, was the record of a barograph, which just at this moment showed a remarkable *rise* in pressure. In the Louisville tornado, also, a barograph within a mile or two of the track showed first a slight sudden fall and recovery, due probably to the wind, and afterward the tornado-rise, as at St. Louis. This evidence is cumulative; and when we consider that the wind blows away from the tornado in front, and that of two similar objects standing side by side, one very heavy and the other light, the former is swept away while the other remains untouched, the evidence seems almost conclusive that there is no diminution of pressure in a tornado. It is probable that there is no fact in the whole observation or make-up of a tornado of such extreme importance as this, and it will be touched upon again in an explanation of a seeming rush of objects into the funnel. It will undoubtedly be thought, that, after all that has preceded, we really know very little of the mechanism of a tornado. This is true; but, if we have advanced far enough to be able to say what it is not, we may congratulate ourselves, and feel that our labor has not been entirely in vain. H. A. HAZEN.

THE MANUFACTURE OF OZONE.

A COMPANY has been formed in Berlin for supplying the necessary plant for the conversion of oxygen into ozone on a larger scale than has hitherto been attempted, and the idea is gaining favor in many quarters that ozone can be economically employed for many sanitary purposes, says London *Industries.* Steps are being taken for extending the operations of the company to New York and London, as they have secured the patent rights for certain improvements in the electrical production of ozone from atmospheric oxygen in most countries. The Berlin doctors have repeatedly employed ozone, with very satisfactory results, in individual cases, and recently the company above alluded to have placed on the market a so-called ozonized water, which is stated to be a solution of ozone in that liquid. It is, however, well known that ozone is not very soluble in water, and that it readily undergoes decomposition, forming hydrogen peroxide and oxygen. The commercial name for this new antiseptic is "antibacterikon," and it possesses remarkable oxidizing properties. When added to water containing any appreciable quantity of living organic matter in the dark, it at once causes a phosphorescent appearance, and the organisms are completely destroyed in a short time. Such ozonized water is stated to have a faint metallic taste, and is used for producing sterilized water, or sterilized fluids, for bacteriological research. At present the ozone is manufactured from oxygen obtained by heating pyrolusite in the old way; but of course, with a greater demand, the Brin's oxygen process could be employed. The conversion takes place in a Siemens tube, or series of Siemens tubes, which do not differ essentially from the orignal form of ozonizer. The electric discharge is made by a Ruhmkorf coil in the usual way, or an accumulator is employed and a mercury contact breaker. It is proposed that ozone should be produced in this manner in large manufactories, and thus contribute to their sanitary improvement. Dr. Förster of Berlin has recently urged the importance of endeavoring to supply a small quantity of ozone to the air of towns and other thickly populated districts, and the company believe that their system can be worked economically and at the same time produce very satisfactory results from a hygienic point of view. It has been pointed out that many epidemics, e.g., influenza, appear to take place at those seasons of the year when the atmospheric ozone is at a minimum, and it is thus argued that an artificial supply of this gaseous oxidizing agent would possibly prevent, and at any rate considerably modify, such outbreaks of disease.

THE OIL-FIELDS IN NEW ZEALAND.

The New Zealand Government attach a great deal of importance to the indications of extensive oil fields in Taranaki. The report of the inspecting engineer of the mines department, who has made a special examination of the territory at the instance of the government, says the *Australasian Journal of Commerce*, is strongly confirmatory of the presence of mineral oil. In the neighborhood of New Plymouth there are many surface indications, particularly along the shore, gathered under bowlders and floating on the water. Farther inland the water gathering in the wells which are sunk is found to have a strong taste and smell of petroleum, so as to be quite unfit for drinking. If all these indications should turn out to be well founded, and oil be discovered in paying quantities, the find will be of great value to New Zealand in many ways, the most important of which, perhaps, is as a fuel for smelting-purposes. Vast quantities of iron sand — according to the "New Zealand Year Book," a sand formed by the grinding-up of iron ore by the action of the waves — lie for hundreds of miles along the coast of the North Island; and this pulverized ore is practically worthless at present from lack of a sufficiently cheap fuel to smelt it. Should oil be obtained in such close proximity to these supplies of ground iron ore, a new and important industry may be developed into large proportions. Such, at least, is the hope of those who are investigating the matter on the spot. Independent of this, however, a new and extensive oil-field in the South Pacific would speedily become the source of supply for the whole of Australasia and the entire East. New Zealand would become an active competitor with the Baku wells, even if the Russian supply should falsify present indications of failure, and continue. The proximity of the supposed New Zealand field to the coast and port of New Plymouth would give it an advantage over both Russian and American oils in lessening the cost of both crude and refined on shipboard.

THE USE OF OIL.

ATTENTION is called by the United States Hydrographic Office to the fact that the Chamber of Commerce of Bordeaux, France, has offered a series of prizes in order to induce masters and officers of vessels to make thorough trial of the use of oil at sea, especially as regards the best way to use it and the practical benefits to be derived from such use. There are three sets of prizes, each set consisting of a first prize of 200 francs ($40) and a second prize of 100 francs ($20), to be awarded for the best reports received by Jan. 31, 1891, based upon actual experience. Programmes for the three competitions are as follows: —

1. STEAMERS.—Trials of the use of oil must be made under various conditions, particularly the following: heavy head sea, heavy quartering sea, towing in bad weather, engine or rudder disabled.

2. SAILING-VESSELS.—Trials to be made under various conditions, but especially when crowding sail with a strong wind abeam.

There must also be considered, in connection with the first and second competitions, the use of oil in lowering and hoisting boats, taking a pilot aboard, saving life at sea, riding out a gale in an unprotected anchorage, loading and unloading in a seaway, wearing and tacking ship.

3. FISHING-VESSELS, PILOT-BOATS, YACHTS, LIFEBOATS, etc.—Experiments in using oil when crossing bars, landing in a surf, etc.

GENERAL RULES FOR THE COMPETITIONS.—Each experiment must be described fully as soon as possible, and an account inserted, under the proper date, in the vessel's log book. In the case of fishing-vessels and pilot-boats, however, this may be dispensed with; but upon return to port a full statement must be made to the maritime authorities. Full details must be given regarding the direction and force of the wind, the state of the sea,

and the condition and speed of the vessel. There must be stated, also, the position and character of the apparatus for the use of oil, the amount of oil used per hour, and the kind of oil used, according to the temperature of the water.

As stated above, each of these three competitions closes Jan. 31, 1891, by which time all reports must have been handed in to the Chamber of Commerce, Bordeaux, France. The published programme makes no specifications as to the nationality of the competitors or the language to be used, and the competition is therefore understood to be open to any one, subject only to the rules stated above, which should be carefully adhered to. The Hydrographic Office will gladly receive and forward any reports offered in competition, whether sent to Washington or handed in at any branch hydrographic office.

It will be noticed that it is the desire of the Bordeaux Chamber of Commerce to encourage the use of oil by masters of vessels, and the prizes are offered with this end in view. Reports are wanted regarding actual trials undertaken and reported as described above.

NOTES AND NEWS.

A PIECE of crown glass forty inches in diameter and two inches and a half thick has been shipped from Paris to Clark Brothers of Cambridge, Mass. It is intended for a forty-inch object-glass of a telescope for the University of Southern California, exceeding in size the Lick telescope. About two years' careful labor will be required to convert the rough glass into a finished lens.

— At a recent meeting of the American Meteorological Society in Washington, resolutions were adopted favoring the recognition of the eminent services of American electricians by perpetuating their names in the nomenclature of electrical units. In the names of units thus far adopted the names of Americans, such as Franklin and Joseph Henry, have not been recognized. It is proposed, as a beginning, that at the electrical conference to be held in this country in 1892 the name of Henry, or some modification of it, be given to the unit of self induction, he having been the first to investigate that phenomenon, and his investigations having been more complete than those of other electricians before or since.

—A special aim of those connected with the Wharton School of Finance and Economy at the University of Pennsylvania has been for some time past the securing of a complete series of the laws of all countries. Such an undertaking it requires scores of years to complete. In this department, however, the Wharton School library has already made a good beginning. There has been presented to it a set of the Prussian Statutes at large, including the years 1806 to 1886. There are to be found all the laws of the new German Empire, from its creation in 1866 down to 1886; a collection of works on German constitutional and administrative laws; and a work upon the public administration of Austria, by Ulbrich.

—Professor Edmund J. James, of the University of Pennsylvania, will present a paper before the American Academy of Political and Social Science on a new system of passenger fares. He will show that the railways of the United States, by their failure to adopt a reasonable and simple system of tariffs for passenger traffic, have prevented that development of this branch of their business which could have been expected, considering the natural tendency of Americans to travel. England has, relative to her population, nearly four times as many passengers on the railroads as the United States, though the character of the American people gives good reason to suppose that we should naturally have twice as many as England.

— The committee having in charge the interests, in this country, of the forthcoming Jamaica International Exhibition are working vigorously to insure a good representation of our manufactures and products. They have secured specially low freight rates for exhibits, and have made arrangements whereby exhibition goods will be returned free of freight from Jamaica, by the line on which they were shipped, on production of the outward bill of lading. Space will be reserved for empty cases, and all exhibits will be conveyed from the wharf to the building free of charge. Exhibiters of apparatus requiring the use of water, gas, or steam, should state, on applying for admission, the quantity considered necessary. Those who wish to show machinery in motion must state the rate of speed at which the machine is to be driven. Motive power to the extent of 100 horse-power will be provided by the commissioners free of charge, but all counter-shafting, pulleys, and connections with main steam-pipe, must be provided by the exhibiters. The motive power will be under the direct control of the commissioners. Applications for space can be sent to the committee up to June 12, or to Kingston up to July 1, and goods will be received in this city from Aug. 20 to Nov. 15, 1890. The despatch, transmission, unpacking, removal of empty cases, fitting up and erection of exhibits, must be done by private agents. A list of those prepared to act as such, both here and through their representatives in Kingston, will be furnished upon application to the committee.

— The latest of the Johns Hopkins University Studies in Historical and Political Science is a pamphlet on "Spanish Colonization in the South-west," by Frank W. Blackmar. The subject of which it treats is much less familiar to the mass of historical readers than the English and French colonization of the Atlantic coast and the Mississippi valley, and yet in its bearings on the history and the legal systems of California and New Mexico it is of great importance. Hence Mr. Blackmar's monograph will be of use. He begins with a general account of Spanish policy, with a somewhat lengthy comparison between Spanish and Roman colonies, which has little bearing on the subject in hand; but after this introductory matter he gives a careful and interesting description of the different kinds of colonies established by the Spaniards in the South west, with some account of the minute laws and regulations framed by the home authorities for their government. The most interesting chapter is that on the mission system, which tells the story of the settlements of converted Indians under the control of the priests, which formed so marked and unique a feature of Spanish control in the South-west. Altogether this is one of the best monographs of the series to which it belongs.

— We have received several numbers of "The Humboldt Library," a series of pamphlets issued by the Humboldt Publishing Company of this city. They are reprints of foreign works in clear type and on good paper, and are sold at the low price of fifteen cents each; double numbers, thirty cents. Some of those now before us, as, for instance, Mill's "Utilitarianism," are so old and familiar as to call for no remark; while others are of more recent composition. Mr. S. Laing's "Modern Science and Modern Thought," which is probably familiar to many of our readers, is an attempt to see how much of Christianity can be reconciled with physical science and historical criticism. It is written in a thoughtful and reverent spirit, but does not contain much but what is now the common property of minds that have been trained in scientific thought. Another of the pamphlets contains Mr. David G. Ritchie's essay on "Darwinism and Politics" and Professor Huxley's well-known paper on "Administrative Nihilism." Mr. Ritchie's work is chiefly a criticism of the doctrine of the "struggle for existence" as applied to social life. He, of course, admits the fact of such a struggle, but insists, in opposition to Spencer and his followers, that it is our duty to regulate it in accordance with reason and right, and that it is wrong to let the struggle proceed in human life and society in the same unmoral way as it does among the brutes. So far we agree with Mr. Ritchie, but we are sorry to have to add that his remedy for the ills of life is socialism. Professor Huxley's paper, as is well known, is an able argument for extended activity on the part of the State, but without any tendency of a socialistic character. Professor A. Schäffle's "Quintessence of Socialism," translated from the German, is a careful, and we think very correct, statement of the practical aims of the State socialists. It is written by an opponent of the system, but is eminently fair as well as thoroughly studied and carefully expressed, while the author's criticisms are pointed and sometimes profound. The work is well worth reading by all who are interested in the subject.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

For some time past there has been a tendency in our colleges and universities to select as their presidents men who have attained eminence in special lines of research. This is notably true in regard to the case of Presidents Jordan of Indiana, Schaffer of Iowa, and Adams of Cornell. Another name may now be added to the list. We refer to the recent selection by the regents of the University of Kansas of Professor F. H. Snow, Ph.D., as chancellor of that institution. Professor Snow was graduated at Williams College in 1862, and afterwards prepared to enter the Congregational ministry. He, however, soon showed a special interest in natural history, and was elected a member of the first faculty of the University of Kansas when it was organized, in 1866. For several years he taught a variety of branches, but as the institution grew in strength he was enabled to confine himself to a greater extent to the specialties in which he had the most interest. He has been an indefatigable collector throughout the Western States and Territories, paying special attention to entomology. In honor of his distinguished services to the State, the new natural-history building recently erected by the State was named "Snow Hall." He has not only carried on the work of instruction in his large classes at the university, but has found time to make careful investigation in various fields of biology, and to furnish much valuable material to current scientific literature. Though a specialist, he is not a narrow man, but is well informed on the topics of the day, especially those that attract the attention of the educational world. In all positions where executive ability is required, he has shown himself eminently fitted for the task. This appointment meets the hearty approval of the faculty of the university, and of the people of the State.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Recognition by Young Children.

One of the most obscure topics, as well as one of the most neglected, of modern psychology is that of recognition. The question, "Why is it that I recognize an image when it returns to my consciousness?" is usually passed over unobserved or intentionally omitted in our general treatises. Experiments, however, upon the question are forcing it upon our notice, thus doing a service which we are coming to expect from the new method wherever it is applied.

I have recently advanced a theory of recognition,[1] based both upon mental analysis and objective experiment,[2] according to which the feeling of familiarity called recognition arises from the re-instatement of the apperceptive or relational process of the earlier presentation. According to this theory, single unrelated homogeneous images (bell-stroke, pure color) would not be recognized, single complex images (human face) would be recognized only in the degree in which the complexity had impressed itself in the first perception, and clear recognition would arise only when the relations attentively discerned were clearly brought out in the reproduced state. A further result would be that images, when reproduced, would largely depend upon and re-enforce each other in producing the feeling of familiarity.

I have recently had an opportunity to test a little child six months and a half old, with these points in view, and the result was quite instructive. Her nurse, who had been with her continuously for five months, was absent for a period of three weeks, and on her return was instructed first to appear to the child simply in her usual dress, but to remain silent; then to withdraw from sight, but to speak as she had been accustomed to; and finally to appear and sing a nursery rhyme, which by special care the little girl had not been allowed to hear during the nurse's absence. The first result was that the child gazed in a questioning way upon the face, but showed no positive sign of recognition; yet the absence of positive fear and antipathy shown at first toward the substitute nurse indicated that the visual image was not entirely strange. Second, the tones of the nurse's voice were not at all recognized, as far as passive indications even of familiarity were concerned,—a result we would expect from the greater purity and simplicity of the auditory images. The third experiment was attended by complete and demonstrative recognition. The visual (face) and auditory (rhyme) images must have re-enforced one another, giving again the old established complex apperception of the nurse.

As to the ultimate meaning of recognition, we are quite in the dark: it is only its mental conditions that fall to the psychologist. On the view given above, it would seem to rest in the active side of our mental life, and to consist in the diminished expenditure (whatever that is) involved in the repetition of an act of attention.

This case also shows, as far as any individual case can, that images from different senses vary greatly in intensity in early child-life, that they are not well differentiated from one another, and that even at the very early age of six months special memories are becoming more or less permanent.

J. Mark Baldwin.

University of Toronto, April 23.

[1] Handbook of Psychology: Senses and Intellect (New York, Holt), pp. 176–178.

[2] Work of Lehmann, Philos. Studien, VI.

Whirlwinds.

IT was my fortune a few days since to see a small whirlwind at the distance of but a few rods. The wind at the time was from the west, and was cold, and somewhat gusty and variable. The whirl persisted for several minutes, dying down and increasing again. Its direction of rotation was from right to left. As it passed across a road, the dust was lifted to a height of about thirty feet, forming a pillar, which disappeared when the grass at the roadside was reached. The query that arose in my mind was as to the nature of the currents which produced this upward movement of the dust. Such movement has commonly been ascribed to the suction effect of an indraught towards the whirl which has been supposed to exist. But as the breeze continued to rise, I could not help but notice that dust was lifted equally high by the chilly wind at points where there was no evidence whatever of a whirl. Such lifting by a cold wind blowing straight along certainly could not have been due to an upward current produced by an indraught. Indeed, this lifting resembles precisely the movements of sand at the bottom of a stream beneath eddies formed by the varying force of the current, a phenomenon readily observed in clear water.

M. A. VEEDER.

Lyons, N.Y., April 23.

Effigy Mound in the Valley of the Big Sioux River, Iowa.

WHILE at Sioux Falls, S. Dak., in the latter part of last July, I took the opportunity to look up and survey a group of mounds and a fort that are located about sixteen miles south-east of that city, in the valley of the Big Sioux River. In 1885, I was informed by an engineer, that, in running a preliminary line for a railroad a few years previous, he had passed through a group of mounds in that locality, and that there was a large fort just south of them.

The group in question is in the western part of Lyon County, Io., a mile and a half west of Granite Station, on the Sioux Falls branch of the Burlington, Cedar Rapids, and Northern Railroad. The country bordering the river here is more or less rolling and broken, especially on the western side. On the east side, at the Burlington crossing, there is a plateau which is from twenty-five to fifty feet in height above the river, and slopes to the southward. Bloody Run flows around the north end, and empties into the river near by.

On this plateau, to the north of the railroad, there are a hundred and five mounds, ranging from a foot to five feet and a half in height. Nearly all of them are common round burial-mounds; but among them are a few that are elliptical in shape, and there is also one animal effigy. The latter is 55½ feet in greatest length, and the body is 2½ feet in height. While apparently rude in design, the outline on the ground is regular, and the surface of the mound is smooth and symmetrical. There are many imitative mounds in the effigy region of Wisconsin that are no better in outline than this one. The peculiarity of this effigy consists in its isolated position, there being no others known to exist in the intermediate space between it and those to the eastward in the Mississippi valley, a distance of fully 270 miles. It is also the first mound of this class discovered within the limits of the Missouri River basin; and its position, therefore, is analogous to those of Ohio and Kentucky, yet the isolation is not so great.

There is no system in the arrangement of the mounds, they being located in a haphazard way, here and there, as fancy dictated. Scattered among them, principally near the centre of the group, are a large number of that kind of stone monuments which, in a published article on the subject, I have called "bowlder outlines." Some of these extend up on the sides of the mounds, and in one case one of the larger mounds is surrounded by a circle of bowlders. These instances denote a later occupancy, or at least that they were placed there after the mounds were constructed.

Just south of this group, on the south side of the railroad-track which separates them, there is a large fort or enclosure, of an irregular elliptical shape, which is the largest one known to exist north-west of Ohio, except "Aztalan," Wisconsin. Its inside area is about fifteen acres, and the walls at the present time are from one to two feet in height, with an average width of eighteen feet. They were probably palisaded when in use. This fort was also built after the mounds were constructed, for at one point the wall intersects a mound which is three feet and a half in height. That the mound was built first, is evident from the fact that the wall was raised in height at the junction, in order to surmount and pass over it without abruptness. Within and around the fort there are seven mounds, and between the fort and the railroad there were several others which have been destroyed by cultivation.

There is plenty of evidence to show that the plateau was occupied as a place of residence at some period in the past. Burned stone and chert flakes are especially numerous, while occasionally stone axes, celts, grooved hammers, arrow-heads, and ornaments of stone and copper, are found. Fragments of steatite vessels and pottery composed of shell and clay, and pulverized stone and clay, are also quite plentiful. Occasionally ornaments, beads, and tubes made of sea-shells have been found in some of the mounds in this and other groups in the vicinity.

This locality was visited in November, 1886, by Professor Frederick Starr of Cedar Rapids, Io., on which occasion he excavated four mounds, two of which were situated on the south side of the railroad track. He described their contents in the *American Antiquarian* for November, 1887 (vol. ix.). In his article he mentioned the existence of the "stone circles," but no reference was

made to the fort or the effigy. The mounds in which his excavations were made were within three hundred feet of the north-east wall of the enclosure, which was certainly in plain view; and it is strange that it should have been overlooked by him.

It is evident that this point was at one time a site of the mound-builders, and that later they were compelled to fortify themselves against some hostile neighbor. The large amount of village *débris* scattered over the plateau, the great number of burial-mounds in that vicinity, together with the size of the fort, indicate also that the inhabitants were quite numerous.

T. H. LEWIS.

St. Paul, Minn., April 23.

Gorse or Furze.

THE following is a copy of an extract from a letter from the United States commissioner of agriculture, dated March 28, 1890, acknowledging the receipt of a specimen of gorse or furze discovered by me growing near Hampton, Va., and stating, that, as far as that department is aware, this is the first instance known of its presence in this country: "Your note of the 26th inst., and the small box of specimens of the European furze (*Ulex Europœus*), received. This plant was probably introduced into the grounds of the Fort [Fort Monroe, Va.] many years ago, and does not seem likely to spread so as to become particularly obnoxious to agriculture. I am not aware that it has been observed in any other part of this country in a wild state."

I should be glad to know whether it has ever been seen in the United States before.

J. R. MCGINNIS.

Fort Monroe, Va., April 23.

Lightning-Discharge.

ON Feb. 24, 1890, at 8.45 P.M., there was a case of lightning-discharge here which is perhaps worthy of notice. The building struck was Newcomb Hall, the property of Washington and Lee University. It is a three-story brick building covered with tin, having seven downfalls not connected with the earth, and having no lightning-rods. On top of the building, for lighting and ventilating purposes, is a square cupola. This has wooden corner-posts six or eight inches square; its walls are almost entirely glass; its roof is tin. The distance between the tin on the roof of the cupola and the nearest tin in connection with that on the roof of the building is about four feet. The lightning struck the roof of the cupola, passed down one of the corner-posts to the roof of the main building, and then down five of the seven downfalls to the ground. The roof of the cupola is "hipped;" and just under each of the four eaves, in a horizontal position, are two planks, each about ten inches wide. The four planks adjacent to the post struck were thrown entirely off. The tin on the roof just above the post was thrown back, uncovering about a square yard of the roof. The post itself was torn to splinters at the top. All but five panes of glass, out of a total of about fifty in the walls of the cupola, were shattered. Nearly all of the glass fell outside, and the tin all over the roof of the cupola showed signs of having been pushed upwards. When the discharge left the post, it divided, part of it going to the tin on the lower part of the post and thence to the roof, and part of it to a strip of tin on the window-sill. This strip of tin was composed of five or six pieces tacked together, not soldered. Nearly all of these joints were separated, about two inches of the tin being bent over in the direction in which the discharge travelled, from above down. This part of the discharge reached the tin on an adjacent post of the cupola, and thence passed down to the roof. One sharp corner of tin was burnt off, leaving a burnt curved edge about an inch in length. The two posts and the tin on them were blackened at the point where the discharge reached the tin. There was no further trace of the discharge until it reached the ground. As already stated, it passed down five of the downfalls, but apparently much the largest part passed down one. At this point, for a distance of ten or twelve feet, the ground was as much turned up as it would have been by a large plough. Some of the earth was thrown to a distance of twenty or thirty yards. The clerk of the faculty has his office in a corner room on the ground floor next to this downfall. He found the steel pens in a box on his desk so strongly magnetized that one pen could support four or five others. The pens in the penholders were also magnetized. Two panes of glass were broken in this room. Fifteen or twenty feet from this corner of the building is a water-pipe, wrought iron, one inch in diameter. This pipe at a short distance connects with a cast-iron pipe whose internal diameter is two inches; this, in turn, connects with the system of pipes supplying the town of Lexington with water. The two-inch cast-iron pipe was found the next day to be leaking badly in seven places within a few hundred yards of Newcomb Hall. There seems to be no reason to doubt that the discharge in some way burst the pipe. The leak nearest the building was over fifty yards away. There were no indications of melting. One hole in the pipe was an inch wide and about three inches long, a piece of that size apparently having been knocked out. The pipe is very old and rotten, being almost as soft as graphite. The water in the pipe is under a pressure of about a hundred feet of water. The only other case with which I am acquainted, where water-pipes were damaged by lightning, is that given by Secchi in the *Telegraphic Journal and Electrical Review* (London, 1872, translated from *Les Mondes*). In that case the pipe was broken, and some lead melted, at the point where the discharge first reached the pipe.

The report at the time of the discharge may be described as terrific; it was the more so, because it was the very first indication of any thing like a thunder-storm. There was no lightning before this discharge, and not much after it.

Besides the facts given above, there were some other reports concerning the discharge which may be of interest. Having heard that some persons saw what seemed to be a ball of lightning, I made as careful inquiry as I could concerning it, with the following result:—

1. A student was sitting before an unshaded window, from the roof of which Newcomb Hall is visible, and less than two hundred yards from it. Attracted by a bright flash, he looked up, and reports that he saw a ball of fire, in size and appearance about like a Roman candle, slowly descending on the building. It disappeared about the time it reached the roof, when the explosion was heard. He at once reported what he saw to his uncle, the president of the university, saying he thought the building was struck. They then looked out for signs of fire, but saw nothing.

2. In another direction, and at a greater distance, is a house from which Newcomb Hall is plainly visible from top to bottom. A lady in this house, sitting before a window, had her attention attracted by a flash, looked up, and saw a shower of fire-balls falling on Newcomb Hall. On careful inquiry, I learned that she did not see these balls above the top of the building: they seemed to be very nearly or quite on it when she saw them. She possibly saw what was concealed by the building from the student. This lady told me that some young ladies in another room in her house saw what she herself saw: I did not talk with them about it.

3. About a quarter of a mile from Newcomb Hall, on Main Street, stands the Court-House, a short distance back from the street. Mr. B. was standing in the door of the Court-House, looking out on Main Street in the direction of Newcomb Hall. He first heard a sharp, quick noise like that produced by slapping the hands together, which seemed to come from his telephone. He then saw across the street from him, at a height of about fifteen feet from the ground, a ball about the size of a large orange just luminous enough to be plainly visible, followed by a brighter trail ten feet long. This ball moved horizontally and slowly up the street about twenty yards, and then burst with the brightest flash Mr. B. ever saw, and a terrible noise. This noise was immediately followed by another of like character in the direction of the university buildings. Mr. B., I should state, is a man of the very highest character, and his word would be taken without question by all who know him. He is calm and unimaginative. I omitted to mention that his face felt as if it had been hit with sand, and that there was an unpleasant sensation for some hours afterwards. It was rainy, and Mr. B. saw no one on the street; but I learned that three negroes were standing on the sidewalk nearly under the point where Mr. B. saw the globe burst. As they were not moving, Mr. B. might easily miss seeing them. I questioned two of these negroes. They were standing facing each other, one looking up the street, and the other down. Each of them thought he saw a ball of fire fall in the street in the direction in which he was looking, and at a distance of from fifty to one hundred yards away. Neither of them knew any thing of the explosion reported by Mr. B., although it was almost immediately over their heads, and only twenty or thirty feet away. Newcomb Hall could not be seen by either Mr. B. or the negroes.

I give the facts as I gathered them, without comment. There is no reason to think that any of the persons questioned failed to give a substantially correct report of the impressions made on their senses. S. T. MORELAND.

Washington and Lee University, Lexington, Va., April 26.

Sunspots and Tornadoes.

THE following figures show a slight parallel between the frequency of tornadoes in the United States for the last twelve years, and the sunspot curve of the eleven-year cycle. The solar data employed have been obtained from Professor Rudolph Wolf (Zurich), the well-known sunspot specialist. The tornado numbers are supplied by Lieut. John P. Finley of the United States Signal Service, but should be regarded as only approximate, and subject to more or less change, for these reasons: (1) better facilities now exist for obtaining news of tornadoes than existed fifteen or twenty years ago, owing to the special activity of the United States service, the organization of State weather bureaus, and the co-operation of the press; and (2) west of the Mississippi the coun-

try is more densely settled than it was one or two decades ago, and many local storms would now be observed where they could not have been seen and reported some years ago. Thus, the average number of tornadoes reported annually for the last ten years is 159, while for the previous ten years it was only 45. For this reason, it would not be safe to compare the spots with any former cycle. In order to make the figures for 1878–89 fairly comparable, those for the first three or four years may be raised slightly, perhaps; and those for the last two may be increased 2 or 3 per cent by belated returns. The annual average, then, would be more than 160 (say 170), with minima at the ends of the series, and a maximum near the centre:—

Year.	Spots.	Tornadoes.	Year.	Spots.	Tornadoes.
1878	3.4	77	1884	63.3	216
1879	6.0	88	1885	50.3	139
1880	31.6	141	1886	25.7	290
1881	54.1	113	1887	13.1	178
1882	59.3	90	1888	6.7	122
1883	62.8	167	1889	6.1	129

Another curious fact is that the greatest number of tornadoes reported upon one day, according to Finley, was 60, on Feb. 19, 1884. Wolf's relative number for January, 1884 (9[illegible].1), is the largest for any month during this whole cycle, except April, 1882 (97.0); but the average for the six or seven months beginning with October, 1883, is much greater than for any similar period in 1882. Tacchini (says *Nature*, July 1, 1886, p. 194) fixes the height of solar excitement in February, 1884; but Professor P. M. Garibaldi of Genoa quotes Tacchini as placing the maximum in May, 1884. The maximum of protuberances found by Tacchini (*Nature*) was in March, 1884, though Garibaldi says June–August, 1884. At the Royal Observatory, Greenwich, the rotation-period (27 days) containing the largest daily average spottedness in twelve years. began July 4, 1883, when it was 2,037 millionths of the sun's visible hemisphere; but the best two-period exhibit was from Dec. 14, 1883, to Feb. 7, 1884, when the daily mean was 1,817 millionths. The greatest facular displays recorded in the Greenwich "Results" were in the rotation-periods beginning Dec. 14, 1883 (3,151 millionths) and Feb. 7, 1884 (3,467 millionths). Garibaldi, at the Royal University, Genoa, recorded the greatest magnetic variation (in the needle's daily swing) in April–July, 1884, and from August, 1885, to April, 1886. At Toronto, the biggest magnetic storms of the maximum stage of this last sunspot cycle occurred in November, 1882, September, October, November, 1884, and March, 1886. During the first seven months of 1884, at Toronto, the magnetic perturbations were few and slight.

The general yearly parallel between spots and tornadoes is far from proving any relation between the phenomena; and the correspondence between the maxima of spots, protuberances, magnetic variations, magnetic storms, and tornadoes is not very close. Yet the comparison here made is not without interest.

JAMES P. HALL.

Brooklyn, N.Y., May 1.

BOOK-REVIEWS.

Graphics, or the Art of Calculation by Drawing Lines. By ROBERT H. SMITH. Part I. London and New York, Longmans, Greene, & Co. 8°.

THIS work treats of graphics as applied especially to mechanical engineering. The volume before us is but the first part of the complete treatise, and deals mainly with the analysis of stresses in engineering structures. It is accompanied by an atlas containing twenty-nine plates and ninety-five diagrams, the text and the diagrams being each essential to the better interpretation and ready comprehension of the other. The second part of the work, which it is hoped will soon be published, will deal mainly with synthetic problems, aiming more at the design than the analysis of structures and machines.

The department or branch of descriptive geometry dealt with in this work, the "art of calculation by drawing lines," has assumed considerable importance, so that Professor Smith's scientific treatise on the subject is as timely as it is practical and comprehensive. The graphic method of computation, of course, has limitations in many directions, being less useful in simple cases than arithmetical and algebraic methods; but the method once thoroughly mastered, and its scope and limitations clearly understood, it will enable those who have a knowledge of elementary mechanics to utilize that knowledge to better advantage and with a greater degree of thoroughness, and to apply it to many of the every-day problems of engineering science without the aid of the more complicated portions of algebraic and trigonometrical mathematics or of the differential and integral calculus. Wherever the method is applicable, its use will result in a saving of mental fatigue, as it possesses great simplicity in many of its applications, leaves but little opportunity for the accumulation of gross errors, and is in itself a test of its own accuracy.

The work opens with a glossary of special terms and symbols, some of which are new and possessed of advantages in the matter of conciseness and precision. The introductory chapter presents clearly and with evident impartiality the advantages as well as the disadvantages of the method, and gives a brief sketch of the theoretical development of the subject. This is followed by a chapter on the instruments needed in the accurate working-out of the method; after which follow in order chapters on graph-arithmetic, graph-algebra, graph-trigonometry and mensuration, combined multiplication and summation, moments of parallel vectors, vector and rotor addition, locor addition and moments of locors and of rotors, the kinematics of mechanisms, flat static structures without beam links, flat static structures containing beam links, and solid static structures. The diagrams in the accompanying atlas are neatly engraved, and clearly printed on heavy plate paper.

AMONG THE PUBLISHERS.

THE issue of *Harper's Weekly* for April 26 devotes considerable space to the Stanley-Emin relief expedition. The article, which is copiously illustrated, gives the whole history of the expedition.

—A cheap edition, limited to a hundred thousand copies, of "Tom Brown's School-Days," is announced by Macmillan & Co., uniform in style with their paper-covered editions of Charles Kingsley's novels, of which something over a million copies have been sold in the past six months.

—One of the literary sensations of the winter in Paris was Camille Flammarion's astronomical romance, "Uranie," of which the Cassell Publishing Company are the American publishers. Up to the present time, M. Flammarion has been known as an astronomer, but now he has become a popular romancer. Mrs. Mary J. Serrano, translator of "Marie Bashkirtseff: The Journal of a Young Artist," has put M. Flammarion's French into English.

—In *Garden and Forest* for last week, Mr. H. H. Hunnewell, whose gardens at Wellesley, Mass., have been famous for a generation throughout the country, writes of rhododendrons and their culture; Professor Greene continues his notes on the shrubs of California; and the concluding portion of the review of Dr. Mayr's great work on the forests of North America is given. "The Woods in Spring," "Wild Plants under Cultivation," and "Hardy Plants for Cut Flowers," are titles of other articles. A road in Sherwood Forest is the subject of one illustration, and there is also a picture of a giant *Cattleya*.

—Messrs. Ginn & Co. announce as in press "Political Science and Comparative Constitutional Law" (two volumes), by J. W. Burgess, professor of constitutional and international law and history in Columbia College. In these two volumes Professor Burgess sets forth the general principles of modern political science and constitutional law. The State, as sovereign organization of the Nation, is sharply distinguished from the government. Government, to the author, is but one of the means through which the State attains its ends. The other means is liberty. The first volume treats of the Nation and the State as concepts of

political science. The formation of the Constitution, also, is regarded and treated as a political, not a legal process. Under the head of "Constitutional Law," the author describes the organization of liberty and of government. The latter topic occupies the entire second volume. The typical constitutions selected for comparison are those of France, Germany, England, and the United States.

— Treason, treason! Let us shout it before it may be too late. Here is Agnes Repplier writing in the May *Atlantic*, "The woman who goes to a Browning society when she would prefer cards and conversation; who sits, perplexed and doubtful, through a performance of 'A Doll's House' when 'Little Lord Fauntleroy' represents her dramatic preference; who reads Matthew Arnold and Tourguéneff, and now and then Mr. Pater, when she really enjoys Owen Meredith and Bootles's 'Baby and the Dutchess,' — pays a heavy price for her enviable reputation." She also makes a plea for the people who resemble that "unfortunate young woman who for years concealed in her bosom the terrible fact that she did not think 'John Gilpin' funny." The article, which is entitled "Literary Shibboleths," claims to be a plea for an honest confession of our real tastes in literature, and a warning against being carried away by literary fashions. Yes, this is all very well, but it would decimate the ranks of the would be literati. Mr. Morton gives us his second paper on "Some Popular Objections to Civil Service Reform."

—The opening article in the *Quarterly Journal of Economics* for April is by Francis A. Walker, on "Protection and Protectionists." It cannot be called a very satisfactory work, for it merely skims the surface of the subject, leaving its deeper aspects untouched; and, moreover, it fails to make clear the author's own position. President Walker begins by calling attention to the fact, well known to those who have watched the changes of public opinion, that the protectionism of the present day is very different from that of our forefathers, inasmuch as protection is now advocated as a permanent policy, and not, as in earlier times, merely as a means of establishing industries that were afterwards to become self-sustaining. He also points out certain other differences of opinion among protectionists, and then touches on a few of the arguments on both sides of the question, but without presenting any thing specially new or profound. The next article in the *Quarterly* is by Professor E. C. K. Gonner of Liverpool, on "Ricardo and his Critics," and is an able defence of the noted English economist against some of the aspersions that have been cast at him. In particular, the writer shows that the attacks on Ricardo by the late German economist, Adolf Held, were not only in great part baseless, but were animated by an unbecoming spirit. Professor Taussig has a paper on "The Silver Situation in the United States," which is appropriate to the time. It is not a discussion of bimetallism, but a history of the coinage and circulation of our present silver money, together with an account of the existing state of the silver currency in its relation to gold on the one hand, and to paper on the other. Now that the advocates of silver are calling for an increased coinage of the metal, the facts and suggestions in Professor Taussig's article will doubtless be useful.

—Berly's "Universal Electrical Directory" (London, William Dawson & Son), now in the ninth year of publication, grows in completeness and usefulness with each succeeding year. The issue for 1890, which has recently made its appearance on this side of the Atlantic, contains a complete record of all industries directly or indirectly connected with electricity and magnetism, and the names and addresses of manufacturers in America, Great Britain, the continent of Europe, India, and the British colonies, beside much other matter of interest to those connected with electrical industries.

—D. C. Heath & Co. will shortly issue a manual on the "Reproduction of Geographical Forms," by Jacques W. Redway, author of "The Teacher's Manual of Geography." It is designed for teachers and students who wish to learn the details of sand and clay modelling as applied to geographical forms, and the projection, drawing, and interpretation of maps. The manual will be illustrated with the various projections used in map-drawing, including a number of very easily constructed ones that may be used by younger pupils.

Publications received at Editor's Office, April 21–26.

ALLEN, H. A Clinical Study of the Skull. Washington, Smithsonian Inst. 79 p. 8°.
BLACKMAR, F. W. Spanish Colonization in the Southwest. Baltimore, Johns Hopkins Univ. 79 p. 8°. 50 cents.
BLOXAM, C. L. Chemistry, Inorganic and Organic. 7th ed. Ed. by J. M. Thomson and A. G. Bloxam. Philadelphia, Blakiston. 799 p. 8°.
CHECKLEY, E. A Natural Method of Physical Training. Brooklyn, N.Y., William C. Bryant & Co. 152 p. 16°. $1.50.
CURTMAN, C. O. Uses, Tests for Purity and Preparation of Chemical Reagents employed in Qualitative, Quantitative, Volumetric, Docimastic, Microscopic and Petrographic Analysis. St. Louis, Mo., J. L. Boland Book & Stationery Co. 256 p. 12°.
GRAY, J. Electrical Influence Machines. London, Whittaker & Co.; New York, Van Nostrand. 237 p. 16°. $1.75.
GURNEY, J. H., Jun., and RUSSELL, C. The House Sparrow. The English Sparrow in America, by Elliott Coues. London, William Wesley & Son. 70 p. 12°.
KAPP, G. Electric Transmission of Energy. 2d ed. London, Whittaker & Co.; New York, Van Nostrand. 348 p. 12°. $3.
KUNZ, G. F. Gems and Precious Stones of North America. New York, Scientific Publ. Co. 336 p. 4°. $10.
LAING, S. Modern Science and Modern Thought. Parts I. and II. New York, Humboldt Publ. Co. 187 p. 8°. 45 cents.
LEE, A. B. The Microtomist's Vade-Mecum. 2d ed. Philadelphia, Blakiston. 413 p. 8°.
MILL, J. S. Utilitarianism. New York, Humboldt Publ. Co. 57 p. 8°. 15 cents.
MUIR, T. The Theory of Determinants in the Historical Order of its Development. Part I. Determinants in General. London and New York, Macmillan. 278 p. 8°.
RAMSAY, A. C., and others. Upon the Origin of Alpine and Italian Lakes and upon Glacial Erosion. Parts I. and II. New York, Humboldt Publ. Co. 148 p. 8°. 45 cents.
RITCHIE, D. G., and HUXLEY, T. H. Darwinism and Politics, and Administrative Nihilism. New York, Humboldt Publ. Co. 55 p. 8°. 15 cents.
SCHAEFFLE, A. Quintessence of Socialism. Tr. by Bernard Bosanquet, M.A. New York, Humboldt Publ. Co. 55 p. 8°. 15 cents.

— Kossuth has nearly ready for publication three additional volumes of his memoirs. They are said to contain, among other things, his remarks upon the policy of Napoleon III. toward the Vienna Court, and upon the endeavors of the Pope to retain his secular power.

— "Midnight Talks at the Club" is the title of a volume shortly to be published by Fords, Howard, & Hulbert. It is made up chiefly of a series of articles under the same title from the Sunday issues of the *New York Times*, which excited a good deal of interest when they first appeared, and of an article entitled "A Protest against Dogma," by the same author, Amos K. Fiske, which attracted much attention in a recent number of *The Forum*. These papers contain free and candid discussions of various religious, social, political, and moral questions that interest thinking people of the present day.

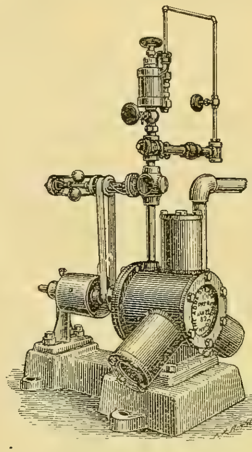
INDUSTRIAL NOTES.

The Abbe High-Speed Steam-Engine.

A STEAM-ENGINE of novel design is shown in the accompanying illustrations. It is of the three cylinder type, and is being introduced to the notice of power users by the Abbe Steam Engine Company of this city. The cylinders are arranged around a central crank-chamber, equidistant from each other. The pistons, which are single-acting, are connected direct to the crank-pin, the piston itself acting as a cross-head, and a simple device being provided for taking up all wear or lost motion at the crank-pin and connecting-rod.

The inner bearing of the crank-shaft is located in a partition separating the crank-chamber from the valve-chamber. In this partition are also located the steam and exhaust passages leading to and from the cylinders. The valve, which revolves with the crank-shaft, is at the back of this partition, being so balanced that there is just sufficient excess of steam-pressure on one side to keep it up to its seat without undue friction.

To provide for thorough lubrication of all working parts in the crank-chamber, a quantity of oil is placed in the lower part of the chamber, each revolution of the crank distributing it to all

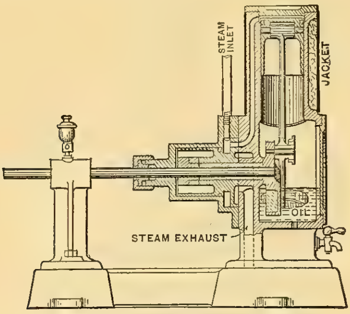


parts. The valve and valve-chamber are lubricated in the usual manner by oil carried in by the steam.

As the engine has no dead centre, it can be started with the crank in any position; and as the cylinders take steam only at one end, the connecting-rods are always in compression; so that,

even at the highest speeds, there can be no sudden irregularities of pressure or pounding upon the crank-pin. The working parts being incased, they are exempt from the extra wear induced by the accumulation and grinding-in of dust and dirt.

The engine of this type now on exhibition at the company's office in this city is neat and compact, and very light for the amount



of power claimed. It should be admirably adapted for running dynamos, ventilating-fans, hoisting-engines, and similar machinery requiring high speed; and for boat and yacht engines it should find a wide application, a special valve-gear for reversing being provided, making it available for that purpose.

The Loomis Electric System.

THE Eureka Electric Company (Loomis system), whose ingenious self-regulating system of electric lighting was described and illustrated in these columns about a year ago, have installed many important plants during the past few months. One of their most recent contracts is one for an installation of two thousand incandescent and several low-tension arc lamps for a large hotel at Tampa, Fla. A notable feature of this installation is the fact that current for both kinds of lamps will be supplied from the same dynamos. Another feature of this installation is that each bedroom in the hotel is furnished with a special incandescent night-lamp, which can be kept burning all night, and at any degree of brilliancy desired by the occupant of the room.

The engines, boilers, and dynamos are placed in a separate building situated some distance from the hotel. The boilers have a total capacity of 250 horse-power, and supply steam to two automatic high-speed engines of 110 horse-power each. These furnish power for four dynamos of five hundred lights each. The main switch is of special design, and controls all the lights, both arc and incandescent. It is so constructed that the dynamos can be run singly, in pairs, or in multiple, any desired combination being made in a moment. Four main circuits run from the dynamo building to the hotel through an underground conduit. Each circuit is provided with an ammeter and a ground detector, and each is connected, by a compound switch, with a voltmeter; so that the electro-motive force of all, or of any one, or of any combination of dynamos, may be quickly taken. As a whole, the installation is expected to be the principal electrical feature of Tampa.

The Eureka Company have also installed a plant at Duncansville, Penn., one-half the output of the dynamos being used for arc lamps, the other for incandescent. They have also recently put in plants, incandescent or mixed, in Hollidaysburg, Penn.; Wakefield, Mass.; Paterson, N.J.; Bloomfield, N.J.; Marcellus, N.Y.; West New York, N.J.; Portland, Ore.; Little Falls, N.Y.; Chester, Penn.; Pinkney, Tenn.; and quite a number of large plants in important business buildings in this city. The growth of their business has been so rapid and constant, that the company have been compelled to remove their factory from this city to larger and more convenient quarters in Brooklyn.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

April 26.—G. W. Littlehales, On a New Method of recording and reproducing Articulate Speech; William Eimbeck, On a New Method of determining Astronomical Differences of Longitude; Romyn Hitchcock, The Burial Mounds of Japan (illustrated by lantern projections).

Women's Anthropological Society of America, Washington.

April 26.—Mrs. Eliza Nelson Blair, A Study in Washington Charities.

Natural Science Association of Staten Island.

April 10.—The secretary of the Building Fund Committee reported progress to date; Mr. Ira K. Morris presented a brass spur, of Spanish fashion, which was lately ploughed up on the Poorhouse Farm; a specimen of the violet spotted salamander (*Amblystoma punctata*) was shown, in which the tail was bifurcated, each branch being about half an inch in length. It was captured by Mr. John Tynan in the Snug Harbor woods, and presented to the association.

Engineers' Club, St. Louis.

April 16.—Isaac A. Smith, Railway Inclines; Arthur J. Frith, Some Practical and Theoretical Considerations of the Screw as an Element of Mechanism; Robert Moore, Exhibition of Some Cubes of Clay taken from the Bottom of the Mississippi River at Memphis; Professor Johnson, Data regarding Recent Tests of Granitoid Beams.

Royal Meteorological Society, London.

April 16.—C. Harding, The Cold Period at the Beginning of March, 1890; J. E. Clark, Note on the Whirlwind which occurred at Fulford, near York, March 8, 1890; A. E. Watson, On the Possibility of forecasting the Weather by Means of Monthly Averages; W. B. Tripp, Rainfall of the Globe.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 379.

NEW YORK, MAY 9, 1890.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

THE MICRO-GRAPHOPHONE.

IN the construction of my talking-machine, which I call the micro-graphophone, my object was to record articulate speech and other sounds, and reproduce them more distinctly, more naturally, and with greater volume, in order to obviate the necessity of hearing-tubes, and to be sure always of having a good record made and a good reproduction.

My experiments have shown me that to attain these ends there points, called "nodes,"— points where the vibrations are indistinct or dead. If Tyndall and other scientists are correct (which I think will not be disputed), if a knife is attached to only one point on the diaphragm, the point selected may sometimes be dead or nearly dead, and consequently the vibrations existing in the plate cannot be correctly recorded. Such a diaphragm may sometimes make a very good record, and sometimes an altogether unsatisfactory one.

Suppose a spider attached to a vibratory body by many legs of

LIEUT. BETTINI'S MICRO-GRAPHOPHONE.

must be changes made as much in the recording device as in the reproducer. In my recorder, instead of attaching the recording knife to one point in the centre of the diaphragm, as in other talking-machines, I use a device which I call a spider, to which the knife is attached, and which has branches or legs of different lengths attached to several points of the diaphragm.

A diaphragm made to vibrate by sound-waves vibrates over its entire surface, but with different degrees of vibration at different points. Tyndall, and other masters of the science of sound, show how a vibrating diaphragm or body is covered with dead

different lengths, six or eight, or more (Figs. 2 and 3). Two or three of the points of attachment may be dead points, and unable to transmit vibrations; but by the others the knife will receive all that is necessary to make a good record.

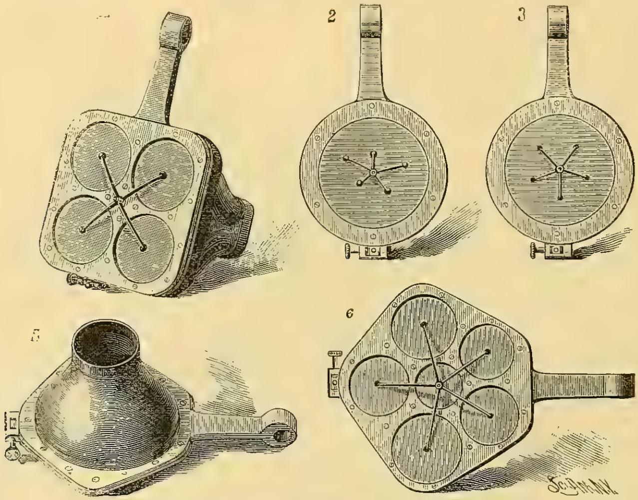
The spider gives to my device other advantages. It gives more force to the knife in making a record, as this force is concentrated from several points, whereas in other machines it has but one source; further, it gives to the knife great steadiness, which I consider most important; and, further yet, a great advantage is that in my device not only are all the tones recorded, but also

the half-tones, the over-tones, and the intermediate tones. This I am able to demonstrate by mathematical figures.

To recapitulate. In recording articulate speech, or other sounds, I take the vibrations from the body or diaphragm at several points or places, and communicate them by independent conductors to a common point or place, causing the record to be made from this common point or place; and the record thus obtained is a perfect one.

In the reproducing device, instead of a small diaphragm made to vibrate by means of a needle attached in the centre by a point, I have a larger diaphragm (Figs. 1 and 6) divided into several smaller divisions,—three, four, five, or more,—and the vibrations are communicated to these different diaphragms by a spider, having in the centre, on one side, a reproducing needle, and, on the obverse side, legs extending to the centre of each of the smaller divisions.

Thus the method of reproducing articulate or other sound or sounds consists in causing a record of vibration to act at a single point or place, and from this point or place to communicate vibrations by independent conductors to the several diaphragms.



DIAPHRAGMS FOR BETTINI'S MICRO-GRAPHOPHONE.

It is very easily seen that a single diaphragm, which is made to vibrate in the centre by a needle attached to one point, will give a minimum result, because the diaphragm only vibrates, with appreciable result for our ears, in a small part of the centre.

A reproducing diaphragm, with a spider attached by its legs at several points, will vibrate over more of its surface; but the best method is to use a diaphragm with several smaller divisions. The result of several diaphragms vibrating at the same time will naturally give more amplitude to the reproduction.

But this is not the only important end attained by this device. It is very desirable to be able to reproduce the exact natural pitch or tone of the voice or other sound.

As with a number of tuning-forks, some of which will gather vibrations where others will not, one diaphragm, also, will take certain vibrations which others are unable to take on account of differences in tensions, dimensions, and other physical conditions.

In my device, having a diaphragm divided into several divisions of different tensions or dimensions, or varying in other physical conditions, I succeed in giving a more natural reproduction, both in volume and in pitch, because, in case unusual vibrations should be reproduced, I have always one or more diaphragms that will sympathize with these vibrations, and no vibration is lost.

With such devices, the micro-graphophone gives a reproduction for which no hearing-tubes are necessary. The voice and all other sounds are always emitted into the room, still retaining all their natural qualities, and each completely distinct and distinguishable.

The micro-graphophone is shown in perspective in the accompanying illustration. In the base is an electro-motor, which, by means of the pulley shown at the right, drives the horizontal shaft carrying the recording cylinders. The illustration shows the reproducing diaphragm in position. The recording diaphragm is swung back, and is seen at the left of the figure. This recording diaphragm is operated by means of a flexible tube, which, with two of the recording cylinders, appear to the left of the base. The other device shown with these is the planing-tool for smoothing the cylinders preparatory to their use.

Gianni Bettini.

THE SOCIETY AND THE "FAD."

In a very recent issue of a young ladies' magazine (picturesquely called *Poet-Lore*) there lately met my eye the following sentence: "Browning and Ibsen are the only really dramatic authors of their century." As things sometimes strongly suggest their opposites, this sentence reminded me of one of Professor Tyndall's splendid chapters, the one entitled "The Scientific Use of the Imagination;" which chapter quotes as its text the following passage from an address of Sir Benjamin Brodie to the Royal Society: "Physical investigation, more than any thing besides, helps to teach us the actual value and right use of the imagination,—of that wondrous faculty, which, left to ramble uncontrolled, leads us astray into a wilderness of perplexities and errors,—a land of mists and shadows,—but which, properly controlled by experience and reflection, becomes the noblest attribute of man, the source of poetic genius, the instrument of discovery in science, without the aid of which Newton would never have invented fluxions, nor Davy have decomposed the earths and alkalies, nor would Columbus have found another continent."

There is a use of the imagination which is of prophetic value: as, for example, the use which a poet like Goethe makes of it when he foresees, in his poetry, that which the

sciences shall in due time arrange for, and the arts accomplish. Goethe himself expresses this,—

> "Thus in the roaring loom of Time I ply,
> And weave for God the garment thou seest him by."

There is also that nearer use of the imagination which is of immediate commercial importance, as when the promoter of a continental railway sees, in his mind's eye, a location through yawning cañons, and trackless forests on unbeaten mountain-sides, where his locomotives may clamber. And there is yet a third use of the imagination, which discerns enough importance in material and passing things, which to the general reader seem trivial and valueless, to lead the poet to preserve and chronicle them, and so perpetuate that which otherwise would disappear, and be lost forever to the student of humanity and of history. Poetry, then, in the latter case, has its practical as well as its sentimental uses, and it is not a matter of supererogation that organizations of individuals should meet to study and interpret the works of a poet as well as the works of a publicist or a philosopher. But when the poetry of a certain poet, however magnificent, is merely delineation of, or soliloquy concerning, that of which all the race is tenant in common along with the poet, it would seem as if the organization of a great society or a learned academy to penetrate that particular poetry or that particular poet was rather what we call a "fad," or a crochet, than a work of any value to anybody. To illustrate the situation by use of an honored name (to which name I have no wish to allude other than with the highest respect): the death of Mr. Robert Browning has terminated what I think is one of the most wonderful—certainly the most unprecedented—phenomena in literature; namely, the spectacle of a poet writing poetry, and of the simultaneous organization on two continents of learned societies to comprehend that poetry as fast as it was written. Indeed, the remark of the witty person—that, just as great physical works are beyond the capacity of individuals, and so must be intrusted to corporations, so the comprehension of Mr. Browning's poetry, being beyond the single intellect, was committed to aggregations of intellect known as "Browning Societies"—appears to have been less a *bon mot*, and much nearer the truth, than had been generally supposed; for Dr. Furnivall tells us why he founded the original Browning Society. "The main motive for taking the step," says the excellent doctor, "was some talk and writing of a certain cymbal-tinkler being a greater poet (that is, maker) than Browning. I couldn't stand that!" which rather appears to be only another way of saying that Browning was in danger of being neglected, simply because people could not readily ascertain whether there was any thing in him to study; and so that organizations must be formed, not to study something or other that was in him, but to find out if that something or other was there.

What I propose in this paper is an attempt to show, that, unlike the Browning Society, the Shakespeare Society is not an institution of this character, not organized to worship Shakespeare, or to study the Shakespearian method and form: but that it is an institution productive of real benefit, because its purpose is to study the matter (the material) in which Shakespeare deals; because we know that this matter is in him, without the organization of any preliminary parsing societies — simply because, so unapproachably simple and coherent and scientific is his form, that we are able at a glance to ascertain whether he is worth studying or not.

Indeed, it would appear, from this very statement of the founder of Browning societies, that he himself perfectly well understood that a study of Browning merely meant a study of the particular Browning expression, fashion, method, form (or neglect of form, of which Browning himself boasts in his "The Inn Album"). And, if this were the excellent founder's meaning, we can well understand that he was right: for certainly, if Mr. Browning's own contemporary must quarry in Mr. Browning's poetry—must go at him with pick and spade just as a twenty-second century grammarian might do, he must not expect the yield he unearths to be any secret of his own century,—any thing not already his own property in common with Browning himself; any thing he did not know before, or could not have procured with less or equal labor elsewhere,—for certainly Mr. Browning had no sources of information, or access to sources of information, which his contemporaries did and do not enjoy or cannot procure. What the Browning Society occupies itself with, then, must be exactly that which, had Shakespeare societies been organized during Shakespeare's lifetime or immediately after his death, those societies would have been occupied with as to Shakespeare. The Shakespeare societies of 1600–16 would have found themselves in precisely the same position as to their poet as are our Browning societies to theirs. Their aim would have necessarily been, not to learn about their own century, about their own manners, their own customs, their own emotions, sensations, habits and speech, from the writings of one of themselves, but would have been limited simply to a study and interpretation of William Shakespeare's expression of his delineation of those customs, sensations, and emotions.

The Shakespeare Society of our day, as I understand it, has no such purpose as that outlined above. It is not founded and maintained in order to study, still less to worship, either Shakespeare the man, or Shakespeare the expressionist. Still less than either, I may remark in passing, is the Shakespeare Society organized to translate Shakespeare into the vernacular of the nineteenth century. As a matter of fact, Shakespeare's language is actually nearer our own than is that of any writer of any century preceding ours. Attempts to paraphrase usually end in obscuring him. There is not a sentence in the plays the drift and point of which—however an obsolete word, or archaic construction, or typographical error therein, may occasionally baffle us—is not perfectly intelligible. The Shakespeare Society is formed, rather, to study the age and customs in which and among which Shakespeare lived and wrote: the Shakespeare Society, in other words, is an antiquarian society, which has limited its researches to that the most interesting age of the English-speaking world,—the age in which those modern institutions which we prize most—art, manners, letters, society, jurisprudence, the common law which protects all these—were all springing to birth; of which institutions, it seems, William Shakespeare epitomized the very life, fibre, and being; leaving behind him not only a literature for the library and the student, but a record to which

the historian, the politician, the man of science himself, are eager to square themselves. And again: since the dramatic is the highest form of literature, and since Shakespeare made it so, the Shakespeare Society is also a dramatic society, and nothing which is dramatic should be alienated from it. At least, such was the belief of the first Shakespeare Society, founded in London by such gentlemen as the late honored James Orchard Halliwell (since Halliwell-Phillips), John Payne Collier, William Harness, Alexander Dyce, Douglas Jerrold, Bolton Corney, Charles Dickens, Peter Cunningham, Henry Hallam, and others. Harder-headed men than the above enumerated surely never came together; and if any one will take the trouble to look over the titles of the publications of this first Shakespeare Society, he will at least be conscientiously unable to continue to jeer at *that* Shakespearian Society as a mutual admiration assembly. Those publications are entirely devoted to the preservation of such literary matter, records or chronicles, as throw, or threw then, a new light upon the Elizabethan and Jacobean ages, whose central figure William Shakespeare undoubtedly was. I do not know, had "æsthetic criticism" been then invented, whether or not the above-named gentlemen would have succumbed to its temptations; but I find it very hard to imagine that they would have so succumbed. I find it very hard to imagine Halliwell-Phillips and Charles Dickens and Henry Hallam lying "among the daisies, and discoursing in novel phrases of the complicated state of mind" of William Shakespeare. I am quite sure, indeed, that William Shakespeare himself would have been the very last to accept the "creative" or "æsthetic" (it is the same thing) criticism of the present period; which reads all sorts of sublime eschatological and moral moods, motives, and purposes into the few honest, direct, and laborious years which he passed in the busy London of Elizabeth and her successor,—passed there, at first in a struggle to earn his daily bread as a stranger in the crowded streets; then, later, to accumulate a fortune with which, like Horace's ideal gentleman, "far from the noise of trade" to retire to his boyhood's home, and "plough with oxen the fields of his ancestors." Blink the fact as we may:—insist on Shakespeare's moral purposes and immense visions of didactic services to his race as we may: still the fact remains that all the immortal plays were written in the course of this struggle, first for bread and then for wealth, and that William Shakespeare himself was, not only a poet and a dramatist, but a practical mounter of plays, and maintainer of theatres and theatrical companies, and lived and died so utterly unconscious that he had done any thing more than any other playright, that he never made the slightest effort to perpetuate a line he had ever written, and took no notice in his will of any thing but his farms, his curtilages, and his cash. This is no place to give a list of the publications of that first Shakespeare Society; but I happen to recall one of them, a reproduction of the long-lost and forgotten cartoons which Inigo Jones drew in freehand to guide the designers and court carpenters in mounting certain masques for the entertainment of royalty, and this one publication may stand here for all the rest. Not in all those twenty or thirty volumes was there any posing of Shakespeare as a missionary, or dogmatic philosopher teaching moral, or æsthetic, or platonic, or any other sort of doctrines to his race. He (Shakespeare) may be a great moral teacher to-day; but, had he been "a great moral teacher" in his own day, he would have played his companies to empty houses. In short, the purpose of the first Shakespeare Society was, what in my opinion the purpose of every Shakespeare club or society to-day should be: to illustrate rather than supply, and to preserve rather than to create. Here, then, is the point. Shakespeare was, however unwittingly, what we call "scientific" in the use of his imagination, not only because he wrote fully up to the despotic requirements of a stage and a scenic art which he could only imagine (since it was to be born centuries after his funeral), but because he selected for perpetuation, out of his own environment,—out of the riff-raff as well as the splendor, the lewd and vulgar as well as the lofty and the romantic,—that which was formative and genuine, and that of which—because it was formative and genuine, and not illusive and temporary—the centuries beyond him would be interested to study and inquire. Ben Jonson and his associate dramatists were on the ground just as Shakespeare was: they had precisely the access to their contemporary civilization that Shakespeare had; they preserved the fashions and the fads (what Aubrey called "the coxcombities") of their date just as well as Shakespeare did. But, since they were not vouchsafed what Sir Benjamin Brodie calls "the scientific imagination," as well as the romantic and dramatic imagination, they could not and did not know "which seed would grow, and which would not." The Elizabethan dramatists did not, as a rule, it seems, know to which "airy nothings" to give the "local habitation" and "name" which succeeding centuries should found academies and societies to investigate. Glorious as was the age they lived in, their eyes, as a rule, were sealed to the possibilities which were being born around him. Only to one among them was it given to body forth and turn to shapes the forms which should be valuable to posterity,—those actual, practical, and scientific forms which we throng our own theatres to-day to see with our own physical eyes, and which we organize our Shakespeare societies to study and to illustrate.

This, then, is the situation. Because Shakespeare held the mirror up to the nature which environed him, because he became the chronicler of those manners, societies, and civilizations of his Elizabethan day which were the germs of our own, it is worth while to organize societies to study him in every aspect and from every point of view. The Shelley society or the Browning society, on the other hand, has and will have only the form, the expression, the mood, of its poet to investigate and debate; for the material in which Shelley and Browning worked is not unique or personal either to Browning or to Shelley. Their preserve is just exactly the preserve of all other poets:—the Humanities, which are always to the fore, always the same, and always the quarry of contemporary poets. And the poet who appears to-day, or who shall appear to-morrow, will be more apt, I think, to write works which the centuries to come after him shall not willingly let die, if he looks for his society to be organized in those centuries rather than to-day or to-morrow; and this because it is only the centuries to come after him which shall be competent to decide whether his work was fit to live, or was only the thing of the moment,—"the tune of the time," as Hamlet called Osric's flourishes.

Perhaps, in the flood of intellectual commentary and the analysis of Shakespeare's melody, eloquence, and literary style, attention has not been sufficiently attracted to this practical scientific form,—this "local habitation" which Shakespeare gave to his imagination,—how, with this scientific use of his imagination, he actually realized and provided for, not only the possibilities of the stage carpenter (an unknown functionary in his day), but that very modern opulence of modern stage architecture and effect which attracts us to our own theatres. Nobody can fail to be impressed, in witnessing modern Shakespearian revival, with the fact that the costliest and most prodigal of stage mounting which can be lavished upon a Shakespeare play on our metropolitan stage actually requires no amplification, or embellishment, or enlargement of the text, action or situations, to justify it; and that the stage directions of the acting editions of Shakespeare to-day are only those implied, if not expressed, in the text as Shakespeare himself left it. We have seen the splendors of Mr. Rignold's "Henry the Fifth," and of Mr. Booth's and Mr. Wilson Barrett's and Mr. Irving's "Hamlet," "Othello," and "Merchant of Venice," and of Mr. Daly's "Merry Wives of Windsor," "Taming of the Shrew," and "Midsummer Night's Dream;" but it should never be left unrealized that this dramatic author, who—three centuries ago—wrought out this dramatic material, never saw, except in imagination, and without the slightest rudimentary attempt at stage effect to guide his vision, all this machinery which his work to-day, and for our eyes, so imperatively demands.

The stage contrivances of Bottom's company—the man besmeared with loam to represent a wall, the man with a lantern and a dog to represent a moon—were scarcely burlesques upon the meanness and poverty, the petty economies and pitiable makeshifts, of the stage as Shakespeare himself knew it. I was most particularly impressed, in witnessing Mr. Daly's reproduction of "The Merry Wives of Windsor," with Mr. Daly's success in intimating this, without demeaning the effect of his own lavish stage machinery. Of course, the room in Ford's house in which Falstaff meets the ladies was, in the day to be represented, strewn with rushes (about a century was to elapse before interior luxury had even suggested sand). The ceilings were low and the timbers hewn, and the decorations mostly confined to an arrangement of the table utensils: trenchers, tankards, pots, and jugs. But to bring to his audiences the idea of the house of a thriving tradesman who had amassed "legions of angels," and so to tell the story of Falstaff's motives, Mr. Daly, of course, made the room a beautiful interior with carved furniture and wainscotings, and covered the floor with costly rugs. Shakespeare's own plays were not only mounted upon, but were immediately written for, a barren platform, where, if a couch was drawn in to signify a bed-chamber, or a table and two stools to signify an inn taproom, it was the force of a realism which could no further go. It was a company like the clown companies in "Love's Labour's Lost" or the "Midsummer Night's Dream," oftener than a company of Burbadges or of Lowins, that spoke Shakespeare's mighty lines in the ear of Shakespeare himself; and his majestic and noble and tender women were, perforce, intrusted to beardless and callow boys, in days when for a woman to play a woman's part was an ineffable disgrace. The modern stage, at the height of its opulence, is, then, but the imagination and the prophetic mind of Shakespeare; and Shakespeare was not only summit of the dramatic creator, but of the dramatic art as well. Like the projector of the continental railway, who sits in his saddle in the primeval forest and sees his vestibuled palace coaches, and hears his panting locomotives, Shakespeare stood upon his rude stage in the uncouth barn they called a play-house, and foresaw all that three centuries could amass of stage opulence and the lavishness of scenic art; and there and then he devised the situations, and moulded into poetry the dialogue which should describe and justify that opulence and that summit of dramatic art. There and then he bodied forth the form of things unknown—turned them to shapes, and gave to airy nothings a local habitation and a name. I do not say he knew what he saw, or knew that he was so writing for that which was to be his future. I do not know whether he did or not; but the result is here to day.

Certainly this age, and the ages to come, may well organize into academies to study the mind and the workmanship of a man and a poetry like these.

Now, if Shakespeare has a rival; if there is another poet who builds and creates and preserves: and who—with a use of the imagination which we may thus properly call scientific—supplies not only his own generation and contemporaries, but generations yet to be born, with that which is useful (in that it can be acted) and beautiful (in that it can be admired) in poetry,—then let us organize an academy to that poet also; let societies be founded in his honor; and the less time we lose in the work, the better it will be for us. Have we such another poet? Is it Robert Browning? If there is any truth declared, or any discovery announced, in Mr. Browning's poetry, except the ordinary humanities with which all poetry deals,—the loveliness of virtue, the deadliness of vice, etc. (matters rather settled by this time, and as to which further testimony or didactic illustration is merely cumulative),—if there is, then by all means let us have Browning societies, and plenty of them. But if there is not; if it should appear that the great attractiveness of Robert Browning's poetry, the real reason why a taste for it has been sufficient to make it develop into a fad, and why the study of it associates worthy and excellent people into societies and clubs, has always been and is, simply that its meaning is not (like the meaning of Shakespeare's poetry, for example) apparent on its face: that it is not perfectly intelligible, that nouns are situated at long distances from their predicates, and that verbs, adverbs, pronouns, prepositions, and various other parts of speech, are understood from their absence or are to be guessed at from the tumultuous context; should it appear that, were Mr. Browning's poetry paraphrased into perfectly commonplace English, each noun and verb in its place, every substantive and predicate in their proper order, there would be no Browning societies;—then, I submit, it would seem as if Mr. Browning's poetry was and is, nothing but cumulative poetry. And the question arises whether your Browning societies are any thing more than societies for the working-out of conundrums, or puzzles, or rebuses; not, perhaps, adult parsing societies, but societies organized to ask what well-known sentiment could Mr. Browning have intended to express in these five words, what perfectly familiar proposition of mor-

als did he mean to restate by those six, etc. I do not by any means say that this is the case, or that Browning is not a great original poet for other reasons than a somewhat complicated syntax. I am only taking the liberty of using him, with the permission of his admirers, as an illustration; just as I have used Shakespeare as an illustration of a poet whose works have lived because (as I think) they are not purely didactic, or purely cumulative of examples of those principles and tendencies with which the world, since the date of its emergence from chaos, has been perfectly familiar.

Is it not a fact, that if, three hundred years from this date, a twenty-second century man should come across one of Mr. Harrigan's dramatic pieces (one of the "Mulligan" series, for example), he would find in it more chronicle of the familiar manners of the nineteenth century than he will find in Mr. Browning's poetry? Should the twenty-second century sociologist or philologist be interested in the city of New York, for example, will he not be more instructed by one of Mr. Harrigan's "Mulligan" plays than by reiterations, however antiquarian their sources, of those truths of human nature with which doubtless his own twenty-second century literature will teem? Men and women are pretty much alike in any century, have always been and doubtless always will be—the same passions, motives, and frailties. The comparative safety of virtue, and perilousness of vice; that goodness is rewarded and badness punished,—are items which doubtless the twenty-second century reader will concede as freely as we do. Nor will a narrative, however distinctly re-teaching those admirable lessons, become solely on that account immortal. The twenty-second century man will doubtless be fairly aware of the average moral probabilities. But, should he be a student of intellectual progress, or curious as to the Browning century, and desire to learn about this nineteenth-century poet's American cousins (to learn about as much of them as Shakespeare has dropped as to his own contemporary Dutchman and Frenchman and Spaniard); should he happen to direct his inquiries as to what were the manners, not of superior persons, but of the general, in the metropolis of the western nineteenth-century world; should he unearth its motley *mise en scene*, where Christian, Jew, and Pagan, where Occidental, Oriental, and African (white, yellow, and black), were all massed in good-natured communion,—he would find in one of Mr. Harrigan's pieces as rich a storehouse of folk-lore, and annotate it as eagerly and as learnedly as we annotate the "Comedy of Errors" or the "Merry Wives of Windsor." He would make notes upon the fact that such interesting ellipses as "Go chase yourself around the block," or "Take a drop, will you?" were an invitation to over-much pretension to descend from its stilts, with quite as much appetite, for example, as we to-day discover that such "sabre cuts of Saxon speech" as "painting the town red,"[1] or to "fire out,"[2] or "to shake,"[3] or "It's a cold day"[4] (meaning a day of disappointment), or "too thin,"[5] are actually resurrections from the Shakespearian day and date.

[Continued on p. 288.]

[1] 1 Henry IV., II. iv. 13.

[2] Sonnet, cxliv. 14; Passionate Pilgrim, ii. 14.

[3] Lear, I. i. 42.

[4] Cymbeline, II. iii.; 2 Henry VI., I. i. 237.

[5] Henry VIII., V. iii, 125.

NOTES AND NEWS.

THE Philopatrian Society of New York have waited upon Provost Pepper of the University of Pennsylvania with a view of establishing a chair in Gaelic at that institution. The question is under consideration.

—The Mexican Government has granted a concession to a company to construct a railroad from a point on the Inter-Oceanic Railway to the volcanoes of Popocatapetl and Ixtaccihuatl, and up the sides of those mountains.

—The United Electric Traction Company has been organized in this city, with a capital of seven million dollars. The new company is virtually a consolidation of all the various Daft electric companies into one central company. This will doubtless give a new impetus to the development of electric traction.

—The American Metrological Society, at a meeting held in Washington last month, advocated the adoption of the metric system by the government for custom-house and foreign mail service. The metric system is now used by twenty-four nations in invoicing goods for shipment abroad, and many of them use it for all purposes.

—The council of the Appalachian Mountain Club has issued invitations to a number of persons throughout the State of Massachusetts to a conference, to consider the subject of the preservation of natural scenery and historic sites in that State. The conference will be held at the Massachusetts Institute of Technology, on Saturday, May 24, at 12 noon.

—At the commencement of the Medical and Dental Departments of the University of Pennsylvania, held May 1, there were graduated 117 in medicine and 70 in dentistry. Of these, 3 were from Brazil, 2 from Cuba, 5 from Germany, 3 from Switzerland, 3 from Scotland, and one each from Hayti, Nicaragua, New Brunswick, Prince Edward Island, Nova Scotia, Japan, England, and United States of Colombia.

—Some interesting experiments on the physiology of sponges have been recently made by Dr. Lendenfeld of Innsbruck (*Humboldt*). He operated with eighteen different species, putting carmine, starch, or milk in the water of the aquarium, and also trying the effect of various poisons,—morphine, strychnine, etc. The following are some of his results, as we learn from *Nature*: absorption of food does not take place at the outer surface, but in the interior; only foreign substances used for building up the skeleton enter the sponge without passing into the canal-system. Grains of carmine and other matters often adhere to the flat cells of the canals, but true absorption only takes place in the ciliated cylindrical cells of the ciliated chamber. These get quite filled with carmine grains or milk spherules, but starch grains prove too large for them. Remaining in these cells a few days, the carmine cells are then ejected; while milk particles are partly digested, and then passed on to the migratory cells of the intermediate layer. Any carmine particles found in these latter cells have entered accidentally through external lesions. The sponge contracts its pores when poisons are put in the water, and the action is very like that of poisons on muscles of the higher animals. Especially remarkable is the cramp of sponges under strychnine, and the lethargy (to other stimuli) of sponges treated with cocaine. As these poisons, in the higher animals, act indirectly on the muscles through the nerves, it seems not without warrant to suppose that sponges also have nerve cells which cause muscular contraction.

—The four most valuable minerals found in Persia are coal, iron, copper, and lead, while it has been ascertained that there are large deposits of the purest petroleum in south-west Persia. In the north a coal-field of great extent has been proved to exist in the neignborhood of Teheran. The coal has been tested, and experts affirm that it will bear comparison not unfavorably with the best English coal. Another coal-field of excellent quality has more recently been discovered in the Gisakim Hills, less than fifty miles from Bushire. The total area covered by the coal-fields of Persia is belived to be vast. Nor are the iron mines less promising than coal. Those in the vicinity of Teheran, according to *Bradstreet's*, are very rich, the ore containimg about 70 per cent of metal; and they are situate within half a mile of the coal field.

Iron does not seem confined to the one spot, iron and coal occurring in juxtaposition throughout the hills skirting the road from the capital to Kazvin, or even farther west. Much of the Persian iron is noted as containing hardly any sulphur and no phosphorus.

—One of the important objects of the American Museum of Natural History is the collecting and preserving a library of books and pamphlets; and to this object its trustees make an earnest appeal to its friends for their co-operation. Two very valuable libraries have been presented to the museum, — one on conchology, by Miss C. L. Wolfe; and the other on ichthyology, by Robert L. Stuart. The paper-mills of our country are annually grinding up tons and tons of old and new books of value to scientific institutions, and in some cases making it almost impossible to obtain them for the completion of sets. It is therefore desirable at once, so far as practicable, to secure copies of every thing which has been printed on natural history; for in this age of scientific research there is nothing which may not at some time be useful.

—The University of Pennsylvania authorities have at last taken a hand in college athletics, and hereafter the students will be more restricted in the various sports. The following rules, drawn up by a committee consisting of several of the faculty and representative undergraduates, will in the future govern all college contests: No student whose general average in the mid-term or term report is below "medium" shall be permitted to engage in any university athletic contests or match rowing-races, or play in any match games of base-ball, foot-ball, cricket, tennis, lacrosse, etc.; no student shall train for or enter any university athletic contest or rowing-race, or play in any match game of base ball, foot-ball, cricket, tennis, lacrosse, etc., without the consent in writing of Dr. Leuf; the university athletic contests and match rowing-races shall be held only on Saturdays or holidays; match games of base-ball, foot-ball, cricket, tennis, lacrosse, etc, may be played on the university grounds, on days other than Saturdays or holidays, after 3 P.M.; no team, or crew, or representative of the athletic clubs or associations, shall make more than one engagement each week to play outside of Philadelphia, excluding Saturdays and holidays.

—At a recent meeting of the American Academy of Political and Social Science, held in Philadelphia, Professor E. J. James of the University of Pennsylvania read a novel and interesting paper. He said that for the last nine months a most interesting experiment in railroad management has been going on in Hungary. As a result, a new system of passenger tariffs was worked out and put into operation on the first of August, 1889. The method adopted was that commonly known as the zone-tariff system, in which the rates are fixed, not according to the number of miles travelled by the passenger, but according to the number of zones traversed or entered upon during the journey. Starting from a given centre, the railroads are divided into fourteen zones or stretches. The first zone includes all stations within 25 kilometres of the centre; the second, all more than 25 and less than 40, etc.; each zone after the first, up to the twelfth, being 15 kilometres long, or, as we should perhaps better say, wide. Tickets are sold by zones, being good for all stations within the zone. How radical a change this system implies for a large part of the traffic can be seen in the extreme cases; i.e, in those in which the reduction has been the greatest The fare for all stations in the fourteenth zone, which includes all stations more than 225 kilometres from the capital, are 8, 5 80 and 4 gulden respectively for the three classes, corresponding to \$2 88, \$2 08, and \$1.44. If we had the same rate in this country, it would be possible to buy a railroad-ticket to Chicago from New York for \$2.92. The fare from New York to Philadelphia would be 29 cents The simplification of the tariff is very great. Under the old system, the number of distinct tickets which had to be kept in every large office was nearly 700. It is now only 92. The railroad-tickets are now placed on sale like postage stamps at the post-offices, hotels, cigar-shops, and other convenient places. The public is greatly pleased at the discarding of the complicated machinery of ticket-selling as practised under the old system. The most interesting thing, however, in this experiment, is the way in which the passenger traffic has increased under the stimulus of the new rates. The number of passengers during the last five months of 1887 was 2,389,400; during the same period of 1888 it was 2,381,200; while for the same period of 1889 — the first period under the new system — it was 5,584,600, an increase of over 133 per cent. The receipts from the traffic under the new system were over 18 per cent greater than under the old. In other words, passenger traffic will respond to lower rates, — a thing which some railroad managers have denied. It would be well for our own railroad managers, who complain that passenger traffic is not profitable, to look into the matter. The American people, reputed to be the most restless in the world, do not have nearly as many passengers per head of the population as England, and it is far exceeded in the number of passengers to mile of railway by half a dozen countries of Europe.

—A writer in the *North China Herald* of Shanghai says that the climate of Asia is becoming colder than it formerly was, and its tropical animals and plants are retreating southwards at a slow rate. This is true of China, and it is also the case in western Asia The elephant in a wild state was hunted in the eighth century B.C. by Tiglath Pileser, the King of Assyria, near Carchemish, which lay near the Euphrates in Syria. Four or five centuries before this, Thothmes III., King of Egypt, hunted the same animal near Aleppo. In high antiquity the elephant and rhinoceros were known to the Chinese, they had names for them, and their tusks and horns were valued. South China has a very warm climate, which melts insensibly into that of Cochin-China; so that the animals of the Indo-Chinese peninsula would, if there were a secular cooling of climate, retreat gradually to the south. This is just what seems to have taken place. In the time of Confucius, elephants were in use for the army on the Yangtse River. A hundred and fifty years after this, Mencius speaks of the tiger, the Leopard, the rhinoceros, and the elephant as having been, in many parts of the empire, driven away from the neighborhood of the Chinese inhabitants by the founders of the Chou dynasty. Tigers and leopards are not yet by any means extinct in China. The elephant and rhinoceros are again spoken of in the first century of our era. If to these particulars regarding elephants be added the retreat from the rivers of South China of the ferocious alligators that formerly infested them, the change in the fauna of China certainly seems to show that the climate is much less favorable for tropical animals than it formerly was: in fact, it appears to have become dryer and colder. The water-buffalo still lives, and is an extremely useful domestic animal, all along the Yangtse and south of it, but is not seen north of the old Yellow River in the province of Kiangsu. The Chinese alligator is still found on the Yangtse, but so rare is its appearance that foreign residents in China knew nothing about it till it was described by M Fauvel. The flora is also affected by the increasing coldness of the climate in China. The bamboo is still grown in Peking, with the aid of good shelter, moisture, and favorable soil; but it is not found naturally growing into forest in North China, as was its habit two thousand years ago. It grows now in that part of the empire as a sort of garden plant only. It is in Szechuan province that the southern flora reaches farthest to the northward.

—An interesting little railway has just been opened for traffic in England, between Lynton and Lynmouth, which are separated from each other by a cliff nearly 500 feet high, and are only connected by a road so steep as to be almost impracticable for vehicles. The new line, according to *Engineering*, is 900 feet long, with a uniform gradient of 1 in $1\frac{3}{4}$, which is the steepest incline in the world. In spite of its shortness, the construction of the road has involved considerable difficulties; deep cutting having to be made through solid rock, and several streams of water having to be regulated. The motive power is supplied by water which is brought by 4-inch pipes from West Lynn, a distance of a mile, to a reservoir near the top of the incline. Two cars connected by a wire rope are moved together, the one dragging the other up the line as it descends. the necessary excess of weight being obtained by filling a tank on the car at the top of the incline from the reservoir already mentioned. Safety appliances have been fitted to stop the cars in case of accident.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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THE SOCIETY AND THE "FAD."

[Concluded from p. 286.]

And this, possibly, may be where the line is to be drawn between the usefulness of a poet or a dramatist to his own generation and date, and his value as an embalmer of manners to generations and dates long beyond him. Indeed, the very first piece of Shakespearian criticism extant[1] (it was written by John Aubrey prior to the year 1680, and I cannot see that the criticism of these two hundred or so years since has practically done any thing more than indorse it) represents Shakespeare in London in his own day, doing just exactly what Mr. Harrigan in New York has done in his. Shakespeare, who wrote "Hamlet," did not scruple to take his auditors into the tavern, the inn-yard, the bagnio, the jail; into the bum-bailiff's and the watchman's court, just as Mr. Harrigan has escorted his audiences into the slums, the opium-joints, the bar-rooms, the ten cent lodging-houses, to the polls, the picnics, the chowder-parties, and the cheap excursions of the self-respecting newsboy and boot-black. The ears of Mr. Harrigan's audiences are treated less coarsely than were those of Shakespeare. The nineteenth-century theatre-goer takes its Shakespeare extremely Bowdlerized. Doubtless Shakespeare went to a great many places where he should not, and where, had a Shakespeare society for the transcendental illumination of his works kept at his heels, he perhaps could not or would not have gone But it is precisely because he did go to all these places, good or bad, untrammelled, that his pages are of such peculiar value to ourselves: preserving so much that but for him had been misunderstood, but which he recognized as worth the embalming; not minimizing for the sake of ears polite, nor yet distorting into prominence for the prurient, but simply embalming—life-size, as it was, and where it belonged—in the great *comedie humaine* of those matchless dramas. From courtier to courtezan, from commander to camp-follower, the sovereign, the soldier, the statesman, the merchant, the peasant, the clown—how they all talked and walked, and lived and died, Shakespeare has told us. King Henry discusses state-craft with his great ministers; we turn the page, and Pistol and Doll Tear-sheet are hurling Billingsgate at each other, with Falstaff as a mocking peacemaker; two carriers with lanterns are shifting their packs in an inn-yard, and talking of poor Robin, the last hostler, who is dead; another page, and Lady Percy, in Warkworth Castle, is pleading with the noble Hotspur to dwell less upon wars and big events,

> "Of sallies, and retires; of trenches, tents,
> Of palisados, frontiers, parapets;
> Of basilisks, of cannon, culverin;
> Of prisoner's ransoms, and of soldiers slain,
> And all the currents of a heady fight"—

and to give some thought to wife and home and family. And in every one of these thirty-seven dramas there is the same rush of movement, the same panorama of life, of color, and of action, untrammelled and uninterfered with by any slightest hint that the poet preferred or enjoyed any one movement, class, or color, or life, to any other,—a simple photograph—and a negative untouched! And still from out this panorama may biographies be written, and still histories and sociologies unfolded, simply because this negative has not been tampered with. Here, too, is a faithful transcript of the progress of the date of the procession in which Shakespeare was marching along with the rest; and it is worth our while to pause a moment for an example of it. Observe that in the first quarto of "Hamlet" (1603) we have a stage direction, "Enter King. Queen, Corambis, and other lords;" in the second (1604) this entry is directed to be accompanied with "trumpets and kettle drums;" but, in 1623, the words "Danish March" are added to this stage direction. Here is a steady progress in realism: the play being Danish, the march was to be Danish also. Again in 2 Henry VI., in its first quarto form ("*The Contention,*" etc.), 1594, Suffolk says to his captor,—

> "Hast thou not waited at my trencher,
> When I have feasted with Queen Margaret?"

But in the folio some thirty years later, Suffolk says,—

> "How often hast thou waited at my cup,
> Fed from my trencher."

This is a step in table etiquette. It came to be only the servant, and not the nobleman, who used the trencher. The

[1] "He did gather humours of men daily, his comedies will remain witt as long as the English language is spoken, for that he handles *mores hominum*. He took in the humour of the constable at Grendon-in-Bucks which is on the road from London to Stratford."

procession marches past us,—the lewd, the unpleasant, the coarse: along with the noble, the stately, the refined. It is all in perspective, and the perspective of Shakespeare is the perspective of history.

And so: because these pages of Shakespeare are crowded with data for the student of civilization: are not a single phase (much less a phrase)—of literature—not puzzles or rebuses to find the meaning of which is beyond the single intellect, but for which societies and clubs and guessing-parties must be formed: therefore it is that a society for the illustration of Shakespeare, and of the field of research which his name implies, is not the fad or fashion of the moment. Its work is not to worry and debate and wrangle as to the meaning of this or that or the other, ellipsis: or as to what truth of human nature the poet intended to refer in this or that or the other, monologue, or cryptogram, or episode, or epigram: its work is simply to trace, from the cues they find in the plays of Shakespeare, the origin of things now familiar, of institutions now important, and of customs still fraught with significance. So long as there is a substance to work, let us have the society and the academy to work it. It matters not much if the student's exuberance overbear him, or his commentary burst into apotheosis: what it behooves him, rather, to beware of, is a confounding of the scientific uses of the imagination with that considerable over-use of the imagination which in time becomes the febrile, not the scientific vision. To see the Spanish fleet which is not yet in sight requires only faith. It will materialize with patience; but—for those who see insight and introspection and dramatic power in whatever is beneath their analysis, in whatever they cannot parse, or (and I am not now speaking of Mr. Browning) which offends the ear polite—not faith, but the faith-cure, is the proper specific. Cumulative poetry may have its uses, but it is hardly worth while to organize societies to discuss it.

I beg to repeat that I have only used Mr. Browning and his poetry as illustrations, in this paper. I am very far from wishing to be understood as implying that both are not great, or that I do not honor the memory of the one or admire the majestic qualities of the other. Still less do I propose attempting prophecy on my own account, by asserting that in three centuries, or one century, from this date, great societies and colleges will not be incorporated to sit at the feet of Robert Browning's poetry, and to write volumes of æsthetic criticism, and to fill libraries with controversial biographies of Mr. Browning.

Not to make too much of the pronouncement, then, in the young ladies' magazine picturesquely called *Poet-Lore*,[1] that "Browning and Ibsen are the only two really dramatic authors of this century," it is as good a text, perhaps, as any other upon which to protest, not against the fad poetic (which is an institution, that, with one excuse or another,—Browning, Tolstoi, or Ibsen,—is, like the poor, always with us), but against this cruel misuse of the word "dramatic," and this (perhaps I may call it) over "bumptious" employment of the prophetic vision, which magnifies our own taste of the moment into a judgment as to the probable opinions of posterity.

Certainly Browning is a dramatic poet, if writing plays that cannot be acted constitutes one a dramatic poet. (The answer to this is, of course, that Browning's dramas have been acted: an equivalent argument would prove that women are men, because, once in a while, certain women have acted like men.) And as to Ibsen: well, one swallow makes a summer—sometimes; and the Ibsen craze is some weeks old already. As to the almost forgotten Tolstoi: if what is called "realism" is dramatic, then Tolstoi, like a photograph, is dramatic. Certainly, in this view, a photograph is more dramatic than an oil painting. But one is perhaps to be allowed his taste in photographs? One might, for example, prefer a photograph of his mother or of his lady-love to a photograph of a dog fight or a pig-sticking; though the latter, of course, everybody would pronounce much the more dramatic. The fad poetic, in itself, is perfectly innocuous: the only possible danger is, that young persons are often led by it into the belief that any thing which is unpleasant or repulsive, or which has the taste of forbidden fruit,—any thing, in short, with which literature as a rule does not deal largely, or as to which the less said the better,—is dramatic. It is because I believe in the Shakespeare Society, and because it is to be feared that the Shakespeare Society (as an Institution) may be thoughtlessly confounded, in the minds of some, with this fad poetic (as an Institution), that I have attempted to here briefly dwell upon a few points wherein they differ.

Let us repeat. There is much that is coarse in the panorama of Shakespeare: but it is there, in its place, and does not dwarf the rest; nor is it the coarseness, any more than (to speak mildly) any other single feature of his dramas, which has made Shakespeare immortal. What is dirty is not on that account dramatic; it certainly is not on that account scientific. We may all of us enjoy Brown, Jones, and Robinson; but, keenly as we may enjoy them, Brown, Jones, and Robinson are not, from the mere fact that we do enjoy them yet (I quote again from the young ladies' magazine), "the only really dramatic poets of the century." As to that, it would seem rather the province of the centuries which come after Brown, Jones, and Robinson, to judge.

I believe that the great verdict as to who are, and who are not, great,—great poets, great dramatists, great masters of any art,—whose mortal labors deserve and justify and satisfy the founding of great societies,—are always, always have been, and always will be, based upon some such proposition as has been considered here. I believe that any thing which survives its own century must have something of the practical (of the scientific if you will) about it—even if it be a work of the imagination pure and simple. I believe that the verdict of the centuries as to who are, and who are not, dramatic poets, will be always based on just such tests as the centuries so far have applied to William Shakespeare. Were the "shapes" to which his pen turned "things unknown" actual and practical? Have we seen them with our own physical eyes? We know that the pages of Shakespeare have stood these tests, and that they have proved Shakespeare's poetry to be an orderly, symmetrical, proportionate, and absolutely true, chronicle of his own age and vicinage: not lifted into the clouds beyond the realm of human nature's daily food; glorified by an imagination none the less superb because not hectic,—an imagination which "bodied forth" forms, not chimeras; and truths, not fantasies. And I believe that it is because Shakespeare is the poet of the true

[1] March, 1890.

and the living, rather than of the didactic and the transcendental, that he is perennial and immortal.

APPLETON MORGAN.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Kiowa County, Kan., Meteorites.

A REMARKABLE fall of meteorites of unknown date in Kiowa County, Kan., has recently been brought to the knowledge of the scientific world. Many of the citizens of Greensburgh, the county seat, were aware of the existence of these strange irons, and commonly called them meteoric; but there seems to have been no suspicion of their true character and value. Indeed, until the 17th of March, 1890, a specimen weighing 101.5 pounds had ornamented the sidewalk in front of a real estate office in the above-named town for about three years. The farmers in the vicinity of the locality where the fall had occurred had put some of the specimens to various uses

They were first observed by cowboys, long before that portion of Kansas was open to settlement, while it was still a portion of the unrestricted cattle-range of western Kansas. The specimen before referred to, with two others of somewhat smaller size, had been removed from its original location by a cowboy, and buried at the head of a gulch about a mile distant. The cowboy had intended to carry the irons to Green's stage-station, about eight miles distant, but was unable to transport so heavy a weight upon his pony. This was in 1885. The town of Greensburgh was laid out in that year, before the close of which the cowboy was taken sick, and died. Before his death, however, he informed two or three citizens of Greensburgh of his burial of the three strange stones. These citizens, about a year later, searched for and found the meteorites, bringing them in to Greensburgh.

Professor F. W. Cragin of Washburn College was the first scientific man who visited the farm upon which these masses had fallen, this visit occurring on March 13. He secured from one of the farmers five meteorites, aggregating in weight over a thousand pounds, the heaviest specimen weighing 466 pounds.

Professor Robert Hay arrived on the spot March 14, but did not obtain any specimens. The writer reached the interesting locality on March 17, and obtained one of the Greensburgh specimens which had just been secured by the farmer. He made a second visit on the 22d, securing the two remaining Greensburgh specimens, thus obtaining all three of the masses which had been removed by the cowboy. He made a third visit March 29, securing two other specimens, which had been obtained by the farmer from his neighbors. The weights of these five specimens are respectively 101.32, 71.50, 54.96, 52.82, and 35.72 pounds. These weights have been accurately determined (except that of the 71.50-pound mass) by the United States standard scales in charge of the Department of Physics in the University of Kansas.

The writer retains the 54.96-pound specimen for the Museum of the University of Kansas, the four others being now in the possession of Mr. George F. Kunz of New York City, who has also secured four of the five specimens obtained by Professor Cragin.

The total number of masses included in this fall was at least twenty. Two of them are in the possession of Professor N. H. Winchell of the University of Minnesota, and several have disappeared from view, either having been mislaid or being still in private hands. The total weight of all the masses must have exceeded two thousand pounds. They fell within an oval area about one mile in length.

The most remarkable point connected with the history of these meteorites is the fact that for five years they should have been know to so many citizens of Kiowa County before the attention of scientific men was directed to them. The wife of the farmer upon whose premises most of them were found persistently maintained that they would prove to be of some pecuniary value. This idea was, however, ridiculed by her relatives and neighbors; but she persisted in retaining control of most of the masses found upon the land pre empted by her husband, until now the proceeds of this "iron from heaven" have cleared the farm from a heavy mortgage, and placed the family in comfortable circumstances.

These masses, during the period preceding their discovery by Kansas scientists, were put to a great variety of ignoble uses. One 75-pound specimen was used to keep in place the cover of a rain-barrel or the door of a cellar; another, weighing 350 pounds, served to hold down the roof of a stable; another, weight 210 pounds, was employed to secure the roof of a dug-out; another had been used with other common rocks to help fill up a hole under a barb wire fence through which the hogs had made their escape from their feeding-ground. This was the 35.72-pound specimen obtained on the writer's last visit, and was secured only after a long and anxious search.

Some of these specimens were only partially buried in the ground; others were struck by the breaking plough at a depth of from three to four inches; others at the second ploughing, five or six inches deep; others yet, by the stirring plough at the third ploughing in a subsequent season.

The specimen retained by the university weighed 54.96 pounds, or 24.93 kilos. It is an irregular plum-shaped mass, much pitted, and covered with a burned and weathered crust. Its extreme length is about eleven inches, and its breath is seven inches. This specimen, as well as the others mentioned above, so far as examined by the writer, belongs to that class of meteoric iron known as "pallasite." It is composed of nickeliferous iron, including many cavities throughout the entire interior. These cavities are filled with troilite and a yellowish, glassy mineral, which is probably olivine. Some of the latter is very dark and less transparent.

The specific gravity, determined by Mr. E. C. Franklin, our assistant in chemistry, and obtained by weighing the whole mass, is 4.76. Two hundred and ninety-three grams have been removed from the larger end of the specimen, and a polished surface of about fifteen square inches has been obtained, which shows very well the structure. The Wiedmanstaeten figures, rather coarse in outline, were developed readily upon the polished iron surface by the application of nitric acid. The portion removed from the specimen is being used for analysis by Professor E. H. S. Bailey and Mr. E. C. Franklin, and the results of the analysis will appear later.

F. H. SNOW.

Lawrence, Kan., May 1.

Experiments with Cave-Air.

GRAND AVENUE CAVE is situated in Edmondson County, Ky., four miles from Mammoth Cave, on the Mammoth Cave Railway, and belongs to the system of great caves which are found in this section of the subcarboniferous limestone formation. Its extent has not been determined as yet, though from three to five miles are opened, showing a magnificent series of the grandest avenues to be found on the globe. The main avenue is about two miles long, and will average 40 feet wide and 30 feet high. This being the highest cave in this section makes it the dryest in the rainiest seasons. The floors are covered with dust; but the absolute dryness of the air is best shown by a small house that was built in the cave some eighteen years ago, the wood, nails, lock, and hinges of which are as sound and bright as when first put in. A self-registering thermometer placed in the cave last November has registered 50° ever since, that being the unvarying temperature. Investigations looking to the use of this cool, dry, and pure air have been in progress for the past six months. A shaft 5 inches in diameter and 225 feet deep was sunk into the cave at a distance of 1,500 feet from its mouth, over which a small experimental building was placed. By means of a small Sturtevant exhaust fan, the air from the cave was brought into the room, and the temperature was reduced from 72° to 59° in less than an hour, thereby showing very clearly that with a large shaft, by which the friction would be greatly reduced, any quantity of this air can be distributed through a large building, thus placing it within the power of the owners to absolutely control the climatic conditions

of the house both as to temperature and moisture. The amount of air is inexhaustible, the quantity in sight being sufficient to fill 40,000 rooms 16×18×10 feet. The opinions of many prominent scientists have been obtained concerning the use of this air for sanitary purposes, a few of which are here given.

Major J. W. Powell, director of the United States Geological Survey, in speaking of the utilization of cave-air currents for regulating the temperature of buildings, says, "The phase of the problem in which you are specially interested is of so great practical importance as to demand not only a special but a general solution. It would afford me pleasure to either take up the general problem or assign it to some competent authority for investigation, were the data adequate; but there are not accessible in this office a sufficient number of records concerning air-movements at natural openings of caverns to render the investigation useful; and, moreover, a final solution could not be reached without consideration of just such data as you are to seek, — data which are not now available. In response to your request to make suggestions concerning methods to be pursued and results to be expected, I can say but little. Indeed, I hope that you will soon be in a position to convey information to me and to the world at large upon the subject."

Dr. Billings of the Surgeon-General's Office, Washington, D.C., after making several suggestions, says, "Hoping that these suggestions will be useful to you, and assuring you that if the experiments indicated are properly carried out they will give some very interesting and valuable information, I remain yours sincerely," etc.

Dr. Henry Henry O Marcy, Boston, Mass., after consulting Dr. H. I. Bowditch, says, "Such air must be of the highest value for respiratory use in diseased organs. Of course, sunshine is important, and this is the chief drawback to establishing the sanitarium within the cave. To drive it by means of a fan through a house would certainly seem of much value. An aseptic atmosphere is the gain from the long sea-voyage or living on mountains or in wooded districts. Here we ever have fluctuations in temperature, and other conditions, beside moisture. It has recently been considered as of practical importance to furnish air to a great city, as London, from high towers: why not, and much easier for many reasons, from caves? The air freed from bacteria is, as you are well aware, one of the secrets of success in modern surgery."

Burton, in his "Anatomy of Melancholy," under the head of "Air Rectified" (p. 306), says, "In some parts of Italy they have wind-mills to draw a cooling air out of hollow caves, and disperse the same through all the chambers of the palaces, to refresh them, as at Castoga, the house of Cæsareo Trento, a gentleman of Vicenza, and elsewhere."

The only modern instance with which I am acquainted is the hall of the Palace of the Trocadéro, in Paris. This building is erected over a portion of the old stone quarries. In the course of construction all the openings were closed, with a few exceptions. When it was found that a strong, cool current came from the underground chambers, all the openings save one were closed. This one was walled up to keep out the surface water, and shrubbery was planted around it. The chambers were carefully cleansed and dried, and the air is permitted to enter through this opening, which is never closed. The old quarries act as an immense cooling chamber. Mr. C. H. Blackall, in a letter, says, "At the rear of the stage, on the left, is a large room, the floor of which is only a little below that of the auditorium, and at its lowest point. In this room are the fans which draw the cool air from the quarries through a large opening in the floor, and force it either directly to the hall, as in summer-time, or first to a heating-chamber, where the air is warmed by passing over heated pipes. The fans, air-ducts, etc., are so placed that the fresh air may be introduced at the top of the hall, and foul air drawn out at the bottom, or *vice versa*. The air ascends, or rather is forced up, a large brick shaft behind the stage, and carried across to the centre opening of the dome through galvanized iron ducts about 5×8 feet.

The architect of the palace, after saying that nothing has been prin ed on the subject, writes thus: "I have the honor to inform you that the hall of the Trocadéro has a capacity of about 1,620,000 cubic feet; that ventilation, which furnishes 3,240,000 cubic feet per hour, is obtained by means of two engines, each of 15 horse power, operating two inhaling and two exhaling ventilators (one of each kind for each half of the hall). These ventilators are perfectly alike, they are about 8.4 feet in diameter, and consist of helices of a thickness of half an inch, with eight wings at an inclination of forty-five degrees. The engines are horizontal stationary ones, with two cylinders on the principle of restraint and condensation. Two boilers furnish the steam. Each of these has a heating surface of about 189 square feet, and a capacity of 54 cubic feet. They are gauged to a pressure of 10 pounds. The entire machinery has given excellent results. One may say it works too well, inasmuch as under full power there is a great excess of air. Usually only one-fourth of the total possible power is applied, and this is very amply sufficient."

Taking into consideration the unlimited supply of pure, cool, and, as far as investigations go, aseptic air, together with high altitude (nearly 900 feet above sea-level), its situation in the midst of a virgin forest of oak and hickory, with a sandy soil (resulting from the wear of the Chester sandstone) and splendid drainage — indeed, every thing seems to conspire to make this a favored spot for sanitary purposes. M. H. CRUMP.

Frankfort, Ky., May 3.

Sunspots, Tornadoes, and Magnetic Storms.

IN my letter regarding sunspots and tornadoes, printed in *Science* on May 2, 1890, reference was made to magnetic storms observed at Toronto near the maximum stage of the last sunspot cycle. From that memorandum, by a clerical error, were omitted the words "September, 1883," after "November, 1882."

JAMES P. HALL.

Brooklyn, N.Y., May 3.

Gorse or Furze

EUROPEAN furze grows in one spot in the island of Nantucket, where it has maintained itself for fifty years. It was introduced by an Irishman, who was homesick because it did not grow about his cabin, as in the Old Country. I have never seen the plant growing, but have seen branches gathered from it. I believe it has not spread to any great extent. It may be interesting to some that the Scotch heath also is found in one spot in the island, where it has continued for a long time. GEO. W. PERRY.

Rutland, Vt., May 5.

YOUR correspondent, Mr. J. R. McGinnis, may be interested to learn that the gorse or furze (*Ulex Europœus*) has for many years been fully naturalized in the southern part of Vancouver Island, where, along roadsides and in waste places in the vicinity of Victoria, it is very common. The broom (*Sarothamnus Scoparices*) is also abundant in similar situations in the same locality, and both plants appear to be as much at home as in their native soil.

GEORGE M. DAWSON.

Geological Survey of Canada, May 5.

BOOK-REVIEWS.

Stanley's Emin Pasha Expedition. By A. J. WAUTERS. Philadelphia, Lippincott. 12°. $2.

IF any one besides the great explorer himself is able to describe the progress of Stanley's eventful journey, which led to the complete overthrow of European influence in Equatorial Africa and to the return of the indefatigable Emin Pacha, it is Mr. Wauters, who has closely watched the progress of the expedition from the beginning to the end, and, being closely connected with the Belgian enterprises on the Kongo, had access to all the material bearing on the expedition. The author begins his graphic descriptions with a history of the conquest of the Soudan and the revolt of the Mahdi, which was the immediate cause of the difficulties with which the governor of the Equatorial Province was beset. The first half of the book is taken up by descriptions of the state of affairs in the Soudan, Dr. Junker's important expeditions and his

return home, and the preparations for Stanley's expedition, as well as his reasons for selecting the Kongo route.

As the events treated here comprise a long space of time, and have been the subject of much lively discussion, the concise review given by Wauters will help to gain a clear understanding of the perilous position of the few Europeans who were still in the Equatorial Province, and the greatness of Stanley's undertaking to relieve Emin Pacha. who at that time was completely cut off from civilization, and was badly in need of provisions, clothes, and ammunition.

We follow the journey of the expedition up the Kongo, and the difficult march up the Aruvimi. The mutiny which broke out after Stanley's first arrival in the Equatorial Province is described in letters of Mr. Jephson to Stanley. It is needless to repeat here the difficulties Stanley had to contend with on his march back to Yambuga, — the death of Major Barttelot, Stanley's return to the Albert Nyanza. and his almost forcible rescue of Emin, who, it seems, together with Casati, hoped to be able to continue work in the Soudan. The reports of the retreat of the caravan along the south shore of the Victoria Nyanza to Zanzibar are still too fresh in all minds to need to be repeated here. The book is illustrated with numerous cuts, and accompanied by a good map of the region traversed, in which all the recent discoveries of Stanley, as well as of other travellers, have been made use of.

Essays of an Americanist. By Dr. D. G. BRINTON. Philadelphia, Porter & Coates. 8°.

THE contents of the present book may best be characterized by the author's own words in his preface to the volume: "The articles which make up the volume have been collected from many scattered sources, to which I have from time to time contributed them, for the definite purpose of endeavoring to vindicate certain opinions about debated subjects concerning the ancient population of the American continent. In a number of points, as, for example, in the antiquity of man upon this continent, in the specific distinction of an American race, in the generic similarities of its languages, in recognizing its mythology as often abstract and symbolic, in the phonetic character of some of its graphic methods, in believing that its tribes possessed considerable poetic feeling, in maintaining the absolute autochthony of their culture—in these and in many other points referred to in the following pages I am at variance with most modern anthropologists; and these essays are to show more fully and connectedly than could their separate publication what are my grounds for such opinions."

The collection of essays is divided into four groups: ethnologic and archæologic; mythology and folk-lore; graphic systems and literature; and linguistic. The collection of so much valuable, and, above all, suggestive material in one volume must be highly welcomed, as many of the papers found in this volume were heretofore difficult to obtain. The subjects that are discussed by the author are of so great a variety—and mostly on hotly debated ground—that some of them have been and will be sharply discussed. The references to criticisms of these essays which Dr. Brinton gives will increase the value of the collection to the student. The essays constituting the first part of the book are selected to sustain the theory of the development of the American race on American soil, and of the independent origin of its culture. In the second part Dr. Brinton stoutly defends the possibility of explaining mythologies by means of etymology, by investigating the origin of the name of mythical beings. The essays abound in acute suggestions and theories, and will be found as entertaining as instructive.

Electrical Engineering for Electric Light Artisans and Students. By W. SLINGO and A. BROOKER. London and New York, Longmans, Green, & Co. 12°. $3 50.

THOSE who have watched the growth of electrical literature during the past few years have doubtless noticed the increasing tendency towards what may be called specialization on the part of writers of electrical books. This tendency, of course, is natural. As the literature of a science increases in volume, the major part of it must of necessity be limited in its scope to cer-

tain branches or divisions and subdivisions of that science. Some of the more recent electrical works, therefore, are devoted to dynamo-electric machines, for instance, or to secondary batteries, or to motors; while the electrical treatises of a few years ago, almost without exception, aimed to cover the whole field of the science as far as it was developed at that time. The volume before us is a good example of this tendency toward specialization, and an equally good example of the comprehensive method of treatment followed in the earlier works on electricity. It is devoted wholly to the subject of electric lighting, and it covers that field so thoroughly that it leaves little to be desired in the way of information by either artisans or students.

One of the authors, Mr. Slingo, is principal of the Telegraphists' School of Science, and director of the Electrical Engineering Section of the People's Palace, London; and the other, Mr. Brooker, is instructor in electrical engineering in both the institutions mentioned. Having felt the necessity, in the course of their labors, for a single work covering the whole field of electric lighting, and not finding such a treatise ready to hand, they set to work to fill the gap in electrical literature, and the volume before us is the result. The book, though specially designed to fill a predetermined place in the course at the institutions named above, also embraces in its scope the requirements of those actually engaged in the electric-lighting industry, as well as those of persons who, with little or no electrical knowledge, have under their supervision various kinds of electrical machinery. It will therefore be of service to managers of mines and factories, naval officers, and to all engineers who may at any time be brought into contact with an electric-lighting plant. The book is illustrated by upwards of three hundred engravings.

A Natural Method of Physical Training. By EDWIN CHECKLEY. Brooklyn, W. C. Bryant & Co. 16°. $1.50.

THE method of training advocated and taught in this little volume appeals at once to the good sense of the reader. It requires no machinery or apparatus of any kind, except, of course, the bones and muscles of the person training; and it may be taken up and pursued at any time and in any place, either with or without an instructor. The aim is not to produce champion rowers or boxers or sprinters, nor even to develop good "all-round" athletes, but to do for the body what education does for the mind. The aim is to put the body into the best possible condition for doing the work it has to do, and to keep it in that condition. The author believes that there is more "straining" than "training" in some of the popular systems of physical training practised in and out of the college gymnasium, and his method departs radically from those systems in many respects. But we find nothing in it that physicians could take exception to in the case of any person physically sound. The book is fully illustrated, many of the engravings being made from instantaneous photographs of the author in the different positions assumed in the course of training.

THE *Atlantic Monthly* for June will contain an article by Charles Dudley Warner, entitled "The Novel and the Common School," a pedagogical essay on reading and reading-books.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Through knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

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INDUSTRIAL NOTES.

The Crocker-Wheeler Arc-Current Motor.

THE first electric motors placed on the market by the Crocker-Wheeler Company were intended to be operated by a current of constant potential and low tension,—what is usually termed "an incandescent-light current." Those motors were described and illustrated in these columns several months ago. While there is a large and steadily widening field for those constant potential motors, and an increasing demand for them, there is also a field and a demand for motors wound for higher tension and constant current, to be operated on an arc-light circuit. To meet this demand the motor shown in Fig. 1 has been produced by the Crocker-Wheeler Company. The regulation of this motor is effected in the same way as in the same company's constant-potential motor; namely, by causing the armature to automatically move out of or into the field, thereby keeping the amount of torque or magnetic pull exactly proportionate to the work being done. The speed is thus kept constant, no matter what the variation in the current or the load. The commutator and shaft bearings are made sufficiently long to admit of this longitudinal movement, which, besides its main function of varying the position of the armature with regard to the pole-pieces, also distributes the wear more uniformly on brushes, armature, and bearings.

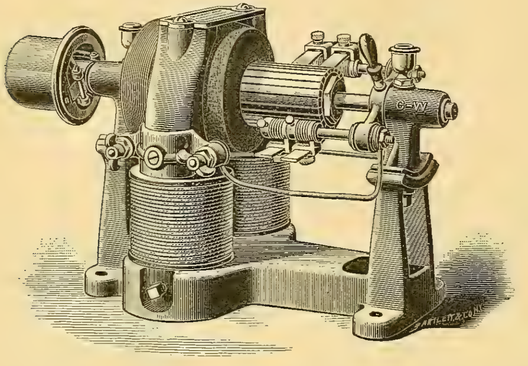

FIG. 1.

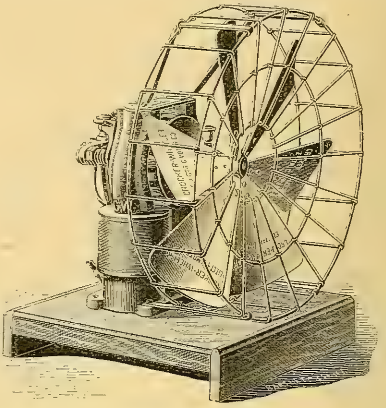

FIG. 2.

Fig. 2 shows a novel application of a safety-cage or wire guard to a fan driven by a Crocker Wheeler motor. This guard is intended mainly to protect the fingers of children or meddlers from the effect of contact with the rapidly revolving fan, we suppose, as we have observed that in cases of such contact the fan, like the equally deceptive buzz-saw, usually protects itself. An electric fan at full speed is cooling and comforting on a hot day, and very pleasing to the eye, but it will not bear handling.

As an effect of the extraordinary demand for electric motors produced by a better public appreciation of their merits, the Crocker-Wheeler Company have been compelled to remove from their former factory, which was by no means small, to a new location,—probable the largest establishment of its kind in the world.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

May 3.—Robert Reyburn, The Life-History of Micro-organisms with its Relation to the Theory of Evolution; George Vasey, A New Grass Genus; W. H. Seaman, The Place of Biology in Public School Instruction; F. A. Lucas, The Present Status of Aurochs.

New York Academy of Anthropology.

May 6.—Edward C. Towne, The Physiological Causes and Evolutionary Conditions of Negro, Indian, and other Inferior-Race Peculiarities (a paper especially designed to present a scientific solution of the negro problem).

May 13.—Lucy M. Hall, The Disposal of the Dead.

Appalachian Mountain Club, Boston.

May 9. — W. F. Dusseault, The White Mountains of New Hampshire; Exhibition of a very fine collection of stereopticon views, prepared by members of the Boston Camera Club.

Boston Society of Natural History.

May 7, Election of Officers.—President, F. W. Putnam; vice-presidents, William H. Niles, B. Joy Jeffries; curator, Alpheus Hyatt; honorary secretary, J. C. White; secretary, J. Walter Fewkes; treasurer, Charles W. Scudder; librarian, J. Walter Fewkes.

J. A. Jeffries, Lamarckism, with an Example; H. W. Haynes exhibited for G. Frederick Wright the palæolithic implement recently discovered by Mr. W. C. Mills in the valley of the Tuscarawas, Ohio.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

A large number of plants from Maine, Connecticut, Indiana and Illinois for exchange. Southern and western exchanges preferred. Address, enclosing lists, L. N. Johnson, 223 Chicago Ave., Evanston, Ill.

For Exchange—Fourteen volumes Encyclopedia Britannica (Stoddard's ninth edition), bound in leather—part in original wrappers, all as new—can arrange to furnish volumes required to complete set, and six volumes "American Naturalist" in numbers. Want small screw-cutting foot lathe and testing galvanometer and rheostat. For particulars address A. B. Campbell, McKean Co., Bradford, Pa.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

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THE CHEROKEES IN PRE-COLUMBIAN TIMES.

I.

THE present paper is an attempt by the writer to trace back the history of a single Indian tribe into the prehistoric or mound-building age. For this purpose the Cherokees have been selected, partly because of their isolated position geographically and linguistically, and partly because the data bearing upon the questions that arise in such an investigation are probably more complete than those relating to any other tribe of the mound section.

Although the scope is thus limited, there are certain facts relating to the mound region and the aboriginal inhabitants thereof, considered generally, which must be taken into account in studying the history of any tribe of this region.

The history of the Western Continent is supposed to begin with the discovery by Columbus, all that antedates that event being considered archæologic or prehistoric. While this is correct in the general sense in which it is used, yet the history of the different sections and different tribes begins with the first knowledge of them obtained by Europeans. The border-line, therefore, between the historic and prehistoric eras, varies in date when referred to the different sections and peoples. For example, history tells us nothing of what was transpiring in the area now called Ohio for a hundred hears after Cortez landed in Mexico. If it be possible to ascertain this, it must be sought in the traditions of the aborigines, the ancient monuments, and other prehistoric data of that area.

It is well known that when the various sections of this country were first visited by Europeans, they were found occupied by Indian tribes; while, on the other hand, there is no historical or other evidence, unless it be found in the monuments, that any other race or people than the Indians ever occupied this region. The possibility of an Irish, Welsh, or Northmen pre-Columbian settlement is not at the present time taken into consideration, as it has no bearing on the subject now under discussion. These tribes all belonged relatively to the same state of culture, which was of a grade inferior to that of the more advanced nations of Mexico and Central America.

Though not recorded in written or printed tomes, these aboriginal tribes must have had a history which still lived to some extent in their traditions, languages, customs, arts, beliefs, and relics, when the whites first became acquainted with them. These languages, customs, etc., though belonging to a plane much lower than that which ethnologists will allow us to call civilized, were not the growth of a season or a lifetime, but of centuries. If they exhibit tribal or ethnic peculiarities, it may be taken for granted that these peculiarities attained their growth subsequent to the separation of the stock into the tribes among which they are found. If they are local or confined to certain geographical areas, it is reasonable to assume that they were adopted by the tribes after reaching these localities. For example: the peculiarities of the civilization of Mexico and Central America, as seen at the time of the discovery of these countries, must be considered indigenous, so long as we are unable to trace them to other sections or other peoples,—a conclusion adopted by leading historians and antiquarians. The same thing is true to a more limited extent in regard to the subdivisions of these comprehensive groups, and affords some basis for estimating the period of occupation.

Those habits, customs, or arts common among savage peoples, of course teach nothing in regard to the occupants of any special locality, except to indicate the culture status. It is therefore to those which are local or ethnic that we must look for guidance in our search.

A second fact relating to the mound region generally is, that the ancient remains found in it, though presenting various types and numerous important differences, probably the result of different local or tribal customs, are evidently the work of peoples in about the same stage of culture. But to this and other general lessons taught by the monuments there will be occasion to call attention further on.

In order to clearly understand the position of the Cherokees' relation to the other tribes in the mound area, we refer briefly to the linguistic distribution of these tribes when they first became known to the whites.

Stretching along the Atlantic coast from the mouth of the St. Lawrence to Pamlico Sound, and extending westward to the Mississippi, was the great Algonquin family, with its numerous divisions and branches. In the midst of this great linguistic sea, occupying most of what is now New York, and extending westward on both sides of [illegible] Lakes to Michigan (with a closely allied and also a distant offshoot— the latter the Cherokees—in the region of Carolina), [illegible] Huron-Iroquois family, with its various branches. [illegible] the head waters of the Mississippi, and reaching westw[illegible] far out upon the plains and southward to [illegible] Arkansas River, was the Dakotan family. Spread o[illegible] the Gulf States was the Muskokee group. Add to these the vestig[illegible] of other stocks found driven, so to speak, into the corners here and there, and we have a condition that could not have been of mushroom growth, but the outcome of centuries. It is quite probable that the family stems migrated from other sections; but the splitting into branches and dialects took place, in part at least, after reaching the area in which these

stocks were found. One proof of this is seen in the grouping and geographical distribution of the comprehensive families over the continent.

Judging by the growth of languages in Europe, although the cases are not exactly parallel, centuries must be allowed for this local development. It is said by those best qualified to judge, that the shifting, changing, and tribal development known to have taken place among the Dakotas of the North-west alone must have required three or four centuries in advance of the Columbian discovery. The necessary inference to be drawn from this is, that the tribes, or rather families of tribes, found inhabiting this "mound region" by the first European explorers, had occupied substantially the same area for hundreds of years previous thereto. Not that there was no shifting or changing of positions by tribes, for there can be no doubt that this occurred to a greater or less extent, but that the families or stocks mentioned, or most of them, were in the area included in the eastern half of the United States and Canada (which we designate in a broad sense the "mound region") for centuries preceding the advent of the white man.

The same method of reasoning will apply to some extent to the growth of customs, as this must also have required time. The result of this course of reasoning, which seems to be justified by the facts, is to force us to one of the following conclusions: 1st, That the mound-builders, if a different race or people from the Indians, disappeared from the mound area many centuries before the advent of the whites; or, 2d, That there was an overlapping of the two races, that is to say, they occupied the area jointly for some centuries; or, 3d, That the Indians were the authors of the ancient monuments. As it will be necessary in the course of this investigation to discuss the question of the authorship of some of these antiquities, the decision reached on this subject is important in this connection.

Turning now to the Cherokees, we will proceed with the special object of this paper.

It is conceded that there is no hope of reconstructing a systematic pre-Columbian history of any one of the tribes or peoples of the area under consideration. The utmost that can be expected is, by a careful and thorough correlation of the data, to throw some light into that past which has so long been considered as wrapped in impenetrable mystery. It is by no means probable that as much will be accomplished in regard to the past of the people of this region as has been done for Mexico and Central America, yet it is the belief of the writer that much more is possible in this direction than has generally been supposed.

This tribe was for a long time a puzzling factor to students of ethnology, as they were in doubt whether to con- [illegible] abnormal offshoot from one of the well-known [illegible] stocks or the remnant of some undetermined or ex- [illegible] family. It now appears, however, to be the clearly settled opinion of linguists that the language is an offshoot of the Huron-Iroquois stock. This is an important fact in the study of the past, not only of this tribe, but also of the family with which it is connected, as it necessitates looking to the same point for the origin of both.

When the people of this tribe first became known to the Europeans, they were located in the mountainous region including the south-east corner of what is now Tennessee, the south-west portion of North Carolina, the north-west part of South Carolina, and a strip along the northern border of Georgia,—a section which they continued to occupy down to a recent date, and where a remnant may still be found.

The first notice of them is found in the chronicles of De Soto's expedition, which speak of them as the "Chelaques" or "Achelaques," words which give more correctly the sound of the name they gave themselves than the modern Anglicized form "Cherokee." These early records locate them about the head waters of the Savannah River. The exact route of the Spanish expedition has not been satisfactorily determined; nevertheless it is conceded by those best qualified to decide, that, when De Soto encountered people of this tribe, he was somewhere about the head waters of the Savannah, probably in the north-eastern part of Georgia. It was in this section, presumably in western North Carolina, that John Lederer encountered them during his visit to this part of the continent in 1669–70, for there can be no longer any reasonable doubt that he alludes to them where he speaks of the Indians of the "Apalatian Mountains." Their subsequent history is too well known to require further mention here.

Their relation to the Iroquois indicates a northern rather than a southern or south-western origin. This seems to be confirmed by the few rays of light which tradition, the records, and archæology throw upon their past history. Haywood states, in his "Natural and Aboriginal History of Tennessee," that they "were firmly established on the Tennessee River or Hogohega (the Holston) before the year 1650, and had dominion over all the country on the east side of the Alleghany Mountains, which includes the head waters of the Yadkin, Catawba, Broad River, and the head waters of the Savannah,"—a statement borne out by the fact that as late as 1756, when the English built Fort Dobbs on the Yadkin, not far from Salisbury, they first obtained the privilege of doing so by treaty with Atacullaculla, the Cherokee chief. The same authority states that they formerly had temporary settlements on New River (the Upper Kanawha) and on the head waters of the Holston. In De Lisle's maps, 1700 to 1712, Cherokee villages are located on the extreme head waters of the Holston and Clinch Rivers, as well as on and about the mouth of the Little Tennessee.

Their traditions in regard to their migrations are somewhat confused, and, like all Indian traditions, must be taken only with careful sifting, and where strengthened by corroborative evidence or well-marked indications of being ancient. Yet there is a uniformity in some respects which, independent of other evidence, would justify the assumption that they contain a vein of truth and have some basis of fact.

One of the most important of these is that mentioned by John Haywood in the work above named, in which they claim to have formerly lived in the Ohio valley, and to have constructed the Grave Creek mound and other earthworks in that section. This author's statement is as follows:—

"The Cherokees had an oration in which was contained the history of their migrations, which was lengthy." This related "that they came from the upper part of the Ohio, where they erected the mounds on Grave Creek, and that they removed hither [East Tennessee] from the country where Mon-

ticello is situated." This tradition of their migrations was, it seems, preserved and handed down by their official orators, who repeated it annually in public at the national festival of the green-corn dance. Haywood adds, "It is now nearly forgotten;" and Dr. D. G. Brinton informs us, in "The Lenape and their Legends," that he has endeavored in vain to recover some fragments of it from the present residents of the Cherokee nation.

Haywood asserts, probably from original statements made to him, that "before the year 1690 the Cherokees, who were once settled upon the Appomattox River in the neighborhood of Monticello, left their former abodes, and came to the West. The Powhatans are said by their descendants to have once been a part of this nation. The probability is that a migration took place about or soon after the year 1632, when the Virginians suddenly and unexpectedly fell upon the Indians, killing all they could find, cutting up and destroying their crops, and causing great numbers to perish by famine. They came to New River and made a temporary settlement, and also on the head of the Holston."

It is obvious that in this passage the author has given his conclusion based on the "oration" mentioned, connecting with it the historical event of the sudden onslaught by the Virginia settlers upon the Indians, in 1632. That his deduction in this respect is erroneous if intended to apply to the whole tribe, is apparent from the following facts: first, because it is evident that a portion, at least, of the tribe was located in their historic seat, in and about East Tennessee and western North Carolina, when De Soto passed through the northern part of Georgia in 1540, as it is admitted that the "Chelaques" or "Achelaques" mentioned by the chroniclers of his expedition were Cherokees; second, because John Lederer, who visited this region in 1669–70, speaking of the Indians of the "Apalatian Mountains,"—doubtless the Cherokees, as he was at that time somewhere in western North Carolina,—says, in his "Discoveries," "The Indians of these parts are none of those which the English removed from Virginia, but were driven by an enemy from the north-west and invited to fix here by an oracle, as they pretend, above four hundred years ago;" third, from what is shown by the archæologic evidence which will be introduced further on.

The language of Lederer indicates that he had heard substantially the same tradition as that of which Haywood speaks. An important addition, however, is the supposed date of this migration, which this author says was "above four hundred years" preceding the date at which he writes (1671–72), which would place it in the latter part of the thirteenth century. The tradition as given by Haywood brings them from the valley of the Upper Ohio; that by Lederer, from the north-west,—a close agreement as to the direction of their former home.

It is doubtful whether any importance is to be attached to Haywood's statement that there was formerly a settlement in the vicinity of Monticello, Va. It is possible, that, during the migration toward the south-east, a party or clan broke off from the main body of the tribe, and settled in that region, where they remained until the general attack by the whites in the early part of the seventeenth century. Mr. Royce, in his paper on the "Cherokee Nation of Indians," in the "Fifth Annual Report of the Bureau of Ethnology," gives a tradition preserved among the Mohicans (or Stockbridges) which he suggests may have some bearing on this question. It is that "many thousand moons ago, before the white men came over the great water, the Delawares dwelt along the banks of the river that bears their name. They had enjoyed a long era of peace and prosperity, when the Cherokees, Nanticokes, and some other nation whose name had been forgotten, envying their condition, came from the south with a great army, and made war upon them. They vanquished the Delawares, and drove them to an island in the river. The latter sent for assistance to the Mohicans, who promptly came to their relief, and the invaders were in turn defeated with great slaughter, and put to flight. They sued for peace, and it was granted on condition that they should return home and never again make war on the Delawares or their allies. These terms were agreed to, and the Cherokees and Nanticokes ever remained faithful to the conditions of the treaty."

Passing over the improbability that a marauding party forced to fly would stop and sue for peace, the tradition may, after all, have some basis of fact, as there is nothing improbable in the supposition that a band of Cherokees went north from the banks of the Holston or Kanawha as far as the Delaware on a war expedition.

What is supposed to be the earliest notice of this tribe through the settlers of Virginia is that given by the historian Burke. According to this author, Sir William Berkely, governor of that State, sent out in 1667 an expedition consisting of fourteen whites and an equal number of friendly Indians, under command of Capt. Henry Blatt, to explore the mountainous region to the west. After seven days' travel from their point of departure at Appomattox, they reached the foot of the mountains. The first ridge they crossed is described as being neither very high nor steep; but the succeeding ones, according to their statement, "seemed to touch the clouds," and were so steep that an average day's march while passing over them did not exceed three miles. After passing beyond the mountains they came into a level region, through which a stream flowed in a westward course. Following this for a few days, they reached some old fields and recently deserted Indian cabins. Beyond this point their Indian guides refused to proceed, alleging that not far away dwelt a powerful tribe that never suffered strangers who discovered their towns to return alive: consequently the party was forced to return. It is believed by some authorities that the powerful nation alluded to in the narrative of this expedition was the Cherokees.

It is probable that the point reached was what is now Floyd or Montgomery County, and that the Indians so much dreaded were located on New River or the extreme head waters of the Holston.

Another tradition related by Haywood is that one party or band of the tribe came to their mountain home from the neighborhood of Charleston, S.C., and settled south of the Little Tennessee, near what is now the Georgia line. The people of this branch called themselves "Ketawanga," and came last into the country.

Another tradition is, that when they first came into this region they found it uninhabited with the exception of a Creek settlement on the Hiawassee River. Ramsey, upon what authority is not known, says this was a Uchee settlement.

It is apparent that all these traditions, except that relating to a clan from the neighborhood of Charleston, point to some northern locality as the former home of the tribe, and that in this respect they correspond with the linguistic indications. But these do not exhaust the evidence bearing on this question, as there is a tradition of another nation, and in this case one of the best known and most reliable of all Indian traditions, which agrees with the others in this respect. This is the Delaware legend regarding their ancestral home and migrations. The earliest writer who gives a detailed statement of it is the Rev. Charles Beatty, who visited the Delaware settlements in Ohio in 1767. According to this authority, "of old time their people were divided by a river, nine parts of ten passing over the river and one part remaining behind; that they knew not, for certainty, how they came to this continent; but account thus for their first coming into these parts where they are now settled; that a king of their nation, where they formerly lived, far to the west, left his kingdom to his two sons; that the one son making war upon the other, the latter thereupon determined to depart and seek some new habitation; that accordingly he sat out accompanied by a number of his people and that, after wandering to and fro for the space of forty years, they at length came to Delaware River where they settled three hundred and seventy years ago. The way they keep an account of this is by putting a black bead of wampum every year on a belt they keep for that purpose."

The reason for mentioning this brief notice of the tradition, rather than relying entirely on the fuller account given below, is that it mentions a date purporting to be derived from the Indians.

The tradition as given by Heckwelder, who heard it from the Delawares themselves, and had the advantage of their interpretation and comments, is as follows:—

"The Lenni Lenape (according to the tradition handed down to them by their ancestors) resided many hundred years ago in a very distant country in the western part of the American continent. For some reason which I do not find accounted for, they determined on migrating to the eastward, and accordingly set out together in a body. After a very long journey and many nights' encampment by the way, they at length arrived on the *Namaesi-Sipu*, where they fell in with the Mengwe, who had likewise emigrated from a distant country and had struck upon this river somewhat higher up. Their object was the same with that of the Delawares: they were proceeding on to the eastward until they should find a country that pleased them. The spies which the Lenape had sent forward for the purpose of reconnoitring, had, long before their arrival, discovered that the country east of the Mississippi was inhabited by a very powerful nation, who had many large towns built on the great rivers flowing through their land. Those people (as I was told) called themselves *Talligew* or *Tallegewi*. . . . Many wonderful things are told of this famous people. They are said to have been remarkably tall and stout; and there is a tradition that there were giants among them, people of a much larger size than the tallest of the Lenape. It is related that they had built to themselves regular fortifications or intrenchments, from whence they would sally out, but were generally repulsed. I have seen many of the fortifications said to have been built by them, two of which in particular were remarkable. One of them was near the mouth of the River Huron, which empties itself into the Lake St. Clair on the north side of that lake, at the distance of about twenty miles north-east of Detroit. This spot of ground was, in the year 1776, owned and occupied by a Mr. Tucker. The other works, properly intrenchments, being walls or banks of earth regularly thrown up, with a deep ditch on the outside, were on the Huron River, east of the Sandusky, about six or eight miles from Lake Erie. Outside of the gateway of each of these two intrenchments, which lay within a mile of each other, were a number of large flat mounds, in which, the Indian pilot said, were buried hundreds of the slain Tallegwi whom I shall hereafter, with Col. Gibson, call Allegewi. Of these intrenchments, Mr. Abraham Steiner, who was with me at the time when I saw them, gave a very accurate description, which was published at Philadelphia in 1789 or 1790, in some periodical work the name of which I cannot at present remember.

"When the Lenape arrived on the banks of the Mississippi, they sent a message to the Alligewi to request permission to settle themselves in their neighborhood. This was refused them, but they obtained leave to pass through the country and seek a settlement farther to the eastward. They accordingly began to cross the Namaesi-Sipu, when the Allegewi, seeing that their numbers were so very great, and in fact they consisted of many thousands, made a furious attack upon those who had crossed, threatening them all with destruction if they dared to persist in coming over to their side of the river. Fired at the treachery of these people and the great loss of men they had sustained, and, besides, not being prepared for a conflict, the Lenape consulted on what was to be done,—whether to retreat in the best manner they could, or to try their strength and let the enemy see that they were not cowards, but men, and too high-minded to suffer themselves to be driven off before they had made a trial of their strength and were convinced that the enemy was too powerful for them. The Mengwe, who had hitherto been satisfied with being spectators from a distance, offered to join them on condition that after conquering the country they should be entitled to share it with them. Their proposal was accepted, and the resolution was taken by the two nations to conquer or die.

"Having thus united their forces, the Lenape and Mengwe declared war against the Alligewi, and great battles were fought, in which many warriors fell on both sides. The enemy fortified their large towns and erected fortifications, especially on large rivers or near lakes, where they were successfully attacked and sometimes stormed by the allies. An engagement took place in which hundreds fell, who were afterwards buried in holes, or laid together in heaps and covered over with earth. No quarter was given, so that the Allegewi at last, finding that their destruction was inevitable if they persisted in their obstinacy, abandoned the country to the conquerors, and fled down the Mississippi River, from whence they never returned.

"The war which was carried on with this nation lasted many years, during which the Lenape lost a great number of their warriors, while the Mengwe would always hang back in the rear, leaving them to face the enemy. In the end the conquerors divided the country between themselves. The Mengwe made choice of the lands in the vicinity of the

Great Lakes and on their tributary streams, and the Lenape took possession of the country to the south. For a long period of time, some say many hundred years, the two nations resided peacefully in this country, and increased very fast. Some of their most enterprising huntsmen and warriors crossed the great swamps, and, falling on streams running to the eastward, followed them down to the great bay river (meaning the Susquehanna, which they call the great bay river from where the west branch falls into the main stream), thence into the bay itself, which we call Chesapeake. As they pursued their travels partly by land and partly by water, sometimes near and at other times on the great salt-water lake, as they call the sea, they discovered the great river which we call the Delaware."

If this tradition has any foundation in fact (and it certainly seems to have), there must have been a people to whom the name "Tallegwi" was applied, for on this a large portion of it hangs. Who were they? Is it possible to trace them to any tribe of modern times? The supposition of Col. Gibson mentioned by Heckwelder, that the name survives in "Alleghany," applied to the chief river and mountains of western Pennsylvania, is not generally accepted by linguists of the present day. Heckwelder was of opinion that "Talligewi" was a word foreign to the Algonquin, which was simply adopted by the Delawares. Dr. Brinton says, "It is not necessarily connected with Alleghany, which may be pure Algonquin. He (Heckwelder) says, 'Those people called themselves Talligeu or Talligewi.' The accent as he gives it, 'Talligéwi,' shows that the word is Tallike, with the substantive verb termination, so that Talligewi means 'He is a Tallike' or 'It is of (belongs to) the Tallike'" ("The Lenape and their Legends," p. 320).

Heckwelder's account, no doubt colored to some extent by his own interpretation, varies slightly from the tradition as given in the "Walam Olum." He interprets *Namaesi-Sipu* by "Mississippi" because of his opinion that the migration was from the west. It is more probable that Mr. Hale is correct in assuming that it was some portion of the great river of the north (the St. Lawrence) which connects together and forms the outlet for the Great Lakes, possibly that portion which connects Lake Huron with Lake Erie. If this supposition be accepted, it would lead to the inference that the Talamatan—the people who joined the Delawares in their war with the Tallegwi—were Hurons or Huron-Iroquois previous to separation. Mr. Hale's views on this question are expressed in the *American Antiquarian*, April, 1883, as follows:—

"The country from which the Lenape migrated was Shinake, the 'land of fir-trees;' not in the west, but in the far north,—evidently the woody region north of Lake Superior. The people who joined them in the war against the Allighewi (or Tallegwi, as they are called in this record) were the Talamatan, a name meaning 'not of themselves,' whom Mr. Squier identifies with the Hurons, and no doubt correctly, if we understand by this name the Huron-Iroquois people as they existed before their separation. The river which they crossed was the Messeesipe, the 'Great River' beyond which the Tallegwi were found 'possessing the east.' That this river is not the Mississippi is evident from the fact that the works of the mound-builders extended far to the westward of the latter river, and would have been encountered by the invading nations if they had approached it from the west long before they had arrived at its banks. The great river was apparently the Upper St Lawrence, and most probably that portion of it which flows from Lake Huron to Lake Erie, and which is commonly known as the Detroit River. Near this river—according to Heckwelder, at a point west of Lake St. Clair, and also at another place just south of Lake Erie—some desperate conflict took place. Hundreds of slain Tallegwi, as he was told, were buried under mounds in that vicinity. This precisely accords with Cusick's statement that 'the people of the great Southern Empire had already penetrated to Lake Erie' at the time the war began. Of course, in coming to the Detroit River from the region north of Lake Superior, the Algonquins would be advancing from the west to the east. . . . The passage already quoted from Cusick's narrative informs us that the contest lasted perhaps one hundred years. In close agreement with this statement, the Delaware record makes it endure during the term of four head chiefs, who in succession presided in the Lenape councils.

The passages of the Delaware record which refer to the Tallegwi, as translated by Dr. Brinton, are as follows:—

"They (the Lenape) separated at Fish River (Nemassipi, sometimes written Mistissippi); the lazy ones remained there.
Cabin-man was chief; the Tallegwi possessed the east.
Strong-Friend was chief; he desired the eastern land.
Some passed on east; the Talega ruler killed some of them.
All say in unison, 'War, war!'
The Talamatin, friends from the north, come and all go together.
The Sharp-one was chief; he was the pipe-bearer beyond the river.
They rejoiced greatly that they should fight and slay the Talega towns.
The Stirrer was chief; the Talega towns were too strong.
The Fire-builder was chief; they all gave to him many towns.
The Breaker-in-pieces was chief; all the Talega go south.
He-has-pleasure was chief; all the people rejoice.
They stay south of the lakes; the Talamatin friends north of the lakes."

Further on, and referring to a later period, are the following verses:—

"14. The Rich-Down-River-Man was chief, at Talega River.
. . . .
18. Snow-hunter was chief; he went to the north land.
19. Look-about was chief; he went to the Talega mountains.
20. East-Villager was chief; he was east of Talega.
. . . .
40. At this time whites came on the eastern sea.
. . . .
42. Well-Praised was chief; he fought at the south.
43. He fought in the land of the Talega and Koweta.
. . . .
45. White-Horn was chief; he went to the Talega,
46. To the Hilini, to the Shawnees, to the Kanawhas."

The reasons for identifying the Tallegwi or Talega of this tradition with the Cherokees, which will be more fully referred to hereafter, are briefly as follows: 1st, The very close agreement in sound between *Tsalake*, the name the Cherokees gave themselves, and *Tallegwi* or *Talega* as given in the tradition; 2d, The fact that the traditions of the Cherokees refer to the region of the Upper Ohio as their former home; 3d, The statement of Bishop Ettwein that the last of the Cherokees were driven from the Upper Ohio about the year 1700 (see Brinton's "Lenape and their Legends," p. 18); 4th, The testimony of the mounds; and,

5th, The apparent identification of the two peoples in the Walam Olum itself in verses 42 and 43, Part V., where it states that

> "Well-Praised was chief; he fought at the south.
> He fought in the land of the Talega and Koweta."

As this part of the record refers to a much later period than that heretofore quoted, a date subsequent to the appearance of the whites on the continent (verse 40, Part V.), there can be no doubt that it alludes to the Tallegwi in their southern home, to which, as stated in verse 59, Part IV., they had been driven. This supposition is apparently confirmed by the fact that it connects with them the Koweta, or Creeks. This, together with the statement that the fighting was at the south, would seem to imply that they were then in their mountain home or historic seat. It is probable, as will be shown hereafter, that where it is stated, in verses 19 and 20, that

> "Look-About was chief; he went to the Talega mountains;
> East-Villager was chief; he was east of Talega,"

their position in the Kanawha valley is referred to, where the evidence indicates that they halted for some time on their way south. CYRUS THOMAS.

KILIMA-NJARO.

DR. HANS MEYER, at a meeting of the Royal Geographical Society, London, on April 12, read a paper on his journey to the summit of Kilima-Njaro. As reported in *Nature*, after giving a short account of his expedition in 1887, and the discouragements to which he had been subjected on two subsequent efforts to carry out his programme, Dr. Meyer went on to say, that, while the main portion of the caravan encamped in Marangu, he ascended with Herr Purtscheller and eight picked men through the primeval forest to a stream beyond, where he had encamped in the year 1887, at an altitude of 9,200 feet. There their large tent was pitched, straw huts were built for the men, and firewood collected. Accompanied by four men, they travelled for two more days up the broad, grassy, southern slopes of Kilima-Njaro to the fields of rapilli on the plateau between Kibo and Mawenzi, and found there to the south-east of Kibo, under the protection afforded by some blocks of lava, a spot, at an altitude of 14,270 feet, well suited for the erection of their small tent. As soon as the instruments and apparatus had been placed under cover, three of the men returned to the camp on the edge of the forest; and only one, a Pangani negro, Mwini Amani by name, remained to share uncomplainingly their sixteen-days' sojourn on the cold and barren heights. With regard to their maintenance, it had been arranged that every third day four men should come up with provisions from the lower camp in Marangu to the central station on the edge of the forest, and that two of the men stationed there should thence convey the necessary food to them in the upper camp, returning immediately afterwards to their respective starting-places; and this, accordingly, was done. Firewood was supplied by the roots of the low bushes still growing there in a few localities, and their negro fetched a daily supply of water from a spring rising below the camp. In that manner they were enabled, as if from an Alpine Club hut, to carry out a settled programme in the ascent and surveying of the upper heights of Kilima-Njaro. The ice-crowned Kibo towered up steeply another 5,000 feet to the west of their camp, itself at an altitude of 14,300 feet. On Oct. 3 they undertook their first ascent. The previous day they had resolved to make the first attempt, not in the direction chosen by him in 1887, but up a large rib of lava which jutted out to the south-east, and formed the southern boundary of the deepest of the eroded ravines on that side of the mountain.

Their plan of operations, which they succeeded in carrying out, was to climb this lava-ridge to the snow-line, to begin from its uppermost tongue the scramble over the mantle of ice, and endeavor to reach by the shortest way the peak to the south of the mountain, which appeared to be the highest point. It was not till half-past seven o'clock that they reached the crown of that rib of lava which had been their goal from the very first, and, panting for breath, they began to pick their way over the bowlders and *débris* covering the steep incline of the ridge. Every ten minutes they had to pause for a few moments to give their lungs and beating hearts a short breathing space; for they had now for some time been above the height of Mont Blanc, and the increasing rarefaction of the atmosphere was making itself gradually felt. At an altitude of 17,220 feet they rested for half an hour. Apparently they had attained an elevation superior to the highest point of Mawenzi, which the rays of the morning sun were painting a ruddy brown. Below them, like so many mole-heaps, lay the hillocks rising from the middle of the saddle. A few roseate cumulus-clouds floated far over the plain, reflecting the reddish-brown laterite soil of the steppe; the lowlands, however, were but dimly visible through the haze of rising vapor. The ice-cap of Kibo was gleaming above their heads, appearing to be almost within reach. Shortly before ten o'clock they stood at its base, at an elevation of 18,270 feet above sea-level. At that point the face of the ice did not ascend, but almost immediately afterwards it rose at an angle of thirty-five degrees; so that, without ice-axes, it would have been absolutely impracticable.

The work of cutting steps in the ice began about half-past ten. Slowly they progressed by the aid of the alpine rope, the brittle and slippery ice necessitating every precaution. They made their way across the crevices of one of the glaciers that projected downwards into the valley which they had traversed in the early morning, and took a rest under the shadow of an extremely steep protuberance of the ice-wall at an altitude of 19,000 feet. On recommencing the ascent, the difficulty of breathing became so pronounced that every fifty paces they had to halt for a few seconds, bending their bodies forward, and gasping for breath. The oxygen of the air amounted there, at an elevation of 19,000 feet, to only 40 per cent, and the humidity to 15 per cent, of what it was at sea-level. No wonder that their lungs had such hard work to do. The surface of the ice became increasingly corroded. More and more it took the form which Güssfeldt, speaking of Aconcagua in Chili, called *nieve penitente*. Honeycombed to a depth of over six feet in the form of rills, teeth, fissures, and pinnacles, the ice-field presented the foot of the mountaineer with difficulties akin to that of a "Karrenfeld." They frequently broke through as far as their breasts, causing their strength to diminish with alarming rapidity. And still the highest ridge of ice appeared to be as distant as ever. At last, about two o'clock, after eleven hours' climb, they drew near the summit of the ridge. A few more hasty steps in the most eager anticipation, and then the secret of Kibo lay unveiled before them. Taking in the whole of Upper Kibo, the precipitous walls of a gigantic crater yawned beneath them. The first glance told that the most lofty elevation of Kibo lay to their left, on the southern brim of the crater, and consisted of three pinnacles of rock rising a few feet above the southern slopes of the mantle of ice.

They first reached the summit on Oct. 6, after passing the night below the limits of the ice, in a spot sheltered by overhanging rocks, at an altitude of 15,160 feet,—an elevation corresponding to that of the summit of Monte Rosa. Wrapped up in their skin bags, they sustained with tolerable comfort even the minimum temperature of 12° F., experienced during the night, and were enabled, about three o'clock on the morning of Oct. 6, to start with fresh energy on their difficult enterprise of climbing the summit; and this time Njaro, the spirit of the ice-crowned mountain, was gracious to them: they reached their goal. At a quarter to nine they were already standing on the upper edge of the crater, at the spot from which they had retraced their steps on Oct. 3. Their further progress from this point to the southern brim of the crater, although not easy, did not present any extraordinary difficulty. An hour and a

half's further ascent brought them to the foot of the three highest pinnacles, which they calmly and systematically climbed one after another. Although the state of the atmosphere and the physical strain of exertion remained the same as on the previous ascent, yet this time they felt far less exhausted because their condition morally was so much more favorable. The central pinnacle reached a height of about 19,700 feet, overtopping the others by 50 to 60 feet. Dr. Meyer was the first to tread, at half-past ten in the morning, the culminating peak. He planted a small German flag, which he had brought with him in his knapsack, upon the rugged lava summit, and christened that—the loftiest spot in Africa—"Kaiser Wilhelm's Peak." After having completed the necessary measurements, the travellers were free to devote their attention to the crater of Kibo, of which an especially fine view was obtainable from Kaiser Wilhelm's Peak. The diameter of the crater measured about 6,500 feet, and it sank down some 600 feet in depth. In the southern portion the walls of lava were either of an ash-gray or reddish-brown color, and were entirely free from ice, descending almost perpendicularly to the base of the crater; and in its northern half, the ice sloped downwards from the upper brim of the crater in terraces, forming blue and white galleries of varying steepness. A rounded cone of eruption, composed of brown ashes and lava, rose in the northern portion of the crater to a height of about 500 feet, which was partly covered by the more than usually thick sheet of ice extending from the northern brim of the crater. The large crater opened westwards in a wide cleft, through which the melting water ran off, and the ice lying upon the western part of the crater and the inner walls issued in the form of a glacier. What a wonderful contrast between this icy stream and the former fiery incandescence of its bed! And above all this there reigned the absolute silence of inanimate nature, forming in its majestic simplicity a scene of the most impressive grandeur. An indelible impression was created in the mind of the traveller to whom it had once been granted to gaze upon a scene like that, and all the more when no human eye had previously beheld it. And certainly, as they sat that evening in their little tent, which they finally reached at nightfall, after a most arduous return march through the driving mist, and carried their thoughts back to the expeditions of 1887 and 1888, they would indeed have changed places with no one. After giving further details of the expedition, Dr. Meyer said that on Oct. 30 they sorrowfully bade farewell to Kilima-Njaro, the most beautiful and interesting, as well as the grandest, region in the Dark Continent.

NOTES AND NEWS.

THERE are said to be at least a hundred thousand acres of phosphate rock scattered through the western part of the State of Florida. The deposits average ten feet in depth, and are rich in phosphate of lime.

— The new government dry-dock at the Brooklyn Navy Yard, which has been in process of construction a little more than two years, was formally opened on the 10th instant, the double-turret monitor "Puritan" being the first vessel docked. The dock is 530 feet long, with an extreme width of 130 feet 4 inches, and a depth of 32 feet 8 inches. The depth of water over the gate-sill at the entrance is 25 feet 6 inches at high water. The pumps have a capacity of 80,000 gallons per minute, and can empty the dock, when no vessel is in it, in an hour and a half.

— Summer courses for 1890 at Harvard University in the following-named subjects will be given: four courses in chemistry (viz., general elementary chemistry, qualitative analysis, quantitative analysis, and organic chemistry), a course in botany, two courses in physics (viz., elementary physics and a higher course in experimental physics), two courses in geology (viz., an elementary course given in Cambridge, and an advanced course given in the field in New York, Connecticut, and Massachusetts), three courses in French, two courses in German, two courses in field engineering (viz., topographical and railroad surveying), a course in physical training, courses in the Medical School. These courses are chiefly clinical, and are designed for graduates and advanced students. For information concerning all courses, except those in the Medical School, address the secretary of Harvard University, Cambridge, Mass. For information concerning the courses in the Medical School, address the secretary of the Harvard Medical School, Boston, Mass.

— The "Princess Louise," which arrived at Victoria, B.C., from Skidegate and way ports, on the evening of April 24, brought news that on Feb. 24 an earthquake shock was felt on all the islands around Skidegate, especially on the west coast of Queen Charlotte Islands, where a few old shanties were levelled to the ground. The totem-poles of the Indians shook like leaves, and in some places the earth was cracked. The shock lasted for about thirty seconds, during which time the Indians were wild with fright. A number of them ran to the church and crowded in. Since that time there have been about twenty different shocks, the last one being on the 12th of April, although none were near as severe as the first. A very slight shock was felt in the Skeena.

—State Geologist Winslow of Missouri made a report, May 6, to Gov. Francis, of the operations of his bureau during the month of April. During the month the work of the survey progressed most favorably, not having been interrupted by the variable conditions of weather which caused serious hinderance during the month of March. Excellent progress has been made in the detailed mapping of the coal-fields, so that now an area of over two hundred square miles has been covered, and is ready to be plotted on the final sheet. Field-work in connection with the investigation of the zinc and lead deposits was suspended early in April, and since that time Mr. Jenny and his assistant have been busy preparing a report of their operations and results, which will be published in a forthcoming bulletin. Early in April the investigation of the clay deposits in the vicinity of St. Louis was begun, and a reconnaissance of the area including these deposits is completed, and some samples are collected. Work in Iron and other south-eastern counties was interrupted in the early part of the month, but since then has been prosecuted continuously, and much has been accomplished in the systematic mapping of this section of the State. The examination of the mineral waters of the State has also made considerable advance. Springs have been visited in Henry, St. Clair, Benton, and Johnson Counties, and samples of water for analysis have been collected from a dozen different localities. During the month, Bulletin No. 1, the first publication of the survey, has been prepared, published, and distributed, nearly fifteen hundred copies having been sent out to people in the State and elsewhere. Cases for the State cabinet have been put up in one of the rooms of the survey, and are now nearly in a condition to receive specimens. The collections of the survey already include over eight hundred specimens. Some of these have been prepared, and will be labelled for exhibit in these cases.

—Mrs. Isabel Mallon has been added to the editorial staff of *The Ladies' Home Journal* of Philadelphia. Her new position makes her the best-paid fashion-writer in the country.

— Three cash prizes, of fifty, thirty, and twenty dollars respectively, are offered by *Public Opinion*, the eclectic weekly magazine of Washington, D.C., for the three best essays, not exceeding two thousand words, on the subject "The Study of Current Topics as a Feature of School, Academic, and College Education.' The papers must reach *Public Opinion* prior to June 15, and the award will be made by a committee of three well-known educators, to be selected and announced before the close of the competition. The prize essays will be published over the signatures o the writers July 5. Particulars of the contest may be had by addressing the editor of *Public Opinion*.

— Bulletin No. 1 of the Missouri Geological Survey, just issued, contains a report of the State geologist, Arthur Winslow, and an article by him on "The Coal-Beds of Lafayette County;" "The Building Stones and Clays of Iron, St. François, and Madison Counties," by G. E. Ladd; "The Mineral Waters of Saline County," by A. E. Woodward; and "A Preliminary Catalogue of the Fossils occurring in Missouri," by G. Hambach. This bulletin is the first of a series to be issued at intervals.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

MENTAL SCIENCE.

Motor Expression of Ideas.[1]

A great deal of study has lately been given to the phenomena of automatism in their various and perplexing forms. There has been accumulated a large number of the extreme cases in which persons write down quite elaborate sentences and are unconscious of doing so, and the view has been advanced that we have here the minute beginnings out of which develop these peculiar cases of the separation of personality into two or more *egos*. It is, however, the study of the more normal cases, in which the psychological factors are more easily analyzed, that seems to be promising of interesting and practical results. The typical experiment consists in fixing the attention of the subject in one direction, placing in his hand a pencil, and observing what will result if the hand holding the pencil be tempted to move. With some subjects there results a very clearly written word or words reflecting what was uppermost in their thoughts. The subject is often as surprised as any one, having no consciousness of what he had done. M. Gley, who has tried the experiment with a number of persons, offers the suggestion that this motor automatism may be a part of a general mental tendency. It is well known that some persons do their mental representation by visual pictures, others mainly by sounds, and a third variety by motor images. The last class would be represented by those who gesticulate as they speak, who think aloud as it were, who talk to themselves, and, in short, to whom thinking is action. It is likely that with such persons thought expresses itself in action more easily than in others, and hence this automatic writing becomes related to a better understood class of phenomena. The suggestion is capable of an experimental verification, and well deserves it.

[1] Bulletino de la Société de Psychologie Physiologique, 1889.

A New Use of Auto-Suggestion.[1]

The acting-out of a suggestion imposed upon an hypnotic subject by the hypnotizer has been compared to the self-imposing of a task or a vow. In both cases there is more or less possibility of the suggestion failing to be enacted, depending largely on the opposition to the normal habits and powers of the individual that the suggestion arouses. This power is very different in different persons, and we have a good illustration of it in the relative difficulty different persons have of suggesting themselves to sleep at night. It is similarly possible to train a good hypnotic subject to put himself to sleep either by imagining that the operator were doing it or by observing a certain ceremony, and so on. A large part of the wonderful cures so constantly brought before the public may be viewed as instances of auto-suggestion. Dr. Burot has shown that this power may be utilized in cases of crime hypnotically suggested. A patient wishing to be hypnotized oftener than he could be attended to, was taught to hypnotize himself, and with good success. The suggestion was given to him to commit a theft, which he promptly did. Upon awakening, he forgot all about it, and it was impossible to get him to acknowledge the deed. He was then told to hypnotize himself for the purpose of recalling the circumstances of the case. He awoke, and voluntarily told the whole story just as it happened. The same experiment was successfully made upon other subjects; and the conclusion drawn by Dr. Burot is, that auto-suggestion offers a safe and useful method of discovering the hypnotic origin of a crime.

An Interesting Case of Brain Localization.[1]

There is in Paris a mutual autopsy society, each member of which pledges his body to be dissected after his death by the rest. Special attention is given to the brain, and the society is composed of well known scientists. In this way M. Manouvrier made a careful study of the brain of M. Adolphe Bertillon, and in a supplementary note calls attention to a few peculiarities of special interest. It appears that M. Bertillon was deaf in the left ear, and had been so from infancy. The sense of hearing having been localized in the first temporal convolution, this part of the brain on both sides was examined to see whether there was any difference in the development of the two halves of the brain. It was found that while on the left side this convolution was well developed, with a number of slight ridges and furrows in it, on the right side it was smaller and without these characteristics (the centre for each ear is located in the opposite hemisphere of the brain). While, of course, a single observation of this kind is far from conclusive, yet the method is one promising to corroborate generalizations otherwise reached, and to suggest and explain peculiarities based upon the individual capabilities.

Visualized Sounds.

A correspondent of *Nature* sends an interesting account of association of visual images with the sounds of musical instruments. "The sound of an oboe brings before me a white pyramid or obelisk, running into a sharp point; the point becoming more acute if the note is acute, blunter if it is grave. The obelisk appears to be sharply defined and solid if the note is loud, and vague and vaporous if it is faint. All the notes of the 'cello, the high notes of the bassoon, trumpet, and trombone, and the low notes of the clarinet and viola, make me see a flat undulating ribbon of strong white fibres. The tone of the horn brings before me a succession of white circles of regularly gradated sizes, overlapping one another. These circles and the ribbon float past me horizontally, but the point of the obelisk seems to come to me." The writer adds, that, though she has been accustomed to hearing music all her life, these effects have been noticed only for five years, in which time they have become more frequent and clearer. If she is familiar with the score of a piece, these visualizations seem to slightly precede the actual sounds. The images are distinctly

seen floating about half way between the seer and the orchestra. While the explanation of these peculiar associations is as yet very defective, the possibility of their anticipating the sounds and their comparatively recent growth, are interesting features of his case, from which a possible explanation might proceed.

Physical and Mental Powers.

A number of physical measurements have been made upon 2,134 Cambridge students within the past few years, and Dr. Venn has tabulated these for the purpose of comparing mental with physical faculty. The measurements taken were the distance at which "diamond" type could be read; the maximum pull exerted, as in the act of stretching a bow; the maximum squeeze of each hand; the head volume, which is the product of the extreme length, by the extreme breadth, by the height above a given plane; the lung capacity; and the height and weight. The men were further classified according to scholarship in three grades, *A*, *B*, and *C*, and the averages of all the measurements were separately tabulated for the three grades. As comparatively large and homogeneous groups are dealt with, any correlation of superior physical with superior mental capacity should be evident. The tables, however, show that there is no practical difference in any of the physical averages between the three grades, except in one respect, the strength of pull. Here the lowest grade has the largest average, while the highest grade has the lowest. Dr. Venn interprets this to mean that each grade of students has about the same general physical development, but that strength of pull is something that results from special devotion to athletic sports, and that it is the men who do not devote themselves so assiduously to scholarship who have most time and inclination to develop this side of their physical culture. One other distinction is also noteworthy: it is that the head volume of the first grade in scholarship is greater than in the lowest grade. The difference amounts to about one-seventh of the size of the head. How important this fact may be must be determined by future statistics. When tabulated according to age (nine-tenths of the men are between nineteen and twenty-four years of age), it seems clear that the heads of university students keep on growing at least until the age of twenty-four, while in the population generally the growth stops at nineteen years. The height of the physical powers seems to be attained at the twenty-second or the twenty-third year. While these results are in agreement with the modern theory of the relation of mind and body, they show the necessity of distinctive measurements and careful interpretation, if sure results are to be obtained.

HEALTH MATTERS.

Nose-Bleed.

OBSTINATE nose-bleeding is frequently one of the most difficult things to check. Several aggravated cases have lately occurred at the Hospital of the University of Pennsylvania. As a last resort, Dr. D. Hayes Agnew tried ham-fat with great success. Two large cylinders of bacon were forced well into the nostrils, and the hemorrhage ceased at once. This is a very simple remedy, and one which should be remembered for cases of emergency in the country.

Ground-Water and Typhus.

It is well known that a connection has been observed (in Munich and other towns) between ground-water and typhus; the disease gaining force as the water goes down, and declining as the water rises. It is thought that certain decompositions are favored by air taking the place of water in the ground. While in former years Hamburg has exemplified this effect, says *Nature*, the last typhus epidemic there, according to Professor Brückner, was quite in discordance with the variations of ground-water. From 1838, it is stated, the typhus mortality in Hamburg steadily fell from 19 to 2 or 3 per 1000; but from 1885 it rose again to 9; and whereas before 1885 the epidemic was a summer one, with its maximum in August, it now became a winter one, with maximum in December. The curve of ground-water continued to have the same course as before. Professor Brückner points out that this epidemic of 1884–87 corresponded in time with certain harbor works being carried out at Hamburg; and he attributes it to the upturning of enormous masses of earth, the abode of numberless bacteria, whose diffusion among the inhabitants was thus facilitated.

The Physiology of Taste.

The localization of the different forms of taste sensations is a subject which is usually cursorily passed over in text-books, with the statements that the posterior third, the tip, and sides of the tongue only are sensitive; that sweet substances are best perceived by the tip, bitter ones at the back; and so on. In a German medical journal is an abstract of interesting observations by Oehrwall, who, by the aid of a lens, stimulated the individual papillæ by means of a fine brush dipped in solutions of sugar, quinine. acetic acid, and salt. He found that, as had before been observed, the circumvallate papillæ were particularly sensitive, but that on the sides and tip the fungiform papillæ only were sensitive. He estimated that in the whole tongue there were 350 to 400 of these papillæ, of which he found 125 only to respond to stimuli. Many of them appeared to be excited by all four of the substances employed, but in other cases papillæ were found to respond to one form of stimulus but not to another. Thus nineteen per cent responded to acetic acid, but not to sugar; twenty-four per cent which were sensitive to acid were unaffected by quinine; while fifteen per cent which recognized sugar did not respond at all to the application of quinine. All of the papillæ were sensitive to touch, pain, heat, and cold. When stimulated by a mild faradic current, an acid taste only was excited. He confirmed the observations of older authors, that most of the anterior two-thirds of the dorsum of the tongue was devoid of gustatory papillæ.

The Pre-Frontal Region of the Brain.

Modern physiologists, says a Berlin correspondent of the *Lancet*, regard the pre-frontal part of the brain as the seat of character and intellect. After the removal of this part in dogs and monkeys, no paralysis of any muscles or loss of sensibility occurs, but singular changes in the behavior, emotions, and character of the animals have been observed. They become livelier, restless, impatient, irritable, quarrelsome, and violent. Their movements seem purposeless, and their attention to what is going on around them, and their intelligence, are diminished. These observations have been confirmed by similar phenomena in the case of human beings. The well-known "Crowbar case," described by the American physician Dr. Harlow, is one in point. A young man was busy tamping a bursting-charge into a rock with a pointed iron rod, when the charge suddenly exploded and the rod entered his head under the angle of the lower jaw, came out in the frontal region, and was found some distance off, covered with blood and brain-substance. He became childish, wilful, fickle, and restless, and suffered loss of intellectual power. Gradually, however, these symptoms disappeared: he recovered, and lived for thirteen years. His skull is preserved in Harvard University.

Gastric Juice and Pathogenic Germs.

Drs. Kurlow and Wagner, in a paper on "The Influence of Gastric Juice on Pathogenic Germs," which they publish in the *Vrach*, describe some interesting experiments which they have made on this subject, from which they are led to the conclusion that constant or specific microbes do not exist in the stomach; and those which enter it, together with sputum, food, or other ingesta, are only accidental and temporary residents, and cannot live in the normally acid contents of the stomach. Gastric juice is, according to the authors' experiments, an exceedingly strong germicidal agent, and when living bacilli get into the intestinal canal it is due to various conditions entirely independent of the gastric juice. When the latter is normal and in full activity, only the most prolific microbes, such as tubercle bacilli, the bacilli of anthrax, and perhaps the staphylococci, escape its destructive action; all others are destroyed in less than half an hour. Similar influences exist in the intestines, as proved by inoculations with the cholera bacilli. On the latter subject the authors intend making further experiments.

Caisson or Tunnel Disease.

As one of the New York members of the board of consultants of St. Francis Hospital, Jersey City, J. Leonard Corning, M.A., M.D., of New York, had the rare opportunity of studying a number of cases of that remarkable affection known as the "caisson" or "tunnel disease," which he reported in the *Medical Record* for May 10, 1890. The disease is an affection of the spinal cord, due to a sudden transition from a relatively high atmospheric pressure to one much lower. Hence, those who work in caissons, or submerged tunnels, under an external pressure of two atmospheres or more, are liable to be attacked by the disease shortly after leaving the tunnel. The seizure never, however, occurs while the subject is in the caisson, or, in other words, while he remains under pressure.

The chief clinical features of the disease are pain, which may be relatively mild, as when confined to some portion of one or more extremities, or of frightful intensity, as when it appears in the ears knees, back, or abdomen; anæsthesia and paralysis, usually of paraplegic type; bladder symptoms, assuming the form of retention or incontinence; and, more rarely, rectal disturbances (usually incontinence).

In cases of moderate severity the patient usually recovers in a few days or weeks, while in the very severe ones he gradually loses strength, and eventually succumbs. Besides these extreme phases of the disease, there is an intermediate class of cases in which the patient, though grievously ill, may recover sufficiently to get about with sticks, or even unassisted. In these cases recovery is, however, but partial, the subject remaining more or less feeble and hyperæsthetic during the remainder of his life.

Since Triger, a French engineer, first described the characteristic pains of the caisson-disease in 1841, the affection has several times received attention at the hands of European physicians who were in a position to observe it in connection with the diving-bell, bridge-building, mining, and other operations requiring the use of compressed air.

In the United States several opportunities of studying the disease have occurred during the last few years. The most noteworthy of such occasions were the construction of the St. Louis Bridge in 1868, the Brooklyn Bridge at New York about the same time, and the Hudson River Tunnel at a later date.

The Inefficiency of Sand Filters.

Drs. Frankel and Piefke of Berlin have recently made an exhaustive study on the filtration of drinking-water through sand (*Zeitschrift für Hygiene*, No. 1, 1890). Their experiments conclusively prove, says *Medical News*, that the danger of infection from impure water is only slightly reduced by filtration through sand; bacteria passing through at all times, but in larger numbers just after the filter has been cleaned, and again after it has been in use for some time.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Census of Hallucinations.

MAY I ask for the publicity of your pages to aid me in procuring co-operation in a scientific investigation for which I am responsible? I refer to the "Census of Hallucinations," which was begun several years ago by the Society for Psychical Research, and of which the International Congress of Experimental Psychology at Paris, last summer, assumed the future responsibility, naming a committee in each country to carry on the work.

The object of the inquiry is twofold: 1st, to get a mass of facts about hallucinations which may serve as a basis for a scientific study of these phenomena; and, 2d, to ascertain approximately the proportion of persons who have had such experiences. Until the average frequency of hallucinations in the community is known, it can never be decided whether the so-called "veridical" hallucinations (visions or other "warnings" of the death, etc., of people at a distance) which are so frequently reported, are accidental coincidences or something more.

Some eight thousand or more persons in England, France, and the United States, have already returned answers to the question which heads the census-sheets, and which runs as follows:—

"Have you ever, when completely awake, had a vivid impression of seeing or being touched by a living being or inanimate object, or of hearing a voice; which impression, so far as you could discover, was not due to any external physical cause?"

The congress hopes that at its next meeting, in England in 1892, as many as fifty thousand answers may have been collected. It is obvious that for the purely statistical inquiry, the answer "No" is as important as the answer "Yes."

I have been appointed to superintend the census in America, and I most earnestly bespeak the co-operation of any among your readers who may be actively interested in the subject. It is clear that very many volunteer canvassers will be needed to secure success. Each census-blank contains instructions to the collector, and places for twenty-five names; and special blanks for the "Yes" cases are furnished in addition. I shall be most happy to supply these blanks to any one who will be good enough to make application for them.

WM. JAMES.

Harvard University, Cambridge, Mass., May 10.

The Winnebago County (Iowa) Meteorites.

ON Friday evening, May 2, 1890, at 5.15 P.M., standard western time, a meteor was observed over a good part of the State of Iowa, and is described as a bright ball of fire, moving from west to east, leaving a trail of smoke which was visible for some minutes. It was accompanied by a noise likened to that of heavy cannonading or of thunder; and many people rushed to the doors, thinking it was the rumbling of an earthquake. Substantiated reports have been received from Des Moines, Mason City, Fort Dodge, Emmetsburg, Algonia, Ruthven, Brett, and Forest City. The noise was also heard at Sioux City. Some of these places were at a distance of over a hundred miles from the point where the meteor fell. It exploded about eleven miles north of Forest City, Winnebago County, in the centre of the nortnern part of Iowa, latitude 43° 15′, longitude 93° 45′ west of Greenwich, near the Minnesota State line. The fragments were scattered over a considerable surface of ground. Up to the present time, there have been found a 104-pound, a 70-pound, and a 10-pound mass, and a number of fragments weighing from one to twenty ounces each; and a part of the main mass of the meteorite is believed to have passed over into Minnesota. The pieces are all angular, with rounded edges.

This meteorite is a typical chrondite, apparently of the type of the Parnallite group of Meunier, which fell Feb. 28, 1857, at Parnallee, India. The stone is porous, and when it is placed in water to ascertain its specific gravity, there is a considerable ebullition of air. The specific gravity, on a fifteen-gramme piece, was found to be 3.638. The crust is rather thin, opaque black, not shining, and, under the microscope, is very scorious, resembling the Knyahinya (Hungary) and the West Liberty (Iowa) meteoric stones. A broken surface shows the interior color to be gray, spotted with brown, black, and white; the latter showing the existence of small specks of meteoric iron from one-tenth to four-tenths of a millimetre across. Troilite is also present in small rounded masses of about the same size. On one broken surface was a very thin seam of a soft black substance, evidently graphite (?), and soft enough to mark white paper; a felspar (anorthite?) was also observed, and enstatite was also present. I present a paper on this meteorite at the meeting of the New York Academy of Sciences, May 12, and will give full particulars at the next meeting.

This is the fourth meteorite that has been seen to fall in Iowa. The other three falls were as follows: at Hartford, Linn County, Feb. 25, 1847; at West Liberty, Iowa County, Feb. 12, 1875; and the great fall of siderolites at Estherville, Emmet County, May 10, 1879, which fall comprised over two thousand pieces weighing from a tenth of an ounce to four hundred pounds.

GEORGE F. KUNZ.

New York, May 8.

A REMARKABLE meteor, or meteoric shower, passed over this State at 5.30 P.M., Friday, May 2. In spite of the brightness of the sun, shining at the time in a nearly cloudless sky, the light of the meteor was very noticeable. Its great size, powerful illumination, discharge of sparks, comet-like tail three to five degrees in length, and the great train of smoke which marked its course for a full ten minutes after its passage, made a strong and lasting impression on the minds of all who saw it. Unfortunately the clamor over an exciting game of ball prevented the many members of the college who saw it from making as careful observations as they would otherwise have done: so it was impossible to tell whether its passage was accompanied by sound or not, although farmers near here report a faint hissing noise. It appeared to enter the atmosphere about twenty to thirty degrees south of the zenith, and, descending at an angle of about fifty to sixty degrees, passed below the horizon north-north-west of this place. By telegraphing, one small meteorite weighing one-fifth of a pound, and several fragments from a 70-pound one, were secured, and analyses and microscopic sections at once made. They contain a large amount of metal for the "stone" class of meteorites.

Following is the analysis of the matrix of the 70-pound meteorite: silica, 47.03; iron oxide, 29.43; oxide aluminium, 2.94; lime, 17.58; magnesia, 2.96; total, 99.94.

The specific gravity is 2.63. The shower covered an area at least two and a half miles long by one wide, near Forest City, Io. There the meteorites are said to have fallen in great numbers; and already many have been found, varying from a few ounces to sixty or seventy pounds in weight.

It seems worthy of mention, that, in accordance with theories entertained here, a 100-pound aerolite has just been found in Kossuth County, some thirty or forty miles farther north. These meteorites all have the characteristic burned, blackened surfaces. Within they are light gray, interspersed with innumerable irregular spots of iron. The many exaggerated and excited reports make it difficult to get at facts: so it seems best for the present to make only a preliminary statement and analysis, until we can make a full and accurate report on this last and highly interesting Iowa meteor.

JOSEPH TORREY, JR.
ERWIN H. BARBOUR.

Iowa College, Grinnell, May 9.

BOOK-REVIEWS.

Die Entstehung der Arten durch räumliche Sonderung. Von MORITZ WAGNER. Basel, 1889. 8°.

MORITZ WAGNER, traveller and journalist, was born Oct. 3, 1813, at Bayreuth, and died at Munich, May 30, 1887, by his own hand. He regarded the principal achievement of his life to have been the enunciation of his theory of the origin of species by geographical separation. He wished, toward the close of his life, to publish a comprehensive work on this theory; but an accident having crippled him, and illness interfering, he never carried out his purpose. His nephew and namesake, Dr. Moritz Wagner, 2d, of Baden by Zurich, has collected most of the elder Moritz' essays in a single bulky volume, to which he has added his own "rider" in the shape of a speculative dissertation on the origin of life and the evolution of species, and prefixed a memoir by Von Scherzer. In judging of Wagner, we have to remember always that journalism was his profession and means of support, and that natural history, though his favorite study, always occupied a second place until the latter part of his life. His father was a school-teacher in poor circumstances, and with six children. Young Moritz showed his master passion by keeping animals and making large collections. When only fifteen years, he contributed editorial articles to some of the local newspapers of Augsburg, where his family were then living. In 1836, when twenty-three years old, he undertook his first journey, going to northern Africa, where he secured an appointment to accompany the French Army in Algiers. The necessary preliminary outlay was covered by advances made by his brothers and friends, and all the expenses were finally met by the sale of his collections and the earnings of his pen. He sent frequent letters to the *Augsburger Allgemeine Zeitung*, then as now a leading journal. These letters were eminently successful; and from this time on, Wagner undertook one journey after another, earning the means by his writing. After his first journey he felt the lack of scientific training, and accordingly spent two years at Göttingen, studying geology principally, maintaining all the while his newspaper activity. His next enterprise was a journey to the Caucasus, Black Sea, and Persia, and later followed his principal journey. In company with Von Scherzer, he came to New York, May, 1852, travelled over the United States for a year and in Central America for two years, much of the time collecting archæological material for the British Museum. His reputation as a writer and traveller attracted the favor of the King of Bavaria, who gave him liberal aid for another long exploring journey to Central and South America.

Except as regards the Australian and polar regions, Wagner possessed an intimate acquaintance with all the principal faunas and floras of the world, and the central interest of all his work lies in the study of the geographical distribution of species. The phenomenon which attracted his attention most was that of closely allied species occupying separated areas of distribution. Thus among rattlesnakes, all of which are American, *Crotalus durissus* belongs to the Atlantic fauna; *C. rhomibifer*, to Central America; *C. miliarius*, to the south-western United States; *C. tergeminus*, to the Rocky Mountains; *C. horridus*, to Brazil; and so on. Similar instances recur in all classes of plants and animals. The most striking examples are furnished by the humming-birds, some of which are widely distributed, like our own *Trochilus colubris*, which ranges from Mexico to Labrador, while others are exceedingly restricted, there being a number of species which are limited not merely to a single mountain, but also to certain altitudes. There is, says Gould, a new species about every thousand feet. The genus *Orestrochilus* occurs only at great heights, 10,000 feet and more, and is represented by distinct species on Aconcagua, Cotopaxi, Chimborazo, Cayambe, and other mountains. *Orostrochilus chimborazo* lives up to 16,000 feet, and hunts for flies above the snow limit. Wagner's writings give these examples and many others. This class of facts acquired an immense importance in his mind, and led him to think that species always are distinguished by separate areas of distribution; and as a corollary from this opinion he maintained that species arise by a common stock, having two or more areas of distribution, which become distinct or separated by some physical barrier, and that the separation *causes* the differentiation of the original single species into a corresponding number of new species.

The first formal announcement of his theory was made by Wagner in a brochure published at Leipzig in 1868, and entitled "Die Darwin'sche Theorie und das Migrationsgesetz der Organismen." He defended the theory in 1870 in a pamphlet on the influence of geographical isolation, and also in three articles published in the periodical *Kosmos* for 1880. All of these, and others bearing upon the subject, are included in the volume before us. Wagner's essays show the journalist. They are all discursive and pleasant, it is easy to read along in them, but there is a complete absence of that formidable marshalling of facts and unconquerable logic which is the stamp of Darwin's work. Wagner nowhere compiles all the facts of geographical isolation, nor enumerates those which conflict with his theory, either to acknowledge their force or explain them away. He leaves us, moreover, completely in the dark as to *how* geographical isolation *causes* new species. All that he has done is to make the generalization that in a large class of cases closely allied species have distinct areas of distribution, — a fact which indicates that separation is a favorable condition for the development of species, but does not prove it to be a cause. Moreover, the fact that often closely allied species have similar or even identical areas of distribution shows that species arise from other influences than mere separation. Nor can Wagner's theory explain the phenomena of mimicry. These objections have all been urged against Wagner's theory of the origin of species,[1] and their force has justly prevented the general acceptance of the theory: at the same time naturalists have recognized the value of the array of facts presented by Wagner.

[1] See especially August Weismann's criticisms, published in 1872.

The appendix by the nephew, the younger Moritz, is one of those odd pieces of speculative effort to solve the most abstruse problems of science which are only possible when the range of knowledge is very limited in the speculator's mind. He puts forward the hypothesis that life arose while the earth was a core of liquid fire surrounded by gases; an electric spark caused an explosion in the gaseous envelope, which produced organic compounds; the compound at once existed in the form of separate living particles; the circulation in the atmosphere caused the particles to enter into vortices, and when the centrifugal motion predominated pseudopodia were thrown out, when the centripetal force got the control a nucleus was generated; and there have been nuclei ever since. It will be remembered that when the bean split itself with laughing, it was sewed up by the tailor, and all beans have had black seams ever since; but who can tell us how the nucleus and the bean got hold of such enduring heredity of acquired characteristics? In the following chapters of the appendix there is more regard paid to the conceivable: yet throughout, the editor is seen not to be grown to his work; for example, in discussing the planorbis shells at Steinheim, he makes no mention of Professor Hyatt's work.

The editor has fulfilled a graceful and acceptable labor in gathering together his uncle's papers, and we hope that as now collected they may secure renewed attention, not to Moritz Wagner's migration theory, but to the peculiar facts of geographical distribution which led to the theory, and have an important bearing on the problem of natural selection. CHARLES S. MINOT.

Electric Transmission of Energy, and its Transformation, Subdivision, and Distribution. By GISBERT KAPP. New York, Van Nostrand. 12°. $3.

THIS is the second edition of a work which first appeared some three or four years ago, a notice of it being printed in these columns at the time. It belongs to the well-known "Specialists' Series," intended mainly for the use of students and electrical engineers; though to all persons interested in the special field it occupies it will prove useful and valuable, especially so to students of what may be termed "the comparative anatomy of dynamos and motors."

We are glad to see that the changes necessitated in such a work by the progress of electrical science during the past few years have been made, "bringing the book up to date," as the author says. Among the changes made, it may be mentioned that the author's method for the predetermination of the characteristics of dynamos has been introduced, thereby making the theoretical part of the work more complete. Though this now well-known method had been made use of by Mr. Kapp before the appearance of the first edition of the work, he had not sufficient confidence in its general applicability to give it a place in the book. Since that time, however, the results of the method, as applied by other electrical engineers, have been so satisfactory that it has been deemed worthy of a place in the volume, and justly so.

In the portion of the volume devoted to practical electrics many noticeable alterations have been made, due mainly to recent progress in the construction of dynamos. Obsolete machines are no longer mentioned, and descriptions of new types, or new modifications of previous types, are introduced, data comprising the leading features of such machines and the results of actual tests being given whenever practicable. This is done because the author believes that precise information regarding a few characteristic features in the design of successful dynamos are of much greater value to the electrician than more extended general descriptions.

The portion of the work devoted to electric railways has received but slight addition, notwithstanding the great progress made in that department during the past few years. The reason for this seeming omission is obvious. To do the subject justice would require a volume larger than that in which a single chapter only can be spared it without infringing on other portions of the field, all of which are equally important in a general survey such as this aims to be.

The transmission of energy by alternating currents is not touched upon, that phase of electrical development being still in the experimental stage (except for lighting); though Mr. Kapp considers it possible, that, "for the transmission of very large powers over very long distances, the alternating current may eventually prove more convenient than the continuous current."

The book is an important one, covering a field through which Progress seems to travel in seven-league boots; and the brief interval between the appearance of the two editions seems to be a very close measure of the time between the experimental stage and the complete commercial success of long-distance transmission of electrical energy.

The Economic Basis of Protection. By SIMON N. PATTEN. Philadelphia, Lippincott. 12°. $1.

THIS book is a plea for the high tariff; but it is one of the least efficient of such pleas that we have met with. It is a mass of confusion, the author often getting bewildered with his own argument,—a fact that will not surprise those who have read his other works. He uses the deductive method exclusively, and is not at all particular about his premises. Indeed, he expressly says that "the theory of a subject must always be developed previous to any intelligent study of the facts" (p. 9); and he has certainly applied this rule faithfully in the present case. We cannot undertake to give an analysis of his arguments here; but one of his chief points is the endeavor to show that free trade fos-

Publications received at Editor's Office,
April 28–May 10.

AFRICA, Pictorial. New York and Chicago, Fleming H. Revell. 396 p. $2.50

CARNOT, N.-L.-S. Reflections on the Motive Power of Heat and on Machines fitted to Develop that Power. Ed. by R. H. Thurston. New York, Wiley. 260 p. 12°. $2.

CHAMBERS, G. F. A Handbook of Descriptive and Practical Astronomy. II. Instruments and Practical Astronomy. 4th ed. Oxford, Clarendon Pr. 8°. (New York, Macmillan, $5.25.)

GEOLOGISK kart over De skandinaviske lande og Finland. Udgivet af Hans Reusch. New York, N. D. C. Hodges, 47 Lafayette Place f°. 40 cents.

GREEN, W. S. Among the Selkirk Glaciers. London and New York, Macmillan & Co. 251 p. 12°. $2 25.

PATTEN, S. The Economic Basis of Protection. Philadelphia, Lippincott. 144 p. 12°. $1.

TUTHILL, Mrs. L. C. The True and the Beautiful in Nature, Art, Morals, and Religion. Selected from the works of John Ruskin, with a notice of the author. 2 vols. New York, Wiley. 638 p. 12°. $2.

WHITING, H. A Short Course of Experiments in Physical Measurement. Part I. Density, Heat, Light and Sound. Cambridge, Mass., John Wilson & Son. 278 p. 8°.

ters what he calls "natural monopolies," or, in other words, that it increases the cost of food and the rent of land. His arguments in support of this position are strangely inconclusive, and the whole theory is upset by the example of the English corn-laws. It was not free trade, but protection, that made food dear in England; and it would have become still dearer if the corn laws had not been repealed. Professor Patten advocates protectionism, not as a temporary expedient, but as "part of a fixed national policy" (p. 8). He maintains that "our economic conditions are so different from those of any foreign nation that an American industrial policy must be of a distinct type from that of other nations" (p. 14); and he thinks it best for us to "isolate ourselves" as much as possible from the nations of Europe. Such are some of the salient points of the work; but we doubt if they will have much influence on public opinion.

AMONG THE PUBLISHERS.

A small geological map of the Scandinavian Peninsula, Denmark, Finland, Iceland Greenland, and Spitzbergen, by Dr. Hans Reusch, the director of the Norwegian Geological Survey, has lately been published in Christiania, Norway. Copies of this map will be sent postpaid, on receipt of 40 cents, by N. D. C. Hodges, 47 Lafayette Place, New York.

—John Wiley & Sons announce as in preparation "Elliptic Functions," by Professor Arthur L. Baker of Stevens Institute.

—George Keil, publisher, 1214 Filbert Street, Philadelphia, requests the members of the medical profession in the States of New York, Ohio, Illinois, Indiana, and Iowa, to forward, at their earliest convenience, the following points: name in full, school of graduation and year, post-office address, and State. This will be used in the pages of the "Medical Register Directory and Intelligencer;" Dr. William B. Atkinson, editor. A copy of the book will be forwarded without charge to each physician whose name appears in its pages. The matter in preparation for it is of such value that every one who receives a copy will be sure to keep it at hand for reference. Its list of national and local medical organizations and post-office addresses of physicians will be complete to date of issue, besides other information.

—Messrs. E. & F. N. Spon announce as ready about June 1 "The Disposal of Household Wastes," a discussion of the best methods of treatment of the sewage of isolated country houses, of suburban dwellings, of houses in villages and smaller towns, and of large institutions, and of the modes of removal and disposal of garbage, ashes, and other solid house-refuse, by W. P. Gerhard. They also announce as published, "Tropical Agriculture" (new edition, revised, bringing down the statistical and general information to the present time), a treatise on the culture, preparation, commerce, and consumption of the principal products of the vegetable kingdom, by P. L. Simmonds; "Buchanan's Tables of Squares," containing the square of every foot, inch, and sixteenth of an inch between one-sixteenth of an inch and fifty feet, by E. E. Buchanan; and "Domestic Electricity for Amateurs," an interesting book for the general reader as well as the electrician, translated from the French of E. Hospitalier, with additions, by C. J. Wharton.

— Macmillan & Co. announce as just ready a folio volume on "Scottish National Memorials," with three hundred illustrations, including thirty full-page plates. The following subjects are treated: Scottish archæology, historical and personal relics, Scottish literature and literary relics, burghal memorials of Edinburgh and other cities, etc. A series of small books under the general title "Science in Plain Language" is also announced. The first volume, to be published immediately, includes the following subjects: evolution, antiquity of man, bacteria, etc.; the object of the author being to give the general results of scientific investigation in plain, every-day language for the general reader.

— Andrew D. White will take "The Antiquity of Man and Egyptology" as the subject of a chapter in the Warfare of Science Series, to appear in the June *Popular Science Monthly*. His account of how Egyptian chronology was cramped and twisted to make it agree with the belief that the first man was created just 4,004 years before Christ, shows an intellectual servility in the past that can hardly be realized at the present day. The June number will also contain "In the Atelier of a Glass-Worker," by Professor C. H. Henderson (the fourth illustrated article on glass-making), which will tell how the beautiful designs are produced that delight us in engraved, etched, and cut glass; the concluding chapters on "Justice," which are to form a part of Herbert Spencer's system of philosophy, in which the sentiment of justice and the idea of justice are carefully analyzed; and an article describing certain evidences of glacial action in south-eastern Connecticut, by David A. Wells. This account will be illustrated with pictures of some of the great bowlders which are thickly strewed over this region.

— John Wiley & Sons, New York, are publishing in a neat and convenient size some of Mr. Ruskin's most popular works. They are printed from new plates on fine paper, and bound in extra cloth, gilt head, and uncut edges. This series will consist of at least twelve volumes, 18mo, price one dollar per volume, and will be extended to include his complete works. The following volumes are now ready; viz., "Sesame and Lilies," "Ethics of the Dust," "The Crown of Wild Olive," "Queen of the Air." They also announce, uniform with the above in size, style, and price, a second series, selections from the works of John Ruskin, edited by Mrs. Tuthill and others. Of this latter series, "The True and Beautiful in Nature, Art, Morals, and Religion," by Mrs. L. C. Tuthill, is now ready, and it will be followed immediately by "Præterita; or, The Autobiography of John Ruskin" (from new plates, with frontispieces).

— "Hatred of England," the existence of which in the United States he denies, is discussed in *The North American Review* for May by Goldwin Smith. In the same number Sir Richard Cartwright gives an account of "Protection in Canada." Other subjects of timely interest are, "A Few Words on Col. Ingersoll," by Archdeacon Farrar; "Audacity in Woman Novelists," by George Lathrop Parsons; "Why Cities are Badly Governed," by State Senator Fassett; and "The Typical American," by Andrew Lang and Max O'Rell.

— "A Catalogue of Minerals and Synonyms," by Professor Thomas Egleston, Ph.D., School of Mines, Columbia College, was published in April, 1889, by the National Museum in Washington, and the edition was exhausted within a few months after its publication. There has been so great a demand for the work since the distribution of the first edition, that it is proposed to republish it in an improved form (one column on a page), leaving a large margin for notes and additions, that it may be more serviceable as a catalogue of mineral collections. The catalogue will be carefully revised and brought up to date, and re-issued, provided a sufficient number of subscribers can be obtained to warrant it. It is believed that this will prove to be a most useful book to those making or possessing collections of minerals. The price by subscription will be two dollars, and after publication $2.50. John Wiley & Sons, New York, are the publishers.

CALENDAR OF SOCIETIES.

The Anthropological Society, Washington.

May 6. — A. P. Montague, Roman Stationery; J. Owen Dorsey, A Teton's Account of the Sun-Dance; George E. Curtis, Notes on the Amish.

Philosophical Society, Washington.

May 10. — J. Elfreth Watkins, Early Dividing-Engines, with Special Reference to that constructed by J. Ramsden, in 1775; W. J. McGee, Recent Geographic Changes on the Atlantic and Gulf Coasts.

Women's Anthropological Society of America, Washington.

May 10. — Mrs. Laura M. Schofield, Revision of the Presbyterian Creed.

Engineers' Club, St. Louis.

May 7. — Arthur T. Woods, Compound Locomotives; Otto Schmitz, Granitoid Curb and Gutter.

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SCIENCE

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THE STANLEY MEDAL.

As the Royal Geographical Society of Great Britain had already presented Mr. Stanley with one of their royal medals, the council of the society determined that the most suitable manner of putting on record their sense of the skill and energy shown in his last journey across Africa, and of the importance of the geographical results obtained in the linking of the old Equatorial Province of Egypt and the territories of the Kongo State, the discovery of a new source of the Nile, the restoration to their true place in maps of the legendary snow-capped Mountains of the Moon, and the enlargement of the Victoria Nyanza by a new bay, would be to strike a special medal for Mr. Stanley and his European officers. On the advice of the officials of the Medal Department of the British Museum, the designing of the medal was intrusted to Miss

E. Hallé, whose medals of Herr Joachim and Cardinal Newman are well known. An illustration of the medal is given on this page. The head of Mr. Stanley was modelled from Professor Herkomer's portrait and numerous photographs taken before his departure. The design on the obverse shows a female figure, the Africa of classical tradition, wearing on her head a helmet in the design of an elephant's head, and pouring from urns the two great rivers Mr. Stanley has done so much to throw light on. A lake, a great mountain, and a tropical forest form an appropriate background. The gold of the medal to be presented to Mr. Stanley was supplied to the council by Mr. Pritchard Morgan, M.P., who liberally presented it from his Welsh mines. Bronze copies of the medal will be presented to each of the European officers connected with the expedition. For Mr. Stanley's colored followers a silver star has been designed, which will bear in the centre the monogram of the Royal Geographical Society, and the words "Emin Relief Expedition, 1887–89."

TUBERCULOUS MILK.

In the April bulletin of the Massachusetts Agricultural College, Harold C. Ernst, A.M., M.D., of Boston, has a paper on "How far may a Cow be Tuberculous before Her Milk becomes Dangerous as an Article of Food?" The change of opinion in regard to the infectious nature of tuberculosis has been very marked in the last few years, not among the scientists, but among the people at large. Of course, the medical world has, as a rule, accepted the conclusions to be drawn from Villemin's work of twenty-five years ago, and the discovery of the specific cause of the disease by Koch has only added strength to the theories advanced in certain quarters before that time. The change of opinion spoken of is, after all, hardly a change, but, more properly, an acceptance of the knowledge gained in regard to the disease by the more recent and exact methods of research, and a much wider diffusion of that knowledge. More and more is it the rule that the knowledge of the transmissibility of tuberculosis by means of infected material is recognized among those whom it concerns the most, and nothing but good can come from the diffusion of that knowledge. The results of the work upon this subject which is being done under the auspices of the Massachusetts Society for the Promotion of Agriculture are to a certain extent preliminary. They show, however, first and emphatically, that the milk from cows affected with tuberculosis in any part of the body may contain the virus of the disease; second, that the virus is present, whether there is disease of the udder or not; third, that there is no ground for the assertion that there must be a lesion of the udder before the milk can contain the infection of tuberculosis; fourth, that, on the contrary, the bacilli of tuberculosis are present and active in a very large proportion of cases in the milk of cows affected with tuberculosis, but with no discoverable lesion of the udder.

THE TORNADO: APPEARANCES; LIEUT. FINLEY'S VIEWS.

WHILE it would appear that the most encouraging line of research is in determining the conditions leading up to a tornado, yet thus far the most time has been spent in studying the destruction, distribution of *débris*, violence of the wind, whirling of the clouds, etc., just at the tornado proper, and where investigation would be the most difficult. A tornado appears to be such a definite phenomenon, that it seems at first sight as though the testimony of different observers would be cumulative, and that there ought to be no difficulty in obtaining definite information regarding all its peculiarities. A very short research, however, dispels this view. The reasons for this are so well and concisely given by Dr. Wadsworth, who investigated the tornado of April 14, 1879, at Collinsville, Ill., that I quote from him.

"It must be borne in mind that this phenomenon came upon our people without warning, and passed before their vision with a probable speed of more than a mile a minute. The impression thus made would necessarily be far from complete. Of those in or near the path of the tornado, one would observe the lower, another a higher portion, very few noticing just the same features. It came to some with the shock of an explosion, or, if they were so fortunate as to have it lift as it passed over them, they might see that a lumber-yard was being poured down upon them, which would be equivalent to not seeing the real cause at all, only a secondary result. To others, again, personal preservation was the first law of nature. To those to the north or south, or some distance in advance, and so fortunate as to have their attention properly directed, are we most indebted for what little history we have been able to gather, otherwise than that to be obtained from the study of the destruction it left behind." To this may be added, (1) no two tornadoes ever had the same appearance; (2) in the same tornado the movements are so complex that it is practically impossible to grasp the whole scene; (3) it is believed that it is almost impossible to avoid preconceived opinions, which give an observer a bias one way or another (this is recognized by the most skilled physicists); (4) in many cases leading questions would tend to cloud the truth; (5) it is probable that sometimes a storm not a tornado is mistaken for one, and this serves to confuse the appearances. This was much more of a difficulty forty years ago than now. A good illustration of this (5) may be found in the so-called Natchez tornado.

Natchez (Mississippi) Tornado.

This hurricane, for it was undoubtedly a West India cyclone or hurricane, occurred May 7, 1840. Mr. Tooley's description is quoted from. "At 12.45 P.M., the roar of the approaching storm began to be distinctly heard, the wind blowing a gale N. E., 6 (Beaufort). The roar and commotion of the storm grew more loud and terrific, attended with incessant coruscations and flashes of forked lightning. As the storm approached nearer, the wind veered to the E., 7. At 1.45 a blackness of darkness overspread the heavens; and when the annulus approached the city, the wind suddenly veered to the S. E., 8, attended with such crashing thunder as shook the solid earth. At 2 the tornado, 10, burst upon the city, attended with such murky darkness, roaring and crashing, that the citizens saw not, heard not, knew not, the wide-wasting destruction around them. At this moment the barometer fell to 29.37″ (it had been 29.49″ at noon). The wind that desolated Natchez was from the S. E. A brick house on the north side of Main Street had the leeward gable end thrown out, the windward end remaining uninjured. The windward gable end of a large house adjoining the Commercial Bank bursted outward against the face of the storm; the leeward end was uninjured." It is plain, from the veering of the wind and the steady fall of the barometer, that this storm was not a tornado, and we shall avoid a good deal of difficulty by throwing it out in our studies.

Two Epochs of Study.

It is rather remarkable that between the years 1840 and 1850 there was most diligent attention paid to this subject by the most noted physicists and meteorologists of that day,— Joseph Henry, A. D. Bache, Loomis, Espy, Reid, Redfield, Hare, and others; and after that period for nearly twenty years, or till the Signal Service was established, there appear to have been very scanty studies of the phenomenon. In some respects this will be an advantage to us, as we can compare the later studies, having all the advantages of weather-maps, concerted action, simultaneous observations, etc., with the meagre data of the earlier explorers in this enchanting field. These appearances have been so differently described, and there seems to be so much confusion in some cases, that it is best to quote quite freely from the testimony of those who were eye-witnesses or personal investigators.

New Brunswick, N.J., June 19, 1835.

One of the best studied of all tornadoes was this one in New Jersey. I quote from Professors Johnson and Henry. "In a few cases, in which the ridge of a building lay north and south, the eastern slope of roof was observed to be removed, or at least stripped of its shingles, while the western slope remained entire. I do not recollect to have encountered a single case in which the top of a tree, with its roots in the ground, was lying towards the west, though I cannot say that none occurred. None were seen with the tops fron the centre of the path. A lad of eight or nine years was carried upward and onward with the wind a distance of several hundred yards, and afterwards descended in safety, being prevented from a violent fall by the upward forces. Rafters which penetrated buildings south of the track, entered them on the north side. Their descent, in some instances, was with great violence, contrary to what happened in the range of the upward motions, where a lad, already referred to, was deposited in safety after a journey of one-fourth of a mile." Professor Bache also investigated this tornado. He says, "I think it entirely made out that there was a rush of air in all directions at the surface of the ground towards the moving meteor, this rush of air carrying objects with it. The effects all indicate a moving column of rarefied air, without any whirling motion at or near the surface of the earth."

New Haven, Conn., July 31, 1839.

A short time before this tornado the wind blew fresh south-east. It changed suddenly south, and in a moment west, where it continued. Professor Olmstead says, "Accompa-

nying these changes, a heavy rumbling noise was heard, not unlike the passing of a long train of cars, which was audible in every part of the city. All describe it as a strange cloud of terrific aspect, white, like a driving snow-storm or light fog, and agitated by the most violent intestine motions. It came suddenly upon them with torrents of water. Trees and other objects that mark the direction of the wind which prostrated them are, with a very few exceptions, turned inwards on both sides towards the centre of the track; while near the centre the direction of the prostrate bodies is coincident with that of the storm. A barn was demolished, and a dove-cote scattered in fragments, while a hen-roost which stood feebly on blocks was unharmed. In a barn that was blown down, a boy that was on a load of hay in the barn was transported across the street and deposited in a neighboring field unharmed. In other cases, however, forces seem to have acted with great violence upon the individual parts of bodies. Numerous instances occurred where hens were completely stripped of their feathers. Trees and other heavy bodies, that were raised into the air and transported to a distance, did not generally appear to have fallen with the ordinary force of falling bodies. Forces appear to have acted in contrary directions. The legs of the same table were found deposited at the distance of many feet from each other in different directions."

Pine Plains, N.Y., June 19, 1835.

The day had been very sultry. Clouds highly charged with electricity darkened the horizon at 3 P.M. At 6 P.M. "our attention was arrested by the peculiar manœuvring of dark and heavy clouds a little south of west. As the black cloud arose (it had the appearance and commotion of dense volumes of smoke bursting from a burning building), light and windy clouds from all that part of the heavens veered toward it with unspeakable confusion and velocity. Mr. Anthony Simmons, near Best's, was on the road with his team loaded with a hogshead of sugar (1,250 pounds). Horses, wagon, and sugar were hurled over a stone wall into a perfect wreck; himself blown in an opposite direction about fifteen rods."

Stow, O., Oct. 20, 1837.

Professor Loomis gives a graphic account of this tornado. There was a tremendous roar heard. "Several of the fowls were picked almost clean of their feathers, as if it had been done carefully by hand. There were two powerful currents of wind blowing from opposite sides of the track,—that is, within a few rods of each other,—and with such violence that the stoutest oaks fell before it. What then became of the air thus accumulated in the centre? That there was a powerful current upward from the surface of the earth, near the middle of the track, is proved by the objects which were elevated. A tree which was levelled as this whirl was approaching it, would be turned to the right; and another, which fell as the whirl was receding, would be inclined to the left."

Mayfield, O., Feb. 4, 1842.

Professor Loomis has given us a description of this tornado also. "The lightning was quite sharp just before the blow came on, and thunder was distinctly heard above the roar of the tornado. This roar was almost deafening, and was compared to a heavy surf upon the seashore, or to the Falls of Niagara." Professor Loomis loaded a six-pounder with a pound and a quarter of powder and with pieces of board. These were fired into a side hill, and from the penetration he decided that some of the boards in this tornado were driven into the earth with a velocity of 682 miles per hour. The stripping of fowls attracted much attention in this and other tornadoes. In order to determine the velocity needed to strip these feathers, the above six-pounder was loaded with five ounces of powder, and for a ball a chicken just killed. Professor Loomis says, "The gun was pointed vertically upwards and fired. The feathers rose twenty or thirty feet, and were scattered by the wind. On examination, they were found to be pulled out clean, the skin seldom adhering to them. The body was torn into small fragments, only a part of which could be found. The velocity was 341 miles per hour. A fowl, then, forced through the air with this velocity is torn entirely to pieces; with a less velocity, it is probable most of the feathers might be pulled out without mutilating the body."

Professor Loomis gives a list of twenty-one tornadoes down to March, 1842, and the following *résumé* of all the appearances: "1. No season of the year is exempt, but they are most numerous in May and June. 2. They occur chiefly between noon and sunset. 3. The temperature at the time is unusually elevated. 4. They are invariably accompanied by lightning and rain, and frequently by hail. 5. Their progress in this country is invariably eastwardly, the mean being twelve degrees north of east. 6. Their average breadth is about 120 rods; length, 15 miles; velocity of progress when violent, about 30 miles per hour; duration of destructive violence, 45 seconds. 7. Light objects are frequently transported 3 to 20 miles. 8. Very few human lives are lost, about one to a tornado. 9. Leeward roofs are generally taken in preference to windward (Professor Loomis thought the windward side of a roof would be pressed down on the rafters, while the wind would cause a partial vacuum on the leeward side, which would suffice to throw that off). 10. Fowls are frequently picked of most of their feathers. 11. In passing over ponds or rivers, water is invariably raised in considerable quantity."

The omissions in this summary of any ascending motion in the centre of the tornado, any whirling from right to left or left to right, and any evidence of a partial vacuum, are most extraordinary and well-nigh inexplicable. Professor Loomis also adds several significant facts. The Morgan (Ohio) tornado of June 19, 1823, is thus described: "At 9.30 P.M the observer heard a roaring as of heavy thunder, which called him to the door. Upon opening it, he immediately discovered a bright cloud, having precisely the color of a glowing oven, apparently of the size of a half-acre of ground, lower than the dark canopy which remained unbroken above, and moving rapidly in the direction of his house. The brightness of the cloud made the face of things light above the brightness of a full moon. There was neither hail nor rain during the passage of the tornado, neither flashes of lightning nor distinguishable peals of thunder, but an intense brightness of the cloud and a continual and tremendous roar." Such descriptions as these might be given for hundreds of pages; but the above is a

fair sample of them, and must suffice. Before remarking upon these quotations, it will be of interest to bring down such descriptions thirty years later.

Signal Office Notes.

In making investigations of tornadoes, the observer was furnished with fifteen to twenty topics of search, and usually framed a number of questions to be asked each person. It is also probable that in these answers all classes of replies by the more interested and by those less so are mingled together. Oftentimes the localities were visited some weeks after the tornado, and when many valuable facts could not be ascertained. To any one desiring a more connected account of these tornadoes, they will find them in the annual reports of the chief signal officer for 1873 and 1875. I will here simply make quotations without giving names.

Iowa and Illinois Tornadoes of May 22, 1873.

"Saw two clouds—one in the south-west, and the other in the north-west—which appeared to rush together in the west."

"Saw tornado approaching like two dark clouds, with an intervening lighter-colored space between them. These two clouds presented a funnel-shaped appearance. It whirled contrary to the hands of a watch. Heard some thunder previous to tornado, but saw no lightning."

"Heard it roaring a long time before it arrived. As it approached, saw two funnels distinctly. Saw funnel on the south side, which was the smaller, swing around in a half-circle and join the larger one. When it struck the ground it seemed to smoke, the smoke surging up like spray upon a wave-beaten rock. Saw lightning during the tornado."

"Saw lightning during the tornado, and heard thunder above its roar."

"Saw the funnel whirling contrary to the sun. Saw lightning flash up and down the funnel. Saw a tree thrown out from the top of the funnel about one foot in diameter."

"The roaring was terrific. It resembled the sounds of machinery magnified a million times. It was a combined 'woo-oo-oo' and 'whir-r-r-r.' When the funnel came near, it grew as dark as midnight."

"Observed sheet lightning in the tornado several times. When the tornado had passed about a mile and a half, it appeared to stand still; and a strong gale, with rain, blew directly from it, so that I thought the storm was coming back."

"The tornado first appeared as two clouds—one from the south-west, and the other from the west—rushing to one point."

"Heard roaring about half an hour before it came."

"Heard roaring an hour before the storm came. Did not hear it after it passed. Saw a cloud rushing from the south, and another rushing to meet it from the north."

"The roaring was very loud for an hour previous to its arrival. Did not hear it after it passed. Saw no lightning."

"It was impossible to hear thunder, owing to the noise of the storm, which was terrific."

"Noticed a very black cloud in the west, with a lighter space on each side of it. Did not hear the roaring very distinctly until it was nearly opposite. Then it was an awful ocean-like roaring."

"Saw two clouds—one in the north-west, and one in the south-west—rushing together with great rapidity. A whirling began right where they met, assuming the form of a funnel. Saw it whirling with the hands of a watch at the distance of about two miles."

"There seemed to be a dark cloud to the south-west, another to the north-west. The roaring, like the whirring of a thousand threshing-machines, was so loud that I could not hear the breaking of the buildings."

Georgia and South Carolina Tornadoes, March 20, 1875.

"The cloud was very black, with a reddish appearance beneath. Approached with a rising and falling motion, and sometimes bursting upward, like dense, black smoke from a furnace."

"The cloud was fiery in appearance, throwing up, at times, what looked like tongues of flame."

"The form of the cloud was that of an inverted cone, and its appearance luminous. The red cloud moved with great velocity."

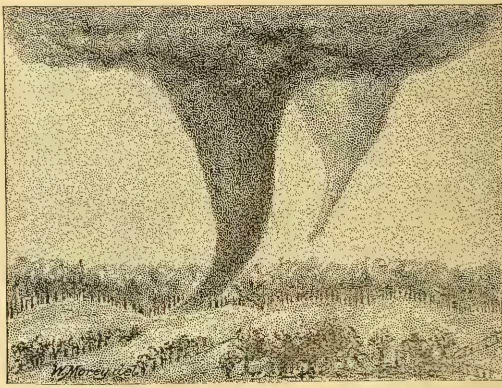

FIG. 1.—TORNADO-CLOUD.

"The roar of the tornado was terrific, as if a thousand locomotives were racing across the country at full speed."

"Saw a bright column reaching from the ground to a height of nearly a hundred yards."

This tornado occurred just about noon, and it is not a little strange that many of the observers saw a more or less bright light connected with the funnel. A photograph of the ruins of Massey's house, near Sparta, Ga., shows a remarkable parallelism in the distribution of the *débris* The house stood directly in the path of the tornado, and was built of heavy hewn timbers dovetailed together at the corners. The south-east side was first crushed in; then the whole house was moved ten feet east, and torn to fragments. The present writer saw precisely the same lines of *débris* parallel to the tornado-track in the Wallingford (Connecticut) tornado of Aug 9, 1878. This illustration (Fig. 1) of a tornado-cloud is given as a good representation of the phenomenon. It will be found that nearly every picture has waving lines upon it, as though the funnel were whirling, but the amorphous appearance here given is probably more accurate. Dr. McPherson gives this description: "The horizontal whirl, con-

trary to watch-hands, was plainly visible, together with a rolling motion inward and upward, giving the appearance of dense volumes of black smoke ascending from a tar-kiln. Coruscations were observed shooting out on the right or south side of the cloud. A light funnel-shaped cloud, looking much like white steam, immediately preceded the black cloud."

Summary.

I have read over about a thousand pages of tornado literature in making these quotations. They are extremely disjointed, as must be necessarily the case in the scope of this paper. I have had no theory to support, and in consequence the quotations are without bias. It is hardly probable, however, that any one person can read such a mass of matter and make the best selections to give the more prominent appearances; and it is much to be hoped that some one will go over this ground and make independent selections of the salient points. I think the omissions in these appearances are oftentimes more suggestive than the positive statements.

The Loud Roar.

The well-nigh universal testimony is, that there was an indescribable roaring in connection with the tornado. It is probable that this was heard in the earlier cases, but was not regarded of enough importance to note. It is hardly probable that the loudest of this roar could be heard more than a few minutes before the outburst. Little weight can be attached to the observations of a few, that it was *not* heard after the passage. It is entirely improbable that this can be caused by the wind, or by the tornado whirling in the air. We very much need more careful observations. Attention should be directed especially to a comparison of the sound with a continuous rumble of thunder.

The ascending current has also been largely commented on. The attempt to show an updraught by the fact that some persons were let down gently is more than counterbalanced by the fact that pieces of board and timber were driven into the ground many inches. The evidence on this point of an ascending current is very contradictory, and it is highly probable that a fierce blast from two directions, together with the assistance of the topography, will account for most of the phenomena. There is almost overwhelming evidence that air rushing into a partial vacuum does not produce this updraught. The evidence shows that the direction of the path of the tornado is pre eminently toward the north-east.

Whirling of Tornado-Cloud.

Perhaps the least satisfactory testimony is regarding this appearance. We may set down at once the uselessness of any one trying to determine this whirling if he is more than a thousand feet away, and probably the limit should be five hundred feet. Attention should be directed to the ground, and most careful observations made of the whirling fragments. The distribution of the *débris* is markedly against any whirling. It is impossible to see how a whirl of a hundred feet diameter could throw down one tree to the north-east, and its neighbor to the south-east on top of the other. Some one has well suggested, that, if the cloud is whirling, the trees on the edges of the tornado should lie parallel to the track, while those in the centre should lie at right angles; but we know that precisely the contrary is the appearance. The writer once made an observation which may help to elucidate this problem. In the streets of Washington, during the laying of the cable-road, there were employed furnaces for heating tar, and in these furnaces it was customary to consume the remains of the tar-barrels for fuel. The smoke from these furnaces was most dense and black. The draught was so strong that the smoke issued from the chimney at a velocity fully equal to the wind that was blowing. The top of the chimney was not more than three feet from the eye, thus giving a most excellent opportunity for noting the slightest movement. When it was nearly calm, the smoke ascended perfectly straight, and with no whirling motion. The moment the wind blew, an extraordinary phenomenon was seen. Taking a vertical plane in the direction of the wind, and looking with the wind at the back, it was found that on the right of the plane the smoke whirled from right to left, while on the left it whirled from left to right. The appearance of this smoke thus doubling upon itself was most interesting, and invariably occurred when the wind blew. It seems as though most of the contradictions in the testimony would disappear if some such action as this took place. We may be certain that there is no uniform whirl in tornadoes in either direction.

Stripping Feathers from Fowls.

This is undoubtedly a true phenomenon. The attempts to prove that this could be caused by the expansion of air in the quills, due to the passage of a vacuum, have signally failed. Fowls under an air-pump could not be deplumed by exhausting the air. We must also regard Professor Loomis's experiment of shooting a fowl out of a cannon as an entire failure, I mean for elucidating this phenomenon. He thought, that, if the fowl could have been fired at a hundred miles per hour instead of three hundred and forty, the result would have been very different; but this certainly is very doubtful. A wind of a hundred miles per hour would have carried along the fowl, feathers and all. It would be an interesting experiment to fire a fowl at a hundred miles per hour; but it is entirely probable that no fowl could live under such a shock as that, and the feathers would not be driven off until the velocity became enough to dismember the fowl. It would also be interesting to hold a fowl before a blast, and determine, if possible, the velocity needed for depluming. The most singular fact is, that the fowl lives under the depluming process. In some cases roosters have been seen walking around, days after the tornado, crowing, and without a feather on their backs. The appearance can be readily accounted for on the supposition that an electric charge threw off the feathers, and this seems the only way of explaining the stripping of clothes from a person.

The conclusion seems forced upon us that we need, more than all else, much more accurate observations by persons accustomed to note physical phenomena. It will be seen that in later days the appearance of clouds from the north-west and south-west is attracting great attention. That this fact was not emphasized before, may be due, in part, to the fact that it was not regarded as of any special importance in accounting for the phenomena. It seems that these appearances certainly attend the tornado, and are seen all along its

course of a hundred or two hundred miles; so that they cannot be regarded as individual clouds, whose meeting produces the funnel.

[Continued on p. 316.]

NOTES AND NEWS.

Any one interested in the sick benefit, funeral aid, and death-beneficiary associations of the United States can help make the statistics of their organizations for the forthcoming census more complete, and disseminate the knowledge of the good work they are doing, by sending the names of such societies as they may know of, and the addresses of their principal officers, to Mr. Charles A. Jenney, special agent of the Eleventh Census, 58 William Street, New York City.

— Professor S. T. Maynard, in the April bulletin of the Hatch Experiment Station of the Massachusetts Agricultural College at Amherst, states that the fact that healthy and vigorous peach-trees can be grown to the age of six to ten years in New England needs no demonstration, but that we seldom find healthy trees of a greater age on account of the destruction resulting from the cold and by the disease called the "yellows." While we do not know the exact nature of the disease called the "yellows," and cannot wholly control the atmospheric causes, the other causes, says Professor Maynard, we can largely control; and by careful cultivation in the spring and early summer only, by the use of complete fertilizers in the fall or early in the spring, we can largely prevent this destructive disease. It may not be profitable to try to save diseased trees, and it would be advisable to destroy them as a matter of safety, although there is no evidence that the disease is contagious: for upon the college grounds more or less diseased trees may be found at all times; and young trees are planted where old trees have died, and, with an abundance of plant-food, have grown in perfect health for six years.

— Experiments in the cutting of seed-potatoes after various methods have been carried on each season since the organization of the Ohio Agricultural Station. In 1889 the work was carried on upon a larger scale than formerly, and with a greater number of varieties, the object being to test the validity of conclusions drawn from the results of former experiments, also to compare varieties. There is sufficient uniformity in the results of different seasons to warrant the following conclusions, says Professor W. J. Green, the horticulturist: 1. Other conditions being the same, the larger the cutting, the greater the total product; i.e., the total product varies in about the same ratio as the size of the cutting. 2. The marketable product also increases as the size of the cutting is increased, but does not follow the same ratio as the total product, the rate of gain being less. 3. The increase is found in both the large and small potatoes, the greater portion being in the latter. 4. A crop grown from whole potatoes matures at an earlier date than one from small cuttings. 5. Small cuttings require soil that is more highly enriched and thoroughly prepared than large cuttings and whole potatoes, in order to secure a good stand and to produce a profitable crop. 6. The question of relative profit, as between the use of small cuttings and whole potatoes, depends upon the cost of seed-potatoes, the date at which the crop is to be harvested and sold, and the condition of the soil at planting-time. 7. In ordinary practice it will usually be found that neither extreme, as to quantity of seed used, will be found to be profitable. The safest plan is to use large, well-matured, healthy potatoes, and cut to two and three eyes.

— Much discussion having been provoked relative to the results of experiments at the Massachusetts Agricultural College, Amherst, Mass., with steam and hot water for heating greenhouses (reported in Bulletins Nos. 4 and 6), especially as to the accuracy of the results, Professor S. T. Maynard has the past winter made a careful repetition of the experiments to correct any errors that might be found, and to verify previous results. The boilers having been run with the greatest care possible from Dec. 1, 1889, to March, 1890, and every precaution having been taken that no error should occur, he finds the total coal consumed between those dates, for the hot-water boiler, to be 6,598 pounds, the average daily temperature for the time being 49.74°; and for the steam-boiler the total coal consumed in the same time was 9 734 pounds, the average daily temperature for the time being 48.39°. The following criticisms have been made by parties not conversant with the facts of the case: 1. That the piping and check-valve were not arranged so as to get the most perfect circulation of steam without a great loss of fuel. 2. That the flues from the two boilers entered the chimney in such a way as to give a better draught to the hot-water boiler. 3. That the exposure of the two houses was such that the house heated by hot water received more sun-heat than the one heated by steam. These criticisms Professor Maynard thinks can be answered to the entire satisfaction of all fair-minded readers. By numerous test examinations he found that the circulation of steam through all the pipes, above the water-line of the boiler, is perfect whenever there is fire enough to create steam in the boiler; that the check-valve must consequently work easily; and that there is never any standing water in the return-pipes above the water line of the boiler. The flues are arranged so as to give as nearly equal draught to the boilers as is possible and have them enter the same chimney, and enter at the same point; and if there is any difference in the draught of the two, it is in favor of the steam-boiler. It was suggested by the late Mr. George Hills of Arlington, that perhaps from their location the steam-heated house received less sun-heat than that heated by hot water. To test this matter, two standard thermometers were placed in each house, so that the sun's rays should fall upon them equally in both houses at the same time, — one on the eastern, and one on the western exposure. Records were made three times each day for twenty days, ending March 18. Of these twenty days, about eleven days were cloudy and nine clear, and probably the period of time under observation was long enough to show that the amount of sun-heat received by each house is so nearly equal as to in no way change the results given in the temperatures of each house.

— In the *American Chemical Journal* (vol. xii. No. 4) Mr. H. J. Patterson of the Maryland Agricultural Experiment Station, Agricultural College, has an article on "The Use of Animal Charcoal in the Determination of Fat (Ether Extract) in Feeding-Stuffs." His conclusions are, that the use of charcoal results in a closer approximation to the truth than any other method in use, though absolute accuracy is not claimed. The following points may be claimed in favor of the use of animal charcoal in the determination of fat (ether extract) in feeding-stuffs: 1. That the product obtained is nearly pure fat or vegetable oil. 2. That the product obtained gives a more correct idea of the physical nature of the fats from various substances. 3. That slight quantities of water that may exist in the substance and pass out with the extract will be removed by the charcoal. 4. That soluble acids of the plant, or acid which may be formed by the continuous distillation of ether, in connection with some constituents of plants, will be partially, if not wholly, removed by the animal charcoal. 5. That the animal charcoal will partially obviate, if not wholly remove, the difficulty of change in the amount of ether extract (which generally increases) with the aging of the sample.

— The April bulletin of the Michigan Agricultural Experiment Station is on "Foul Brood," by A. J. Cook. By special request of several bee-keepers, Professor Cook issues the bulletin upon the most serious malady that ever attacks bees in this or any other country. The problem of safe wintering, once so important, is now solved, and the intelligent apiarist feels no longer any dread of winter's cold. Foul brood is now the bee-keeper's terror. Like the cholera — a disease which is close akin to foul brood — among our own kind, so this disease comes into the bee community like a terrible scourge; and if the bee-keeper is ignorant, incautious, or indifferent, it abides with him till it starves for want of bees on which to feed. Terrible, and terribly fatal, as this disease is known to be, experience has proved, certainly, that with full knowledge, and as great care, it can be kept in check and wholly cured, and that with not very serious labor and expense. The minute ovoid spores are brought to the hive probably in honey fed to or brought in by the bees. It is easy to see how honey in a diseased colony of bees would receive these spores. It is diffi-

cult to see how it could be free from them. The spores might also be introduced by giving combs containing the disease brood, or which had previously contained it, to the bees, and so now would have the dormant bacilli or spores. Undoubtedly foul brood is usually first introduced through the honey, while it is often spread rapidly by an exchange of combs in an apiary where only a few of the colonies are affected. While the bacillus cannot develop in the honey, very likely the honey serves admirably to hold and preserve the spores. When the larval bee is once affected, it is disturbed, lies differently in the cell from the healthy larva, soon turns yellow or straw color, then to brown, while the skin seems loose and flabby. Later the mass becomes thick and viscid, and turns dark brown, the color of coffee before any cream is added to it. It now dries up, and at last forms a thin layer over the bottom of the cell. While in the putrid coffee-colored state, if drawn out from the cell by inserting into it a pin-head, it is stringy; and if it fails to hold to the pin, it will fly back. This brown, stringy, elastic mass, with no resemblance to a larva or pupa, is a sure proof of the presence of the dread malady. The larva may never be capped over, but, if attacked late in its development, it usually will be. This cap, however, will appear sunken or concave, instead of being convex or rounding out, as the cappings of brood always do when the brood is healthy. These sunken caps are always suspicious, and should always lead to close investigation. Little irregular holes in the cappings are often seen, which also should awaken suspicion. Another indication not always marked in the early stages is a rank smell, which has been compared to the odor of old glue, and which is not very unlike the odor of decaying brood that has been chilled. Often this odor, in severe cases, is very marked, and can be detected while the hive is closed, and several feet from the one perceiving it. Mr. Cheshire thinks that the mature queen, workers and drones, are also subject to attack, and frequently succumb to the disease. For the remedies we must refer to the bulletin itself.

— Within the past few years much complaint has been made by bee-keepers of a disease among bees which not only depleted the colony, but was made manifest by the appearance of the diseased bees. They look black because of loss of hair, much as do robber bees, or old bees in spring, and frequently make strange motions in front of the hives, as though dancing or in convulsions. They are frequently dragged out of the hives by the other bees. This, like foul brood, is supposed, says Professor A. J. Cook, to be due to fungoid attack. In this, only the mature bees seem to become victims, though the inoculation appears to come through the queen. Thus it is found that superseding the queen with a healthy one cures the malady. It is also reported that abundance of salt water placed close by the hives, where the bees can gain ready access to it, will cure this "nameless bee-disease." It would seem that this malady is the same that has received attention in Europe, and which Mr. Cheshire has said was due to the attack of *Bacillus Gaytoni*.

— The March bulletin of the Agricultural Experiment Station of Cornell University is devoted to "Growing Corn for Fodder and Ensilage," by Messrs. I. P. Roberts and Henry H. Wing. Not all the points given below are based upon the experiments detailed in the bulletin. Some are drawn from work done elsewhere, and some from unpublished results of their own. First, they wish to emphatically repeat the recommendation of last year, that, in growing corn for ensilage, care should be taken to select the largest variety that will fully mature before frost in the locality where grown. Special attention is called to the fact that heretofore it has been a common practice to sow or plant corn for fodder and ensilaging entirely too thick. Starch and sugar are not fully developed without an abundance of sunlight. Immature plants are likely to contain a very large per cent of water. It will readily be seen that twenty-five tons of green corn, containing ninety per cent of water, gives but five thousand pounds of dry matter; while twelve tons, containing seventy-five per cent of water, gives six thousand pounds of dry matter. In the latter case a thousand pounds more dry matter is obtained, and less than half the weight of gross material has to be handled and stored; while the corn will still have sufficient moisture to give the resulting silage that succulence upon which its value for feeding as compared with dry forage largely depends. While the percentage of nitrogen grows less as the plant approaches maturity, a much larger proportion of the nitrogen in the unripe material is in the less valuable form of amides than in the mature plant, so that the less percentage of nitrogen in the riper product is compensated for in its increased nutritive value. So far, all the experiments go to show that the effort should be made to raise the largest yield of grain irrespective of stalks, no matter what purpose it is intended for. If one variety gives an equal yield of grain and a greater amount of stalks and blades, then of course it should be preferred, for fodder and ensilage purposes, to the variety that gives the less stalk and blade; but it will be found that as a rule the larger the yield of grain, the larger will be the yield of stover. Finally, the fact should not be lost sight of, that wood and water alone are not good foods for animals, and that they are expensive products to handle.

—The May bulletin of the Michigan Agricultural Experiment Station is an essay on the English sparrow, by C. B. Cook. Seven States legislate against the English sparrow. Of these, four simply except it from the protection afforded other birds, New York makes it a misdemeanor to harbor or protect them, while Michigan pays a bounty of three cents for each sparrow's head. Over twenty of the remaining States give the English sparrow the same protection that is offered to other birds. The remaining States have no laws on the subject. The first thing that should be done to check the sparrows' increase, says Professor Cook, is the repeal of all laws offering them protection. Doubtless many who would turn their hands against the sparrow are prevented from doing so by bird-laws. As recommended by Mr. Barrows, it may be best that one able man should be employed in every town and city to superintend a systematic warfare against the English sparrow. No matter how much farmers and gardeners desire to destroy these birds, it will be of comparatively little avail so long as the sparrows are permitted to stay in their great breeding-haunts, the cities, unmolested. The alarming rate at which the sparrows have increased during the past few years shows only too clearly that some action is necessary. No doubt a bounty helps to lessen their numbers; but it is a question if this is the best way to exterminate the English sparrow. This method has been employed in Michigan since 1887, and has been found an expensive method of lessening their number. The greatest objection—that other species of birds are killed by careless persons for English sparrows—would apply as well to any other means of destruction. The scheme for offering liberal prizes for the greatest number of birds killed in any given territory is worth considering. If the prizes are sufficiently large, many persons will compete, and great destruction to the sparrows would result. Whatever means are employed, it is of the greatest importance that all States and Territories infested be united in their efforts, and all employ some good means of eradication. One or two States alone can accomplish but little, as the sparrows are spreading so rapidly that the birds would migrate from other States near by as fast as those within the State limits were destroyed. No one should receive sparrows on a bounty or prize that has not thoroughly studied th bird. Far too many of the town clerks in Michigan do not know the English sparrow's head from that of a linnet or thrush. As a result, a great many birds that have been sent in for a bounty are the most beneficial birds. Thus many heads have been sent to this station, on which a bounty was claimed, of such valuable birds as the song-sparrow, red-polled linnet, and evening grossbeak,—birds that the laws protect by a fine of five dollars against their slaughter. Michigan has a good law against destroying native birds, and every person presenting such a bird to the town clerk's office should pay the penalty, which is a fine of five dollars.

— The picture of Ruwenzori (identified by Stanley with the Mountains of the Moon), which will appear in the June *Scribner*, was drawn from Stanley's own sketch made at the time of the discovery. The race of pygmies discovered by Stanley in Africa were photographed by him, and one of the pictures will be reproduced in his article.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

Vol. XV. NEW YORK, May 23, 1890. No. 381.

CONTENTS:

THE TORNADO: APPEARANCES; LIEUT. FINLEY'S VIEWS.

[Continued from p. 314.]

Lieut. Finley's Views.

For the past ten years Lieut. Finley has devoted a great deal of attention to this subject, and has received reports of tornadoes from thousands of observers. His views, then, should have much weight as being a *résumé* of all the facts reported. Quotations will be made from his book entitled "Tornadoes," published in 1887 by the *Insurance Monitor*. No attempt has been made to classify these, but I have given them in the order in which they occur in the book. Speaking of the flow of air on either side of a large storm, we find, "As these conditions continue to prevail, there is a growing contrast of temperature to the north and south of the major axis (of the depression), owing to the long-continued movement of the atmosphere from opposite directions; such movement eventually affecting the disposition of air in the warmer regions of the extreme south, and likewise the colder regions of the extreme north. The contrast of temperature now naturally increases with marked rapidity, and the formation of clouds commences in earnest. Huge masses of dark and portentous appearance bank up in the north-west and south-west with amazing rapidity, and soon the scene becomes one of awful grandeur. The struggle for mastery in the opposing currents is thus indicated by the gathering cloud-formations. The condensation of vapor from the extremely humid southerly currents by contact with the augmenting cold of their struggling opponents continues. It increases rapidly. Finally, when resistance to the unstable equilibrium can no longer be maintained (controlled by the rate of temperature change and rapidity of condensation), the opposing forces are, as it were, broken asunder, followed by the upward rush of huge volumes of air. The outward indication of this event is first shown in the whirling, dashing clouds over the broken surface of the heavy bank of condensed vapor, forming the background,—a scene not easily depicted or realized by one who has not witnessed it, but never to be effaced from the memory of the actual observer. There is an awful terror in the majesty of the power here represented, and in the unnatural movement of the clouds, which affects animals as well as human beings. The next stage in the further development of this atmospheric disturbance is the gradual descent of the funnel-shaped cloud from a point apparently just beneath the position of the enactment of the first scene. The tornado is now before us, not fully developed, but soon to acquire that condition when the terrible violence of its power will make the earth tremble, animals terror-stricken, and men's hearts quake with fear."

"There seems to be some strange connection between the almost simultaneous appearance of clouds in the south-west and north-west, possessing as they do such unusually threatening forms. As they approach from opposite directions, they are suddenly thrown into the greatest confusion, breaking up, as it were, into small portions, which dash pell-mell over each other and in every direction; now darting toward the earth; now rushing upward to considerable heights like sky-rockets, or at moderate elevations rolling over each other in a well-developed whirl. An observer, in describing the approach of the clouds from the south-west and north-west, stated that they came together with a terrific crash, as if thrown from the mouths of cannons. Generally, following closely upon the existence of this condition, the funnel-shaped tornado-cloud appears against the western sky, moving boldly to the front from without this confused mass of flying clouds." Lieut. Finley describes four motions of the tornado: "No. I. is called the whirling or gyratory motion, which is invariably from right to left. Above all other motions, this is attended with the greatest violence. This gyratory motion forms what is termed the 'vortex' of the tornado-cloud, within which the velocity of the centripetal currents of air is almost beyond conception. No. II. is called the progressive motion of the tornado,—the motion which determines the cloud's track from one point to another. No. III. is termed the rising and falling motion of the tornado. No. IV. is called the zigzag motion, or swaying from side to side of the central line of cloud-movement. This movement is sometimes quite suddenly performed, but generally it is a moderately slow movement, and one that can be watched and easily identified. In completing the extent of a single act of this motion, the tornado-cloud will diverge about an equal distance on either side of

the central line of movement, though these tangents to the major axis are not necessarily of equal length."

Lieut. Finley summarizes his study of the relations of a tornado to general atmospheric conditions as follows: "There is a definite portion of an area of low pressure within which the conditions for the development of tornadoes are most favorable, and this is called the dangerous octant. Tornado regions are to the south and east of the region of high contrasts in temperature (temperature gradient) and in dew-points. The area of tornadic action is to the south and east of the region of high contrasts of cool northerly and warm southerly winds,—a rule that seems to follow from the preceding, and is of use when observations of temperature and dew-point are not accessible. The relation of tornado regions to the movement of upper and lower clouds shows that the former indicate the presence of the cold north-west current, and the latter the warm south-west current of air, which ultimately lead to the development of the high contrasts of temperature so essential to the birth of tornadic action. The study of the relations of tornado regions to the form of barometric depressions shows that tornadoes are more frequent when the major axis of the barometric trough trends north and south, or north-east and south-west, than when it trends east and west."

From Lieut. Finley's "Scientific Résumé of Tornado Characteristics," I have selected the following as touching upon points not already mentioned.

"The time of day, the time of year, and the peculiar hot and stifling condition, indicate that heat is the physical agent developing the tornado. By the rotary action of the tornado-cloud the condensed vapor is whirled into a fine mist, giving it the appearance of steam, and lighting the interior of the cloud. The tornado is accompanied by a rumbling noise (very peculiar), which never ceases while the funnel-shaped cloud is upon the earth or a short distance above it. The funnel form of the cloud is due to the peculiar ascensional movement of air-currents, the vapor being condensed along the central line of movement by the cold of elevation. The motive power of a tornado, and the agency which lifts objects or carries them long distances, is that motion of the air in the cloud set up by the variable heat conditions of large masses of air over adjacent regions.

"The tornado vortex may be formed either by an ascensional movement of a mass of heated air, giving rise to unstable equilibrium, or by the meeting of opposite currents with high temperature gradients, or by a combination of these. Two currents of air approaching each other from opposite directions will not come directly together, because of the influence of the relative motion of the earth. The mass of air coming from the south would have a greater velocity eastward than that coming from the north: therefore, instead of meeting each other in a direct line, the two currents will form an angle at their intersection, and the combination of the two masses will give rise to a rotation in a direction contrary to the hands of a watch with its face upwards. These conditions account for the spiral movement of the air-currents and the formation of the vortex in the tornado. The cold air from the northward will under-run the warmer air from the southward, because of the difference in density of the two masses, and as a result will aid in the formation of the whirl.

"The electrical tension of the air cannot, under the most favorable atmospheric conditions, cause the movement of oppositely electrified air masses, because of the excellent conductivity of free air, which always tends to equalize electric potential. The presence of ozone is usually detected in the wake of the tornado. People are stripped of clothing, fowls and birds denuded of feathers. The peculiar roaring noise which accompanies the progress of the tornado cannot be ascribed to the intervention of electrical forces: it is far more reasonable to assert that the noise is produced by the resistance which the rapid and violent indraughts of air encounter while passing into the tornado's vortex. The vortex approximates a vacuum, and the air rushes into it at the spout end near the earth with great violence, atttended by a hollow, sucking sound of marked intensity.

"The peculiar sensations of what are termed 'burning,' 'scorching,' or 'stifling' heat, which are reported by those who experience the violence of the tornado, must be due to the latent heat of vaporization, which is given off in great quantities by the extremely rapid condensation that attends the tornado as a constant feature."

A very interesting comparison may be made between these later views and the appearances noted earlier. Lieut. Finley seems to have slightly confused the conditions which prevail at the centre of the general storm with those at the tornado. Great contrasts of temperature and dew-point, meeting of hot south with cold north winds, etc., can only occur at the centre of the general storm, but that point is four hundred miles from the tornado. It seems probable that altogether too much emphasis has been given to the two clouds,—one in the north-west, and the other south-west—which are described as gathering themselves together as two giants eager for the coming contest. We have already seen that these clouds are an accompaniment of the tornado. They are probably never more than one or two miles apart. They seem to rush together. because, when first seen, a cloud of dust hides the true tornado, and these appendages appear prominently on either side. In a minute or two the observer is enveloped in the dust, and the next instant he sees the death-dealing funnel, and his heated imagination at once leads him to the conclusion that the funnel is produced by the forcible meeting of the clouds.

Contrasts of Temperature.

Lieut. Finley especially insists on such contrasts as a *vera causa* in the formation of a tornado, but it would seem as though he has entirely mistaken the mode of action generally ascribed to an unstable equilibrium. We are impressed with the fact that the clouds and resulting contrasts are on the same level, whereas, in order to have a contrast capable of causing an upsetting in the atmosphere, it is absolutely essential that the cold air be *above* the hot. Lieut. Finley expressly declares against this disposition by stating that the colder air, by its density, under-runs the warmer. It is a matter of deep regret that other writers on this subject have not seen that such a condition as the last mentioned entirely negatives their theories of tornado formation.

Tornado Whirls.

No one who has read all that precedes can be more astonished than the present writer to find that the evidence proving a whirl is so inconclusive and conflicting. I had fully made

up my mind that there must be a whirl, though in doubt as to its direction. In fact, the best testimony we have, scattering of *débris*, is strongly in favor of the view that there is no whirl. Figs. 2 and 3 will show better than pages of text the nature of this testimony. Let us ask what would be the effect of a whirl, in a direction counter-clockwise, passing through an orchard (see Fig 2). Facing the tornado as it approaches, we would see trees passing our eyes at right angles to the track, or leaning over to the right. After the tornado passes, we would see trees on the south side lying

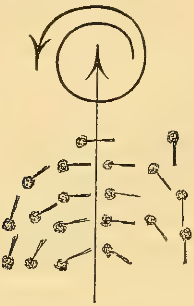

FIG. 2.—ORCHARD BLOWN DOWN BY A WHIRL FROM RIGHT TO LEFT.

parallel to the track, with tops to east, while on the north side their tops would lie to the west. Fig. 3 shows the true conditions which are found. The *débris* and trees in the centre all lie parallel to the track, while on the north and south sides the trees point inward and forward toward the centre. The writer made a most careful investigation of the conditions at the Wallingford (Connecticut) tornado; and these appearances were repeatedly met with, though the

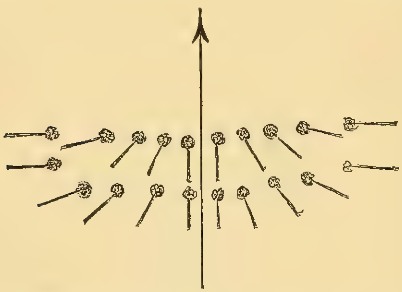

FIG. 3.—ORCHARD AFTER ACTUAL TORNADO HAS PASSED.

true significance of the facts was not fathomed. The strongest argument that has been advanced in favor of a whirl has been the position of tall trees which have crossed each other. Almost invariably the under tree is the one pointing north or north-east, while those above point south-east or south. The proof is very unsatisfactory. If there is a steady whirl in a mass of air, why would it not break down neighboring trees in the same direction?

Further Research.

We are impressed with the imperfection of the evidence regarding the true mechanism of a tornado. Even the apparent drawing-up of water from a pond cannot be regarded as evidence of an uprush. We know, that, even if there were a perfect vacuum, water could not possibly be raised more than thirty-four feet. It is probable that the depression noted as the tornado passes is due to the wind, and the apparent rising of a mass of water is simply fine water-particles or mist borne on the wind. The fact of the existence of a whirl is one of the most important that can be established. While we can never expect that an observer would remain near enough to a very severe tornado to make accurate observations, yet it seems as though this fact might be established by skilled observations in a less severe tornado. If you are on the south side of a tornado, there is little use in looking for a whirl; but attention should be given to the starting of objects into the air. See whether, when a tree starts, it goes suddenly, as if shot from the ground, or is swayed violently at the top first; see whether the *débris* that rises goes up in great confusion, whirling over and over, or whether it is carried lengthwise, as in a stream; etc. If you are on the north side, get as near as you dare, and cling to a large tree, or, better, to a post; note whether a single object near the ground or up in the funnel has any motion whatever toward your right hand as you look at the funnel. The moment the tornado has passed, run with the greatest possible speed to its rear, and, if possible before the dust has enveloped you, see if a single object on the ground or up in the air is moving to your right. If the tornado has moved through an orchard, establish as near as you can the centre line, and then pace off one hundred, two hundred, three hundred feet to north and south, examine trees at the same distance on either side, and see if those on the south are uprooted or broken more than those on the north. If the tornado is moving at the rate of eighty miles per hour, and the whirl a hundred and twenty, on the south side the resultant velocity would be two hundred, while on the north side it would be only forty miles per hour. The greatest care must be taken that we do not blind our eyes with preconceived notions. When some observer who has a barometer has been so fortunate as to take it to a dug-out, and has kept his eye upon it rather than upon the more absorbing tornado, we may hope from his testimony, if the funnel goes over his head, to clear up more doubtful points, and establish more certainties, than can ever be done by any other means. Finally, as the West becomes more thickly populated by skilled observers, we may hope to some time establish many points now very uncertain.

H. A. HAZEN.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

To Discuss Meteorological Topics.

A PRELIMINARY survey is being made to discover if available material enough exists in and near this city to form a society to study and discuss meteorological topics. Such an organization should include physicians, civil engineers, and other professionals, and amateurs who have studied the weather in a scientific way, or the relations of any of its phases to important human interests, like health, construction of dams, bridges, and buildings, navigation for commerce and pleasure, horse and steam car local traffic,

crops, preservation of forests, and writing insurance. Nothing, perhaps, touches people's mundane welfare at so many points as the weather; and yet, as a science, meteorology is really in its infancy. In many civilized countries there are, aside from the official weather bureaus, independent associations made up of persons who are interested in their own or other people's investigations of the weather, in some of its bearings upon the happiness of man. Such are the New England, Royal, and Scottish Meteorological Societies. Some of the members are professional and hard working meteorologists, of national or world-wide fame, like Dr. Buchan and the Hon. Ralph Abercrombie; and some are wealthy but intelligent enthusiasts, like Mr. G. Lawrence Rotch of Boston, who has built and equipped one of the finest private observatories in the world, and in a quiet way contributes much to the advancement of science. There can be no question as to the value of such an organization. A few minutes' reflection should satisfy any well-informed resident of this city and vicinity that men enough, admirably qualified to conduct such an enterprise, are to be found hereabouts; and the advantages of affiliation for this purpose ought to be too apparent to need pointing out. The discussion of appropriate papers from members or outside experts, the education which even the most accomplished scholars would derive from others' labors, the stimulus and direction given to individual investigation, the procuring of a common library for use in meteorological research, the shaping of popular ideas about weather, and the depreciation of "cranks" of the Wiggins type, would be among these benefits. Whether those persons best fitted to carry on this work have the time and inclination to carry the proposed society through a short infancy into an assured permanence and a usefulness worthy of the American metropolis and its environs, is really the only question to be solved. I should be glad to be the humble means of bringing together for organization those who will favor the movement in private letters to the editor of *Science*. JAMES P. HALL.

Brooklyn, N.Y., May 20.

BOOK-REVIEWS.

Midnight Talks at the Club. Reported by AMOS K. FISKE. New Yord, Fords, Howard, & Hulbert. 16°. $1.

MOST of the chapters of this book were originally published as a series of articles in the Sunday edition of the *New York Times*, and purport to be accounts of certain talks and discussions at the Asphodel Club, at which the author was present as a listener. The principal talker is known as "the Judge," who is obviously intended as the author's mouthpiece. The talks are almost entirely on religious themes, "the Judge's" views being those of the most advanced liberal Christians of the present day. He is represented as regarding "the restraint and elevating influence of Christianity over society as necessary to the uplifting of mankind from their low condition, the salvation of free institutions, and the system of popular government" (p. 108). But he holds that "the Church, in order to maintain its great influence and power for good, and do the work which most needs to be done, absolutely must range itself in line with modern progress in knowledge and thought" (p. 221). But the Church, he says, has not kept up with the intellectual progress of recent times, and for this reason is losing its hold upon the world. The remedy that "the Judge" proposes is to "discard the requirement of a belief in the miraculous" as a condition of admission to Christian fellowship. Such a loosening of the bonds of dogma would, he thinks, bring into the Church all the best minds of the age; and make it the saving and elevating power that it ought to be. It will be seen, therefore, that the views expressed in the book are those now commonly held by scientific men and historical critics, but they have not until recently been expressed in this country with such freedom and emphasis. Unfortunately, however, "the Judge's" views, like those of most liberal Christians, are mainly negative and critical; and he has little to say as to the positive side of religion, except that he believes in the being of God and the immortality of the soul. Hence, although the work is written in an excellent spirit, and contains many good points, the reader lays it down with the consciousness of something lacking.

Epitomes of Three Sciences: Comparative Philology, Psychology, and Old Testament History. Chicago, Open Court Publ. Co. 12°. 75 cents.

THIS volume contains three essays designed to give an account of recent investigations in certain departments of science, with their most important results. The ablest and most interesting is the first, on "The Study of Sanskrit," written by Professor H. Oldenberg of Kiel. It is not, as the title of the book would lead us to think, an exposition of comparative philology, which is only incidentally alluded to, but is an historical account of the discovery and elucidation of the ancient Sanscrit literature. Beginning with Sir William Jones, the author traces the progress of Sanscrit studies through various vicissitudes and difficulties to the present day, and shows how much has been done toward the recovery of this important literature, and by what means the work has been accomplished.

The second paper, entitled "Aspects of Modern Psychology," by Professor Joseph Jastrow, is really devoted to the new science of psycho-physics. It is not a summary of the science, but a brief history of its origin and development. The contributions of the different nations are recorded, those of Germany naturally occupying the most prominent place; and there are also a few pages on recent investigations in comparative psychology and in animal psychology.

The third essay, "Rise of the People of Israel," by Professor C. H. Cornill of Königsberg, is an attempt to state the grains of historical truth in the early traditions and legends of the Israelites. The author holds that every such historical legend has a basis of truth; but by what criterion he discriminates between the truth and its attendant falsehoods he does not tell us. However, he sets before us what he believes to be the real outline of Israelitish history from Abraham to David, which has at least the merit of being based on conscientious and painstaking study. On the whole, this little volume is well worthy of perusal.

Pure Logic and other Minor Works. By W. STANLEY JEVONS. New York, Macmillan. 8°. $2.50.

THIS volume is made up of several of the author's shorter works, with a preface by Professor Robert Adamson. It contains the work on "Pure Logic" first published in 1864; "The Substitution of Similars," which appeared in 1869; and some minor logical essays, closing with the four papers entitled "John Stuart Mill's Philosophy Tested," originally published in the *Contemporary Review*. As all of them have long been before the world, and most students of logic and philosophy have already formed their opinion of them, we shall not discuss them here; but we cannot help recording our opinion that neither these nor the author's other works have such high merit as his admirers claim for them. Jevons was always trying to be original, and to revolutionize the branches of knowledge with which he dealt; yet his only valuable contributions to them relate to minor points. The criticisms of Mill might better, we should think, have been left to slumber in the pages of the magazine in which they originally appeared, as they are no benefit to their author's reputation. He does, indeed, point out some defects in Mill's philosophy; but many of his criticisms are worthless and misleading, while their tone and temper are about as bad as is possible. They are, in fact, models of all that controversial writings ought not to be.

How to Remember History. By VIRGINIA CONSER SHAFFER. Philadelphia, Lippincott. 8°. $1.

THE main object of this work is to assist the student of history in remembering dates. It presents a summary of the leading events of the sixteenth, seventeenth, eighteenth, and nineteenth centuries, some thirty or forty in each one, with charts designed to make the dates and character of these events apparent to the eye. The occurrences of each century are first stated in brief chronological form, it being intended that these statements shall be committed to memory; and then follows a succinct historical account of the events themselves. But the charts are the peculiar feature of the work, and are believed, not only by the authoress but by others who have used them, to be valuable aids to the memory. The plan of the charts was originally borrowed from

some German writer, but is here given with modifications, each chart consisting of one hundred squares representing the years of the century, while colored sections within the squares indicate the important events. The plan is certainly ingenious; but we must confess to having considerable doubt as to the efficacy of any such contrivances. It may be worth trying, however, and the book is meritorious even apart from the charts.

AMONG THE PUBLISHERS.

IN *Lippincott's Magazine* for June, Robert Kennaway Douglas has an article upon "The Origin of Chinese Culture and Civilization." Mr. Douglas maintains that the Chinese were not aboriginal in China, but were immigrants into that country from Babylonia.

—Messrs. John Wiley & Sons announce as in preparation "Least Squares," by Professor W. W. Johnson of the United States Naval Academy.

—Henry Holt & Co. have issued a new catalogue covering their educational publications in science, mathematics, history and political science, English, French, German, Greek, Latin, Italian, and Spanish.

—Robert Bonner's Sons, New York, announce "Africa Re-Discovered: Five Years with the Congo Cannibals," by Herbert Ward. Mr. Ward's travels in Africa commenced in 1884, when he received an appointment in the service of the Kongo Free State. He was a member of the Stanley Relief Expedition, and made his memorable canoe journey of eleven hundred miles on the Kongo in the service of H. M. Stanley.

—Columbia College, in its recent change of administration, has attracted to itself considerable public attention. The *New England Magazine*, in the coming June number, will contain an illustrated article on this subject by Professor Van Amringe.

— President Seth Low (ex-mayor of Brooklyn), in his article on "The Rights of the Citizen as a User of Public Conveyances," in the June *Scribner*, says, "The most valuable city franchises in the United States have been parted with, for the most part, for nothing. In Europe they have been largely retained as a source of revenue to the community. If we can find the reason for the facts as they exist here, much light may be thrown on the question of remedy."

—*The Chautauquan* for June opens with the second of a two-part article on "The Making of Italy," by Edward A. Freeman, the eminent English historian; James A. Harrison, LL.D., of Washington and Lee University, takes "The Archæological Club in Italy" to the end of its journey; Bella H. Stillman continues her studies of "Life in Modern Italy," this time giving a glimpse of the customs of the upper classes; Principal James Donaldson, LL.D., of the University of St. Andrews, Scotland, closes his series of articles on "Roman Morals;" a characteristic article on "How to Travel in Italy" is contributed by J. P. Mahaffy, M.A.,

Publications received at Editor's Office, May 12–17.

BONAPARTE, Prince Roland. Le Glacier de l'Aletsch et le Lac de Märjelen. Paris, The Author. 26 p. 4°.
—— Le Premier Etablissement des Néerlandais a Maurice. Paris, The Author. 60 p. 4°.
CHURCH, A. H. The Chemistry of Paints and Painting. London, Seeley & Co., 310 p. 12°. (New York, Macmillan, $1.75.)
DURHAM, W. Evolution, Antiquity of Man, Bacteria, etc. Edinburgh, Adam & Charles Black. 127 p. 12°. 50 cts.
FISKE, A. K. Midnight Talks at the Club. New York, Fords, Howard & Hulbert. 298 p. 16°. $1.
HENSHAW, S. Bibliography of the More Important Contributions to American Economic Entomology. Parts I., II., III. The More Important Writings of Benjamin Dann Walsh and Charles Valentine Riley. Washington, Government. 454 p. 8°.
HENSOLDT, H. Zwei Jahre in Ceylon. New York, Druck der Cherouny Pr. and Publ. Co. 51 p. 8°.
JEVONS, W. S. Pure Logic and other Minor Works. Ed. by R. Adamson and Harriet A. Jevons. London and New York, Macmillan. 299 p. 8°. $2.50.
MARILAUN, A. K. v. Allgemeine Naturkunde. Lief. 118–123. Pflanzenleben, II. Hefte 1–6. Leipzig, Bibliographische Institut. 320 p. 8°. (New York, Westermann.)
OLD TESTAMENT Stories in Scripture Language. From the Dispersion at Babel to the Conquest of Canaan. (Riverside Literature Series, No. 46.) New York and Boston, Houghton, Mifflin, & Co. 100 p. 16° 15 cents.
OLDENBERG, H.; JASTROW, J.; and CORNILL, C. H. Epitomes of Three Sciences. Comparative Philology, Psychology, and Old Testament History. Chicago, Open Court Publ. Co. 139 p. 12°. 75 cts.
SHAFFER, Virginia C. How to Remember History. Philadelphia, Lippincott. 143 p. 8° $1.
THAYER, W. R., *ed.* The Best Elizabethan Plays. Boston, Ginn & Co. 611 p. 12°. $1 40.
WARNER, F. A Course of Lectures on the Growth and Means of Training the Mental Faculty. Cambridge, University Pr. 222 p. 12°. (New York, Macmillan, 90 cents.)
WILEY, H. W. Record of Experiments in the Production of Sugar from Sorghum in 1889. Washington, Government. 112 p. 8°.
WITNESS, The. Vol. I. No. 1. m. Frankfort, Ky., S. F. Smith. 4 p. f°. 25 cents per year.

of Dublin University; "How Electricity is Measured" is the subject of an entertaining article by Professor Edward L. Nichols of Cornell University: that the new Greece is worth studying as well as the old. is shown in "The Greeks of To-day," by Albert Shaw, Ph.D.; and John Burroughs explains what to him is "The Secret of Happiness."

— Messrs. Ginn & Co. announce to be ready in June, "The Leading Facts of American History," by D. H. Montgomery, author of "The Leading Facts of English History," "The Leading Facts of French History," etc. This work is based on a study of the highest recognized authorities in United States history. Its object is to present in a clear, connected, and forcible manner, adapted to the wants of grammar-school pupils, the important events in the life of the American people from the earliest period to the present time.

— The famous Bill of Rights adopted by Parliament in 1689, which finally settled the constitutional character of the English Government and brought kings strictly under law, has just been added to the Old South Leaflets, being the nineteenth number in the new general series, published for the directors of the Old South work, by D. C. Heath & Co., Boston. The historical and bibliographical notes to this leaflet, by Mr. Mead, are especially full. These original documents, so many of which are being furnished at so trifling an expense by the Old South people, are invaluable for our students of history.

— Mr. Edwin D. Mead's addresses on the Roman Catholic Church and the public schools have been put together in a little volume of a hundred pages, which will be published immediately by George H. Ellis, Boston. The collection includes the addresses given before the Woman Suffrage League in Boston during the controversy over Swinton's "History," the address before the Massachusetts Schoolmasters' Club at the close of the Boston conflict. and the address before the National Educational Association at Nashville last summer in the debate with Bishop Keane. These addresses have already been published as separate pamphlets, and of the Nashville address nearly fifty thousand copies have been circulated. Their publication together at this time, when the struggle over the Bennett law in Wisconsin has drawn the attention of the country anew to the whole subject, is opportune. There is almost no phase of the subject which Mr. Mead does not touch in these addresses. What is chiefly worthy of remark is, that although he is the warmest defender of the public-school system, and the most outspoken critic of the parochial schools, he has treated the Roman Catholics with a careful justice, which has won their confidence, as has been done, perhaps, by no other of their critics. *The Catholic Review*, the ablest of the Catholic newspapers, wrote last summer, "What we desire to call attention to in these pamphlets is the remarkable fairness with which Mr. Mead treats Catholics and their views. The first fourteen pages of the first essay might have been written by a Catholic. It looks as if, for the first time in American history, Catholics were about to meet in the arena a foeman who knows their strong and weak points as well as his own."

— Russell Sturgis, the well-known architect, has written for the June *Scribner* an article on "The City House" (one of the series on homes), in which he says, "Nothing more incongruous than our New York palaces, of which the first notable one was the marble structure at the corner of Fifth Avenue and 34th Street, has ever been planned or erected. They are in almost all respects small houses looked at through a magnifying-glass; the necessary conditions of a stately house, a sort of palazzo, have hardly been considered in them; the American citizen whose fortune has increased a hundred-fold builds a house perhaps ten-fold larger than he would otherwise have done, but in other respects very similar to that one in which his father lived in days of comparative poverty."

—A recent number of *Garden and Forest* has an interesting picture of the substantial old stone bridge which spans the Ipswich at Topsfield, Mass., and the descriptive text contains a plea for more of these solid arches, which harmonize so well with the scenery of a hilly country. A fruiting branch of the Chinese privet is the subject of another picture in the same number; and the titles of some of its articles are, "Flower-Painting," In a California Cañon," "Vegetation in Southern Alabama," "Legislation for the Adirondacks," "Grapes for Home Use," "Pruning the Peach," "Hardy Plants for Cut Flowers, and Notes on Wild Flowers." The usual amount of select correspondence, book-reviews, and notes on timely topics, complete the number.

—D. C. Heath & Co. have recently made the following important additions to their Modern Language Series: "Practical Lessons in German Conversation," by Professor A. L. Meissner of Queen's College, Belfast (this book furnishes a graduated and systematic series of lessons to give facility in speaking German); "Goethe's Sesenheim" (from *Dichtung und Wahrheit*), edited by Professor H. C. O. Huss of Princeton; "A Primer of French Literature," by Professor F. M. Warren, based on lectures delivered by the author in his classes in Johns Hopkins University.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

May 17.—Erwin F. Smith, A New Species of the Genus Aphis; T. S. Palmer, Some Early Views of the Geographical Distribution of Species; Frederick W. True, Exhibition of a Specimen of Lophiomys inhausii, a Rare and Remarkable Rodent from Africa; W. H. Seaman, The Place of Biology in Public School Instruction.

Natural Science Association of Staten Island.

May 8.—Charles W. Leng, Staten Island Fire-flies.

Boston Society of Natural History.

May 21.—Warren Upham, Geographic Limits of Species of Plants in the Basin of the Red River of the North; W. O. Crosby, Composition of the Till or Bowlder Clay; S. H. Scudder, The Variety of Myriapodal Life in the Carboniferous Period.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—At the BRYANT SUMMER SCHOOL, Roslyn, L. I., THREE professors to teach Sciences, Languages, Mathematics, etc. July 8–Sept. 8. Also, a six months' term beginning now. Other papers please copy. E. HINDS, A.M., Principal.

A GRADUATE of Princeton, for several years university student and Fellow in Biology, desires a position either to teach biology or as assistant in a biological laboratory. Would prefer the latter and be satisfied with a moderate salary if the position afforded time for the prosecution of original research. Address, O. S., BOX 86, Princeton, N. J.

THE ADVERTISER—A Third Year Student in Honor Sciences at Toronto University, is willing to take position as Science-Teacher or Tutor until next October. Enthusiastic and practical instructor in Biology, Chemistry, Physics, Mineralogy and Geology. Latin and Greek and other branches additional if required. Young, good family. References as to character and ability. CHEMIA, UNIV. COLL., TORONTO.

WANTED—Information concerning the production of Mushrooms in caves and other places. Address M. H. CRUMP, care Ky. Theological Sem'y, Frankfort, Ky.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Through knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

WANTED—Two first-class Instrument Makers. Apply by letter to T. C. MENDENHALL, Superintendent United States Coast and Geodetic Survey, Washington, D.C.

AN EXPERIENCED Technical Chemist will be open to engagement this summer. Highest references. Address DIRECTOR, Office of SCIENCE.

PROF. WILLIAM FINDLAY, of the Philadelphia Institute of Physical Culture, is open to engagement in summer school to teach Free Movements, Wands, Clubs, Dumb-bells, Fencing and Sparring. Address 1,009 Arch St., Phila., Pa.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

A large number of plants from Maine, Connecticut, Indiana and Illinois for exchange. Southern and western exchanges preferred. Address, enclosing lists, L. N. Johnson, 223 Chicago Ave., Evanston, Ill.

For Exchange—Fourteen volumes Encyclopedia Britannica (Stoddard's ninth edition), bound in leather—part in original wrappers, all as new—can arrange to furnish volumes required to complete set, and six volumes "American Naturalist" in numbers. Want small screw-cutting foot lathe and testing galvanometer and rheostat. For particulars address A. B. Campbell, McKean Co., Bradford, Pa.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 382.

NEW YORK, MAY 30, 1890.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

THE CHEROKEES IN PRE-COLUMBIAN TIMES.[1]

II.

HAVING thus followed back the chain by the light of history and tradition, we turn next to the evidence derived from the mounds.

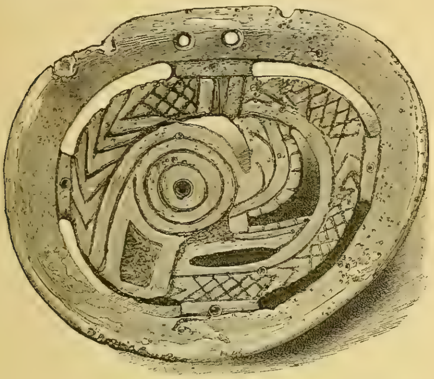

FIG. 1.

Although it cannot be stated positively that no tribe except the Cherokees occupied this Appalachian region between 1540 and 1690, still the evidence and indications leading to that conclusion are so strong as to justify us in assuming that it is correct. It is possible that clans or small parties from other tribes may have taken up their abode temporarily with these mountain Indians; but, so far as history informs us and the remains indicate, a single instance of the kind only is known. It is therefore a fair presumption that such mounds or other works of this area, not constructed by the whites, which indicate contact with European civilization, if there be any, are to be attributed to the Cherokees.

[1] Continued from Science of May 16, p. 300.

One of the ancient burial-places in Caldwell County, N.C., explored by the agents of the United States Bureau of Ethnology, is described as being a burial-pit in the form of a triangle, the two long sides 48 feet each, and the southern base 32 feet, in which the bodies and accompanying articles were deposited and then covered over, but not so as to raise any distinct mound above the natural surface of the ground, or, if so, it had settled to the level of the latter. The depth of the original excavation, the sides of which could be distinctly traced, varied from two and a half to three feet. In this pit were twenty-seven skeletons arranged as follows: nine lying horizontally on their backs on the bottom of the pit, with nothing over them except the dirt (these were buried separately); four were in a sitting posture, and over each a small beehive-shaped vault of cobblestones; four buried two and two in vaults, but lying horizontally at full length; and ten or more in one group, which, from their arrangement in regard to each other, the explorers believed must have been interred at one time, the skeleton of the principal personage of the group resting horizontally on his face on the bottom of the pit. Under the head of this skeleton was a large engraved shell gorget shown in the figure (Fig. 1). Around the neck were a number of large-sized shell beads, probably the remains of a necklace; at the sides of the head, near the ears, five elongate copper beads, or rather small cylinders, varying in length from one and a half to four inches, part of the leather thong on which the smaller ones were strung yet remaining in them. These beads were made of thin copper cut into strips, and then rolled up so as to bring the edges together on one side in a straight line. The plate out of which they were made was as smooth and even as though it had been rolled. Under the breast of the same skeleton was also a piece of copper. The arms were partially extended, the hands resting about a foot from the head. About each wrist were the remains of a bracelet composed of alternate beads of copper and shell. At his right hand were four iron specimens much corroded,

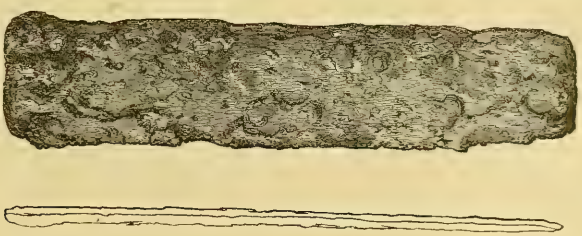

FIG. 2.

but sufficiently distinct to indicate their form and use. One of these was in the form of a thin celt; another, about five inches long, is apparently part of the blade of a long slender cutting or thrusting implement of some kind, as a sword, dagger, or knife (shown in Fig. 2); another is part of a round awl-shaped implement, a small part of the bone handle in which it was fixed yet remaining attached to it. A careful analysis of the iron of these implements has been made by Professor Clark of the United States Geological Survey, who decides that it is not meteoric. Under the left hand of the same skeleton was another engraved shell, the concave side upward, and filled with shell beads of various sizes.

Around and over the skeleton of this chief personage, with their heads near his, were nine other skeletons. Under the heads of two of these were two engraved shells. Scattered over and between the skeletons of this group were numerous polished celts, discoidal stones, copper arrow-points, plates of mica, lumps of paint, etc.

That these iron articles cannot be attributed to an intrusive burial is evident from the preceding description. They were found at the bottom of the pit, which had been dug before depositing the bodies. With them were engraved shells, polished celts, and other relics of this character, and all were deposited with the principal personage who had been buried in the mound. There were, in fact, no indications whatever of intrusive burials here.

As it is conceded that neither the Indians nor the more civilized tribes of Mexico and Central America were acquainted with the art of manufacturing iron, the presence of these iron articles in the mound indicates contact with the civilization of the Old World. Moreover, a careful examination of the copper cylinders will probably satisfy any one that the plate of which they were made had been rolled or regularly hammered by other than stone implements, and that the strips had been cut into proper shape with some hard metallic instrument. It is reasonable, therefore, to conclude that this burial-pit was dug, and the bodies deposited, subsequent to the discovery of America by Columbus, and in all probability after the date of De Soto's expedition. As the Cherokees alone inhabited this particular section from the time of De Soto's expedition until it was settled by the whites, it is more than probable that the burials were made by them.

This is an important step in the attempt to trace backward the history of this tribe, as it is seemingly the link which crosses the border-line between the historic and prehistoric eras. It should therefore be well sustained by other data before being used as a basis for further advance; but this is not wanting.

On the same farm as the preceding was another burial-place, also explored by the agents of the Bureau of Ethnology, of which an account is given in the "Fifth Annual Report." In this case we have a true mound, although of comparatively little height. This was almost a true circle in outline, thirty-eight feet in diameter, but not more than a foot and a half in height above the natural surface of the ground. Thorough excavation, however, revealed the fact that the builders of the mound had first dug a circular pit of the same diameter, with perpendicular margin, to the depth of three feet, on the bottom of which they deposited their dead, some in little stone vaults and some without any stone enclosure, and covered them over with earth, raising the mound above the pit.

A plan of the pit, showing the stone vaults and skeletons after the removal of the dirt, is given in Fig. 3. The bee-hive-shaped vaults were built of water-worn bowlders, with merely sufficient clay to hold them in place.

No. 1 indicates a stone vault standing exactly in the centre of the pit. In this case a small circular hole a little over three feet in diameter, and extending down three feet below the bottom of the pit, had been dug, the body or skeleton placed perpendicularly upon its feet, and a wall built up around it, converging, after a height of four feet was reached, so as to be covered at the top by a single soapstone slab of moderate size. On the top of the head of the skeleton, and immediately under the capstone, were several plates of silver mica, which had evidently been cut with some rude implement. Although the bones were much decayed, yet they were retained in an upright position by the dirt which filled

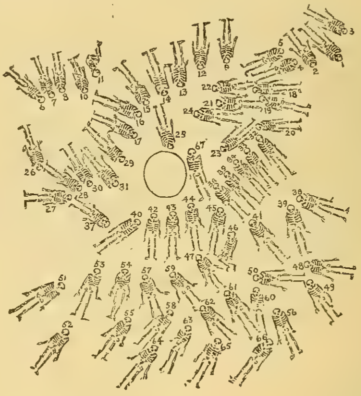

FIG. 3.

the vault,—an indication that the flesh had been removed before burial, and earth packed around the skeleton as the vault was built up.

Nos. 2, 3, 4, 5, 6, 7, 8, 9, and 10 are small vaults, each covering a skeleton placed in a sitting or squatting posture on the bottom of the pit. Nos. 11, 12, and 13 are uncovered skeletons in a squatting posture. Nos. 14 and 15 are uncovered skeletons lying horizontally on the bottom of the pit. No. 16 is an unenclosed squatting skeleton of unusually large size: *A*, a quantity of black paint in lumps; and *B*, a cubical mass of water-worn bowlders built up solidly and regularly, twenty-four inches long, eighteen inches wide, and eighteen inches high, but with no bones, specimens of art, coals, ashes, or indications of fire on or about it. Many of the stones of the little vaults and the earth immediately around them, on the contrary, bore unmistakable evidences of fire; in fact, the heat in some cases had been so intense as to leave its mark on the bones of the enclosed skeletons,—another indication that the flesh had been removed before burial.

The only relic found deserving notice here was a soapstone pipe near the mouth of No. 16.

The proximity of this mound to the Triangle, the occurrence of the pit, and the similarity in the modes of burial, are sufficient to justify us in attributing them to one and the same people. Two hundred yards east of the Triangle was another low mound, covering a circular pit similar to that described. In this were twenty-five skeletons and one stone heap. Some of the skeletons were in a sitting posture, covered with stone vaults, others unenclosed. Some were stretched horizontally on the bottom of the pit, unenclosed. Four of the latter were lying together, with large stones resting on their legs below the knees.

In a different part of the same county, another similar circular burial-pit was explored, in which, besides the separate sitting and horizontal skeletons, there was a kind of communal grave similar to that in the Triangle. As there can be no reasonable doubt that all these are the burial-places of one tribe, and there are no indications of intrusive burials, it is legitimate to consider them together, and to draw inferences in regard to the customs of the authors from what is found in either.

Referring to the account given in the "Fifth Annual Report of the Bureau of Ethnology," it is seen that the following articles were found buried with the skeletons of the last-mentioned pit alone: one stone axe; forty-three polished celts; nine vessels of clay, including four pots and two food-cups, the handle of one representing an owl's head, and that of the other an eagle's head; thirty-two arrow-heads; twenty soapstone pipes, mostly uninjured; twelve discoidal stones; ten rubbing-stones; one broken soapstone vessel; six engraved shells, some of the designs on them like that shown in Fig. 4; four shell gorgets; one sea-shell (*Busycon perversum*) entire, and two or three broken ones; five very large copper beads; a lot of shell fragments, some of them engraved; a few rude shell pins made from the *columellæ* of sea-univalves; shell beads and a few small copper beads.

It is evident, from the mode of burial and the articles found, that these works cannot be attributed to white men of post-Columbian times. Can they be attributed to the Indians found inhabiting this region at the time of the advent of the whites? If the evidence justifies this conclusion, we may then attribute them without hesitancy to the Cherokees.

Lawson, who travelled through North Carolina in 1700, states that "the Indians oftentimes make of a certain large sea-shell a sort of gorge, which they wear about their neck in a string, so it hangs on their collar, whereon is sometimes engraven a cross or some odd sort of figure which comes next in their fancy." Beverly, in his "History of Virginia," evidently alluding to the same customs, says, "Of this shell [the conch] they also make round tablets of about four inches in diameter, which they polish as smooth as the other, and sometimes they etch or grave thereon circles, stars, a half-moon, or any other figure suitable to their fancy." Adair states, in his "History of the American Indians," that the priest wears a breastplate made of a white conch-shell, with two holes bored in the middle of it, through which he puts the ends of an otter-skin strap, and fastens a buck-horn white button to the outside of each.

Here, then, is evidence of a custom among the Indians precisely similar to that which prevailed among the mound-builders of the region to which reference has been made. Nor does the comparison stop with the general resemblance in customs; for among the shells found in the burial-mounds mentioned was one with a cross engraved upon it, and on others were engraved figures that might be readily taken for stars and half-moons (Fig. 4). Moreover, while some are "engraved," others are "smooth," without any devices upon them; and all are pierced with holes for inserting strings by which to hang them about the neck. They are usually made from *Busycon perversum*, which is designated in common parlance a "conch."

That shells of this kind, bearing precisely similar engraved designs, were in use among the veritable mound-builders, is proven by the fact that they have been found in mounds of some of the most important groups of Georgia, Tennessee, and elsewhere. This fact is sufficient of itself to show that the North Carolina burial-places alluded to belong to the mound-building age. If these shell ornaments are the work of Indians, as appears from the statements of the above-named writers, they must have been used by the Cherokees, and buried with their dead.

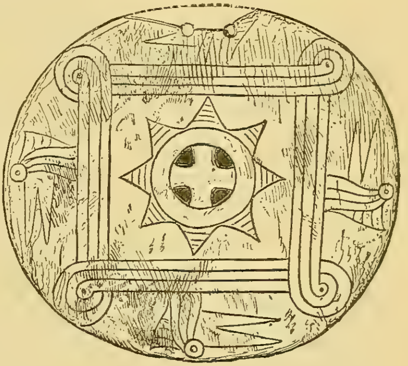

FIG. 4.

The author above quoted says that at the fall of the leaf the Indians gather hickory-nuts, "which they pound with a round stone, upon a stone, thick and hollowed for the purpose." Quite a number of precisely such stones as here mentioned, "thick and hollowed" at the ends, were found in the mounds of Caldwell County, N.C. All who examined them ascribed them without hesitancy to the use mentioned by Adair.

Another fact not mentioned in the preceding description of these mounds and burial-places is that in one,—the circular pit,—mixed with those having heads of the ordinary form, were some eight or ten skeletons with heads of elongate form, due to artificial pressure.

This furnishes strong evidence that the people who buried here were Indians. It is true, it was not a custom of the Cherokees to compress the head, but it was of their neighbors and hereditary foes, the Catawbas As this is the only instance of skulls of that form being found in the mounds of this section, it is possible they were captives from that tribe; but why buried here, unless they had been adopted by the Cherokees, is a question difficult to answer.

In the mounds and burial-places mentioned were also found a large number of nicely carved soapstone pipes, usually

with the stem made in connection with the bowl, though some of them are without this addition, consisting only of the bowl, with a hole for the insertion of a cane or wooden stem.

By turning to Adair's "History of the American Indians," we find this statement: "They [the Indians] make beautiful stone pipes, and the Cherokees the best of any of the Indians, for their mountainous country contains many different sorts and colors of soils proper for such uses. They easily form them with their tomahawks, and afterwards finish them in any desired form with their knives; the pipes being of a very soft quality till they are smoked with, and used with the fire, when they become quite hard. They are often a full span long, and the bowls are about half as long again as those of our English pipes. The fore-part of each commonly runs out with a sharp peak two or three fingers broad and a quarter of an inch thick."

FIG. 5.

Not only were pipes made of soapstone found with the stem carved in connection with them, as indicated in the above quotation, but two or three were obtained of precisely the form mentioned by Adair, with the fore-part running out in front of the bowl; and others of the same form have been found in West Virginia, Ohio, and elsewhere. Some of the forms, including one from a mound in Sullivan County, East Tenn., are shown in Figs. 5 and 6. As will be seen, one of these, of which numerous examples were found, has a very modern appearance,—a form which was first adopted in England in the time of Queen Elizabeth. It may be remarked, in passing, that the mound in Sullivan County, Tenn. (shown in Fig. 37, "Fifth Annual Report of the Bureau of Ethnology"), belongs to the same type as that of Caldwell County, N.C. Here, however, instead of a pit, a circular wall some three or four feet high is built on the natural surface of the ground, and the bodies or skeletons are seated in regular order on this natural surface, after charcoal and ashes have been strewn over it, and over each a little vault built.

Haywood, in his "Natural and Aboriginal History of Tennessee," says, "Mr. Brown, a Scotchman, came into the Cherokee nation in the year 1761, and settled on the Hiawassee River or near it. He saw on the Hiawassee and Tennessee the remains of old forts, about which were axes, guns, hoes, and other metallic utensils. The Indians at that time told him that the French had formerly been there and built these forts."

During the year 1883 one of the assistants of the Bureau of Ethnology explored this particular section which Haywood refers to. An overflow and a change in the channel of the river brought to light the remains of old habitations and numerous relics of the people who formerly dwelt there. Moreover, this was in the precise locality where tradition and the statement of the Cherokees located a Cherokee town. Digging was resorted to in order to complete the exposure which the water had begun. The only object in view in referring to this exploration is to note some of the articles found: ten discoidal stones precisely like those from the mounds of Caldwell County, N.C.; nine strings of glass beads; a number of shell beads exactly like those from the mounds; a number of flint arrow-points; one soapstone pipe; some pieces of smooth sheet copper; three conical copper ear pendants precisely of the pattern of some found in one of the Carolina mounds; three buttons of modern type; one small brass gouge; fragments of iron articles belonging to a bridle; one bronze sleigh-bell; one stone awl or drill; fragments of a soapstone pot; one soapstone gorget; several polished stone celts similar to those found in the Carolina mounds; grooved stone axes; a piece of sheet lead.

This admixture of articles of civilized and savage life confirms the statement made by Haywood, at least so far as regards the early presence of white people in this section. It follows, from what has been presented, that the Indians living here after the appearance of the whites must have been Cherokees; and the fact that the implements and ornaments of aboriginal manufacture found here are throughout precisely like those obtained from the mounds mentioned, affords a very strong proof that the latter are to be attributed to the same people.

Additional and perhaps stronger evidence, if stronger is needed, that the people of this tribe were the authors of most of the ancient works in western North Carolina and East Tennessee, is to be found in certain discoveries made by the Bureau assistants in Monroe County, Tenn.

A careful exploration of the valley of the Little Tennessee River from the point where it leaves the mountain to its confluence with the Holston was made, and the various mound groups located and carefully surveyed.

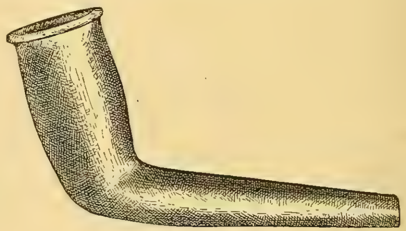

FIG. 6.

Here, on the exact sites of the "Over-hill towns," as shown by Henry Timberlake's map of 1765, using the map of the same region by the Geological Survey as a means of comparison, were found mound groups; not in a general sense only, but in the order given and at the points indicated, a group for each town, and in the only spots the valley, for this distance, affords. Commencing with the large island immediately below the mouth of Tellico River at the west end of Timberlake's map, we see the town of Mialoqua, partly on the island, and partly on the south bank. Referring to the Bureau map, which will appear in the general report of mound explorations, we see that the mounds are also

partly on the island, and partly on the south bank. On the latter map, group No. 2 corresponds with "Toskegee" of Timberlake's map; No. 3, with "Tommotley;" No. 4, with "Toqua;" No. 5, with "Tennessee;" No. 6, with "Chote;" No. 7, with "Settacoo;" No. 8, with "Half-way Town;" No. 9, with "Chilhowey;" and No. 10, with "Tellassee." Such remarkable coincidence cannot be attributed to mere chance. There is also the additional fact that the evidences of village sites which must have been left by the Cherokee towns were found only about the groups, though careful search was made by the Bureau agents along the valley.

As these mounds, when explored, yielded precisely the kind of ornaments and implements used by the Cherokees, it is reasonable to believe they built them.

Ramsey also gives a map of the Cherokee towns in his "Annals of Tennessee;" but his list, although corresponding, so far as it goes, with the order given by Timberlake, evidently refers to a date corresponding with the close of their occupancy of this section. Bartram gives a more complete list. This includes some towns on the Holston (his "Cherokee") River and some on the Tellico Plains, the localities corresponding with mound groups discovered by the Bureau agents. For example: some three or four groups are in the region of the Tellico Plains, and five or six on the Little Tennessee below Fort Loudon, and on the Holston near the junction of the two. One large mound and a group were discovered on the "Big Island" mentioned by Bartram, on which he locates a town, but fails to give the name.

The largest of these groups is situated on the Little Tennessee above Fort Loudon, and corresponds with the position of the ancient "Beloved town of Chota" ("Great Chote" of Bartram) as located by tradition and Timberlake's map. According to Ramsey, at the time the pioneers, following in the wake of Daniel Boone near the close of the eighteenth century, were pouring over the mountains into the valley of the Watauga, a Mrs. Bean, who was captured by the Cherokees near Watauga, was brought to their town at this place, bound, and taken to the "top of a mound" to be burned, when Nancy Ward, then exercising in the nation the functions of the "beloved" or "pretty woman," interfered, and pronounced her pardon. Ramsey does not give his authority for this statement, but, in all probability, obtained the information from the descendants of Mrs. Bean, who, as the writer knows, were residing in Hawkins County as late as 1850, and probably at the present time. "Nancy Ward" probably received her English name from some white family that resided for a time in that section.

During the explorations of the mounds of this region by the Bureau agents, a peculiar type of clay beds was found in several of the larger tumuli. These were always saucer-shaped, varying in diameter from six to fifteen feet and in thickness from four to twelve inches. In nearly every instance there was a series one above another, with a layer of coals and ashes between. A series usually consisted of from three to five beds, sometimes only two, decreasing in diameter from the lowest one upwards. These apparently marked the stages of the growth of the mound, the upper one always being near the present surface.

The large mound on the supposed site of Chota, and possibly the one on which Mrs. Bean was about to be burned, was thoroughly explored, and found to contain a series of these clay beds, which always show the action of fire. In the centre of some of these were found the charred remains of a stake, and about them the usual layer of coals and ashes; but in this instance immediately around where the stake stood were the charred fragments of human bones. There may be no connection between this fact and Ramsey's statement, yet the coincidence is suggestive.

The burials in this mound, which was a large one some twelve feet high, were at various depths, from two and a half to nine feet, and, although the series of clay beds indicated growth, there was nothing to indicate separate and distinct periods, or to lead to the belief that any of these were intrusive. On the contrary, the evidence is pretty clear that all these burials were by one tribe or people. It is believed that no satisfactory evidence of intrusive burials has been discovered in this entire Appalachian region. By the side of nearly every skeleton in this mound were one or more articles, as shell masks, engraved shells similar to those heretofore mentioned, shell pins, shell beads, perforated shells, discoidal stones, polished celts, arrow-heads, spear-heads, stone gorgets, bone implements, clay vessels, and copper hawk-bells. The last-named articles were with the skeleton of a child found at the depth of three feet and a half. They are precisely of the form of the ordinary sleigh-bell of the present day, but with pebbles and shell beads for rattles.

That this child belonged to the people by whom the other burials, some of which were at less depth, were made, there is no reason to doubt; and that the bells indicate contact with Europeans must be conceded.

In another mound a little farther up the river, one of a group marking the site of one of the "Over-hill towns," were discovered two carved stone pipes of a comparatively modern Cherokee type.

During the fall of 1888, a farmer of East Tennessee, while examining a cave with a view of storing potatoes in it during the winter, unearthed a well-preserved human skeleton, which was wrapped in a large piece of cane matting. This, which measures about six by four feet, is quite pliant, and, with the exception of a rent in the corner, perfectly sound. It has a broad, submarginal stripe of red running around it. Enclosed with the skeleton was a piece of cloth made of flax, about fourteen by twenty inches, almost uninjured, pliant, but apparently unfinished. The stitch in which it is woven is precisely the same as that imprinted on pottery shown in a cut in Mr. Holmes's paper on "Mound-Builders' Textile Fabrics" ("Fifth Annual Report of the Bureau of Ethnology"). Although the earth in the cave contains salts which would aid in preserving any thing buried in it, these articles cannot be assigned to any very ancient date, especially as there were with them the remains of a dog from which the skin had not all rotted away. These were in all probability placed here by the Cherokees of modern times, and form a link between the historic and prehistoric times not easily broken.

Another important find was made in this locality by one of the Bureau agents in 1889. This is a small stone on which some characters have been rudely etched, and is shown in the figure on p. 328. An examination by those familiar with the subject will probably soon satisfy them that some of the characters, if not all, are letters of the

Cherokee alphabet. As the presence of the stone in the mound cannot be attributed to an intrusive burial, it is evident that the mound must have been built since 1820, that Mr. Guess was not the author of the Cherokee alphabet, or that the stone is a fraud. The mound in which this was found is described as follows:—

"The Tipton group is situated on the north side of the Little Tennessee, about two miles from Morganton. No. 3 of this group, which stands about one hundred feet from No. 2, is of small size, measuring twenty-eight feet in diameter and about five feet in height. Some large trees," says Mr. Emmert, the Bureau agent, "were standing on the mound, and Mr. Tipton informed me that he had cut other trees off of it forty years ago, and that it had been a cluster of trees and grape-vines as far back as the oldest settler could recollect. There was an old stump yet in the centre, the roots of which ran down in the mound almost or quite to where the skeletons were found. . . . Having worked to the bottom, I found here nine skeletons lying at full length on the natural surface, with faces up, and surrounded by dark-colored earth. No. 1 (as shown in the diagram which accompanies his report) was lying with head to the south;

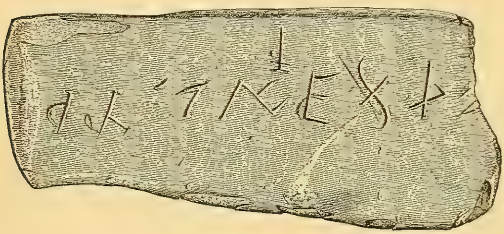

FIG. 7.

while No. 2, close by the side of it, had the head to the north, and feet almost touching the head of the other. On the same level, but apart from the preceding, were seven other skeletons lying closely side by side, heads all to the north, and all in a line. No relics of any kind were found with any of the skeletons except No. 1. Immediately under the skull and jaw-bones were two copper bracelets, an engraved stone (Fig. 7), a small drilled stone, a single copper bead, a bone instrument, and some small pieces of polished wood. The earth about the skeletons was wet, and the pieces of wood were soft and colored green by contact with the copper bracelets. These bracelets had been rolled up in something which crumbled off when they were taken out, but whether buckskin or bark I was unable to decide. The engraved stone was lying partially under the skull. I punched it with my steel prod on the rough side in probing, before I reached the skeletons."

As soon as the collections made by Mr. Emmert during this exploration were received at the office in Washington, a member of the Bureau was sent to the field where Mr. Emmert was at work, to learn the whole history of the find. This course was taken by the Bureau merely as a means of being fortified with all possible evidence as to the facts of the find being as stated. The examination by the person sent confirmed the statement by Mr. Emmert in every particular. This, therefore, necessitates one of two conclusions,—that the mound was thrown up since 1820, or that some one was at work on the Cherokee alphabet before Mr. Guess's time. But this is a question which has no bearing on the present discussion.

[Continued on p. 330.]

DR. FREIRE'S PROTECTIVE INOCULATION.—FACTS *VERSUS* FIGURES.[1]

The *Medical Record* published some time since a translation of a communication, made by Dr. Domingos Freire of Brazil to the French Academy of Sciences, relating to his protective inoculations. This summary statement has been copied in this country by *Science*, and probably by other journals, and will doubtless be read by many who will never see a copy of the volume containing my official report[2] of investigations made in Brazil, in which I show that Dr. Freire's statistics are misleading, and that his "vaccinations" have no prophylactic value.

Dr. Freire's recent statistics have also been brought to the notice of the profession by an article by Dr. J. McF. Gaston, published in the *Journal of the American Medical Association*, March 22 1890. In order that the profession in this country may be able to estimate Dr. Freire's statistics at their true value, I beg leave to call attention to the following facts:—

First, there has been no veritable discovery of the specific germ of yellow-fever, and consequently there is no "attenuated virus" at Dr. Freire's command with which to vaccinate against the disease. It is certain that the micrococcus, which he presented to me at the time of my visit to Brazil as his yellow-fever microbe, has nothing to do with the etiology of this disease. A careful bacteriological study of forty fatal cases, made in Havana since my return from Brazil, enables me to affirm this in the most positive manner.

There is, then, no scientific basis for the wholesale inoculations which Dr. Freire has made; and his statistics, when viewed in the light of certain facts not brought out in his publications, give no substantial support to his claims.

As my personal investigations were made in the city of Rio de Janeiro, and a majority of Dr. Freire's inoculations have been made in that city, I shall consider at present only those figures which relate to his recent inoculations in the Brazilian capital. With reference to these, Dr. Freire says in his latest publication,[3]—

"Between March 1 and June 30, 1889, 2,407 persons died of yellow-fever (including the deaths at the Jurajuba Hospital), 21 of whom had been vaccinated; that is to say, that 2,386 non-vaccinated persons succumbed to the disease (1,606 in the city, 800 at Jurajuba, in all)."

Now, the total population of Rio is estimated at 400,000. Let us suppose that 100,000 of this population enjoys protection from having suffered an attack of the disease: we have left 300,000 persons who may fairly be compared with those vaccinated by Freire, and who were exposed during the epidemic. The mortality upon this estimate is 1 in 125 and a fraction ($\frac{300000}{2386}=125.7$). Among the 2,087 vaccinated, there were, according to Dr. Freire, 21 deaths (*loc. cit.*, p. 16), that is, one in 99 and a fraction ($\frac{2087}{21}=99.38$). It will be seen that this comparison is not at all favorable to Dr. Freire's method. But no doubt he will claim that the comparison is unfair, and that the 2,087 vaccinated by him represent a greater proportion of susceptible persons than the 300,000 with whom we have compared them. Let us, then, deduct another 100,000 of the population, considering one-half as protected by a previous attack or long residence in the city. The remaining moiety includes the entire foreign population; Brazilians not born in the city of Rio; all young children, who, according to Freire, are to be classed with strangers as to susceptibility: in short, a population that may be fairly compared with those vaccinated.

[1] From the Medical Record.

[2] Annual volume of the Marine Hospital Service for 1889.

[3] Statistique des vaccinations au moyen des cultures du microbe atténué de la fièvre jaune (Rio de Janeiro, 1890).

The ratio of mortality under this estimate is 1 in 83 and a fraction ($\frac{200000}{2380}$=83.78). But in this comparison we have ignored some very important factors which are in favor of Dr. Freire's statistics. A large number of the deaths, no doubt, occurred among strangers who did not belong to the population of the city, and especially among the sailors on foreign vessels arriving during the epidemic, who are commonly sent to the Jurajuba Hospital when taken sick. On the other hand, we have no definite information as to the precise date when the vaccinations were practised, and no data with reference to the exposure before and after vaccination. In the statistics of previous years a very considerable number of persons were vaccinated after the epidemic had terminated; that is, persons who had passed through the epidemic season without contracting the disease were vaccinated, and counted among those supposed to be protected from an attack by this procedure. Evidently, the later in the epidemic the vaccinations were practised, the less value can be accorded to the subsequent exposure as a test of protection. Previous exposure without being taken sick is, on the contrary, evidence of comparative insusceptibility. To put those vaccinated on the same footing with the 200,000 of the population of Rio with whom we have compared them, they should have been vaccinated at the outset and exposed in the infected city throughout the epidemic season. How many were vaccinated when the epidemic had commenced to decline, or after it had practically terminated? How many left the city soon after being vaccinated? These are questions we cannot answer for 1889; but the facts with reference to 1884, 1885, and 1886 are given in my published report heretofore referred to, some extracts from which I beg leave to quote. Referring to the year 1885, I say,—

"Dr. Freire has omitted to state one very important fact with reference to vaccinations practised during the period included in this tabular statement. The date of vaccinations is not given. Fortunately, I am able to supply this omission from his journal containing the names of the vaccinated, which he kindly placed in my hands during my stay in Rio. I find from this record that the inoculations were practised as follows:—

January	392
February	342
March	611
April	139
May	273
June	813
July	481

"Now, it is well known that June and July are months during which yellow-fever does not prevail in Rio, and that, in fact, the month of May furnishes as a rule but few cases.

"The exposure even in an epidemic year amounts to very little during the months of May, June, and July, and may be considered practically *nil* in a year like 1885, when the whole mortality was only 278 in a city of 400,000 inhabitants. But Dr. Freire has included in his list 1,294 persons who were vaccinated during the healthy winter months of June and July, and who presumably had been exposed during the preceding comparatively unhealthy months of January, February, March, and April. If these 1,294 individuals were protected from an attack of yellow-fever by the inoculation practised in June or July, what protected them from being attacked during the preceding epidemic season? We must insist upon excluding these 1,294 persons from consideration during the year 1885, to which the report under review relates, and we think that it would be quite proper also to exclude those inoculated during the month of May, but will not insist upon this point. We have, then, to consider the value of the evidence offered by Dr. Freire as regards 1,757 inoculated persons, instead of 3,051 included by him in his statistics for the year.

. . . .

"Again I find, that in 1886, as in 1885, Dr. Freire has included in his statistics a large number of persons who were vaccinated after the termination of the epidemic, and whose exposure was but little greater than that of the 1,476 imaginary persons who must be added to his list in order to give the mortality of 1 per 1,000.

"Dr. Freire has not given us the date of his vaccinations in his elaborate presentation of his statistical results, but I find from his manuscript record that they were distributed throughout the year as follows (I place in parallel column the figures showing the total mortality from yellow-fever during the period):—

Month.	Vaccinations.	Total Deaths from Yellow-Fever.
1886.		
January	84	135
February	376	234
March	253	347
April	167	220
May	945	48
June	21	18
July	57	9
August	3	2

"This table shows that during the epidemic period, from Jan. 1 to April 30, there were 880 vaccinations, and during the same period 936 deaths occurred from yellow-fever; while during the months of May, June, July, and August, when the total mortality was but 77, the number of vaccinations was 1,026: i.e., a majority of the vaccinations were practised after the epidemic season was over, and upon persons who, no doubt, had for the most part passed through the epidemic season without contracting the disease.

"We turn now to the age of the vaccinated persons. Dr. Freire says, in his report first quoted, that the greater proportion of the deaths is comprised between one and thirty years. This is, then, the period most favorable for the development of yellow-fever. Now, it will be seen that among the number vaccinated, which we give in the second part of our statistics, 2,624 individuals are comprised in this period. But Dr. Freire has elsewhere shown us that the age which gives the greatest mortality is from twenty-one to thirty years. Let us then see what proportion of the vaccinated are included in these limits. Reference to his tables shows the deaths between twenty-one and thirty years of age to have constituted 39 per cent of the entire mortality, while only 15 per cent of the vaccinated fell within these limits of age. On the other hand, 43 per cent of the vaccinated were less than ten years of age, while the mortality for this period was only 12.5 per cent of the entire mortality. We note, also, that a large number of the children vaccinated were infants below two years of age.

. . . .

"In Dr. Freire's report under review, he says, on p. 7, 'We include in these figures all the vaccinated during the two previous years *who have been carefully observed during the epidemic season.*'

"That portion of the sentence which I have italicized surprises me exceedingly. From what has been said, it will be seen that a careful observation of the floating population of the cortiços, in which most of the vaccinated persons resided, would be practically impossible, even with a large force of inspectors at command.

"Dr. Freire himself did not find time to make the vaccinations among these poor people of the cortiços, but delegated this work to certain apothecaries. One of these, Mr. Telles, informed me that he had himself vaccinated between three and four thousand persons. He also communicated the startling information that none of those inoculated with the 'attenuated microbe' of yellow-fever had contracted small-pox during the recent epidemic in Rio, leaving me to infer that the vaccine was a protection against both diseases. This intelligent(?) apothecary, a mulatto, recorded a large portion of the statistics which Dr. Freire has tabulated."

I have said enough to show Dr. Freire's method of manufacturing statistics, and must refer the reader who desires fuller details to my published report. GEORGE M. STERNBERG, M.D.

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VOL. XV. NEW YORK, MAY 30, 1890. No. 382.

CONTENTS:

THE CHEROKEES IN PRE-COLUMBIAN TIMES.

II.

[Continued from p. 328.]

What has been presented is probably sufficient to convince any unbiassed mind that the Cherokees were mound-builders, nevertheless there is other evidence of a more general character which serves to show that the builders of the East Tennessee and North Carolina mounds were contemporaneous with the authors of the works of other sections.

Proof that in general the mound-builders were Indians would, as a matter of course, have a strong bearing on the case under discussion, but this would require too much space to be introduced here. The following extracts from Major J. W. Powell's article on "Prehistoric Man in America," in the *Forum* of January, 1890, will give what is now becoming the settled conclusion of most of the leading archæologists of the present day:—

"The research of the past ten or fifteen years has put this subject in a proper light. First, the annals of the Columbian epoch have been carefully studied, and it is found that some of the mounds have been constructed in historical time, while early explorers and settlers found many actually used by tribes of North American Indians: so we know many of them were builders of mounds. Again, hundreds and thousands of these mounds have been carefully examined, and the works of art found therein have been collected and assembled in museums. At the same time, the works of art of the Indian tribes, as they were produced before modification by European culture, have been assembled in the same museums, and the classes of collections have been carefully compared. All this has been done with the greatest painstaking, and the mound-builders' arts and the Indians' arts are found to be substantially identical. No fragment of evidence remains to support the figment of theory that there was an ancient race of mound-builders superior in culture to the North American Indians. . . . It is enough to say that the mound-builders were the Indian tribes discovered by white men."

Once it is admitted that the mound-builders were Indians, it requires much less proof to carry conviction that a particular tribe was accustomed to erect such structures. There are, however, two facts which seem to carry back the Cherokees to the mound-building age, even independently of this general argument.

The first of these to which attention is called is that afforded by a certain class of stone graves or cists found in great numbers in some sections. These cists, usually designated "box-shaped stone graves," are formed of rough unhewn slabs or flat pieces of stone, thus: first, in a pit some two or three feet deep and of the desired dimensions, dug for the purpose, a layer is placed to form the floor; next, similar pieces are set on edge for the sides and ends, over which other slabs are laid flat, forming the covering; the whole, when finished, making a rude box-shaped coffin or sepulchre. Sometimes one or more of the six faces are wanting; occasionally the bottom consists of a layer of water-worn bowlders; sometimes the top is not a single layer, but other pieces are laid over the joints; and sometimes they are placed in the fashion of shingles. They vary in length from fourteen inches to eight feet, and in width from nine inches to three feet.

Now, it happens that quite a number of graves of this particular type are found on the site of one of the "Over-hill towns" heretofore mentioned, and others are scattered over parts of the Cherokee district. As the location of those about the village site is such as to justify the belief that they were contemporaneous with the existence of the village, we must conclude that the authors of the graves of this type, and the Cherokees, were contemporaneous. Additional proof of this is found in the seemingly conclusive evidence, which is too lengthy to be introduced here, that the graves of this form found south of the Ohio are due to the Shawnees. The well-known fact that the Cherokees and Shawnees were long hereditary and bitter foes, almost constantly at war with each other, would seem to forbid the above supposition that a Shawnee colony was living in connection with a Cherokee village; yet the following historical items furnish a satisfactory explanation.

Haywood, in his "Natural and Aboriginal History of Tennessee," gives the following statement by Gen. Robertson: "In 1772 the Little Corn-Planter, an intelligent Cherokee chief who was then supposed to be ninety years of age, stated, in giving a history of his own nation, that the Sa-

vannechers, which was the name universally given by the Indians to those whom the English call Shawnees, removed from Savannah River, between Georgia and South Carolina, by permission of the Cherokees, to Cumberland, they having been attacked and almost ruined by a combination of several of the neighboring tribes of Indians; that many years afterwards a difference took place between the two nations, and the Cherokees, unexpectedly to the Shawnees, marched in a large body to the frontier of the latter."

There is, however, another item of evidence directly in point found in the following statement in Schoolcraft's "History of the Indian Tribes:" "A discontented portion of the Shawnee tribe from Virginia broke off from the nation which removed to the Scioto country in Ohio about the year 1730, and formed a town known by the name of 'Lulbegrud' in what is now Clark County (Kentucky), about thirty miles east of this place (Lexington). This tribe left this country about 1750, and went to East Tennessee, to the Cherokee nation." It is very probable that the stone graves about the sites of the "Over-hill towns" are due to this band.

The importance and bearing of this evidence in the present connection lie in the fact that numbers of graves of this type are found in mounds, some of which are of comparatively large size, and connected with works which no one hesitates to attribute to the true mound-building age. Sometimes they are arranged in these tumuli in two, three, and even four tiers. Not only are they found in mounds of considerable size, but they are also connected with one of the most noted groups in the United States; namely, the one on Col. Tumlin's place, near Cartersville, Ga., known as the "Etowah mounds," of which a full description will be found in the "Fifth Annual Report of the Bureau of Ethnology" and in Jones's "History of the Southern Indians." In the smallest of the three large mounds of this group were found stone graves precisely of the type described; not in a situation where they could be attributed to intrusive burial, but in the bottom layer of a mound some thirteen or fourteen feet high, with a thick and undisturbed layer two feet thick of hard-packed clay above them. In them were found the remarkable figured copper plates and engraved shells which are described by the writer in the "Fifth Annual Report of the Bureau of Ethnology," also in *Science*. In singular corroboration of the idea here advanced, the only other similar copper plates were found in a stone grave at Lebanon, Tenn.; in a stone-grave mound at Mill Creek, southern Illinois; in a stone grave in Jackson County, Ill.; in a mound of Madison County, Ill.; and in a small mound at Peoria, Ill.; not all, of course, attributed to Shawnees, but in stone graves or mounds, thus connecting them with the mound-building age, which is the only point with which we are at present interested.

Another important link in this discussion is found in the engraved shells, of which specimens were found in the mounds of North Carolina and East Tennessee, attributable to the Cherokees.

The following list, showing localities where and circumstances under which specimens have been found, will suffice to show their relation to the mounds and stone graves: Lick Creek, and near Knoxville, E. Tenn., in mound; near Nashville, Tenn., in mound, also in stone grave; Old Town, Franklin, and Sevierville, Tenn., in mound; Bartow County, Ga., in stone grave in mound; Monroe County, E Tenn., Lee County, Va., and Caldwell County, N.C., in mound; near Mussel-Shoals, Ala., in cave; New Madrid, Mo., and Union County, Ill., in mound; St. Clair County, Ill., in stone grave.

As a large number of these bear exactly the same carved designs as those found in the Cherokee mounds, the evidence seems conclusive that we must assign them to the same age. This, of course, connects the Cherokees with the mound-builders' era, and furnishes a justifiable basis for another backward step. But before attempting to take this, I add some information on the point now under discussion, gathered by Mr. James Mooney during his ethnological investigations among the Cherokees in behalf of the Bureau of Ethnology. This is given in a paper read before the Anthropological Society.

"In connection with my work, at the instance of the Bureau of Ethnology, in the summer of 1887, I visited the East Cherokee reservation in western North Carolina. Being delayed over night at a small town called Webster, about twenty miles from the reservation, an opportunity was afforded to make the acquaintance of Capt. J. W. Terrell, the postmaster, an intelligent American, who in his younger days had been a trader among the Cherokees, and who has some knowledge of the language. In the course of our conversation he stated that about thirty years ago he had been told by an old Indian named Tsiskwaya that the Cherokees had built the mounds in their country, and that on the occasion of the annual green-corn dance it was the custom in ancient times for each household to procure fresh fire from a new fire kindled in the town-house. I afterward found that this Tsiskwaya had been regarded as an authority on such matters.

"Subsequently, in investigating the ceremonies of the green-corn dance, this statement was confirmed by another old man, who volunteered the additional information that it was customary to begin a mound on the occasion of this dance, when representatives of the seven gentes brought baskets filled with earth, which was placed in a common pile with appropriate ceremonies, and afterward added to by the labors of the common people. This man is somewhat unreliable, and his testimony would have little weight by itself, but it is of value in so far as it is borne out by the statements of others. It is proper to state, however, that he was one of the masters of ceremonies at the green-corn dance of 1887, so that he may reasonably be supposed to know something on that subject. Of curious interest in this connection is the fact that Miss Alice C. Fletcher witnessed a similar ceremonial mound-building at one of the secret rites of the Winnebagoes.

"But the most detailed statement as to the mounds was obtained afterward from Ayunini ('Swimmer'), who, although not an old man, is one of the most prominent Cherokee shamans and a general conservator of Indian knowledge, being probably better acquainted with the myths, traditions, and ceremonial formulas than any other man of the tribe. For some time he refused to talk, but this difficulty was finally overcome by appealing to his professional pride; and his stock of Indian lore proved so extensive, that I brought him to the house, and kept him with me most of the time. This aroused the jealousy of rivals, who took occasion to circulate

damaging reports as to his honesty; but in every instance I found his statements borne out by other testimony or by general analogy. Making due allowance for the mythologic features, which rather serve to establish its traditional character, his account is probably as full and accurate as could be expected at this late day, and briefly is as follows:—

" 'The practice of building mounds originated with the Anintsi, and was kept up by the Ani-Kituhwagi. They were built as sites for town-houses (see Bartram's account of Cowe mound and town-house); and some were low, while others were as high as small trees. In building the mound, a fire was first kindled on the level surface. Around the fire was placed a circle of stones, outside of which were deposited the bodies of seven prominent men, one from each gens, these bodies being exhumed for the purpose from previous interments.'

"Swimmer said that his statement was obtained from a man who died in 1865, aged about seventy. Some time later, while talking with an intelligent woman in regard to local points of interest, she mentioned the large mound near Franklin, in Macon County, and remarked, 'There's fire at the bottom of that mound.' Without giving her any idea of what Swimmer had said, I inquired of her how the fire got there, when she told substantially the same story as she had obtained it from an old woman now dead. She was of the opinion that this fire existed only in the larger mounds; but I found on investigation that the belief was general that the fires still existed, and occasionally sent up columns of smoke above the tops of the mounds." CYRUS THOMAS.

[To be continued.]

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Dr. Hann's Studies on Cyclones and Anticyclones.

ON April 17, Dr. Julius Hann, director of the meteorological observatory at Vienna, presented to the Vienna Academy an essay on "The High Pressure Area of November, 1889, in Central Europe, with Notes on High-Pressure Areas in General." The particular value of the essay lies in the comparison of records from lofty Alpine stations with those from the surrounding low country; the highest station being on the Sonnblick, over 3,100 metres above sea-level. The anticyclone of November, 1889, was chosen because it lay over the Alpine region from the 12th to the 24th of the month, giving ample time for the full determination of its persistent features. The results of the study are thus summarized:—

1. The barometer maximum of November, 1889, extended to a great height in the atmosphere, and was as pronounced at a height of 3,000 metres as at sea-level. At a height of 2,500 metres, the centre of high pressure lay over that at the earth's surface.

2. The body of air in the anticyclone had a high temperature. At 3,000 as well as at 1,000 metres, the temperature stood 8° C. above the mean. The usual depression of temperature, characteristic of winter anticyclones, was limited to the lower layers of air, next to the earth's surface, and was only a few hundred metres thick. The mean excess of temperature over the normal at successive heights up to 3,100 metres, for the period from the 19th to the 23d of November, can be estimated as at least 6° C. An excess of temperature must, at the most moderate determination, have extended up to a height of 5,000 metres.

3. In the upper air, above 1.000 metres altitude, a great dryness prevailed. The mean relative humidity from the 19th to the 23d of November on the Sonnblick (3,100 metres) was only 43 per cent. and on the Säntis (2,500 metres) 34 per cent, according to carefully reduced psychrometer records. Hair hygrometers gave a still lower percentage.

Dr. Hann sees in these facts a strong proof of the descending movement of the air in anticyclones, such as is generally accepted. He then goes further in saying that the motion of the air is not a product of the temperature, but is in spite of it: the temperature is a product of the motion.

A study is then made, for purposes of comparison, of an area of low pressure that passed nearly centrally over the eastern Alps on Oct. 1, 1889. Here the temperature of the air-column averaged 4.3° C. *below* the thirty-year normal for the time and place. Although earlier in the season, the air in this cyclone was absolutely colder than that in the later anticyclone. Even while a warm foehn was blowing down the northern valleys of the eastern Alps, the temperature on the Sonnblick was distinctly below the normal. In reviewing this, Dr. Hann says that it is the high mountain stations, recently founded, that have freed us from the prejudices into which we have been led by observations at low levels. It has been thought that the temperature of cyclones and anticyclones was the chief condition of their motion; but it appears certain from the foregoing, that the theory of cyclones must take account of the fact, that, up to the height of at least four or five kilometres, the central air-column of an anticyclone may be, and probably always is, warmer than that of a cyclone.

It is manifest that this contradicts the prevailing theory of the convectional origin of cyclones and anticyclones, while it confirms the views of those who, like Dr. Hann, regard cyclones and anticyclones as merely subordinate members of the general circulation of the atmosphere, their energy coming from the fundamental and persistent difference of temperature between the equator and the poles. According to this view, as Dr. Hann says, the temperature of the air-masses in cyclones and anticyclones is the product of their motions, and not *vice versa*. In the stationary cyclonic circulation of the far northern Atlantic, and in the winter anticyclones of the continents, differences of temperature are probably operative. Hence the author agrees with Teisserenc de Bort in distinguishing between thermic and dynamic cyclones and anticyclones. Moreover, in dynamic cyclones, the evolution of latent heat will maintain the air-mass at a higher temperature than that to which it would otherwise be reduced; but even then, the descending air in the adjacent anticyclone will be warmer as a whole than that which ascends in the cyclone.

This most interesting conclusion as to the origin of cyclones is a surprise to me; and therefore, having frequently advocated the sufficiency of the convectional theory of cyclones, I now make haste to place Dr. Hann's observations before the readers of *Science*, that they may see how clearly a revision of opinion is called for. The apparently convectional circulation in cyclonic storms is not doubted. There is unquestionably an ascending component of motion in cyclonic areas, and a descending component in anticyclones. It also appears to be generally true that at the earth's surface, temperatures above the normal are noted in cyclones, and below the normal in anticyclones. It cannot be doubted that the evolution of latent heat from condensing vapor in the rainy cyclonic area would favor any convectional movement that had originated from other causes. For all these reasons, the convectional theory came into favor, and other possible explanations were little considered. The convectional theory is merely a local application of a theory that is universally accepted to account for the general circulation of the atmosphere between equator and poles; but the tests now furnished by high-level observations seem to show that the local application of the theory is incorrect.

This is as if an observer who was familiar with stationary steam-engines should see a train of cars for the first time: he would rather naturally say that the locomotive was the motor of the train; he would hardly suggest the possibility that the motor was concealed in the rear car, and that the driving-wheels of the

locomotive made the piston-rod move in the cylinder; in fact, that the engine was a dummy. And yet this curious conclusion appears to be analogous to the one now presented by Dr. Hann. The cyclonic machine does not drive itself by its own store of energy: it is driven by an external motor, the general circulation of the winds. Some of the warm tropical cyclones may at first depend on their own energy; these would be true motors: but, if the definite records quoted by Dr. Hann prove to be of wide application, cyclones generally may come to be considered dummies. The cyclonic air does not rise because it is warm, but, according to Dr. Hann, it is lifted in spite of becoming cool. The anticyclonic air does not sink because it is cold, but is pushed down in spite of becoming warm. The ascending air is cooler than the normal because its adiabatic rate of cooling by expansion in ascent is, on the whole, greater than the mean vertical temperature gradient of the atmosphere; the descending air is warmer than the normal because its adiabatic rate of being warmed by compression in descent is greater than the mean vertical temperature gradient. Cyclones do not work themselves: they are worked by the general winds.

Redfield advocated a theory analogous to this in his early essays. He suggested that cyclones are not generated at places of rarefaction, but are only eddies in the general winds. Other early observers made similar suggestions; but it was not then possible to deduce tests by which this eddy theory could be confirmed or excluded. Faye's modification of Redfield's theory involves so many contradictions to well-established physical facts and laws, that it receives little acceptance. Espy was the first to call attention to the general occurrence of convectional movements in the atmosphere, and to the importance of liberated latent heat in promoting these movements. Reye, in later years, gave precision to Espy's ideas, and advanced the convectional theory greatly in the estimation of many meteorologists. I do not see that his deductions are in any way inaccurate. His calculation of the available horse-power supplied by the latent heat in a tropical cyclone appears to be pertinent, even under Hann's new interpretation of the cause of cyclonic movements. But through all the statements of the convectional theory, it has been tacitly assumed that the warmed air of the cyclone would be cooled by radiation in the anticyclonic area; and this does not seem to be the fact. The anticyclonic air is not much cooled till it approaches the ground; and in this we find confirmation of Searle's theory concerning the atmospheric economy of solar radiation.

The warmth of the body of air in anticyclones has been recognized for some time. Dr. Hann was among the first to give proper emphasis to the fact; but its relation to the convectional theory of cyclones has been slowly perceived. In this country, Hazen has drawn attention to the absence of indication of the "neutral plane," called for deductively; and for this and other reasons he has discarded pretty much all parts of the cyclonic theory, following Faye more closely than any other. The reason why Dr. Hann's objection to the convectional theory of cyclones appears to me so cogent and convincing is that it is presented, not as a contradiction, but as a corollary to the principles of modern physical meteorology, with which this eminent meteorologist is so thoroughly familiar, and to which he has himself contributed so much of value. The theory of the foehn, for example, was known in a general deductive way from the suggestions made independently by Espy, Dove, Tyndall, Helmholtz, and others; but it was demonstrated by Hann. So in the present case: Redfield and many others have thought that the general circulation of the atmosphere might produce cyclones and anticyclones, somewhat in the way that rivers form eddies when flowing in an uneven channel; but there is a long distance between suggestion and proof. General indefinite suggestion of what is afterwards shown to be the correct view is not much superior to the suggestion of what ultimately turns out to be the wrong view. Precise definition and demonstration are of much higher value, and these qualities are truly characteristic of Hann's work. If further observation prove the general applicability of these newer views as to cyclones and anticyclones, the credit of the demonstration will go primarily to Dr. Hann. W. M. D.

Harvard College, May, 1890.

An Hypothesis for the So-called Encroachments of the Sea upon the Land.

IT is assumed that there is no substance which is absolutely rigid. The earth is a plastic mass. Let a mountain-range disappear, the plain on which it once stood rises when relieved of its weight. Let a lake disappear, and its bed becomes contorted, and the contour of its shore-line is changed. The walls of the Grand Cañon of the Colorado are moving toward each other, and, should it become an arid chasm, they would some time meet.

Now, in the southern and eastern portions of the United States the "fall-line" is the boundary of the permanent continent. The "continental outline" is the one-hundred fathom hydrographic contour, as determined by the United States Coast Survey; and from its crest there is a drop of over three thousand feet, — a front equal to one side of the Grand Cañon. From the "fall-line" to this front there is a creeping-forward, which is comparable to the ice-sheets of Greenland: therefore cannot we say that the land at present is crowding down into the sea, instead of the sea encroaching upon the land, which is only an apparent movement, not the real one? The distance from the backbone of the Appalachians to the historic-geologic cedar-stumps of the New Jersey coast has increased, and is increasing.

The deltas of the Mississippi valley and the Gulf coast are not only increasing by deposits of sediment, but are moving forward as well. Therefore may it not be expected in geodetic work on the North American continent that there will be encountered discrepancies between successive determinations of positions which can only be thus accounted for and understood?

GILBERT THOMPSON.

Washington, D.C., May 23.

The Winnebago County (Iowa) Meteorites.

AS the Iowa meteor of May 2 has received notice in your paper, it may be desirable to make the record still more complete. I therefore offer the following notes from the south-western corner of that State. The writer was not in position to see it, nor did the sounds appear to him enough unlike thunder to attract particular attention at the time. It was seen by perhaps a dozen citizens of this place, one of them being at the time less than ten miles from the south-west corner of the State. Most agree in thinking that it passed from the south-west toward the north-east. Some who saw it felt so sure that it struck fields close by to the north north-east, that they searched diligently for it. Many heard it, and thought it thundered. Some compared it to an earthquake shock, the jarring of the ground was so evident. Four distinct explosions were observed by one. A local paper of Malvern, nine miles away, stated that three pieces had fallen in that vicinity, but the statement was based on observations similar to those already given. J. E. TODD.

Tabor, Io., May 20.

Tornadoes.

SOME years since, I visited the scene of a small tornado shortly after its occurrence, and found the arrangement of tree trunks and other *débris* in its track very similar to what is represented in the article by Professor Hazen at p. 318 of *Science* for May 23. It seemed to me, however, that the peculiar arrangement found might be due to the combined effect of a whirling motion of the tornado, together with its motion of translation as a whole. In such a case there must be a compounding of forces, and the direction of the fall of a tree or other object can only be determined theoretically by a somewhat elaborate computation. Practically, and as a matter of fact, I have noticed, however, that when a small whirlwind is passing over a corn-field, the stalks incline inward toward its centre with a twisting motion, and likewise bend forward in the direction toward which it is advancing. I have never seen stalks actually uprooted and left prostrate in this way; but it looks very much as if they would be left with their tops inward and forward if this should happen, thus corresponding precisely to what is found after tornadoes. M. A. VEEDER.

Lyons, N.Y., May 23.

BOOK-REVIEWS.

Electricity in Modern Life. By G. W. TUNZELMANN. New York, Scribner & Welford. 12°. $1.25.

THIS is the second volume of the Contemporary Science Series, a series of inexpensive and handy illustrated books intended to bring within the reach of the general public the "best that is known and thought in all departments of modern scientific research." The scope of the series is broad, but the character of the few volumes issued (some of which have been already noticed in these columns), and the high standing of the writers engaged on forthcoming works, are a guaranty that the subjects are and will be not only well selected, but ably handled.

Owing to the prominent place now occupied by electrical science, it will be readily understood that Professor Tunzelmann's volume is one of the most important in the series. For this reason much will be expected of it; more, perhaps, than should be looked for in a work of its modest size. The field is so large, the ramifications of the subject are so many, and the connections with kindred subjects are so close and so complicated, that the author's work was doubly difficult; but it must be admitted that he has succeeded in giving us a volume fulfilling every requirement of the prospectus quoted above. The more important of the many useful functions of electricity in our daily life, the scientific principles underlying its practical applications, and the history of their development, are briefly but clearly sketched.

Being intended primarily for the use of readers without previous knowledge of the subject, it begins with the familiar but necessary sealing-wax and glass-rod phenomenon, and leads the reader step by step to the modern commercial applications of electricity, as exemplified in the telegraph, telephone, lighting, and the transmission of power. None of the many modern uses to which electrical energy has been adapted appears to have been neglected, though of course the space devoted to many of them is brief. There are errors in the book, more or less important, according to the point from which they are viewed. They will attract the attention of the electrician and the engineer, and have doubtless been pointed out to the author ere this, but they will scarcely detract from the value of the volume for those for whom it is intended.

Evolution and Disease. By J. BLAND SUTTON. New York, Scribner & Welford. 12°. $1.25.

TO demonstrate that there is a natural history of disease as well as of plants and animals was the object the author had in mind in writing this book. The science of disease, or pathology, is generally regarded as of interest only to medical men; yet it is but a department of biology, and should therefore be studied by all who desire to make themselves masters of this science. The basis of the author's argument is, that, as there has been a gradual evolution of complex from simple organisms, it necessarily follows that the principles of evolution ought to apply to diseased conditions if they hold good for the normal or healthy states of organisms: in plain words, there has been an evolution of disease *pari passu* with evolution of animal forms. The author recognizes the difficulty of the task which he has set himself to perform. He thinks that a more extended study will serve to show that many of his conclusions are fallacious, and he candidly invites corrections from all who have opportunities of practically testing his theories. He has certainly succeeded in presenting his subject in a most attractive form, and has apparently succeeded in sustaining the points which he has made. We shall, however, before accepting his claims as proven, wait until his theories have been more fully tested.

A Course of Lectures on the Growth and Means of Training the Mental Faculty. By FRANCIS WARNER. Cambridge, Eng., University Pr. 16°. 90 cents.

THE title of this book is a misnomer, there being very little in it about mental faculty. Dr. Warner's views of human na-

Publications received at Editor's Office,
May 19-24.

CENTURY DICTIONARY, The. Vol. III. G to L. New York, The Century Co. 1134 p. f°.
CHAMBERS'S ENCYCLOPÆDIA. New ed. Vol. V. Friday to Humanitarians. Philadelphia, Lippincott. 828 p. 8° $3.
HACKEL, E. The True Grasses. Tr. by F. Lamson-Scribner and Effie A. Southworth. New York, Holt. 228 p. 8°. $1.50.
ILLINOIS, Sixteenth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of. Fifth Report of S. A. Forbes, for the Years 1887 and 1888. Springfield, State. 226 p. 8°.
MONTEFIORE, A. Henry M. Stanley, the African Explorer. 4th ed. New York and Chicago, Fleming H. Revell. 192 p. 12°. 75 cents.
MOUCHEZ, E. Rapport Annuel sur l'Etat de l'Observatoire de Paris, pour l'Année 1889. Paris, Gauthier-Villars. 27 p 4°.
RIO DE JANEIRO, Annales de l'Observatoire Impérial de. Publiees par L. Cruls. Tome IV. Parts I., II. Rio de Janeiro, H. Lombaerts & C 529 p. f°.
—— Annuario Publicado pelo Imperial Observatorio do, para o Anno de 1888. Rio de Janeiro, H. Lombaerts & C. 343 p 12°.
—— Same. 1889. Rio de Janeiro, H. Lombaerts & C. 322 p. 12°.
—— Annuario Publicado pelo Observatorio Astronomico do, para o Anno de 1890. Rio de Janeiro, H. Lombaerts & C. 386 p. 12°.

ture are very frankly and decidedly materialistic. He says that he has "found it convenient to omit from the definitions and descriptions here used all terms implying subjective conditions which are incapable of direct observation by our senses" (p. 37). In another place he speaks of "the physical action called 'thought'" (p. 39); and again he expresses the opinion that "thought consists in the formation of the union of cells whose motor or efferent action produces expression of the thought" (p. 40). A considerable part of the book is taken up by general discussions about the brain, the body, and the life of animals and plants, much of which has no bearing on the ostensible subject of the work. Whenever we come to the essential part of the book, we find it to be in the main a study of abnormal and pathological states of young children, with advice as to the best mode of dealing with them. On these points he shows abundant knowledge, and makes suggestions that we should think teachers would find useful. He is specially concerned for children that have some mental or physical defect, and points out how faults of temper, as well as inattention and idleness, often arise from physical defect or from weariness. At the end of the book is a catalogue of a museum of natural history, such as the author has found useful in giving instruction, and which will doubtless be interesting to teachers.

AMONG THE PUBLISHERS.

THE question of hours of labor is discussed by Gen. Walker in the *Atlantic* for June. This and Hannis Taylor's consideration of "The National House of Representatives: Its Growing Inefficiency as a Legislative Body," are the two articles which make up the solid reading of the number.

— "With Fly-Rod and Camera" is the title of an elaborately illustrated work announced for immediate publication by the Forest and Stream Publishing Company. The author is Edward A. Samuels of Boston. The book contains 150 full-page reproductions of photographs, to the collection of which Mr. Samuels has devoted the vacations of several years on the picturesque salmon rivers of Canada.

—The size of the *American Machinist* has been increased to twenty pages, the four pages thus added being divided between readers and advertisers. On and after June 1, 1890, the subscription price will be increased to three dollars a year, and the newsstand retail price to six cents a copy.

— Not all new things come from the effete East. The Bannack and Crow Indians and other tribes in the northern Rockies are laboring with an extraordinary delusion that Christ has come to earth, and is now in the Big Horn Mountains, somewhere between Fort Custer and Fort Washakie, Wyoming Territory. Gen. James S. Brifbin, U.S.A., commanding in Montana, has in the New York *Ledger* of May 17 an interesting letter concerning the hallucination, and giving full and interesting details about it.

— Messrs. Houghton, Mifflin, & Co. have in preparation an entirely new and complete large-paper edition of the writings of James Russell Lowell. These have been re-arranged by Mr. Lowell, and will appear in volumes not bearing the titles by which his works have heretofore been known, but titles suggested by the new classification. Thus there will be "Literary Essays," in four volumes; "Political Essays," in one volume; "Literary and Political Addresses," in one volume; "Poems," in four volumes. These will comprise all of Mr. Lowell's writings up to date which he wishes to preserve, and will include several addresses, etc., not contained in his volumes hitherto published. Mr. Lowell has carefully revised the whole, prose and poetry. To "The Biglow Papers," which owed their great effectiveness, at the time of their publication, to their many personal and political allusions almost as much as to their wit, full explanatory notes are added, which will render these remarkable papers more intelligible to readers of this and future generations. Thus his writings in this issue will bear the form which he regards as final, and which for the future will represent his definitive contribution to the world's literature.

— In the Department of Arizona, on May 17, Lieut. Wittenmeyer succeeded in signalling a message by a signal-flash 125 miles from Mount Reno, near Fort McDowell, to Mount Graham, near Fort Grant, where it was received by Capt. Murray. The latter, by turning his instrument, flashed the message to Fort Huachuaca, a distance of 90 miles, making a distance of 215 miles with only one intervening station. This is the best work yet accomplished in heliography, the longest distance heretofore made with a signal-flash being only about 70 miles.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

May 20.—R. E. C. Stearns, The Nishinam Game Ha and the Boston Game Props; F. Webb Hodge, Zuni Foot Race; J. W. B. Hewitt, Genesis Myth of the Iroquois.

Philosophical Society, Washington.

May 24.—H. G. Ogden, Chart-Making; Frederick W. True, An Epitome of the Natural History of the Puma.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

ARCHITECTURAL DRAUGHTSMAN, of four years' practical experience, wants employment during the four months' summer vacation of the Mass. Institute of Technology. Best of references, including former employer. Address I. M. BARROWS, 50 Union Park, Boston, Mass.

AN OHIO STATE UNIVERSITY graduate desires a position for next year as laboratory assistant or instructor in chemistry and physics. Three years' special preparation for such work. Two years' experience in teaching. References as to character and scholarship. Address C. S. ARNOLD, O. S. U., Columbus, O.

WANTED.—At the BRYANT SUMMER SCHOOL, Roslyn, L. I., THREE professors to teach Sciences, Languages, Mathematics, etc. July 8-Sept. 8. Also, a six months' term beginning now. Other papers please copy. E. HINDS, A.M., Principal.

A GRADUATE of Princeton, for several years university student and Fellow in Biology, desires a position either to teach biology or as assistant in a biological laboratory. Would prefer the latter and be satisfied with a moderate salary if the position afforded time for the prosecution of original research. Address, O. S., BOX 86, Princeton, N. J.

THE ADVERTISER—A Third Year Student in Honor Sciences at Toronto University, is willing to take position as Science Teacher or Tutor until next October. Enthusiastic and practical instructor in Biology, Chemistry, Physics, Mineralogy and Geology. Latin and Greek and other branches additional if required. Young, good family References as to character and ability. CHEMIA, UNIV. COLL., TORONTO.

WANTED—Information concerning the production of Mushrooms in caves and other places. Address M. H. CRUMP, care Ky. Theological Sem'y, Frankfort, Ky.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Thorough knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

WANTED—Two first-class Instrument Makers. Apply by letter to T. C. MENDENHALL, Superintendent United States Coast and Geodetic Survey, Washington, D.C.

AN EXPERIENCED Technical Chemist will be open to engagement this summer. Highest references. Address DIRECTOR, Office of SCIENCE.

PROF. WILLIAM FINDLAY, of the Philadelphia Institute of Physical Culture, is open to engagement in summer school to teach Free Movements, Wands, Clubs, Dumb-bells, Fencing and Sparring. Address 1,009 Arch St., Phila., Pa.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

A large number of plants from Maine, Connecticut, Indiana and Illinois for exchange. Southern and western exchanges preferred. Address, enclosing lists, L. N. Johnson, 223 Chicago Ave., Evanston, Ill.

For Exchange—Fourteen volumes Encyclopedia Britannica (Stoddard's ninth edition), bound in leather—part in original wrappers, all as new—can arrange to furnish volumes required to complete set, and six volumes "American Naturalist" in numbers. Want small screw-cutting foot lathe and testing galvanometer and rheostat. For particulars address A. B. Campbell, McKean Co., Bradford, Pa.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson. New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

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WE print to day a description, with cuts, of a new series of portable testing and resistance sets. These sets were all designed in the laboratory of Messrs. Queen & Co., Philadelphia, and are intended to meet the requirements of electric-light men, telephone line construction, dynamo and motor manufacture, and general testing. They will be found adapted to the location of faults in telegraph and electric-light lines, determination of armature and field resistance of dynamos and motors, and the needs of government and other inspectors, as well as to general expert work.

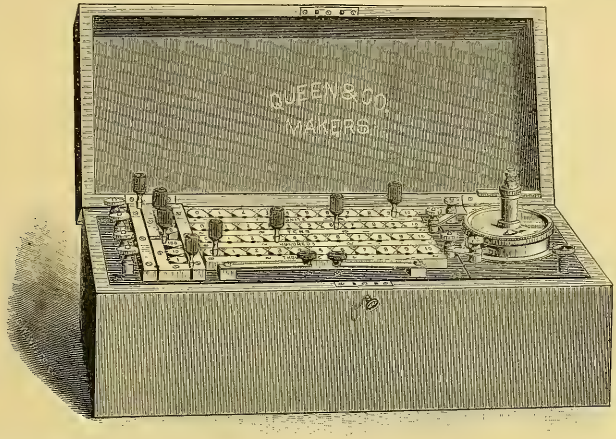

FIG. 1.

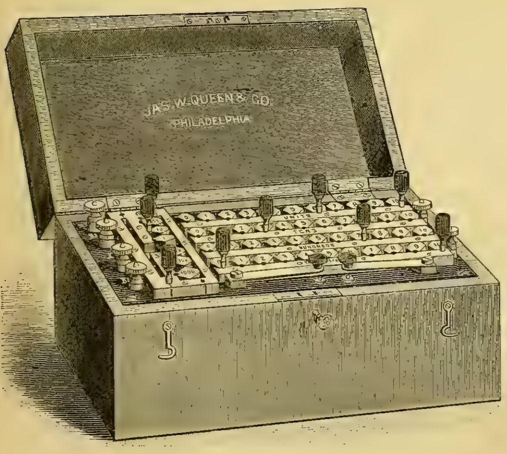

FIG. 2.

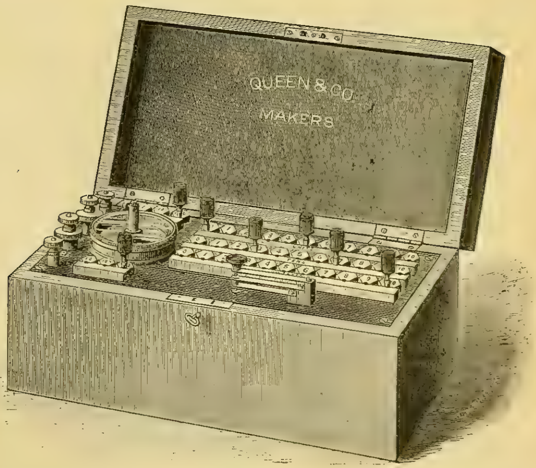

FIG. 3.

The set shown in Fig. 1 is the most complete of the series, and is intended for all kinds of work where considerable accuracy is required. The coils in this set are, as is seen from the figure, arranged in four rows, each row being made up of ten coils of the

same denomination. The blocks in each row are numbered from left to right, and from zero to ten, while the longitudinal bars underneath have engraved upon them the denomination of the coils of that row. The connections of the coils are such that but one plug is required for each denomination. By inserting it in any block, as many coils of that denomination are thrown in as may be indicated by the particular number engraved upon the block. Thus, as the cut represents it, there are in circuit 369 ohms; i.e., no thousands, three hundreds, six tens, and nine units. Another feature of this set is the arrangement of the bridge-arms, which are seen at the left. These are combined with reversing-bars, so that the proportional arms may be instantly interchanged, — an operation which is necessary in many special methods. An additional advantage is, that but six coils are necessary in the bridge, instead of eight as usual, to get the proportion of 1 to 1,000, or 1,000 to 1, thus making the set smaller and more portable. The bridge-coils are 1, 10, and 100 on one side, and 10, 100, and 1,000 on the other. To effect this reversal, two plugs only have to be changed. The coils are platinoid wire, which has a very high specific resistance, and changing by but .0023 of one per cent for each degree Centigrade of temperature variation. They are adjusted by Professor William A. Anthony to an accuracy of from one fifth to one-tenth of one per cent, while the bridge-arms themselves are adjusted to a still higher degree of accuracy. The galvanometer is a successful adaptation of a laboratory instrument to the needs of portable work, and is claimed to be the most sensitive, complete, and portable instrument ever combined in a set of this character. The wire is of several hundred ohms resistance, and is wound so as to have a maximum effect upon the needle. The needle itself is an astatic one, and delicately suspended by a very fine cocoon fibre, so that there is practically no resistance to any deflecting force. By means of a very weak controlling magnet sliding upon the suspension-tube, the needle can be made almost perfectly astatic, and will show an appreciable deflection for currents as small as from $\frac{1}{3000}$ to $\frac{1}{5000}$ of an ampère. The brass box containing needle and coil is movable about a vertical axis; so that the needle can always be brought to zero, whatever the position of the box as a whole. The whole galvanometer lifts out of its position in the case, and can be used independently, or in connection with other apparatus if desired, three levelling-screws being provided for levelling when so used. By closing the cover of the box, the weight of the needles is automatically taken from the fibre, and the latter protected from injury. The battery and galvanometer-key are seen in the front of the box, and are independent of each other. The whole is mounted up in a polished mahogany box with leather handles and lock and key, and measures when complete but 18 inches long by 6½ inches broad. Fig. 2 is a cut of the same thing without the galvanometer, and it is of course somewhat shorter. These sets have a range of measurement from $\frac{1}{1000}$ of an ohm to 10 megohms.

Fig. 3 shows one of the other sets of the series, and is of much the same general character. The coils, instead of platinoid, are made of German silver, and are not quite so accurately adjusted, while the set is without the reversing arrangement found in the ones just described. The galvanometer also is fibre-suspended, but without the automatic release. For this purpose a small set screw is used, which allows the needle to be lowered when not in use. The galvanometer is permanently mounted in the case, and is without the control-magnet. The keys are combined into the regular double contact form. This set, as represented in the cut, has but three rows of resistance; viz., the units, tens, and hundreds. It is also made with an additional row of thousands. This set is also made without the galvanometer.

MESSRS. R. T. HILL and J. S. STONE have recently made some important explorations in southern Indian Territory,—a region about which little has hitherto been known geographically or geologically. They find that the Indian Territory is divided into distinct northern and southern divisions by the Ouachita mountain system. The southernmost of these divisions has been the special object of their studies, and they have secured most valuable data concerning it, as well as the history of the medial portion of Red River, which has not hitherto been investigated.

THE CHEROKEES IN PRE-COLUMBIAN TIMES.

III.

[IN *Science* of May 30, p. 324, in the previous article on this subject, Fig. 3 is incorrect. The correct figure will be given in the revised edition of these papers when published in book form.]

SUMMING up the evidence introduced, it leads to the following conclusions:—

1. That some of the Cherokees reached their historic seat before the year 1540, probably as early as the latter part of the thirteenth century.

2. That they came from some point to the north or northwest, apparently in the region of the Ohio River.

3. That some, if not all, of the mounds of western North Carolina and East Tennessee were built by the people of this tribe.

Assuming these points to be sufficiently established, let us see what evidence can be adduced indicating their line of migration.

If their former home was in the region of the Upper Ohio, and they stopped for a while on New River and the head waters of the Holston, their line of retreat was in all likelihood up the valley of the Great Kanawha. This supposition agrees also with the fact that no traces of them are found in the ancient works of Kentucky or middle Tennessee. In truth, the works along the Ohio River from Portsmouth (except those at this point) to Cincinnati, and throughout northern Kentucky, are different from the typical works of Ohio, and most of them of a type found in no other district. On the other hand, it happens, precisely in accordance with the theory advanced, that we find in the Kanawha valley, near the city of Charleston, a very extensive group of ancient works, stretching along the banks of the stream for more than two miles, consisting of quite large as well as small mounds, circular and rectangular enclosures, etc. A careful survey of this group has been made, and a number of the tumuli, including the larger ones, explored by the representatives of the Bureau of Ethnology.

The result of these explorations has been to bring to light some very important data bearing upon the present question. In fact, the discoveries made here seem to furnish the connecting link between some of the works of Ohio and those of East Tennessee and North Carolina ascribed to the Cherokees.

Subsequent to the preparation of the paper on the "Burial-Mounds of the Northern section," published in the "Fifth Annual Report of the Bureau of Ethnology," further explorations and a careful resurvey of the group near Charleston were made. In order to show the bearing of the data obtained on the questions involved in this discussion, it is necessary to give somewhat detailed descriptions of some of the mounds explored.

Mound 15 of this group (for convenience the numbers in the original sketch are used) was sixty-five feet in diameter and five in height, though a considerable portion had been ploughed off in cultivating the soil. In the top was a basin-shaped fire-bed somewhat oval in outline, being about seven feet long and four feet wide. This was composed of a mixture of clay and ashes burned to a brick red on the upper side; but the under side had a black, greasy appear-

ance. Below this was a similar bed, on and about which were numerous small fragments of bones, but too much broken and charred to show whether they were human or animal.

These basin-shaped beds remind us of those of similar form found in the mounds of East Tennessee, and present one indication of relationship between the mound-builders of the two sections.

Mound No. 18, about the same size as the preceding, contained a similar series of basin-shaped fire-beds, lying one below the other in the central portion. Below them, near the bottom of the mound, was a considerable bed of charcoal and ashes; and immediately under this, on the original surface of the ground, the fragments of a skeleton, with which were a number of broken arrow and spear heads.

Mound No. 1 of the group is of large size, measuring five hundred and twenty feet in circumference and thirty-three in height. This was explored by sinking a shaft twelve feet square to the bottom. At the depth of from three to four feet, in a bed of mixed clay and ashes, were three skeletons lying extended on their backs, doubtless intrusive burials. From this point downwards for twenty feet, nearly all of the material in the shaft consisted of the same mixed substances, so hard as to require the constant use of the pick. At the depth of twenty-four feet there was a sudden change to a much softer and darker-colored earth, in which were the casts and decayed fragments of poles and logs from six to twelve inches in diameter. These, together with fragments of bark, ashes, and animal bones which had been split lengthwise, continued through a layer of about six feet. At the depth of thirty-one feet a human skeleton was discovered lying prostrate, head north, the skull crushed but partly preserved by contact with a sheet of copper (only fragments of which remained) that probably once formed part of a head-dress of some kind. By enlarging and curbing, the shaft was extended to a diameter of sixteen feet. It was then found that a layer of elm-bark had been carefully spread, with the inner side up, upon the smoothed and well-packed surface of the ground. This had been covered with a layer a few inches thick of fine white ashes. On this the body was laid, and covered with similar bark.

Ten other skeletons, all buried in the same manner, were found at this point, arranged, five on each side, in a semicircle around the central one just mentioned, with feet turned toward it. With each skeleton on the east side of the centre was a fine, apparently unused lance-head; and by the side of the northern one of these five, a fish-dart, three arrow-points, and some decayed mussel-shells. Nothing was found with the other five. With the central one, in addition to what has been mentioned, were six shell beads and a large lance-head.

But what interests us more at present is the fact that near the head of the latter was a conical vault of very hard clay, about four feet high and five feet in diameter. This was partially filled with rotten bark, human bones, and dark, decomposed matter. Immediately under this, but covered with clay, were two circular holes about sixteen inches in diameter, and four feet deep. A similar pair of holes was found at the head of each of the ten surrounding skeletons, ranging in depth from two to three feet, and in diameter from eight to twelve inches.

The little beehive vault, resembling so exactly in form and size those of North Carolina, although built of clay, is another indication of relationship between the mound-builders of the two sections. On the other hand, the burial between the layers of bark is precisely what is often found to be the case in the Ohio mounds, as appears from the following statements by Messrs. Squier and Davis in "Ancient Monuments:" "The course of preparation for the burial seemed to have been as follows: the surface of the ground was first carefully levelled, and packed over an area perhaps ten or fifteen feet square. This area was then covered with sheets of bark, on which, in the centre, the body of the dead was deposited, with a few articles of stone at its side, and a few small ornaments near the head. It was then covered over with another layer of bark, and the mound heaped above."

The individual or skeleton buried in the conical vault had probably been wrapped in bark.

That there was a wooden structure of some kind covering the area occupied by the skeletons is more than probable, as thus only can we account for the timbers. The holes mentioned may indicate the position of a former structure, but this had been removed before the burials took place. It would seem that most, if not all, of the burials took place at one time, and after the flesh had been removed.

Mound 21, known locally as the "Great Smith Mound," is the largest of the group, being a regular cone, thirty-five feet high, and one hundred and seventy-five feet in diameter at the base. This was explored by sinking a shaft to the bottom twelve feet in diameter. It is a double mound, or mound of two stages. The first building carried it to the height of twenty feet: after a considerable time had elapsed, another stage of work carried it to its present height. Near the top were some skeletons, probably intrusive burials. At the depth of twelve feet the explorers began to find the fragments and casts of logs, the first being that of a black-walnut log, which must have been nearly twelve inches in diameter and several feet in length. Further excavation made it apparent that these timbers were the remains of a wooden vault about thirteen feet long and twelve feet wide. From all the indications,—the casts of the posts and logs, the bark and clay lining, the fallen timbers, the bark of the roof, etc.,—it was inferred that the vault was constructed as follows: after the mound, which was at this time twenty feet high, had been standing for an indefinite length of time, a square pit, twelve by thirteen feet, was dug in the top to the depth of six feet; posts were then placed along the sides and ends, the former reaching only to the surface, but the central ones at the ends rising four feet higher; on the latter was placed the ridge-pole (the walnut log first encountered); the sides were plastered with a mixture of clay and ashes, and possibly lined with bark; the roof, which had fallen in, was made of poles, and covered with bark; over all was heaped the superincumbent mound fifteen feet in height.

In this vault were five skeletons, one lying prostrate on the floor at the centre. The other four had been placed, one in each corner, apparently in an upright position. All had been wrapped in bark. The central skeleton was very large, measuring a little over seven feet in length. Each wrist was encircled by six heavy copper bracelets. A fragment of the wrapping, preserved by contact with the copper, shows that it was black-walnut bark. A piece of dressed skin,

which had probably formed the inner wrapping, was also preserved by the copper. Upon the breast was a copper gorget; by each hand were three flint lance-heads; near the right hand, a small hematite celt and a stone axe. Around the head, neck, and hips were about one hundred small, perforated sea-shells and some shell beads. Upon the left shoulder, lying one upon another, were three sheets of mica from eight to ten inches long, six to seven in width, and half an inch thick.

Further discoveries of badly decayed skeletons were made in carrying the shaft downward below the vault, but nothing with which we are at present concerned except the fact that among the articles obtained was the steatite pipe shown in Fig. 8.

The significance of this mound lies in the close resemblance it bears, in some respects, to the Grave Creek mound, which, according to the tradition of the Cherokees, was built by their ancestors. But at present no argument is based upon this part of the tradition. This latter giant tumulus is in the form of a regular cone, seventy feet high, and nearly three hundred in diameter at the base. A shaft sunk from

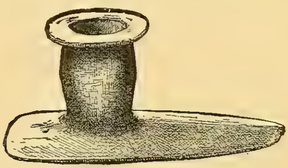

FIG. 8.

the apex to the base disclosed two wooden vaults,—the first about half way down, and the other at the bottom. In the first or upper one was a single skeleton decorated with a profusion of shell beads, copper bracelets, and plates of mica. The lower vault, which was partly in an excavation made in the natural ground, was rectangular, twelve by eight feet, and seven feet high. Placed close together along each side and across the ends of the excavation were upright timbers or posts, which supported others thrown across to form the roof. In this vault were two human skeletons, one of which had no ornaments, while the other was surrounded with hundreds of shell beads. In attempting to enlarge this vault, the workmen discovered around it ten other skeletons.

The similarity in the method of constructing the vaults is marked and peculiar. Wooden vaults are not uncommon; but those partially sunk in a pit, with the sides and ends formed of upright posts, are very rare, and are probably due to some peculiar custom, and indicate tribal identity of the builders. We notice also the presence, with one of the skeletons in each mound, of copper bracelets and plates of mica. In both a vault is built about midway the height.

Mound 31 of the Kanawha group presents some striking resemblances to the so-called sacrificial mounds of Ohio. It is somewhat flattened on top, three hundred and eighteen feet in circumference at the base, and twenty-five feet high. After passing through the top layer of soil, some two feet thick, a layer of clay and ashes one foot thick was encountered. Here, near the centre of the shaft, were two skeletons lying horizontally. These were probably intrusive burials. At the depth of thirteen feet, and a little north of the centre of the mound, were two large skeletons in a sitting posture, with their extended legs interlocked to the knees. Their arms were extended and their hands slightly elevated, as if they were together holding up a sandstone mortar which was between their faces. At the depth of twenty-five feet, and resting on the natural surface of the ground, was one of the so-called "altars," precisely similar to those found in some of the Ohio mounds. This, which was thoroughly traced, was found to be twelve feet long and a little over eight feet wide. It consisted of clay, apparently slightly mixed with ashes, the middle portion basin-shaped, and the margins sloping downwards and outwards; in other words, it was a typical "altar," similar to that shown in Fig. 32, "Ancient Monuments." The depth of the basin in the centre was a little over a foot, and the thickness of the bottom at this point about six inches. On this rested a compact layer of very fine white ashes from one to two feet thick, entirely covering this clay bed. Scattered through them were many water-worn bowlders from three to five inches in diameter, all bearing indications of exposure to intense heat; also fragments of charred bones, some of which were nearly destroyed by heat. The upper side of this clay bed or "altar" was burned to a brick red.

That this tumulus must be classed with the (so-called) "sacrificial mounds" of Ohio, will, it is presumed, be admitted without any objection. As the custom of building these clay structures, to which Messrs. Squier and Davis applied the name "altars," seems to have been peculiar to one class of Ohio mound-builders, we have here one very strong indication that the people who built the mounds of this Kanawha group belonged to the same tribe.

Mound 23 is of considerable size, measuring three hundred and twelve feet in circumference and twenty-five in height. It had never been disturbed in any way, and was the most pointed and symmetrical of the group.

As the discoveries made in it are important in this connection, the report of the Bureau explorer is given somewhat fully.

It was examined by sinking a large central shaft to the bottom. From the top to the depth of fifteen feet, the material passed through was an exceedingly hard, gray mixture, apparently of ashes and clay. At this depth casts of poles and timbers of various sizes were discovered, but all less than a foot in diameter, extending into the western and southern sides of the shaft. These casts and rotten wood and bark continued to increase in amount nearly to the natural soil, which was reached at the depth of twenty-five feet. The *débris* being removed, and the bottom of the shaft enlarged to fourteeen feet in diameter, it was ascertained that these timbers had formed a square or polygonal vault, twelve feet across, and some eight or ten feet high in the centre. This had been built up in the form of a pen, the ends of the poles extending beyond the corners. The roof must have been sloping, as the ends of the poles used in making it extended downward beyond the walls on which they rested. On the floor of this vault, which corresponded with the original surface of the ground, were two adult skeletons, the bones of which, though but little decayed, were crushed and pressed out of position. No implement or ornament was found with them.

As the earth of this floor did not appear to be the natural soil, the shaft was carried down four feet farther. This revealed a pit, the lateral extent of which could not be determined, but which had been dug to the depth of four feet in the original soil. On the floor of this pit, at one side, arranged in a semicircle, were six small clay vaults in the shape of beehives, about three feet in diameter at the bottom, and the same in height.

They were made of clay and ashes mixed, very hard, and impervious to water. Possibly they had been allowed to dry before being covered with earth. They were partially filled with a dark, dry dust, apparently of some decayed substance. A few fragments of bones were found in them.

In the centre of the space around which these little vaults were arranged, but only two feet below the floor of the large wooden vault, were two small clay-lined cavities about the size and form of the ordinary water-jars from the Arkansas mounds. Possibly they were decayed, unburnt vessels which had been deposited here at the time of burial.

The bottom of the pit, which consisted of the natural deposit of yellow sand, was covered with a layer of charcoal and ashes two or three inches thick. This sand appeared to have been heated, from which it is inferred that the burning took place in the pit previous to the formation of the vaults.

The work was suspended at this stage, on account of extreme cold weather, but was recommenced the following season by running trenches from the sides into the shaft, and afterward carrying a tunnel in at the base. In one of these trenches, nine feet from the top, occurred a layer of soft earth, in which were numerous fragments of decayed timbers and bark, also casts of logs extending horizontally into the sides of the trench. These, it is presumed from what was afterward discovered, pertained to a wooden burial-vault. The tunnel carried in at the base was from the south side, ten feet wide, and eight feet high. For a distance of twenty feet it passed through the hard gray material of which the body of the mound was composed. Here the explorers suddenly encountered a deposit of soft earth in lenticular masses and of various colors, showing that it had been brought from the hillsides and bottoms near by. A short distance from this point they began to find the casts and remains of the timbers of the large central vault, but, before reaching the interior, passed over a small refuse-heap, evidently belonging to an age preceding the date of the building of the mound. As they entered the remains of the vault, they began to find tolerably well preserved human bones, but no whole skeletons. Seeing here indications of the pit before mentioned, the tunnel was carried downward four feet, disclosing five little clay vaults similar to those found on the other side, and, like them, placed in a semicircle. It was now decided to remove and thoroughly explore about one-half of the mound. Many stone implements, some entire but most of them broken, seemingly by the action of fire, were scattered through the hard upper layer; also numerous single valves of mussels which had been used as digging-tools until they were worn from the outside entirely through.

There was a marked dissimilarity between the northern and southern sides of this mound, the former being a compact mass of variously colored soils from different points in the vicinity, in alternate horizontal layers. The separate loads of the individuals who carried this earth were plainly defined; and the different sizes of these small masses indicate that many persons, some much stronger than others, were simultaneously engaged in the work.

With the exception of the imperfect or broken specimens mentioned above, no remains of any kind were found in that portion of the mound above the fire-bed and north of the central shaft, and only two skeletons beneath it; while many interesting finds of implements were made all through the loose, ashy dirt of the southern part, and many skeletons below it. The amount of rotten wood and bark observed, and the positions of the casts of logs and poles, some of which extended downward four feet below the natural surface of the ground, render it probable that there was a wooden structure here twelve feet square and three stories high, or, what is more likely, three structures, one above another.

A foot above the natural surface, or twenty-four feet from the top of the mound, was a smooth horizontal layer of sand and ashes, interrupted by two heavy fire-beds. These beds were circular in form, eight feet in diameter, and about ten feet apart. The earth was burned hard for eight inches below the ashes. Under these beds were several human skeletons.

No. 1, a medium-sized adult, was extended on the back, head south, arms by the side. This was four feet below the centre of the northern fire-bed. No trace of a coffin was observed, but a rude hoe and a rough lance-head were at the left side.

No. 2 was four feet north of No. 1, at the same depth. It lay with the feet toward the centre of the mound, and was enclosed in a kind of coffin formed by leaning flat stones together over the body in the form of an inverted V, and placing a similar stone against the end at the head. A number of relics were with this skeleton, and on the stone at the head was a hematite celt. Two feet north of the head were the fragments of a large clay vessel.

No. 3, similarly placed, was four feet under the north edge of the other fire-bed. Some relics were found above the head, and others in a small conical vault near the left side.

No. 4, same depth as the preceding, had the head toward the centre of the mound. A small vault near the head contained several relics of different sorts.

Nos. 5 and 6 lay near together, with heads south. There was a small vault near the feet of the smaller skeleton.

None of these skeletons were found immediately in the centre of the mound, and all were about four feet below the natural surface of the ground, resting on the bottom of the pit, as were the little conical vaults. Nine vaults in addition to those mentioned were unearthed,—four of them on the bottom of the pit, and five above it. They were similar in form and size to those heretofore described. There was one toward the south side of the pit elongate in form, and not more than two feet wide and two feet high.

Another mound, numbered 30 in the original plat, had a circular pit beneath it, in which were several beehive-shaped clay vaults similar to those heretofore mentioned. The explorer, however, in this case, fails to mention the arrangement or to note particularly the contents, owing perhaps to the pit being partially filled with water, which prevented a thorough examination.

By a careful comparison of the discoveries made in the mounds of this Kanawha group with those made in the mounds of the Cherokee section, the reader will observe some striking similarities which cannot be easily accounted for upon any other theory than that of tribal identity or intimate relations of the peoples of the two sections. It is true that we find enclosures in the former locality, and none in the latter, and it is also true that we notice other dissimilarities; but some changes in customs and works are to be expected where there is a change of location. Necessities, materials, and environments are different, and bring about modifications of customs. These changes are apparent in all parts of the mound area, even where there are good reasons for attributing the works to the same people: in fact, they are sometimes found in a single group.

It is true, we cannot assert positively that the little conical clay vaults above described, except in one or two cases, were depositories of the dead, as were the conical bowlder vaults of North Carolina and East Tennessee; yet the very marked similarity in form and size, and correspondence in their arrangement in the tumuli, justify the belief that there was a relationship between the authors of the works of the two sections. Not only are they similar in size and form, but in both localities pits were dug in the original soil, the floor was covered with coals or ashes in some cases, and the vaults built on these and the mound heaped over them. It should also be borne in mind that vaults of this kind, arranged as here stated, have so far been found only in these two sections. The arrangement in a circle found in the mound in Sullivan County, Tenn., has its parallel in one of the mounds of thd Kanawah group. In one was also found the pipe shown in Fig. 8; in the other, that shown in Fig. 5.

In further corroboration of the theory of relationship between the people of the two sections, may be mentioned the fact that in the mounds of both we find the peculiar basin-shaped beds placed in series one above another.

CYRUS THOMAS.

[To be continued.]

NOTES AND NEWS.

LIEUT. J. P. FINLEY, of the United States Signal Corps, has gone to San Francisco to take charge of the Pacific Coast Weather Service.

—Professor John C. Branner, State geologist of Arkansas, delivered a course of lectures on geology to the senior and junior classes at the Rose Polytechnic Institute, Terre Haute, Ind., week before last.

—Dr. William K. Newton of Paterson has resigned as dairy and food commissioner of New Jersey. This was done two months since to the State Board of Health, which, on the 6th of May, appointed one of Dr. Newton's assistants, Mr. George W. McGuire of Trenton, to fill the vacancy.

—We learn from *Nature* that Professor Von Nordenskiöld lately announced to the Stockholm Academy of Sciences that a scientific expedition would start during the summer for Spitzbergen. Among the party will be his son, M. G. Nordenskiöld, and MM. Klinckowström and Bahaman. The expenses of the expedition will be defrayed by Baron Dickson and M. F. Beijer, the publisher.

—A statistical investigation of lightning-strokes in central Germany, covering a period of twenty-six years, has been carried out by Herr Kastner. According to *Nature*, the number of cases has increased about 129 per cent, and last year (1889) it amounted to 1,145. The author distinguishes four thunder-storm paths. The starting-points of all these are in hills, and in their course the woodless districts and flat country, the river-valleys, and low meadow-ground about lakes, seem specially liable, while the wooded and hilly parts generally escape. The hottest months (June, and especially July), and the hottest hours of the day, or those immediately following them (3 to 4 P.M.), show the most lightning-strokes.

—We learn from *Humboldt* that in connection with the tenth international medical congress, to be held this year in Berlin from Aug. 4 to Aug. 9, there is to be an international medico-scientific exhibition. The following kinds of objects will be exhibited: new or improved scientific instruments and apparatus for biological and especially medical purposes, including apparatus for photography and spectrum analysis so far as they are of service to medicine; new pharmaceutical and chemical stuffs and preparations; new or improved instruments for operative purposes of medicine, including electrotherapy; new plans and models of hospitals, convalescent homes, disinfection arrangements, baths, etc.; new arrangements for care of the sick, including means of transport, and baths for invalids; newest apparatus for hygienic purposes, etc. Communications (marked "Ausstellungsangelegenheit") should be sent to the office of the congress, Dr. Lassar, Berlin, N.W., Karlstrasse 19.

—The daily and yearly variation, and the distribution, of wind-velocities in the Russian Empire have been fully investigated by Kiersnowski, says *Nature*. The highest velocities (mean 6.3 metres per second) occur in the Baltic provinces. On the White Sea, on the Caspian, in the region of the North Russian lakes, and on the Steppe, the values are also high; in the forest region and the Caucasus they are low. Towards the interior of Asia the velocity decreases, and in Transbaikalia is the minimum (1.5 metres per second). Farther east, towards the Pacific, the velocity increases. In the annual period, the maximum is pretty uniformly in winter, the minimum in summer. A maximum in spring, and a minimum in summer or autumn, are peculiar to the Caspian region, the Ural, and West Siberia, with Central Asia. In eastern Siberia the minimum is in winter. The daily variation shows distinctly the connection with cloudiness. The greatest amplitude occurs in the brighter part of the year: in East Siberia in winter, and in the rest of the country in summer. In general, the amplitude increases regularly with the clearness of the sky eastward, and on land it is greater than on the sea.

—In seven years, experiments at the Ohio Agricultural Station with deep and shallow planting of corn show an advantage in favor of planting one inch rather than two inches deep, but indicate that in dry seasons it may be better to plant two inches deep. The greatest amount of marketable corn has been produced where the stalks averaged twelve inches apart. The variations in yield were slight, whether planted one grain every twelve inches, two every twenty-four, three every thirty-six, or four every forty-eight inches. Three years' trial has not indicated any marked differences in the reproductive qualities of corn from the butts, middles, or tips of the ears. If there is any variation, it is in favor of middles and tips, and against the butts. The experiments of 1888 and 1889 indicate that corn should be cultivated more frequently in a dry season than in a wet or ordinary one. The average results of two years' experiments favor deep cultivation rather than shallow. The implements used were the harrow and cultivator for shallow tillage, and the double shovel for deep. This work was under the care of J. Fremont Hickman.

—The papers read at the May meeting of the Royal Society of Canada included, in the section on mathematical, physical, and chemical sciences, "The Unit Measure of Time," by Dr. Sandford Fleming, president of the section; "Tidal Observations in Canadian Waters, the Present Condition of the Question," by Professor A. Johnson, McGill University, Montreal; "Sunspots observed at McGill College since June 1, 1888," by Professor C. H. McLeod of McGill University; "Notes on Cream-of-Tartar Analysis," and "Notes on Baking-Powder Analysis," by A. McGill; "Milk Analysis by the Asbestos Method," by Frank T. Shutt; "On a Peculiar Form of Metallic Iron found in Huronian Quartzite on the North Shore of St. Joseph Island, Lake Huron, Ontario," by G. Chr.

Hoffmann; "Drift Rocks of Central Ontario," by Professor A. P. Coleman of Victoria University; and "On the Density of Weak Aqueous Solutions of Certain Sulphates," and "On a Test of Ewing and MacGregor's Method of Measuring the Electrical Resistance of Electrolytes," by Professor J. G. MacGregor. Those in the section on geological and biological sciences included the presidential address, "Mesozoic and Tertiary History of the Rocky Mountain Region of Canada," and "Glacial History of the Rocky Mountain Region in Canada," by George M. Dawson; "Foraminifera and other Minute Organisms from the Cretaceous of Manitoba," by J. B. Tyrrell; "On Fossil Plants from the Similkameen River and other Places in the Southern Interior of British Columbia," by Sir William Dawson; "Descriptions of Some New or Previously Unrecorded Species of Brachiopoda and Mollusca from the Devonian Rocks of Manitoba," and "The Marine Invertebrata of the River and Gulf of the St. Lawrence," by J. F. Whiteaves; "Notes Stratigraphiques sur le Rocher de Québec," par l'Abbé Laflamme; "Illustrations of the Fauna of the St. John Group, No. V.," by G. F. Matthew; "The Evidence of a Nova Scotia Carboniferous Conglomerate," by E. Gilpin; and "Southern Invertebrates on the Shores of Acadia," by W. F. Ganong.

—The fourth international congress on inland navigation will be held in Manchester, England, on July 28 and following days. The objects of the congress are, to promote the improvement of inland navigation and of estuaries; to direct attention to the economical value of navigable water-ways; to examine, generally, technical questions relating to the construction and working of canals; to receive the report of the International Statistical Commission appointed at the last congress; and to take further steps towards the collection of statistics bearing on inland navigation. The three previous congresses were held respectively in Brussels, Vienna, and Frankfort-on-the-Main. It is intended to have an exhibition of plans, maps, and models relating to inland navigation. At the Frankfort congress a similar exhibition was held, the most valuable contributions coming from the German Government, who spent $20,000 on their preparation. It is hoped that these plans and models may be available for re-exhibition in Manchester. All communications relating to the congress should be addressed to the secretary, at Lombard Chambers, 46 Brown Street, Manchester, England.

—According to a work recently published by one of the state foresters of Prussia, the entire forest area of Germany now amounts to 14,000,000 hectares (34,596,000 acres). Russia has 200,000,000 hectares (494,228,620 acres) of forests; Austria-Hungary, 19,000,000 hectares (46,952,000 acres); Sweden, 17,000,000 hectares (42,010,000 acres); France, 9,000,000 hectares (22,241,000 acres); Spain, 8,000,000 hectares (19,769,000 acres); Italy, 4,000,000 hectares (9,884,572 acres); and England, 2,471,000 acres. The United States commercial agent at Mayence says that the proportion of communal to state and crown forests in the different states of Germany is as follows: Prussia, 1,355,000 hectares of communal and 2,423,000 state forests; Bavaria, 388,000 and 941,000 respectively; Wurtemburg, 190,000 and 192,000; Hesse, 90,000 and 67,000; Baden, 259,000 and 93,000; and Alsace-Lorraine, 195,000 and 151,000 hectares. In Saxony and in the other states of the empire, with the exception of Saxe-Meiningen, about one-half of all the forests are state or communal property, considering the possessions of the crown as a species of state property; and these are all subject to a well-regulated permanent administration and supervision under state control, while the older forests in many of the states are not under any public control. It is stated, in the work referred to above, that there are 9,100,000 hectares (22,487,400 acres) of coniferous, and 4,800,000 hectares (11,800,000 acres) of foliaceous, trees in Germany. Of the coniferous trees, it is stated that a greater part are on a soil adapted only to such growth, and on which nothing else can be cultivated. Of the coniferous trees, 3,000,000 hectares (7,413,000 acres) are of the fir kind, and 6,000,000 hectares (14,826,800 acres) pines. The greater part of the pines are in the mountains, preponderating in the Hartz Mountains, the Riesengebirge, the Erzgebirge, in the Thuringian forests, in the Verm, in the Vosges Mountains, in the Black Forest, in the so-called Bavarian Alps, in the Bavarian Forest, and in the Franconian, Jura, and Fichtel Mountains. The pines are mostly on level tracts, and more than half of them are on soil unfit for the successful cultivation of useful timber. The 4,800,000 hectares of foliaceous trees are principally made up of beeches.

—Dr. Max Buchner, who has spent a year and nine months in Australia, Japan, China, and Manila, has returned to Munich, Germany. He carried back a valuable scientific collection for the Ethnographical Museum, of which he is the director.

—An annual prize of fifty dollars, for a period of three years, has been offered by a member of the Baltimore bar to that member of the Johns Hopkins University who shall make the best contribution to institutional or legal history. The field is not restricted to American or English laws and institutions, but is extended to the history of early society. Papers should be handed to Dr. Herbert B. Adams before Feb. 1, 1891.

—The Draper medal was awarded to Professor H. A. Rowland by the National Academy of Sciences at its April meeting in Washington. The medal is given every two years for original investigations in the department of astronomical physics. Professor Rowland was awarded the medal for his work in spectrum analysis, the perfecting of diffraction gratings for producing spectra, and his investigations of the solar spectrum.

—In connection with the report of the United States Eclipse Expedition to West Africa, under the direction of Professor D. P. Todd, a work of very great importance to navigators is to be undertaken; namely, the preparation of a set of daily weather-maps of both oceans from October to May inclusive, the entire period of the cruise of the United States Steamship "Pensacola." The United States Hydrographic Office calls attention to the importance of this subject, and the exceptional opportunity that is presented for utilizing the data already at hand, together with such additional data as may be contributed for this purpose by various government offices and individual navigators. The scheme determined upon consists in the preparation of a weather-map for each day at noon, Greenwich mean time, from Oct. 1, 1889, to May 31, 1890, inclusive, for the entire area between latitude 70° north and 60° south, longitude 20° east and 100° west. In addition to the Greenwich noon observations that are kept regularly for the Hydrographic Office by nearly two thousand voluntary observers, it is earnestly desired that other navigators of these waters, within the limits of time and place mentioned above, forward to that office such data from their log-books as may be useful in this connection, selecting those observations that come nearest to noon, Greenwich mean time, and stating as many details as possible regarding wind, weather, state of the sea, and velocity and set of currents. Data from land stations are also very important, especially such as are not accessible in any published records. To make this great undertaking a success, however, there must be further and cordial co-operation among the nations interested in the meteorology of this vast area, and among navigators of every nationality. It has long been the desire of the Hydrographic Office to commence the publication of a pilot chart of the South Atlantic and west coast of South America, and the present undertaking will furnish an admirable basis for this work. The "Pilot Chart of the North Atlantic Ocean" has won a place for itself in the esteem of navigators generally, without regard to nationality, and it is intended to publish the result of the present investigation in such form, and with such wide distribution, as well to repay every one who contributes to its success. Reports handed to any United States consul, or to the commanding officer of any United States naval vessel, will be transmitted free of all expense to the observer, and in each case due credit will be given in the published report.

—A new catalogue of electrical testing apparatus has just been issued by James W. Queen & Co., Philadelphia. This catalogue is believed to be the most complete in its special field of any yet published in this country. We shall call attention in this and early issues to their new resistance-boxes, portable testing-pieces, and photometers for use in electric-light comparisons. The catalogue will be sent by the firm to any interested.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

CORNELL AND THE LOST WILL.

The newspapers are publishing the customary type of absurd stories about the history and loss of the great bequest of Mrs Jennie McGraw Fiske, which has just been lost to Cornell University through the operation of a technicality in law, and the active exertions of her surviving husband and of the next of kin, who brought suit to secure what they, and all the world, knew that they were not given by the deceased owner of the property. The true history of the case in brief, as we obtain it from a reliable source, is the following: —

John McGraw was, at the time of his death, an old lumberman who had made an enormous fortune in the North-west, working in company with Henry W. Sage, Hiram Sibley, and a few other equally successful comrades and friends. He was a friend and fellow trustee with Ezra Cornell at the founding of Cornell University, and took great interest in that now great institution of learning. He contributed largely to its treasury and needs, in its early days, and finally died with fortune unimpaired, leaving it mainly to his only child, Jennie. Miss McGraw had grown up in the midst of the little circle of wealthy and liberal men who did so much to make the university what it is, and from them (for she was intimate with all) had received her inspiration. When her father built what is now known as McGraw Hall, the largest building of the dozen scattered over the great campus, the child asked the privilege of contributing the beautiful chime of bells which now hangs in its tower, and calls the students to their daily tasks. This interest she never lost: it increased, rather than decreased with time.

Miss McGraw, a few years before her death, lost her health, and remained in a critical condition to the end. Meantime she had made the acquaintance of the librarian of the university, Professor Fiske, and after a time, becoming interested in each other, they were married, and the professor took his bride to Europe in the vain hope that her health might be restored. She failed steadily, and finally returned with her husband to her home on the university campus, to die. Her death took place within a few days of their return.

Meantime, under her directions, a large and beautiful house had been built on a commanding site between the university and the bank of Cayuga Lake, which was never occupied; the couple living, in the interval, in a modest little cottage, still standing within the university grounds. A pre-nuptial contract had been entered into between the affianced pair, by which Mrs. Fiske was permitted to dispose of her millions as she might choose, and which provided properly for her husband in case of her death. At her death it was found that a will had also been made, giving liberally to the natural heirs, and leaving her husband $300,000 and personal property. The university was given $40,000 to found a hospital; and the residue of the estate, now amounting to nearly two millions of dollars, after paying legacies, was to be devoted to the building and endowment of a library for the university. All legacies were promptly paid by the executor, and the balance of the estate was in process of conversion into the university treasury, when suit was brought by the husband to break the will, — a suit in which he was presently joined by the heirs, to whom, as well as to the husband, liberal legacies had been paid.

It appeared that a clause existed in the charter of the university, limiting its holdings of property to a gross amount of $3,000,000. This had been inserted in the document at the first, and had never been removed, although it must have been known that the holdings were approaching perilously near this limit. The plaintiffs in the case asserted that the university already possessed so nearly this amount — above $2,000,000, as they stated — that it was legally debarred from accepting the gift of Mrs. Fiske; and the property must therefore go to the next of kin. The trustees and the executor of the will, as defendants, asserted that this was not the fact, the property inventoried including large amounts held in trust for the State, and not the property of the university, though its income was pledged to the university for educational purposes. Other and technical defences were raised by the defendants. No one, on either side, claimed or admitted that there was any question of the intent of the testatrix; no one disputed the fact that she had desired and intended to give her property to the university, and that no one else had the slightest moral right to it. The question was simply and solely whether a technical interpretation of the laws affecting the holding of property could be made to give to others what they had no moral claim upon, and to take from the university, and to deflect from its great purpose, a gift of enormous value and potential usefulness, which was morally the absolute property of the institution, and pledged to the specified purpose.

The Surrogate's Court decided in favor of the university: the higher courts of the State, and the Supreme Court of the United States, reversed the finding, and gave the property to the claimants. They now hold it, though every one gaining by the transaction is fully aware that the deceased, if conscious of what is going on here below, must feel that her intent has been defeated; that they have no real right to her property; that the intent must always stand a moral bar to their receiving the money for any other purpose than to carry into effect her intention, defeated as it is, for the moment at least, by the operation of an unexpected legal impediment.

The amount involved approaches $2,000,000; but legal expenses, and losses in realizing on the property, may bring the net sum below a million and a half. Had this great fund gone into the hands of the trustees of the university, it would have founded perhaps the noblest library on the American continent. As it is, it may be seriously questioned whether it is likely to do much good, even to the legal but yet false inheritors. The daily papers

are full of sensational stories relating to the personal relations of the testatrix, her husband, and the responsible officers of the university; the one side attempting to justify the action of the will-breakers by asserting injustice on the opposite side, the other side defending the action of the university authorities. The public are not concerned in that phase of the matter, and the university authorities evidently feel themselves unaffected by the gossip of the newspapers. Mr. Sage, a year ago, began the erection of a great library building to be given the university as a memorial of the originally intending giver if the suit should be lost, or to be paid for by her bequest should the university hold its own in the case. He gives also $300,000 as an endowment, the income to be applied solely to the purchase of books. Most colleges would be considered fortunate if given so much, even failing to obtain a $2,000,000 library. Practically the university gains: it loses a million which it never possessed; but it gains a positive quantity in the half million and over, which is now actually passing into its possession. It is the impression of some of its best-informed friends that it will untimately actually gain through awakened sympathy and interest, and the gifts likely to be the practical expression of that interest and sympathy, more than the amount now seemingly so unfortunately lost. It is very certain, also, that some of this scattered property will come directly back to the university by the action of the receivers of what they regard as unfairly acquired property.

This affair seems to have no effect on the plans of the university authorities. They will begin the next year with an enlarged teaching force, new and distinguished professors in the faculty, a $10,000 equipment in illustrations of the work of classical instruction, a new chemical laboratory to accommodate six hundred, a physical laboratory of double the space now occupied, new workshops doubling the present area and capable of handling six hundred Sibley College men, new mechanical laboratory arrangements of nearly proportional extent, a new foundery and new forge large enough to meet a similar growth, and engines (experimental and other), boilers of 600 horse-power, and dynamos more numerous and powerful in the aggregate than can be found elsewhere in the world.

All this looks very much as if Cornell University and the Sibley College of Mechanical and Electrical Engineering were likely to survive for a time still.

HEALTH MATTERS.

Another Forty Days' Fast.

SIGNOR SUCCI, who is gaining the reputation of being a "hunger virtuoso," completed in May a fast of forty days in London. The medical journals of that city credit him with the genuine performance of the feat. Signor Succi has done no more than our own Tanner, but he has been subjected to a more careful physiological study, and he has shown that a forty-days' fast is possible to more than one human being. During the last days of his fast, Succi lost about half a pound a day, his temperature remained normal, but his pulse was more than ordinarily rapid. The lesson of Signor Succi's experiment, says the *Medical Record*, is one that has often been taught before, and it is that people eat too much, and, in this country at least, drink too little. More diseases come from excessive and intemperate feeding than from alcohol, for wrong feeding is the basis of gouty, rheumatic, diabetic, and obese diatheses, as well as of an infinite number of gastro-intestinal ills.

Excision of Local Pulmonary Tuberculosis.

At the recent congress of the German Society for Surgery, Professor Tillmanns exhibited a man of about thirty years, from whom he had removed a tubercular deposit involving a portion of the left lung, pleura, and thorax. After the operation the lung contracted in such a manner that by a second operation the remaining tubercular area was completely removed. The wound was covered with cutaneous flaps and healed completely, and the patient is now able to work. As the operation was performed about two years ago, the cure may be regarded as permanent. Tillmanns thinks that the surgical treatment of pulmonary tuberculosis is proper if the disease is localized, but that in most cases two operations will be required,—the first to expose the affected part in order to bring about atrophy and contraction; the second to remove the disease.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Practical Applications of Meteorology.

IN the United States the making of weather predictions has been the chief use of meteorological observations for so long a time, that few persons have taken the trouble to consider the manifold applications of this class of data. In order to bring this matter to the notice of those who are interested in, but not informed on, this practically very important question, I have given below, in a roughly systematic manner, some few of the many points which should be taken into consideration in the framing of any future plans for extending the usefulness of meteorology in our country. In order to show with any considerable degree of fulness the exact relation of meteorology to practical life, it would be necessary to devote the space allowed for a magazine article to each one of the separate headings which I have assumed as conveniently and appropriately marking the subdivisions of the whole subject; so that, in the present paper, only a few lines can be devoted to each topic. This is mentioned in order to explain the omission of many points which could be readily suggested as being of equal importance with those mentioned.

1. AGRICULTURE.—We have but to note the gradual change in the character of plant-life with the increase of latitude or altitude, in order to see what an all-important factor climate is, in marking the limits of individual plant-growth. Some plants require a preponderance of heat, others of moisture, and still others of sunlight, in order to bring them to maturity. Civilized nations have long since ceased relying on indigenous plants; but, in order to transplant successfully from one country to another, it is necessary to know something of the climates of the two countries. Meteorologists are constantly extending their network of observing-stations, and are thus reducing the areas the climates of which are unknown. When the agricultural physicists shall have determined the climatic constants of all our useful plants, it will be possible to foretell the successful, or the probability of successful, cultivation of any of these plants, when we know the latitude, longitude, and altitude above sea-level, of the place of planting.

We need better systems of estimating the condition of plant-growth during the period from sprouting to ripening (or harvesting). Reliable estimates of this kind would be a valuable criterion for market prices of produce. The usefulness of storm predictions, frost warnings, and cold-wave predictions, is so well established that we only take space to say that the non-fulfilment of the latter causes great loss to farmers who slaughter their own animals.

2. COMMERCE.—In dictating what can or shall not be grown in any particular country, climate controls indirectly the nature of the articles carried from one country to another. Merchants will not send articles intended for a hot climate to a cold climate, and *vice versa*. Still, a great many sailing-vessels are employed in trade, and their navigators pay the strictest attention to the laws of winds which have been discovered to hold good for various quarters of the globe. This knowledge often makes a saving of months in a long voyage. Storm-predictions are of special importance to our coast shipping and to fishermen; but the recent inquiries instituted by the German Government show that storms must be predicted considerably in advance to render such forecasting of real use. In shipping perishable produce it is of great importance to know whether damaging weather is likely to occur during the transit, frosts being the principal danger which the shipper must guard against. A meteorological record extending

over a number of years is also necessary to show what precautions must be taken to prevent serious interruption of traffic; the record of snow-storms being most desirable along railroad routes, and of ice periods and low water on the water-ways.

3. MANUFACTURES AND ARTS.—The unremitting labor necessary for the successful operation of manufactories is best obtained in the colder climates. The arts of a nation are, many of them, regulated by the nature of the climate. Water-power, while it is dependent on the slope of the land and other local peculiarities for the head of water, is principally influenced by the amount and regularity of rainfall, conditions which are favorable to alternate floods and draughts being especially unfavorable to use of water-power. Many articles will not stand the removal from one country to another having a different climate, an instance being the cracking of picture-frames brought to our country from the moister European lands; and such instruments as the zither, we are told, cannot be successfully brought to America. The manufacture of some articles requires an excess or deficiency of moisture, as in the case of some textile fabrics. The still unharnessed wind-power will play an important part in our manufactures when its force can be conveniently and economically transposed into electrical energy. Few persons are aware that a wind-wheel twenty feet in diameter, exposed at a moderate elevation above the ground, will furnish on the average one horse-power throughout the year, taking the average of our country east of the Rocky Mountains.

4. INSURANCE.—The increasing application of the principles of science to insurance adjustment must include meteorological data, when this begins to be carefully considered in this connection. Frequent remarks in the late insurance journals show that some meteorological events can no longer be excluded from the computation of risks, and even new fields are being entered upon. The recently established tornado insurance will doubtless be extended to include all storms; but the damages by floods are usually so dependent on local peculiarities, that such insurance can hardly be said to have a scientific basis. Unhealthy climates, and regions of scourges, which usually have marked climatic features, should not be included with healthier countries in any general rate of premium for life insurance. In marine insurance it is possible to take into account the probability of storms, not only for various seas and at different seasons of the year, but also for any sailing course between two ports on any particular sea. In fire insurance the high temperatures, and especially heated terms, and the amounts and frequency of rainfall, must be considered. Nor can we neglect the wind distribution as regards average velocity, and the relative frequency of high winds, and especially the sudden rise of winds which may start smouldering fires which are temporarily unattended.

5. MEDICINE.—Climate as applied to the treatment of disease has generally been studied in a desultory manner, although some general rules have been formulated which are accepted by the medical profession. In most cases, however, there is a wide difference of opinion as to what climatic factors are the most potent as a means of curing or preventing certain diseases; and we find physicians of the highest attainments recommending such extremes as to show that individual opinion in such matters has not yet given way to generally accepted results obtained by the careful study of statistics.

Each one of the climatic elements plays a special *rôle* in the combined effect produced on mankind, and it is these separate effects which must be studied more closely. We know that great daily ranges of temperature, or rapid changes from day to day, are to be avoided in certain diseases, and yet for our own country little data are accessible concerning the latter of these conditions. In recommending long journeys (for instance, from New England to California), how few physicians take into account the hygrometric and barometric conditions to be encountered *en route!* Observations on moisture, relative amounts of sunshine and cloudiness, ozone, and winds, are also necessary for determining the desirability of a place of residence for invalids.

6. MISCELLANEOUS ECONOMIC QUESTIONS.—Under this heading we may put a great many kinds of work in which meteorological data may be very useful. All subjects connected with drainage require a knowledge of amount and frequency of rainfall. Railroad routes, especially where local traffic is to be the main source of income, are not laid out without a careful study of the climates of the countries through which they are to pass. Many engineering undertakings are directly affected by the climatic elements; as, for instance, the effects of winds on bridges. The first question to be answered in connection with the reclamation of our Western arid lands, which interests us so much at present, is, "What is the climate of the country to be reclaimed?" While our politicians are wrangling over the question of protection and free trade, few of them have recognized the bearing of climate on the question. While the use of the winds in aerial navigation is not of practical importance just at present, yet we have but to recall their universal use as power in the flat countries of Europe to show their possible application on our great plains, where a velocity is found almost equal to that on the seacoasts. Climate should be carefully considered in questions of emigration, for the immigrant will usually succeed best in a country having a climate similar to that which he left as an emigrant.

FRANK WALDO.

Cincinnati, O., May 23.

Temperature in Storms and High Areas.

I AM strongly of the opinion that Professor Davis has found a veritable "mare's nest" in his presentation of this subject in last week's *Science*. He is certainly nearly three years behind the times; for this whole matter has been thoroughly ventilated, and the palpable errors into which Dr. Hann has fallen have been already pointed out (see the *American Meteorological Journal*, October, 1887; March, 1888; July, 1889: and the *Scientific American Supplement*, June 15, 1889). The ordinary theory is, that in our storms the air, up to about ten thousand feet, is abnormally heated, and this causes an ascending current of moist, warm air, which has its moisture condensed through the cold of expansion; and that the latent heat set free serves to warm up the air, and thus to produce a rarefaction, which serves to accelerate the ascending current. This acceleration in the air-current causes a more rapid condensation, in turn a greater rarefaction, and so on till our most violent tornadoes are evolved. It is difficult to see why the latent heat of condensation does not exactly balance the cooling by expansion, but I leave that point for others to explain. Dr. Hann himself has made a most elaborate computation of this increased heat in a storm, in which he has shown that up to sixteen thousand feet the average temperature in a vertical direction may be about 50°, while in a high area it must be only 30° (see *Austrian Meteorological Journal*, 1874, p. 321). Professor Ferrel of our own country has written hundreds of pages in which the essential point is that there is an ascending current of moist heated air in our storms. In all his theories he has followed most closely the theoretical results deduced by Hann. All this, and I may say the pet theories of a dozen other authorities, are brushed away with a single stroke of the pen: they vanish as an ethereal essence into thin air, out of which we may say they were reasoned on exceedingly unsubstantial grounds.

These would seem most important conclusions, and should not be put forth without incontestable facts to establish them. Let us inquire into the nature of this evidence. 1st, Dr. Hann's observations are all made in the Alps, a region two thousand miles to the south-east of the average track of storms, also a region fifteen hundred miles from the nearly permanent winter high area in Siberia. Surely we are not to consider that it is possible to get an idea of the distribution of temperature in the centres of our storms and high areas under these conditions. The pressure undoubtedly rises and falls in the Alps; but the storms that cross there are in the nature of secondaries, and there is no opportunity to study real storms. No one ought to think that a study of temperature in the border of a storm and five hundred or a thousand miles from its centre, can give the central conditions. 2d, It would be a great mistake to study simply a fall or rise in pressure on a mountain as the passage of a storm or high area. One of the greatest falls in pressure on Pic du Midi, in France, accompanied a high area, and was caused by the intense cold. This

single fact is sufficient to disprove all these finely spun theories of Dr. Hann. 3d, The evidence of our own storms is absolutely conclusive on this point, and I kindly turn Professor Davis's attention to this. Fortunately we have a mountain in this country which lifts its head sixty-three hundred feet directly into the centre of more than half our storms and a great number of our high areas. We cannot ask for better evidence than Mount Washington furnishes us with so lavish a hand. Observations are given us for eighteen years from this most remarkable vantage-ground, and these give no uncertain sound on this question. When a storm approaches within five hundred or six hundred miles of this almost perpendicular and isolated height, the temperature begins to rise, and, when the centre passes, the average temperature of its central core is more than ten degrees higher than that of the air five hundred miles in advance. As the storm passes off, the temperature rapidly falls, and is fifteen degrees lower five hundred miles after it than at the centre. When a high area passes, the temperature begins falling, and the diminution and subsequent rise follow each other in almost exactly the manner and to the degree of the reverse operation in a storm.

The evidence on this point is absolutely conclusive; and, since the seeming contradiction in the Alps can be easily explained, we see that there is no need of changing theories on this account. It will be understood that the ordinary theories of storm-generation are none the less utterly worthless, even though this supposed proof of their worthlessness is itself worthless. It is highly probable that Dr. Hann has been misinterpreted in this presentation of his views, and no one will be more shocked than he at this outcome. Dr. Hann found in a certain October storm the average temperature nearly eight degrees below the thirty years' normal for the height in consideration, and in this storm the air was colder than in a high area nearly two months later. Surely this proves nothing whatsoever. The temperature in a vertical direction in a storm is not fixed, but may be ten degrees, or even more, lower than the average, and yet be many degrees above that of the surrounding region. That the temperature in an October storm was lower than in a November high area is not in any wise remarkable.

Professor Davis makes this remarkable statement: "The cyclonic air does not rise because it is warm, but, according to Dr. Hann, it is lifted in spite of becoming cool." I doubt if there is a sadder example of bowing down to authority than this. Where is the jack-screw by which this air is lifted? If the air becomes cooler than the surrounding air, does not its specific gravity at once cause it to descend? Is the law of gravity so easily overcome, and swept away by a single stroke? If there is some mighty force pressing down the air in our cold waves, and causing it to warm up the lower it gets, why does it not warm up clear down through? Where is this plane of demarcation, and change from a warm region to one just the opposite and bringing us the coldest period of the winter? There are millions who will thank Professor Davis if he will prove to them that they will not need to buy coal next winter, because, by a newly discovered law, our cold waves hereafter are going to be really warm waves, to use an Irishism.

Professor Davis says, further, "In this country, Hazen has drawn attention to the absence of indication of the 'neutral plane,' called for deductively; and for this and other reasons he has discarded pretty much all parts of the cyclonic theory, following Faye more closely than any other." It seems to me this is an exceedingly unfortunate allusion, if the intention is to support Dr. Hann in his views. The only reason why this so-called "neutral plane" was discarded was because in the centre of a storm it was found that the temperature continually rose, the higher up one went. It is easy to see that this condition is absolutely contrary to that presented by Dr. Hann. Faye has not been followed in this country, but his view that there was a downrush in a general storm has been denied. I am sure that no one will be as much pleased at this corroboration of his views by Professor Davis, and this proof of a downrush in a storm carrying in the cooler air of the upper regions, than M. Faye himself. If readers of *Science* are led to the belief that, after all, we know next to nothing of the real cause of a storm, and that the great and crying necessity that is pressing upon the meteorologic world at present is reliable observation in the storm region, it will be a great advance.

H. A. HAZEN.

Washington, D.C., June 2.

The Winnebago County (Iowa) Meteorites.

A FRAGMENT of the 104-pound "meteorite" found in the northern part of Kossuth County has been examined by us, and we are perfectly well satisfied that it is not of meteoric origin at all. In outward appearance it is suspicious at first sight. The color is darker than that of the other pieces. There is no distinct crust, and no metal present. The gravity taken on a piece weighing about half a gram was 2.83, which is nearly a unit lower than that of the well-established specimens. Under the microscope the crushed mineral shows by reflected light a mass of colorless, transparent particles mingled with dark green particles resembling pyroxene. The analyses given below, together with the appearance of the chip furnished us, strongly suggest diorite or some closely allied rock.

Silica	71.63
Oxides of iron and aluminum	14.39
Lime	6.80
Magnesia	—
Soda	5.55
Water	1.63
Total	100.00

Some circumstances connected with the finding of this piece have made us slightly suspicious from the first, and such examination as we have given thus far seems to be conclusive.

JOSEPH TORREY, JR.
ERWIN H. BARBOUR.

Iowa College, Grinnell, Io., May 24.

BOOK-REVIEWS.

The Village Community, with Special Reference to the Origin and Form of its Survivals in Britain. By GEORGE LAURENCE GOMME. New York, Scribner & Welford. 12°. $1.25.

THE special object of this work, which is the latest volume of the Contemporary Science Series, is to present the author's theory as to the origin of British village communities. He rejects the view most commonly held, that they are exclusively Aryan institutions, and particularly repudiates the theory of their Roman origin, and endeavors to show that they date back to prehistoric times, when the British Isles were peopled by Iberians. He admits, of course, that there is no direct evidence to support this view, but attempts to prove it by reference to India, where village communities are known to have existed before the advent of the Aryan conquerors. He adduces a number of facts relating to the British communities in historic times, and shows that they have parallels more or less close in those of India; and from these facts he draws the conclusion that the origin of the two systems must have been similar. "Over and over again," he says, "the certain evidence of these race distinctions which is forthcoming from the unamalgamated elements in Indian villages finds a parallel among the existing archæological and traditional facts of English villages; and my contention is that the parallel must be true all along the line —must therefore tell us of the old race origins of the English village life" (p. 115). The evidence he adduces in support of this view is by no means sufficient to make it an established theory, though it does show that such an origin of the British communities is possible. The subject, as every one who has even a slight knowledge of it knows, is a difficult one, and it will probably be some time before a general agreement is reached in regard to it. But meanwhile it is necessary to consider the question in all its aspects, and for this reason students of the subject will take a good deal of interest in reading Mr. Gomme's work. He marshals a great array of facts in support of his theory, though he acknowledges that some of them admit of other interpretations than those he gives; and both the facts and his reasonings on them will be useful to other investigators.

Electrical Influence Machines. By JOHN GRAY. London, Whittaker; New York, Van Nostrand. 12°. $1.75.

IN this volume Professor Gray, who is an associate of the Institute of Electrical Engineers of London, gives a very full account of the historical development and modern forms of electrical influence-machines, together with instructions for making them. The branch of electrical science covered by this treatise has been apparently somewhat neglected of late years; and for that reason alone the volume would be welcome, aside from the fact that it contains in compact form all that is really useful and interesting about influence-machines. It shows, also, that the neglect of investigators in this direction has been more apparent than real, for great progress has been made, but the greater progress made in the development and commercial utilization of dynamical electricity has made it seem that the static form had almost been forgotten. But, as the author shows, the influence-machine has an important field of its own, and, in some of its latest and most improved forms, is a simple and convenient generator of high-tension electricity, nearly as reliable as the induction-coil, and less expensive.

The work is divided into three parts. The first is devoted to a general sketch of the phenomena and leading principles of static electricity, a chapter each being given to experimental data, to a working hypothesis of the electrical field, and to electrometers. This part is sufficiently complete to serve instead of a text-book for beginners, and will enable those with little mathematical knowledge to understand the nature of electrical quantities. The second part is devoted to the historical development of the machines, and also contains descriptions of modern ones, such as Varley and Töpler's, Holtz's, Wimshurst's, Sir W. Thomson's, Maxwell's, and "addition" machines such as Bertsch's and Carré's. The third part contains all the information needed by instrument-makers and amateurs to guide them in making the influence-machines most commonly used. The book is illustrated by two hundred and twenty-eight engravings, and has a very complete index.

AMONG THE PUBLISHERS.

IT is proposed to publish the results of the research of the special students in the Department of American History at the University of Pennsylvania in a regular series of pamphlets.

— D. C. Heath & Co. will publish June 10, "A Compendious French Grammar," by A. H. Edgren, professor of modern languages in the University of Nebraska.

—The *New York Home Journal* just now is of especial interest to people who contemplate spending the summer, or part of it, in the country. It is issuing several editions of a "Summer Resort Guide," of which it has for years made a feature.

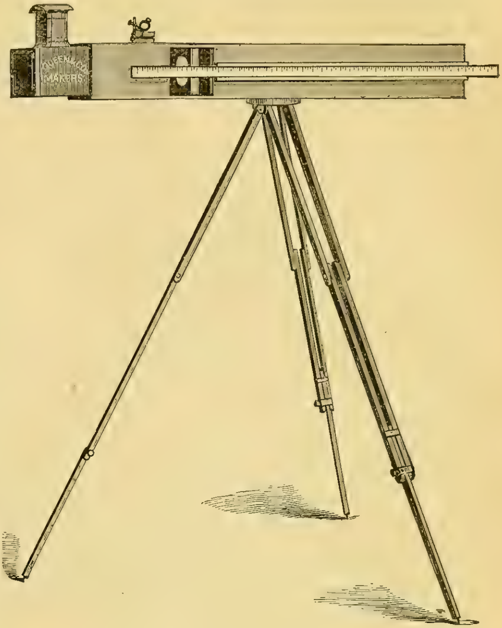
—*The Political Science Quarterly* for June opens with a defence of national sovereignty in the United States, by John A. Jameson, against the theories of the "analytical jurists;" E. I. Renick of the Treasury Department discusses the relations of the

comptrollers and the courts in the settlement of claims against the government; Dr. Charles B. Elliott, writing of the legislatures and the courts, gives an interesting history of the origin and development of the power to declare a law unconstitutional; Professor R. M. Smith, in a timely paper on census methods, shows the scientific importance of the census, and suggests improvements in the methods of taking it; Professor Seligman contributes the first of a series of articles on "The Taxation of Corporations," containing an exhaustive review of all the legislation on the subject in the United States; and Horace White replies to Professor Patten's criticism of Wells's "Recent Economic Changes." There is the usual number of reviews, and a "Record of Political Events" for the six months ending May 1.

INDUSTRIAL NOTES.

New Portable Photometer.

To meet the demand created by the rapid adoption of the electric light for town and city lighting, and consequent necessity of making frequent tests for the purpose of conforming to certain standard conditions, Messrs. Queen & Co. have recently brought out a new form of Bunsen's photometer. This instrument is designed especially for street-work, and will be found invaluable to municipal and government inspectors and experts having occasion to make candle-power tests of arc and incandescent lamps. The photometer is 5½ inches square in cross-sections, and 38 inches in length. The lantern, as shown in the cut, slips into one end of the box, where it is firmly held. A small adjustable holder carries the standard light, which may be either one or two standard candles. This adjustment regulates the height at which the flame stands, and also its distance from the screen. By making this latter distance exactly one foot, computation is greatly facilitated. Distances are measured by a graduated bar which slides in grooves along the side of the box. To allow for the difference in vision between the right and the left eye, the instrument is made reversible; i.e., it may be turned completely over, so that the right eye observes the side of the disk before observed by the left, and *vice versa*. When not in use, the lantern-chimney slips out, and can be placed inside the lantern itself, after which the entire lantern-box may be pushed inside the photometer, and small slides made to cover the two ends and the sight hole of the instrument, making a solid box of it. A brass handle on one side allows the instrument to be carried as easily as a small hand-bag.



QUEEN'S NEW PHOTOMETER.

If desirable, a small incandescent lamp may be used as a standard instead of the candles. The range of the instrument is from about four candle-power up.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

May 31.—Theo. Gill, Characteristics of the Halosauroids or Lyopomes; C. Hart Merriam, Exhibition of Specimens of New Species of North American Mammals; J. N. Rose, Coulterella, a New Genus of Compositæ; Joseph F. James, Organisms in the St. Peter's Sandstone.

Engineers' Club, St. Louis.

May 21.—George A. Brown, The Function of the Government in a Plan for General Irrigation. In the discussion, Professor Nipher said that experiments extending over a long period of years had demonstrated that the apparent increase in rainfall in forests was due to the fact that the rain caught in the gauges was not affected by wind-currents. Improved forms of rain-gauges had shown that there was no actual difference between the amount of rain falling in forests and in open places.

Royal Meteorological Society, London.

May 21.—W. B. Tripp, Rainfall of the Globe. This was a comparative chronological account of some of the principal rainfall records. The earliest record is that of Paris, which commenced in 1689. The English records began in 1726. The rainfall observations in the southern hemisphere do not extend over a very long period. At Adelaide they were commenced in 1839, but they do not go back farther than 1866 for New Zealand. The greatest fall in any particular year at the stations given by the author was 160.9 inches at St. Bernard, in 1839; and the least, 3 inches, at San Diego, in California, in 1863. By combining the stations in the northern and southern hemispheres, the author finds that in recent times the years with the highest average rainfall were 1878, 1879, and 1883, and the years with the lowest average were 1854 and 1861. W. H. Dines, Mutual Influence of Two Pressure Plates upon Each Other, and Comparison of the Pressures upon Small and Large Plates; On the Variations of Pressure caused by the Wind blowing across the Mouth of a Tube. In these two papers the author gives the results of some experiments on wind-pressure which he has made mostly on a whirling-machine at Hersham, Surrey. From these experiments it seems probable that a decrease of pressure per square foot with an increase of size of plate may be taken as a general rule.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—At the Bryant Summer School, Roslyn, L. I., a Professor to teach the botany and zoölogy of the sea, marine life, etc., etc. July 8–Sept. 8. Also, a six months' term beginning now. Other papers please copy. E. HINDS, A.M., Principal.

ARCHITECTURAL DRAUGHTSMAN, of four years' practical experience, wants employment during the four months' summer vacation of the Mass. Institute of Technology. Best of references, including former employer. Address I. M. BARROWS, 50 Union Park, Boston, Mass.

AN OHIO STATE UNIVERSITY graduate desires a position for next year as laboratory assistant or instructor in chemistry and physics. Three years' special preparation for such work. Two years' experience in teaching. References as to character and scholarship. Address C. S. ARNOLD, O. S. U., Columbus, O.

WANTED.—At the BRYANT SUMMER SCHOOL, Roslyn, L. I., THREE professors to teach Sciences, Languages, Mathematics, etc. July 8–Sept. 8. Also. a six months' term beginning now. Other papers please copy. E. HINDS, A.M., Principal.

A GRADUATE of Princeton, for several years university student and Fellow in Biology, desires a position either to teach biology or as assistant in a biological laboratory. Would prefer the latter and be satisfied with a moderate salary if the position afforded time for the prosecution of original research. Address, O. S., BOX 86, Princeton, N. J.

THE ADVERTISER—A Third Year Student in Honor Sciences at Toronto University, is willing to take position as Science-Teacher or Tutor until next October. Enthusiastic and practical instructor in Biology, Chemistry, Physics, Mineralogy and Geology. Latin and Greek and other branches additional if required. Young, good family. References as to character and ability. CHEMIA, UNIV. COLL., TORONTO.

WANTED—Information concerning the production of Mushrooms in caves and other places. Address M. H. CRUMP, care Ky. Theological Sem'y, Frankfort, Ky.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Thorough knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

AN EXPERIENCED Technical Chemist will be open to engagement this summer. Highest references. Address DIRECTOR, Office of SCIENCE.

PROF. WILLIAM FINDLAY, of the Philadelphia Institute of Physical Culture, is open to engagement in summer school to teach Free Movements, Wands, Clubs, Dumb-bells, Fencing and Sparring. Address 1,009 Arch St., Phila., Pa.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Wanted.—To exchange land and fresh-water mollusca (principally *Helices Achatinellae*, Clausiliae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

To exchange for other books: Meek's Invertebrate Paleontology, Cope's Cretace us Vertebrata, Leidy's Extinct Vertebrate Fauna, Lesquereux Cretaceous Flora. All being volumes of the Hayden Final Reports. Address, giving lists, T. N. Glover, Suffern, N. Y.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia, Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

For Exchange—Fourteen volumes Encyclopedia Britannica (Stoddard's ninth edition), bound in leather—part in original wrappers, all as new—can arrange to furnish volumes required to complete set, and six volumes "American Naturalist" in numbers. Want small screw-cutting foot lathe and testing galvanometer and rheostat. For particulars address A. B. Campbell, McKean Co., Bradford, Pa.

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THE TORNADO: THEORIES; OBJECTIONS.

IT is somewhat difficult to give an adequate idea of the development of theories or pure speculations in this subject. Owing to the complex nature of the phenomenon, and the well-nigh utter lack of observations in the region of tornado-formation, the earlier views were more or less crude, and in some particulars have been slightly modified as broader and more comprehensive generalizations have been made. We shall be surprised, however, to find, on a careful study, how few changes the last fifty years have wrought. The original and essential ideas of tornado-generation and of sources of its power remain to-day as first propounded by Espy in 1840. Since his day, Professor Ferrel has been the most prominent exponent and amplifier of his views; and, with very few exceptions, theorists have followed Ferrel down to the present time. In many respects it would be a great advantage if one could give an impartial and trustworthy summing-up of the views of these men, and could bring out distinctly their gradual development. It will be far safer, however, since there are scores of students to-day who call in question many of these deductions, to give, as far as possible, an unbiassed *résumé* of these theories in the exact words of their defenders, and thus enable any one for himself to examine their adequacy for explaining the phenomena as they are manifested before our eyes.

Espy's Views.

It is not a little remarkable that the first investigator of any note in this field based all his theories on direct experiment in the laboratory. All theorists since Espy's day have not considered that there was any need of propounding any of these questions to Nature herself, but have contented themselves with the assumptions and necessarily imperfect and crude results obtained by the first experimenter. This is the more remarkable when we consider the extreme gravity of the subject, and the methods employed in all other sciences, except meteorology, to establish upon a firm and impregnable basis such profound and far-reaching theories. Espy's few and simple experiments at almost the very dawn of this science have never been repeated by theorists as far as the writer is aware. This one fact would seem of the extremest importance; and when we see, further, that even Espy himself was entirely unable to account for some of the anomalies in these very experiments, we can but feel the extreme necessity of further light. This feeling has borne fruit in other countries, as is shown by the diligence recently manifested in researches with rapidly revolving fans, which cause a supposed simulation of the phenomena in nature. While we can never hope to completely unravel the mysteries hidden in our storms until we question Nature herself in her own great laboratory, yet we can insist upon an examination of the original researches used as a basis for these theories, and demand a determination of their adequacy upon which to base the completer speculations of modern times.

Nephelescope.

The apparatus Espy used he called a "cloud-examiner." It consisted of a glass cylindrical vessel, having attached to it by an opening at the top (1) a condensing syringe, by which the air in the vessel could be compressed; (2) a glass U-tube half full of mercury, by which the amount of compression could be measured; (3) a stop-cock between the syringe and the vessel. "After the instrument is charged, the stop-cock is turned, and the pump removed. When the air within acquires the temperature of the air without, a measure is carefully applied to the barometer gauge to ascertain how much higher the mercury stands in the outer leg than in the inner; the stop-cock is then turned, and the air permitted to escape; and at the moment of equilibrium the stop-cock is closed again. Now, as the cock is closed at the moment the greatest cold is produced by expansion, the mercury in the outer leg will begin to ascend, and that in the inner leg to descend, because the air within receives heat from without; and the difference of level, being measured as before, will indicate the number of degrees cooled by a given expansion. When dry air is used in the experiment, the temperature is reduced about twice as much as when moist air is used, on account of latent caloric evolved in the latter case by the formation of cloud which is plainly visible." Saturation of the air was attempted by placing a little water in the bottom of the vessel. The amount of compression varied from two to twenty-five inches; that is, the gauge indicated an increased pressure inside the vessel, amounting in some instances to nearly that of an atmosphere. These experiments were certainly unique; and, while we shall see that they by no means prove Espy's theory, yet they must be regarded as a step in the right direction, and a faithful effort to elucidate a most complex problem. As all clouds in these experiments were formed by expansion of compressed air, it is not a little remarkable to read the following as Espy's method of forming clouds, given by Professor Ferrel: "As Espy with a few strokes of the handle of an air-pump produced a cloud in the receiver from the expansion and cooling of the moist air within, so nature, by means of a whirl in the open atmosphere, produces a cloud in the vortex of a tornado, from the expansion and cooling of the air there, on account of the partial vacuum caused by the centrifugal force of the gyrations." It is entirely probable that the rapidity of this expansion and consequent cool-

ing was very much greater than can ever occur in nature. It is also probable that his air was far from saturation, and that the cloud he saw was due to dust which was pumped in. Experiment has shown that such a cloud can be formed in quite dry air, provided the expansion is quick enough.

One very important element does not seem to have been considered, and that is the velocity of escape of the compressed air needed to form a cloud. It is probable that this was more than five hundred feet per second, or at least fifty times as great as can ever take place in the formation of cloud in our storms. It is a little singular that Espy himself did not discover more than he did. He found, that, while the results he obtained with dry air were very regular and constant, yet with moist air they were just the contrary; and the irregularities seemed to depend in part upon the interval after the compression, before the escape of the air. The following table is of much interest, and shows, in the first column, the number of minutes after compression, before opening the stop-cock, and, in the second column, the ratio between the amount of compression and the final reading of the gauge. In dry air this ratio was found to be from four to five; so that if Espy's statement just given is correct, that the temperature with dry air is reduced twice as much as with moist, the ratios should be eight to ten in this second column, according to his reasoning.

Minutes.	Ratio.	Minutes.	Ratio.
13,160	4.2	360	6.9
10,080	7.5	180	7.3
7,200	4.5	180	6.9
5,760	4.5	180	7.4
5,760	4.2	180	7.0
5,040	4.3	90	6.9
4,320	4.4	60	7.4
4,320	4.5	60	7.4
1,800	4.4	15	5.5
1,680	4.5	10	7.8
1,200	4.7	10	5.1
1,080	5.5		

Espy considers this result, "so contrary to all our notions since the experiments of Dalton on the subject of the dew-point," very remarkable.

We have not all the data needed to give a complete explanation of Espy's results, but this much we do know: if Espy had allowed a slower escape of the moist air, there would have been no cloud, and he would have had no difference between dry and moist air. When the explosion was very sudden, a cloud was formed, and the conditions inside the apparatus were very different from those with dry air, but not because of the liberation of latent caloric. At the end of ten minutes he found the ratio much smaller, apparently, than at the end of an hour or two; and after that the ratio diminished until it became exactly what it was in dry air. It is plain that this final result could not be attributed to the gradual non-saturation of the air, as Espy thought. There are no other experiments made by Espy under exactly similar conditions of temperature in moist and dry air. The evidence is conclusive, from these and other more recent experiments by the writer, that practically no different result will be produced, whether moist or dry air be introduced into the nephelescope.

I have dwelt upon these experiments at some length for the reason that they form the sum and substance of all efforts in this line up to very recent times.

Upon these experiments depend all of Espy's theories as to tornado-formation, and he has been quite closely followed in all views as to the essence of the forces underlying our most violent tornadoes. Mr. Espy gives the following *résumé* of his theories as ascertained and promulgated by the French Academy of Sciences:—

"If a very extended stratum of warm and humid air at rest covers the surface of a region of land or sea, and by any cause whatever (for example, a less local density) an ascending current is formed in this mass of humid air, the ascending force, instead of diminishing in consequence of the elevation of the rising column, will increase with the height of the column exactly as though a current of hydrogen was rising through the common air, which current would be pushed towards the top of the atmosphere with a force and velocity in proportion to its height. This column of heated air may also be compared to that in chimneys and stove-pipes, of which the draught is in proportion to the height of the pipe containing the warm air. What, then, is the cause which renders the warm and humid ascending current lighter in each of its parts than the air which is found at the same height with these different portions of the ascending column?

"This cause, according to the sufficiently exact calculations of Mr. Espy, is the constantly higher temperature which the ascending column retains, and which proceeds from the heat furnished by the partial condensation of the vapor mixed with the air, making this ascending column a true column of heated air, that is to say, of a lighter gas; for the weight of the water which passes into the liquid state is far from compensating the excess of levity which proceeds from the more elevated temperature which the air preserves.

"Thus the higher the column is, the greater is the ascending force; and the rushing-in of the surrounding air on all sides will be produced with more energy. To understand this effect better, let us consider a mass of warm and dry air rising in the midst of a colder atmosphere. In proportion as this air rises it will expand, because of the less pressure which it will experience, and consequently become colder; it will arrive then quickly at an equilibrium both of temperature and pressure with a layer more or less elevated, which it will soon reach, and in which it will remain; but if this only cause of cold, expansion, is overbalanced by a cause of heat (for example, the heat furnished by the vapor which is condensing), this air will remain constantly warmer than would have been necessary to attain the same temperature and pressure as the surrounding air. It will then be constantly lighter; and the higher the column, the greater the ascending force."

This statement contains, perhaps, as clear a view of Espy's theories as can be obtained. There are, however, one or two additional opinions, regarding tornadoes specifically, that should be mentioned. Mr. Espy says, "Suppose a receiver (Fig. 4) only a few hundred yards in diameter, but so lofty that its top would reach to where the barometer would stand at 10 inches, and that it contained air about 25.25°, for example, hotter than the air on the outside, this latter being at a mean, 32°. The column of air then in the inside of the receiver would be expanded $\frac{25.25}{505.25}$ of the whole, or one-twentieth of the whole bulk. Now, as the air on the outside

of the receiver, from the surface of the earth to the top of the receiver, weighs 20 inches of mercury, the air on the inside will weigh only 19 inches; and of course it will be pressed upwards against the upper end of the receiver at a with a force of about half a pound on the square inch, the bottom of the receiver being open at c.

"Also, if a barometer should be placed in the inside at the top a, it would stand an inch higher than one on the outside at the same height: therefore, if a small hole should be made in the top of the receiver, the air would spout out with a velocity due to a head of pressure equal to one inch of mercury. This is equal in weight to about 900 feet of air of mean density at the earth's surface. The velocity with which it would spout, on supposition of its having this density, will be found to be $8\sqrt{900} = 240$ feet per second (164 miles per hour). But the air at the top a is only one-third the assumed density, provided no allowance is made for temperature; and as the velocity of spouting fluids under equal

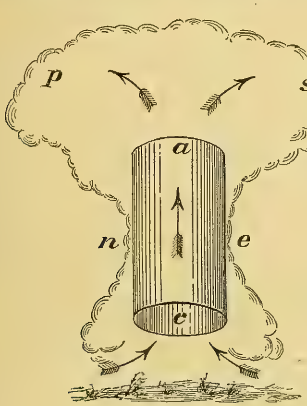

FIG. 4.

pressure is inversely as the square root of their densities, the real velocity with which the air will spout out at a will be $240\sqrt{3} = 415$ feet per second (283 miles per hour).

"If, now, we suppose the whole top of the receiver to be taken off, the velocity will be the same, if there is no friction up the sides of the receiver, and the air gets freely in at the bottom; an allowance, of course, being made for the reaction of the air in the upper part of the receiver on the air below, in consequence of the velocity increasing all the way up. If we remove the entire sides of the receiver, it is manifest that the heated column of air, which we suppose to be the same as before, would spread out laterally in ascending, in the form of an inverted cone, or mushroom, as exhibited by the dotted lines p, s, n, e.

"When the air near the earth's surface becomes very much heated, or very highly charged with aqueous vapor, such an ascending column as is here imagined may actually take place, and be kept up for a long time. The difference of temperature of the ascending column and that of the atmosphere through which it passes may be much greater than that here supposed, partly caused by its greater temperature below, but chiefly from the great quantity of latent caloric evolved by the condensation of vapor into cloud."

These quotations might be multiplied by the score; but enough has been given to show that Espy relied upon his experiments with the nephelescope for the facts upon which to base his theory, and that, according to his view, the setting-free of latent caloric by the condensation of moisture in an uprushing current was the principal factor to be considered in tornado-generation.

Ferrel's Views.

Professor Ferrel began writing upon mathematical theories in meteorology more than thirty years ago, and it will be of some interest to quote from both the earlier and later works. According to these earlier views, we may consider that there are two forces acting in the production of a tornado or hurricane: 1. A primitive impulse, such as an abnormal heating of the air, thus giving rise to an upward tendency; 2. A constantly acting force. "This force (2) may be furnished by the condensation of vapor ascending in the upward current in the middle of the hurricane, in accordance with Professor Espy's theory of storms and rains. According to this theory, all storms are produced by an ascending current of warmer atmosphere saturated with moisture, and this current is kept in motion by the continual rarefaction of the atmosphere above by means of the caloric given out of the vapor which is condensed as it ascends to colder regions above. The violence of the hurricane, and also its duration, depend upon the quantity of vapor supplied by the currents flowing in below" (see *Nashville Journal of Medicine and Surgery*, 1856).

Again: "The preceding condition, found in the unequal distribution of temperature, must be regarded simply as a primary cause of disturbance, giving rise merely to the initial cyclonic disturbances; for without other conditions, depending upon the hygrometric state of the atmosphere, and upon the rate of decrease of temperature with increase of altitude in the atmosphere generally in which the cyclone exists, we would have no cyclone of long continuance or of much violence. If air is saturated with vapor, after ascending to only a moderate elevation, its tension and temperature are so much diminished that the vapor is condensed into cloud and rain; and the heat given out in the condensation of the vapor as the air ascends prevents the rapid cooling which takes place in dry air, and the rate of cooling with increase of altitude is reduced, in ordinary temperatures and elevations, to less than half of what it is in dry air. Tornadoes are simply very small cyclones, extending over so small an area that the effect of the earth's rotation has no sensible influence; and the gyrations arise from a disturbed state of the atmosphere in which the tornado occurs, which renders it impossible for the air to flow from all sides towards a centre without running into gyrations around that centre." An illustration of this principle is given in the flow of water from a basin by an opening at the bottom. "In a tornado the diminution of pressure and tension in the centre arises almost entirely from the centrifugal force. On account of the rapidity of the gyrations near the centre, this diminution of pressure may be very great there, while at a very short distance from the centre it is imperceptible. When these gyrations begin above, as they usually do, since the air there is most frequently in the state of unstable equilibrium (i.e., having a tendency to rush upward), they

gradually extend downward; for the gyrations cause a great diminution of tension and of density, and the air consequently in the centre rushes up with great velocity, and that below of the still unagitated strata is drawn in to supply its place, which likewise runs into gyrations around the centre, so that the gyrations in a very short time extend down to the earth's surface. The whole column of gyrating air is like a tall flue containing very rarefied air, the centrifugal force of the gyrations acting as a barrier to prevent the inflow of air from all sides into the interior; and if the gyrations at the earth's surface were as rapid as those above, it would be similar to such a flue with all the draught cut off.

"But very near the earth these gyrations, and consequently the centrifugal force, are very much diminished on account of the friction at the surface, and this allows the air to rush in quite near the surface to supply the draught of the interior ascending current" (see *American Journal of Science*, July, 1881).

These views are repeated or amplified in "Recent Advances in Meteorology" (1886), with the following suggestions added: "When the air expands as it is heated, it requires a greater quantity of heat to raise its temperature through 1°, since in this case work is done, and it is done at the expense of heat supplied. An additional amount of heat, therefore, the equivalent of the work done, has to be supplied." "The complete temperature conditions of a cyclone, therefore, rarely extend down to the earth's surface, but the interchanging and gyratory motions, commencing first up in the cloud regions, are soon propagated downwards to the earth's surface by the action through friction of the upper strata upon the lower ones." Speaking of unstable equilibrium, we find, "Currents of air at the earth's surface which come from a warmer latitude are caused to flow under the colder upper strata, where the normal motion is nearly eastward. In the south-east octant within the cyclone, the surface currents are from the south, bringing warm and moist air northward under the cold-air currents above from the north. This increases the temperature below, and decreases it above, and gives rise to the large vertical gradient of temperature, decreasing with increase of altitude, which is necessary to the unstable state."

A few final quotations are made from "Popular Treatise on the Winds" (1889):—

"The pressure near the centre of tornadoes becomes very much diminished, and in their passage over a place there is sometimes a very sudden change in pressure. Corks fly from empty bottles, cellar-doors are burst open against the force of a strong wind blowing against them on the outside, the walls of houses are thrown outward on all sides." "The direction of the general drift of the air is very nearly that of the progressive motion of the tornado, and so mostly from south-west to north-east. The velocity of this is always considerable in comparison with, though generally much less than, the gyratory velocity of the violent part of the tornado." Professor Ferrel quotes a statement regarding the fall of trees in the Gentry County tornado: "Those on the south (right-hand) side of the centre were pointing to the east and north-east, and even north-west when very near the centre. On the north side they were pointing north-west, west, south-west, and south-east."

Hail-Storms.

"A hail-storm is simply a tornado in which the ascending currents are so strong, and reach so high up into the upper strata of the atmosphere, that the raindrops are carried up into the cold regions above, where they are frozen into hail." The theoretical velocity needed to keep up a hail-stone 2.58 inches in diameter is one hundred miles per hour. The fall of rain and hail is said to always precede the tornado by ten to thirty minutes.

Thunder-Storms.

"The fundamental conditions of thunder-storms, as of cyclones and tornadoes, are the state of unstable equilibrium, at least for saturated if not for dry air, and a high relative humidity. In what are usually called thunder-storms, the conditions are nearly or quite absent which give rise to a gyratory circulation over a large area, such as takes place in the case of cyclones, and usually the conditions are wanting which give rise to small local and violent tornadic gyrations, though most tornadoes are thunder-storms. According to Finley, "of 473 cases in which the atmospheric conditions preceding tornadoes were observed, 410 were reported as violent thunder-storms." If the air is in the unstable state, and over a given circular area is a little warmer and lighter than that of the surrounding parts, there is set up a vertical circulation, with an ascending current in the interior, and an incoming current from all sides in the lower part of the air, to supply the ascending current. In the interior ascending current the height of incipient condensation and of the base of the cloud depends upon the depression of the dew-point of the air; and the aqueous vapor above that height is condensed, falls as rain, and cools the air through which it falls, until its temperature is lower than that of the surrounding air. This central cooled air, being now heavier than the surrounding air, both on account of its greater density and the amount of falling rain pressing on it, now gradually settles down, and causes an outward current in all directions from the centre. If there were at any one time rain and hail falling with uniform velocity equivalent to a rainfall of 13.6 millimetres in depth, it would increase the barometric pressure 1 millimetre; and from this alone would arise a squall with a velocity of about 34 miles per hour, making no allowance for friction."

More than two thousand pages have been perused in making these quotations. While no one person, perhaps, could give a perfect *résumé* of such a mass of matter, yet it is hoped that no important theory has been omitted.

Faye's Views.

It is necessary to mention one other theory that has been maintained by M. Faye of Paris. He has made a study of the appearances on the sun around his spots, and has been led to conclude that action in terrestrial storms is analogous in many respects. He thinks that this action originates in the upper atmosphere, and is propagated downward to the earth. A storm is practically a whirl in the swift-moving easterly current, similar to whirls in streams where an obstruction exists. This theory calls for a single remark. There does not seem to be a cause existent in the atmosphere in any degree adequate to set up such a whirl, unless we appeal to some force outside of the motion of the upper current. The transfer of the origin of the storm to the upper

current is satisfactory, and we have seen that Professor Ferrel has done the same thing in his later studies. The fatal objection to Faye's view is, that a downrush of air must necessarily cause its heating; and it has been proved that in such a case there can be no condensation of vapor and precipitation, but just the reverse.

Objections.

I am well aware that the position of an objector is an unenviable one, and to be avoided if possible. It seems to me, however, that all modern theories of tornadoes have intrenched themselves behind such a flimsy breastwork of fact that they can be regarded as little more than the "baseless fabric of a dream," and it is very important that the utter valuelessness of these supposed experiments be demonstrated. An attempt has been made to give, as nearly as could be done in so short a space, all the theories that have had their origin in Espy's experiments, and it is my purpose to examine these a little in detail.

Nephelescope.

The earlier form of this apparatus just described was superseded some years later by a double instrument, with which very extensive researches were made. These later experiments were much more complicated than the earlier, but, when properly interpreted, do not seem to lead to any different conclusions. It has already been shown that Espy was entirely misled by his results, and that, if they show any thing at all, they show that moist air did not behave differently in his apparatus from dry. Somewhat the same line of research, carried on by the writer with the best of modern appliances, has shown conclusively that no different result is had on the condensation of cloud from moist air than from the expansion of air in which no cloud is formed (see *American Meteorological Journal*, September, 1889).

Summation of Theories.

In tornado-generation there must be (1) a primitive impulse or an unstable equilibrium, brought about (*a*) by a local diminution of density, or (*b*) by an abnormal heating of the air near the earth, or (*c*) by a warm current from the south underrunning a cooler from the north; (2) a constantly acting force furnished by the condensation of vapor in an uprushing column of warm, moist air, which produces rarefaction by means of the caloric given out of the vapor; (3) work performed by the uprushing air in pushing aside the atmosphere into which it expands; (4) gyrations of great velocity from right to left set up in the uprushing air, which, from the centrifugal effect, produce a great diminution of pressure (corks fly from empty bottles, cellar-doors are thrown off, whole houses burst open, etc.); (5) a violent inrush of air into the partial vacuum in the centre, the whole effect being likened to that of heated air rushing into a flue or chimney; (6) an origin of these motions in the cloud region from which they are gradually propagated to the earth by the action through friction of the upper strata upon the lower; (7) a progressive motion of the tornado in the direction of the general drift of the atmosphere from south-west to north-east; (8) frequently a passing from a severe thunder-storm into a tornado.

Let us consider each of these theories in turn.

1. A PRIMITIVE IMPULSE.—It is a mistake to suppose that the sun heats any particular locality, whereby circumscribed ascending currents are set up. The hottest part of the day, that is, the time during which the heating effect is greatest, is about one hour, so that the heat of the sun acts uniformly upon a circle about a thousand miles in diameter. This heat acts only upon the earth's surface, and that in turn upon a layer of air only a few feet in thickness, as has been proved by experiment. To avoid these difficulties, it has been suggested that warm south wind underruns that which is cooler from the north. This, however, is an impossible condition, for the denser must always be beneath the lighter; moreover, as we have seen before, the clouds are always in the same direction as the lower wind. Finally, by (7) we see, that, if the tornado drifts in the upper current from south-west to north-east, that current certainly cannot be from the north.

2, 3. CONDENSATION OF VAPOR, AND WORK PERFORMED.—There is nothing in the science of meteorology, or possibly in any physical science, that has been developed from such a worthless origin as this theory of the liberation of energy on the condensation of moisture. We have already seen that Espy's own researches contradicted themselves. Ought we not to be allowed to theorize a little on this question? The most important effect of the liberation of latent heat is conceded to be the heating of the air, which produces a marked diminution of density. In cooling any air, we must consider the heating effect upon the surrounding air; that is, if a mass of air is cooled, the heat must be used up either in performing work or in heating other air. Take a cubic foot of saturated air at 80°, and cool it down to 79° by expansion: moisture is condensed, and latent heat becomes sensible. For the sake of the argument, let us suppose that a fraction of this heat is used in performing the work of expansion. The remainder of the heat will warm up, let us say, a cubic foot of air near by to above 81°, thereby rendering it no longer saturated. We shall have, then, one cubic foot of air at 79° and saturated, and another at above 81° and unsaturated. If we mix these, we shall have two cubic feet of air at just above 80° and unsaturated, and this must be cooled below 80° to saturate it; so that the air in no wise is heated by the liberation of latent heat.

We may look at this from another standpoint. The liberation of an infinitesimal amount of latent heat from the condensation of moisture would be just sufficient to re-evaporate the condensed moisture, so that no heat could be spared for heating the air. Even if a portion of the heat is used up in performing *work*, it is very plain that that could not be used in heating the air. Surely, no one thinks for a moment that this heat from condensation can be used for two purposes, each of which must take all of it at the same time. This reasoning is so obvious, that it is difficult to see how the force of it can be avoided. We have arrived at precisely the same result both by most careful experiment and by an unanswerable train of reasoning. The proof is overwhelming that this great source of energy amounts to nothing.

The following language, recently used by Professor Davis, seems very remarkable. When the air is warm and saturated, he says (*American Meteorological Journal*, December, 1889), "a given amount of cooling causes a larger amount of condensation than the same cooling of cold saturated air. This is thoroughly in accord with well-tried

physical principles; it has been abundantly tested by experiment, both on a small scale in the laboratory, and, as we may say, on a large scale in nature; it is universally accepted by men eminent in physical study, whose original ability and careful, studious work have led them to be regarded as authorities in their science, but who, being authorities, have not thereby become arbitrary and irrational. It is therefore difficult to understand why the question should be so confused by Hazen in the *American Meteorological Journal*, September, 1889."

We have already seen that these so-called authorities have tried no personal experiments,—at least, Ferrel does not allude to any such experiments,—and have been entirely misled by a few crude and contradictory researches. Is it not high time that this appeal to authorities be done away with? One of the main arguments advanced in support of storm theories is that such men as Ferrel, Hann, Mohn, and a host of others, are agreed,—agreed, however, as we have seen, upon exceedingly unsatisfactory evidence. Professor Davis suggests that these theories rest upon experiments, "as we may say, on a large scale in nature." This certainly is far from the truth. All the reasoning regarding the diminution of temperature in dry and moist air as we ascend in the atmosphere is founded upon purely theoretical considerations. Every experiment, whether in the laboratory or in nature, has proved that these theories, in their sum and substance, are false. But there is no use in arguing this question. I am so confident of my position in this controversy, and have become so deeply interested in studies regarding it, that I propose risking a little money upon it.

I will give a hundred dollars to the first physicist who will show that Espy's observations and experiments with the nephelescope, as published in his "Philosophy of Storms," giving the effects of expansion in moist and dry air, when properly interpreted, prove his theory.

It will be necessary to show,—

1. That the rise of mercury in the gauge after expansion was entirely due to heat from outside.

2. That the speed of expansion Espy used, or the amount of cooling from expansion, was comparable to the probable speed of expansion in the free air.

3. That by placing water in the bottom of the nephelescope the air would be saturated.

4. That air, under the conditions observed by Espy, will lose its dew-point or become unsaturated to the extent of four or five degrees in twenty hours.

5. That the cloud Espy observed was not largely formed by dust pumped into partly dry air.

6. How, if the heat liberated on condensation of the moisture is used in performing the work of expansion, there can be any heat from that source for expanding the air.

7. Why, if there is any latent heat set free on condensation in saturated air, it would not at once re-evaporate the condensed moisture, or heat the surrounding air to an unsaturated state.

8. That if latent heat is set free on the formation of a cloud in the nephelescope, its effect does not disappear at the moment the cloud disappears, provided none of the moisture settles to the bottom or sides of the nephelescope.

9. By means of delicate thermometers, that there is not practically the same effect upon the air, as regards heat, in expansions like these, whether we use dry or moist air, or, what is the same thing, disprove the experiments and statements made in the *American Meteorological Journal*, September, 1889.

[Continued on p. 358.]

MENTAL SCIENCE.

Motor Hallucinations.[1]

THE hallucinations most frequently recognized are those of sight and hearing. Something is seen that has no objective existence, or something is heard when no sound is made. There is, however, another form of hallucination to which attention has been directed. In the hallucinations connected with language, all these varieties are evident. Imaginary words are seen or heard, and they may also be felt as movements. One patient, subject to all kinds of hallucinations, perceived internal voices compelling her to do and say things against her will; but there was no sound emitted, and the patient perceived the sense of the words by the movements impressed upon her tongue. Several other cases have been reported in which messages are received, not by sight or hearing, but by the feeling of movements in the articulatory apparatus. In one case this was unaccompanied by any other mental defect, so that it was a pure case of verbal hallucination of this motor type. This hallucination has its seat probably in the third frontal convolution, the same part that is affected when motor aphasia sets in, — a condition in which the patient is able to understand written and spoken words, but is unable to give expression to his thoughts for lack of the association between the words and the motor feelings in the organs where those words are to be formed. The hallucination thus arising may be of various degrees of cogency: it may be entirely sensory, or there may be slight movements of the articulatory apparatus, or there may be an irresistible tendency to speak the words that are imparted to the tongue. Moreover, there sometimes occurs the hallucination that the patient is speaking, and yet he utters no word. Here there is in part an auditory hallucination, but also in part a motor one; for the patient has the feeling of having made the movements necessary for speaking the words.

While the special development of speech makes the motor hallucinations of speech unusually prominent, they are by no means limited to this type, but may occur in any field of motor action. While sleeping, we often have the feeling of going through fatiguing and complicated motions, when in reality no movement takes place. This is likewise to be referred to a stimulation of these cortical centres. Similarly we dream of falling down a precipice or of flying, — hallucinations equally frequent in insanity. It is not unlikely that this was the basis of the flights through the air of the witches and those possessed. A special class of these sensations arising from the stimulation of a central organ is to be found in cases of amputation. It is well known, that, when an arm or a leg has been lost, the person still retains all the feelings of the lost member. The hallucination is at times so definite that the clinching of the separate fingers may be felt, though the arm and hand have been gone for years. Out of ninety cases, there were only four who did not describe these hallucinatory sensations. While these hallucinations are in part sensory, there are also motor. Some feel the movements in the absent hand, describing its position as in the act of grasping, of writing, and so on. The seat of these sensations is doubtless in the brain and in those portions from which the innervation impulses arose when the limb was intact.

With regard to the genesis of the hallucinations, we seem warranted in assuming three stages in their formation. The first is central, and consists in forming a sensory image of the movement; the second is centrifugal, and consists of an impulse from the centre to the muscles and nerves; the third is centripetal, indicating that the peripheral organs of locomotion have undergone the changes due to the movement. That the last stage is not necessary to the production of the motor hallucination is shown in the case of the amputated limbs and elsewhere. We

[1] M. Tamburini, in Revue Scientifique, May 10, 1890.

find, too, that all of the types of motor hallucination are explicable as central irritations of these centres, in which these different factors are present in various degrees. The nature of these centres would in each case be both sensory and motor; and the hallucination, if properly analyzed, would also be of the mixed form.

Color-Vision and Color-Blindness.

Mr. R. Brudenell Carter,[1] in a lecture before the Royal Institution, outlined the position of modern science upon this important topic, and from his remarks the following points may be selected: the perceptive layer of the human retina consists of rods and cones; in the centre of the retina, only cones occur; in a ring around this, each cone is surrounded by a circle of rods; and as we recede from the centre, the proportion of rods to cones becomes larger and larger. There is good reason for believing that color-vision is limited to the cones, and certainly the perception of color is best where the cones are most numerous. Nocturnal animals have a less perfect development of cones than diurnal ones. The limitations of the color-sense on the human retina are very considerable. The color-sense is complete for three fundamental colors of the spectrum for not more than thirty degrees of the field, is limited to red and violet in a small ring outside this field, and from there on is sensitive only to differences of light and shade. In the lower animals, especially in those having their eyes more on the side of their heads and possessing acute vision, we find a power of perceiving colors over a much larger area of the retina; and this is associated, as has been shown in birds, in some reptiles, and in fishes, with a more abundant and more even distribution of the cones over the retina. There has recently been observed upon the cones of some birds, globules of a colored oil, which transmit only light of their own color; and green, orange, and red drops prevailed in the birds examined. Why this is so remains to be determined.

When the condition that exists normally in the outer zones of the retina exists also in the centre, we have color-blindness; but such a degree of color-blindness is rare, if indeed it exists at all. The more common defect is that which exists in the zone surrounding the fovea; that is, a blindness to green. Such persons can distinguish violet and yellow, and they can see red, but cannot distinguish it as a color from green. The most common defect, however, is a blindness to red; and an extremely rare form is blindness to violet. The Young-Helmholtz theory regards the defect in the red-blind person as a paralysis or an absence of the red-perceiving elements in the retina. To such a one, spectral red is not absolutely invisible, but appears as a green of feeble luminosity, and the brightest part of his spectrum is in the blue-green. When green stimulates the eye of the green-blind, there results the white of the green-blind, which to ordinary eyes is sort of rose-color. To both red and green blind, then, these two colors are indistinguishable, the only difference being that to the red-blind the red, and to the green-blind the green, seems, in comparison with the other, of feeble luminosity. By looking at colored objects through a glass of peacock-blue the colors will appear somewhat as they do to a red-blind person, and by looking at them through a purple glass they will appear somewhat as they do to the green-blind. These defects exist in about four per cent of the male population, and in about one-tenth of one per cent of the female.

With regard to the dangers resulting from the placing of color-blind persons in responsible positions, it is easy both to exaggerate and to underestimate them. We naturally think of the railway and marine service, in which colored signals are used; and it is certain that a considerable number of those thus employed suffer from this organic and therefore incurable defect. We would be apt to think that such persons would at once reveal the defect, and thus be released from duty. We must remember, however, that the existence of this defect remained unknown until about a hundred years ago, and that it is often concealed by the correct use of color-names, — a rather easy art for the color-blind to acquire. And, again, these persons always know where to look for a signal, and hence under ordinary occasions the slight distinction they make between red and green, aided by good luck, may be sufficient to avoid accidents. The methods of testing and discovering this defect are various, but they all depend upon matching colors and avoiding the use of color-names in the process. There are all degrees of the defect, from a tendency to confusion of dark greens and reds and a hesitation in deciding between them, to absolute indistinguishability of pronounced shades of them. The necessity of an examination in all posts in which color-distinction is necessary is now recognized, and governmental regulations upon the matter have been largely adopted. It may be advisable to add that there is a form of imperfect color-perception not at all related to color-blindness, but sometimes confused with it. It is simply a lack of practice and of training in color-distinctions. It is quite surprising with what ignorance of colors and their various shades children may grow up. This is a thing that may be taught, and is now frequently introduced into primary education.

[1] See Nature, May 15, 1890.

NOTES AND NEWS.

AMONG the geographical expeditions which are decided upon for next summer in Russia, one is of unusual interest, that to the Black Sea. The physical features of this important and deep basin are so little known that we have little information on the depth at even a short distance from the shore. As to the temperature, salinity, etc., of the water at great depths, we have only a few observations along the eastern coast by Professor Lapschin, and near the entrance to the Bosporus by Count Admiral Makarow. Last winter, Professor Klossowsky and Dr. Andrussow, in a memoir addressed to the council of the Imperial Russian Geographical Society, showed clearly the importance of an investigation of the deeper part of this sea. It was warmly supported by the society, and the Ministry of Marine sends a vessel for this purpose on a cruise of a month's duration. The nautical part of the scientific work will be under the direction of Capt.-Lieut. Spindler, while the Geographical Society sends Drs. Wrangell, A. Woeikof, and Andrussow, the last mentioned of whom will have charge of the botany and zoölogy.

—The Elizabeth Thompson Science Fund, which has been established by Mrs. Elizabeth Thompson of Stamford, Conn., "for the advancement and prosecution of scientific research in its broadest sense," now amounts to twenty-six thousand dollars. As accumulated income will be available December next, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points: 1. Precise amount required. Applicants are reminded that one dollar is approximately equivalent to four English shillings, four German marks, five French francs, or five Italian lire. 2. Exact nature of the investigation proposed. 3. Conditions under which the research is to be prosecuted. 4. Manner in which the appropriation asked for is to be expended. All applications should reach before December, 1890, the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A. It is intended to make new grants at the end of 1890. The trustees are disinclined, for the present, to make any grant exceeding three hundred dollars: decided preference will be given to applications for smaller amounts. A list of the grants hitherto made, amounting to about six thousand dollars, is given in a circular just issued by the trustees.

—The American Swedenborg Printing and Publishing Company of this city are issuing the more important of Swedenborg's writings in clearly printed pocket volumes. "Angelic Wisdom concerning the Divine Love and the Divine Wisdom," the latest issue from their press, is a model of neatness and of good book making.

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Vol. XV. NEW YORK, June 13, 1890. No. 384.

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THE TORNADO: THEORIES; OBJECTIONS.

[Continued from p. 356.]

Professor Davis says, further, "It is a mistake to say that the latent heat, when liberated, will warm the air enough to allow the condensed vapor to evaporate again; for the latent heat is completely expended in the work of pushing away the air that surrounds the ascending expanding mass, and therefore cannot be applied to any other task. Espy made this error for a time, but afterwards corrected himself. It is regrettable to see the error now revived by Hazen." I am sure no one could ask for a stronger confirmation of his views than this from an opponent. If the above argument amounts to any thing, it declares that the latent heat of condensation would certainly immediately re-evaporate the moisture, unless it were used up in performing *work*. If it is used for this purpose, it certainly and most emphatically cannot be used for causing a rarefaction in the cloud, and for increasing the energy of the tornado. Professor Davis is entirely wrong in his allusion to Espy. I am inclined to think that even Espy, with all his disadvantages, was too well informed to adopt such a doubtful and visionary idea as this of effective *work* performed in the free upper air. There is not one scintilla of evidence that he ever considered this question, except, possibly, to deny that any thing of the kind was to be thought of.

I challenge Professor Davis, or any one else, to show by Espy's writings that he disposed of any of his heat on this hypothesis, or that he ever thought that the latent heat would re-evaporate the moisture. He very quickly saw that the liberation of so much latent heat as his theory called for would heat up the air enormously, and was forced to dispose of it by radiation into space. It is probable that the amount of energy made effective by this so-called "work" in the free upper air is infinitesimal as regards the development of force. The explosions that Espy made in his nephelescope caused the air to rush with a velocity of perhaps a thousand feet per second. This enormous velocity caused a sufficient cooling to produce a cloud, which, however, was quickly evaporated. All reliable experiments have shown that the expansion of saturated air at velocities probably at least ten times as great as can ever occur in nature does *not* produce any cloud; and we see the reason for this in the fact that the latent heat made sensible does not permit the formation of cloud, for the condensing moisture is re-evaporated before it becomes visible.

It is a very significant fact, and one that has been borne in upon me with no little force by conversation with others, that Ferrel has introduced a long general discussion of this question of work performed by expanding air in his two lastest treatises, but has nowhere made this theory available, or even discussed it, in connection with the generation of storms or tornadoes. It would seem as though the amount of effective energy ought to be computed very closely, and its proper place given it. It is probable that an ascending cylinder of air a hundred miles in diameter would not produce any effective energy or any expenditure of heat in its centre from this cause. I am inclined to think that the total energy that can ever be developed from an ascending mass of saturated air is no whit greater than what may be called the balloon effect. If a hot-air balloon rises in the air at the rate of ten feet per second, it has carried a certain weight, say three thousand pounds, to twenty thousand feet, and there we have potential energy; but, if the balloon descends at the same rate, there will be no display of extraordinary force. If, instead of the confined mass of enormously heated air, we had a mass of air heated a few degrees above the surrounding air, it would rise; but here the air would spread over a great space, and we would not have the concentrated potential energy that we had in the balloon. To say that this air had any power of producing effective energy, or even to say that it could have arisen at all without the corresponding descent of nearly an equal amount of cooler air, is highly problematical.

4, 5. Gyrations in the Uprushing Air and a Violent Inrush.—We have already seen that the evidence for these gyrations is exceedingly contradictory, and the weight of evidence is overwhelmingly against them. It would almost seem as though this theory were introduced to avoid a serious difficulty; at all events, we hear nothing of it for nearly forty years after the first studies. It is plain that a partial vacuum, if there were one, would be filled at once by the air rushing from all sides. Has this theory been invented to provide a whirling mass having sufficient consistency to keep

out the inflowing air? This theory really proves too much; for, if there is this enormous centrifugal effect producing a partial vacuum, how is it possible for moist air to flow in against the centrifugal effect? The theoretical explanation that there is friction at the earth's surface, which breaks up the centrifugal effect at that point, is exceedingly unsatisfactory.

It is given as a proof of this vacuum, that "corks fly from empty bottles." I have searched the tornado literature through and through, and have not found a single well-authenticated case of this phenomenon. The questions naturally arise, "Why were corks *put* in *empty* bottles?" also "Why did not the corks fly from the full bottles?" It is probable that empty bottles and corks were found in a cellar, and the theory could have very easily arisen that they had met with a separation. It would be very interesting to have a confirmation of this fact. It is said that whole houses sometimes burst from the passage of this partial vacuum. We have already advanced an explanation of this.

It should be noted that nearly all pictures of tornado-funnels make them exceedingly circumscribed, perhaps not more than ten feet across at the tip (see Fig. 1). The earliest representation of a tornado-cloud is very different from this, and it is probable that the imagination has had altogether too much to do with all these later pictures. It is to be hoped that wherever possible, in future drawings, there will be given some idea of the size of the funnel. If houses are affected, the funnel should be at least from a hundred to two hundred feet across at the earth. A remarkable evidence of the desire for showing a gyration in a tornado-cloud is to be found in the quotation regarding the Gentry County tornado, from Professor Ferrel's last book, at p. 354. This statement was of an observation in which it was claimed that trees on the north side of the track were thrown to the west and south-west. As shown in Fig. 2, this is exactly the way trees ought to be thrown, if this theory of a gyration is a correct one. This is the only instance, if we grant its authenticity, in which, out of a hundred or a hundred and fifty reports of this phenomenon, trees were ever thrown this way. The evidence of this kind is overwhelmingly in favor of the supposition that there is *no* gyration.

6. ORIGIN IN THE CLOUD REGION.—There can be no doubt that the tornado originates in the cloud region; but to say that this must be from an unstable equilibrium at that point, is a violent assumption. The sun, contrary to theory, undoubtedly heats up a cloud so that there is a steady increase of temperature with height, as shown by balloon observations; but there is no unstable equilibrium, though theory indicates that this should be enormous under these conditions. The tornado frequently arises after sunset, when there is no abnormal heating of the cloud. This transfer of the primitive impulse from the earth to the cloud is very significant, and seems to have been done to avoid a difficulty; which, however, has been increased rather than avoided. The hypothesis that such a disturbance, after starting in the cloud region, is transmitted through friction to the earth's surface, seems a little strained, when we reflect, that, according to computation, it would require more than twenty years for such transmission through a depth of three hundred feet.

7. A PROGRESSIVE MOTION IN THE DRIFT OF THE UPPER CURRENT.—If the general storm motion is in this drift, it certainly seems impossible to ascribe that of the tornado to the same. The tornado moves with a velocity fully double that of the general storm, and it is probable that the centre of its motion is not more than half the height of the former; and, as it is known that the velocity of the current increases rapidly with the height, it is safe to say that the drift at the "power" of the tornado is not more than half that in the case of the general storm. It is also impossible to account for the motion of the tornado for more than a hundred miles, unless it has its own generating force, through the drift of the upper current. If the cloud is about three thousand feet high (not an underestimate), the motion of the upper part will approximate double that of the lower, and, in spite of the utmost centrifugal action, it would in a few minutes be torn apart. The hypothesis that the upper part breaks off, and re-forms itself in front, and afterward communicates its gyrations to the earth through a frictionless medium, must be regarded as one of the most strained that was ever advanced. This would break up the absolutely necessary continuity of the vertical ascending current, and would be fatal to the whole tornado theory.

8. A SIMILARITY BETWEEN THUNDER-STORMS AND TORNADOES.—This view was advanced prominently in 1884, and in the past few years has become a most important factor in all discussions. It demands a notice by itself, which will be given later.

It will be asked, Is not the foregoing a too severe setting-forth of the general weakness of tornado theories? Is not there some good to be gotten out of such theories, even if there are some points not fully settled? I leave the questions where they stand. I have not tried to overdraw the picture. The essential weakness of such theories is a starting from insufficient data and reasoning regarding most complex motions in a region in which we have hardly a dozen reliable records. It may be put down as an undoubted fact that no great advance can be hoped for in such studies, except the abandonment of these theories, until we investigate carefully the region where all these disturbances are developed.

H. A. HAZEN.

ON THE GROUP OF METEORITES RECENTLY DISCOVERED IN BRENHAM TOWNSHIP, KIOWA COUNTY, KAN.[1]

ABOUT four years ago the farmers of Brenham Township ploughed up a number of heavy objects, which they used to weight down haystacks and for other such purposes, as they would have used bowlders. It was discovered in March last that these were not common rocks, but an interesting group of meteorites, numbering over twenty in all, weighing together about 2,000 pounds, and individually from 466 pounds down to one ounce each. They were found embedded at a slight depth in the soil, which here, for about one hundred feet in depth, is formed of a pleistocene marl, originally the bottom of an ancient lake, scattered over a surface over one mile in length; principally, however, in a square of about sixty acres.

What is now Kiowa County, Kan., five years ago formed parts of Edwards and Comanche Counties, and was occupied by large ranges and cattle-ranches. Brenham Township, or Township 27 as it was then called, is in the north-western part of Kiowa County, is covered by a high prairie with some areas of sand-hills,

[1] First announced at the New York Academy of Sciences, April 7, 1890.

and has an altitude of about 220 feet above sea-level. Some drains of the head waters of the Medicine River and its tributaries, farther south, become ravines and valleys; and there a gravel occurs, the *débris* of miocene "Loup Fork" conglomerates. But on the high prairie not a stone of any kind is to be found: hence the ranchmen and settlers were greatly surprised at finding heavy rocks or stones projecting through the prairie sod.

Several years ago, Mr. Davis, a lawyer at Greensburg, identified these as meteorites; and although the farmers had known this for a long time, yet, strange to say, no importance was attached to them until Mrs. Kimberly applied to Professor F. W. Cragin, of Washburn University, in the early part of March. It was not until the 13th of March that Professor Cragin secured four of these masses.

They were nearly all found by being struck by mowing-machines, ploughshares, corn-cultivators, or other farm implements. Over twenty distinct masses have been reported; but it is very evident, from the weight and other facts, that some have been noted several times over.

The history of some of these pieces is quite remarkable. The 35.72-pound piece was found on the Evans place, was lost, and again found in a hole made by some hogs under a barbed-wire fence. The 75-pound mass was used by Mrs. Kimberly to hold down a cellar-door or the cover of a rain-barrel. No. 3 was used to keep down a stable-roof. The 466-pound mass (called by the farmers the "moon meteorite") was covered by only three inches of soil, and broke a ploughshare when it was struck. Apparently none of the masses were buried to a greater depth than five or six inches.

The 101.5-pound, the 71.5-pound, and the 55-pound masses were found four years ago by a cowboy, when the ranch had not yet been occupied by settlers, and was simply used as a cattle-range. He was unable to move them to the "Green's Stage Station," now Greensburg, eight miles distant, and so buried them in the gulch a mile north-west of the "Francisco Claim." About a year afterward he became ill, and died; but before his death he communicated the burial of the "three strange rocks," as he called them, to two of the settlers, who succeeded in finding them and bringing them to the new town of Greensburg about a year after his death. The 55-pound mass was carried over by a neighbor, who used it to weight down his haystack.

FIG. 1.—PRAIRIE LAND, KIMBERLY FARM.

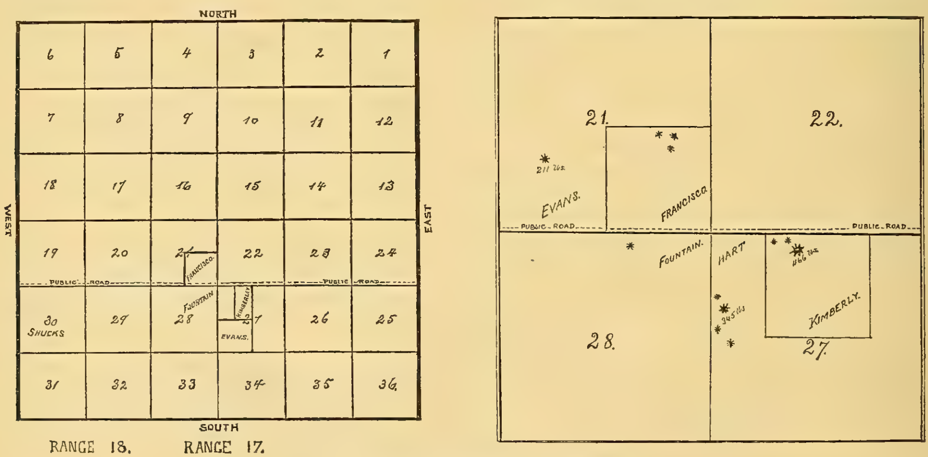


FIG. 2.—TOWN MAP BRENHAM TOWNSHIP.

(The asterisk denotes the spots where meteorites were found.)

The townships are reckoned from the base-line, the 40th parallel; and the ranges, from the 6th principal meridian, which crosses Kansas about longitude 97° 30′ west of Greenwich.

Brenham Township (27) is made up of thirty-six sections, each one mile square, numbering from No. 1 to No. 36. The meteorites seem to have been scattered north-east and south-west, and to have covered an area over one mile in length. Some of the meteorites fell on the east half of the north-west quarter, Section 27, Township 28, Range 17, west of the 6th principal meridian.

Professor Snow of Lawrence, Kan., visited Kiowa County several times, and the last time obtained the 101.5-pound mass in the streets of Greensburg, the county seat, where it had lain for several years in front of a lawyer's real-estate office.

The exterior of all the masses shows the characteristic pitting. The surfaces have all been more or less oxidized by exposure to

the elements, showing that the fall is not recent, and that the original mass was made of crystalline iron as well as of iron filled with crystals of olivine: in other words, the masses show two distinct groups. Of these, the 345-pound and the 75-pound ones are nickeliferous iron of a highly octahedral structure and cleavage, and are caillites, while the others are meteoric iron containing olivine, and belong to the group known as "pallasites."

The largest mass, a pallasite, weighs 466 pounds, or 211.818 kilos. It is thick, slightly flattened, triangular in form, somewhat heart-shaped, and measures through the longest part 61 centimetres, or 24⅛ inches; across the widest part, 43 centimetres, or 19 inches; and in the thickest part, 37 centimetres, or 14½ inches. It is covered with large indentations measuring 10×6×3 centimetres. The coating is more or less oxidized, but the olivine is perceptible in all parts of the mass.

The dimensions of the 345-pound mass (156.818 kilos) are 60×37×29 centimetres, or 23¾×14½×11½ inches. It is slightly arch-shaped, is an iron with many pittings, and shows the characteristic magnetic oxide of iron crust.

The 211-pound mass (95.909 kilos) is somewhat rounded, with a circular depression on one side.

There are two masses weighing 125 pounds (58.863 kilos) and 54.96 pounds (25.084 kilos) respectively.

The 101.5-pound mass (46.136 kilos) is almost round, measuring 35×26×27 centimetres (13¾×10¼×10¾ inches). The exterior is evenly pitted, and the centre of each pitting is an olivine crystal.

The 75-pound one (34.09 kilos) is an iron, and measures 32×22½×15 centimetres (12½×8½×5⅞ inches). It is in shape like a pear or ham, covered with large pittings. The crust has been changed somewhat by weathering.

The 71.5-pound mass (32.485 kilos (measures 27×23×22 centimetres (10½×9×8⅝ inches). It is a jagged, irregular square, and shows olivine crystals all over the exterior.

The 60-pound mass (27.272 kilos) measures 36×21×17 centimetres (14⅛×8×6⅝ inches). It is an elongated, rounded piece, with one large flat side showing large spaces filled with olivine.

The 40-pound mass (18.181 kilos) measures 22×21×21×13 centimetres (8⅝×8⅓×8⅓×5⅛ inches). It is of irregular shape, with one large projecting point.

The 36-pound mass (16.363 kilos) measures 22×22×16 centimetres (8½×8½×6¼ inches). It is a flattened spheroid, containing some olivine, but almost entirely iron, showing large pittings like the 75-pound or the 345-pound masses.

There are also about a dozen small masses weighing 12, 7, 6, 5, 3, and 1 pounds each, and a few weighing only one ounce each. The 211 and 6 pound masses belong to the University of Minnesota; the 125-pound mass, to Harvard University; the 54.96-pound mass, to the University of Kansas; the others are in the collection of the writer.

The specific gravity of the masses is very variable, and was found to be as follows: of the 6-pound mass, 5.17; 40-pound mass, 6.41; 71.5-pound mass, 5.22; 75-pound mass, 7.27; 345-pound mass, about the same density as the 75-pound mass; 466-pound mass, about the same density as the 71.5-pound mass.

The following analyses of the Kiowa meteorite were made by Mr. L. G. Eakins in the laboratory of the United States Geological Survey:—

IRON.		OLIVINE.		DARK OUTER ZONE OF OLIVINE.	
	Per Cent.		Per Cent.		Per Cent.
Fe	88.49	SiO_2	40.70	SiO_2	34.14
Ni	10.35	Al_2O_3	tr?	FeO	23.20
Co	.57	Fe_2O_3	.18	NiO	tr
Cu	.03	FeO	10.79	CoO	.03
P	.14	NiO	.02	MnO	.09
S	.08	MnO	.14	MgO	40.19
C	tr	MgO	48.02	S	5.42
Si	tr?				
	99.66		99.85		103.07
				Less O for S	2.71
					100.36

The specific gravity of the iron freed from olivine was found to be 7.93 at 23.4° Celsius; of the olivine, 3.376 at 23.2°.

The iron is brilliant white, enclosing the troilite, and surrounding the olivine crystals. Occasionally small etched surfaces show delicate figures like that of the Linnville Mountain meteorite.

Troilite exists plentifully in rounded grains from one to five millimetres in diameter, and in thin folia mixed with and surrounding the olivine crystals, as well as running into and filling small spaces in the body of the iron, either as flat plates or rounded masses. Several flat circular plates (crystals?) of graphite two millimetres in diameter were observed.

The olivine crystals are very brilliant, and break out entire, the faces on many of them being distinct enough to measure the angles. The spaces from which they break are highly polished, showing every crystal face with a mirror-like polish; and in the centre there is a coating of a shining black mineral that is jet black in color, and crushes into a jet black powder.

Many of the olivine crystals are in two distinct zones,—the inner half a bright transparent yellow, the outer a dark-brown iron-olivine. In reality this dark zone is an intimate mixture of the troilite and the olivine, as the analysis by Mr. Eakins and a microscopical examination of the crystals by Mr. J. S. Diller of the United States Geological Survey fully proved.

This group of meteorites, which has recently come to me for description, possesses more than ordinary interest, on account both of the peculiar composition and structure, and also of the undoubted ethnological relation. It is especially interesting because of its probable connection with the meteoric iron found in the Turner mounds.

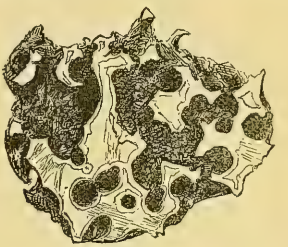


FIG. 3.—SECTION OF METEORIC IRON.

In the spring of 1883, Professor F. W. Putnam found on the altar of mound No. 3 of the Turner group of mounds, in the Little Miami valley, Ohio, several ear-ornaments made of iron, and several others overlaid with iron. With these were also found a number of separate pieces that were thought to be iron. They were covered with cinders, charcoal, pearls (two bushels were found in this group of mounds), and other material, cemented by an oxide of iron, showing that the whole had been subjected to a high temperature. On removing the scale, Dr. Kennicutt found that they were made of iron of meteoric origin.[1] One of the pieces weighed 28 and the other 52 grams.

In the autumn of 1883 a mass was found on the altar of mound No. 4 of this same group, which weighed 767.5 grams (27.25 ounces). Dr. Kennicutt suggested that these were all parts of some larger meteoric mass. The results of the investigation were published in connection with the description of the Atacama meteorites, because in structure they approached more closely to the latter than to those of any other occurrence known of at that time. In the Liberty group of mounds in the same valley, Professor Putnam found a celt five inches long, and in another of the Turner mounds an ornament five inches long and three inches wide, made also of the same meteoric iron.

The Carroll County meteorite was found in 1880, about three-quarters of a mile from Eagle Station, Carroll County, Ky., ten miles from the mouth of the Kentucky River, and about seven miles in a direct line from both the Kentucky and the Ohio Rivers. The distance to the Turner mounds, where Professor Putnam found the meteoric iron and the ornaments made of it, is about sixty miles. The mass, which weighed about 80 pounds, or 36.5 kilos, was rusted on the surface to a depth, in some places, of 10 to 12 milli-

[1] 16th and 17th Reports of the Peabody Museum of Archæology, p. 382.

metres; and deep pits, some 2 centimetres across, are observed in spots where grains of olivine have probably dropped out. The meteorite was largely made up of fine yellow transparent olivine, resembling that of the famous Pallas iron, with a specific gravity of 4.72.

Taking the specific gravity of the iron at 7.6, and that of the olivine at 3.3, we find that the Turner mound meteorite consists of about three parts of olivine to one of iron. Several of the Kiowa masses have about the same constitution. For comparison, see the analyses of the olivine and iron from the Turner mound,[1] here given, and of the Kiowa meteorite, given above.

OLIVINE.	Per Cent.	IRON.	Per Cent.
SiO	40.02	Fe	89.00
FeO	14.06	Ni	10.65
MnO	0.10	Co	0.45
MgO	45.60	Cu	tr
	99.78		100.10

When the Carroll County iron was described by the author in the *American Journal of Science* (vol. xxxiii., March, 1887), it was suggested that the pieces of the meteorite found by Professor Putnam in the Miami mounds had probably been taken from that

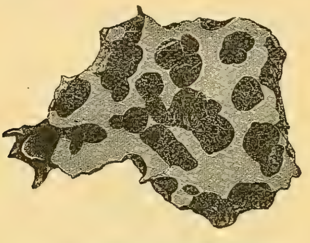


FIG. 4.—TURNER MOUND METEORITE.

mass, since no other olivine meteorite had up to that time been found in North America; while that of Carroll County contained a large percentage of olivine, even greater than the Little Miami specimen. Very little cutting had then been done on the Carroll County mass; and it proved, on being cut, not to be a pallasite, but a brahinite variety of meteorite. In the Little Miami valley meteorite are embedded circular grains or crystals of olivine; whereas that of Carroll County consists of a mass of olivine in which the iron serves as a filling between the crystals. When a section was cut from the Kiowa County material, however, there appeared no doubt as to the identity of this fall with that of the mass from which the ear-rings were made which were found in the mound. In both the Kiowa County and the mound specimens the body of the meteorite is iron, in which are embedded circular masses or crystals of olivine. The fact that in connection with the large Kiowa County masses a number of small portions, weighing from half a pound to six pounds each, were found, makes it very probable that a small mass, weighing perhaps three or four pounds, had been conveyed by the Indians to the Ohio valley. Probably the two ear-rings in the collection of Mr. Warren K. Moorehead, which were recently found by him at Fort Ancient, O., may have been made from a part of the mass weighing 767.5 grams, which is now in the Harvard University collection.

I must here express my indebtedness to Professor F. H. Snow for information, and particularly to Professor Robert Hay for aiding me in procuring many of the meteorites and assisting especially to obtain exact data by visiting the place of finds, and to secure the illustration; as also to Mr. L. G. Eakins for making, and to Professor F. W. Clarke of the United States Geological Survey for his courtesy in having made in the Survey Laboratory, the analyses of the iron and olivine of the Kiowa County meteorite.

GEORGE F. KUNZ.

[1] Kennicutt, 16th and 17th Reports of the Peabody Museum of Archæology, p. 382.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The International Congress of Geologists.

WILL you kindly permit me to publish my correction of an erroneous statement on p. 461 of the last (May) number of the *American Naturalist*? I fear that it will be quoted by other periodicals, to the injury of those who are quite innocent. The statement is to the effect (1) that the director of the United States Geological Survey, Major Powell, moved that the meeting of the International Congress of Geologists appointed for Philadelphia should be held in Washington; and (2) that the motion was carried in committee by the votes of members of the United States Geological Survey, who were present in such numbers as to constitute a working majority of the committee.

The statement is particularly unfortunate, and unjust to Major Powell, seeing that he was not the mover of the resolution, and that he voted against it, after speaking against it, giving his reasons why he was strenuously opposed to the congress meeting in Washington. As a member of the American committee of arrangements for the congress, I was present at the meeting in Washington at which the voting took place, and can therefore testify to Major Powell's opposition, both then, and afterwards in conversation. Furthermore, I take upon myself the responsibility of the change of the meeting-place of the congress from Philadelphia to Washington, if such a change occurs: for I made the first motion; namely, that the local Philadelphia sub-committee (of which I had been made, against my protest, chairman) be discharged; which motion was carried. After some discussion, the next motion was then made (not by Major Powell), not that the congress should meet in Washington instead of in Philadelphia, but that the secretary of the committee should be instructed to express the sentiment of the committee (that the congress should meet in Washington, and not in Philadelphia) to the secretary of the executive bureau of the congress in London, in which alone power was vested *ad interim* to discuss and decide such points. It was understood, that, if a majority of the American committee should express such a sentiment, the bureau abroad would be pretty sure to order the change of place of meeting. Major Powell opposed such an expression of sentiment, and urged that nothing should be done by the American committee to cause such an action abroad. I myself urged that there were reasons for my belief that a meeting in Philadelphia would be a failure, and gave the reasons; and I stand ready to repeat them, in *Science* or elsewhere, if called upon to do so. What I wish to say here, however, is that Major Powell, instead of advocating the motion and getting it passed by the assistant United States geologists present, opposed it, and would have defeated it if he could. In fact, it was only passed by a vote of seven to three (if I recollect aright), all the other members of the committee abstaining from voting either for or against it. By rule of the committee the secretary was then instructed to obtain by correspondence the votes *pro* or *con* of all absent members, as, until this be done, the chairman of the committee, Dr. Newberry, cannot declare the motion either carried or lost. What the bureau abroad will then do about it, no one knows. My own hope is that the bureau will revoke the order for an American meeting of the congress, and appoint some European capital instead of either Philadelphia or Washington. But, if there must be a meeting next year in America, I trust that the bureau will see the propriety of holding it as usual in the capital of the country, which is also, in our case as in Europe, the chief centre of physical science.

J. P. LESLEY.

Philadelphia, June 7.

Counting Bacteria.

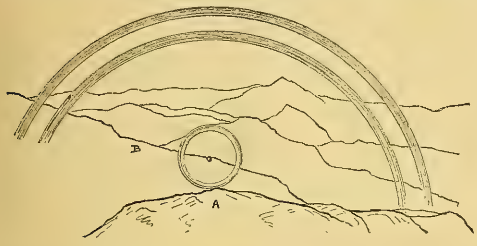
I SHALL feel much obliged if observers who have had experience with the different methods of counting bacteria in water will give their views as to the most reliable method.

M. D. EWELL, M.D.

Chicago, June 2.

Triple Rainbow.

WITHIN a few months we have been twice favored with the following rainbow combination. In each case it occurred just before sunset. Two complete arcs rested on the mountains on one side, and descended into the valley of the Rimac on the other, while in the centre was a complete circle of smaller size. The point of observation (*A*) is 6,500 feet above sea-level. To the east are mountain-ranges rising to the Cordillera in the background. At the times of observation there were high clouds yielding a



gentle rain, by which undoubtedly the two ordinary arcs were caused. At the same time, however, a low, light cloud was drifting through the valley between *A* and *B*, and reaching nearly to the observer.

In this cloud the circle was formed. The indistinct shadow of the observer's head appeared at the centre (*O*), and the lower part of the circle was slightly obscured by the shadow of his body. The colors of the circle were not so brilliant as those of the arcs above. The circle also appeared less distant; but this apparent difference of distance was not so marked but that at first glance the three bows seemed to belong to the same system.

At a point an eighth of a mile nearer the sun, and hence farther from the cloud, only the two superior arcs were visible.

Mount Harvard, Peru, April 26. SOLON I. BAILEY.

BOOK-REVIEWS.

Pictorial Africa, its Heroes, Missionaries and Martyrs. New York, Fleming H. Revell. 4°.

Henry M. Stanley. By ARTHUR MONTEFIORE. New York, Fleming H. Revell. 16°. 75 cents.

THESE two books, both of which are by English authors, are intended as popular accounts of African discovery. The first, which is anonymous, is to a considerable extent a compilation, and gives a summary of most of the noted discoveries in the Dark Continent during the past hundred years, from those of Bruce and Mungo Park down to recent times. Stanley's work is but lightly touched upon, while that of Livingstone is described at great length, the compiler of the book being much interested in Christian missions. The volume contains a good deal of information about the various regions of Africa, their inhabitants and products; yet, as we have said, the work is popular rather than scientific, and it has the defects as well as the merits that popular books are apt to have. It is illustrated with a large number of engravings.

The little volume on Stanley's explorations is an abler work, and, though intended for popular reading, gives, nevertheless, a very good account of the various expeditions that Stanley has made, and of their most important results. It opens with a brief history of his early life, which shows clearly that the experiences he went through in those days helped to train him in the habits of self-reliance and ready resource that were afterward to be so useful to him and to the world. His trips to Abyssinia, Persia, Coomassie, and elsewhere are briefly noticed, and then begins the story of his great discoveries on the Kongo and elsewhere, closing with his arrival at Zanzibar with Emin Pacha. Mr. Montefiore's narrative covers all the more important incidents of the various expeditions, with special regard to their geographical and political significance,

Publications received at Editor's Office, May 26–June 7.

DYNAMICS, Syllabus of Elementary. Part I. Linear Dynamics. Prepared by the Association for the Improvement of Geometrical Teaching. London and New York, Macmillan. 39 p. 8°. 30 cents.

ELLIS, H. The Criminal. New York, Scribner & Welford. 337 p. 12°. $1.25.

FULLERTON, G. S. On Sameness and Identity. (Philosophical Series, No. 1.) Philadelphia, Univ. of Penn. 156 p. 8°.

GOMME, G. L. The Village Community. New York, Scribner & Welford. 299 p. 12°. $1.25.

LANKESTER, E. R. The Advancement of Science. Occasional Essays and Addresses. London and New York, Macmillan. 387 p. 8°. $3.

MAINE, Fifth Annual Report of the State Board of the State of, for the Fiscal Year Ending Dec. 31, 1889. Augusta, State. 304 p. 8°.

MINERAL Resources of Ontario, Report of the Royal Commission on the, and Measures for their Development. Toronto, Ont., Warwick & Sons, Pr. 566 p. 8°.

RELIGIO-PHILOSOPHICAL Journal. Vol. 1. No. 1. w. Chicago, J. C. Bundy. 16 p. f°. $2.50 per year.

SESSIONS, F. C. In Western Levant. New York, Welch, Fracker Co. 252 p. 12°.

THURSTON, R. H. Heat as a Form of Energy. Boston and New York, Houghton, Mifflin, & Co. 261 p. 12°. $1.25.

and conveys a good deal of information in a small compass. As a popular account of Stanley's work, it is worthy of commendation.

AMONG THE PUBLISHERS.

THE latest issues of the *Modern Science Essayist*, devoted to popular evolution essays and lectures, are as follows: No. 25, "Evolution of Arms and Armor," by John C. Kimball; No. 26, "Evolution of the Mechanic Arts," by James A. Skilton; and No. 27, "Evolution of the Wages System," by George Gunton.

— D. C. Heath & Co. will soon publish editions of three of Molière's comedies, — "Le Tartuffe," "Le Bourgeois Gentilhomme," and "Le Médecin Malgré Lui," edited by F. E. A. Gasc.

— Readers of "Robert Elsmere" will be interested to find in Dr. G. P. Fisher's "Nature and Method of Revelation," just issued by the Scribners, a chapter devoted to the discussion of the religious views of Matthew Arnold as advocated by Mrs. Humphry Ward in her novel.

—The interest in meteorology is on the increase in Russia, and by the end of this year or the beginning of next the Geographical Society proposes to start a monthly meteorological journal called *Meteorogiçeski Wjestnik.* Friends of meteorology are requested to inform the society of their intention to subscribe to it. If a sufficient number of subscribers can be obtained, the journal will be started. It will pay great attention not only to bibliography, but also to reviews, and extracts from meteorological works in Russia and abroad, and to the applications of meteorology to agriculture, hygiene, etc.

— One of the popular writers in France to-day is M. Imbert de Saint Amand. During the past few years he has written a series of interesting biographical volumes relating to the famous women of the French Court, which have passed through numerous French editions, and are now being translated into English by Mr. T. S. Perry for the Scribners. The first two volumes, entitled "The Wife of the First Consul," and "The Happy Days of the Empress Marie Louise," have already been published. The next volume, "Marie Antoinette and the End of the Old Régime," will appear at an early date, and other volumes are in preparation.

—Mr. George E. Brett, who established the New York branch of Macmillan & Co. twenty years ago, and who successfully managed it until his retirement from duty on the 1st of this month, died at his residence in this city on Wednesday, June 11, of consumption. He had been ailing for several months, but his many friends had hoped that his well-earned rest would soon restore him to health. The business of Macmillan & Co. in this city will hereafter be carried on by Mr. George P. Brett, who was appointed to the management on June 1, upon his father's retirement.

— Dr. Newman Smyth's new book, entitled "Personal Creeds," just published by the Scribners, aims to show men "how to form a working theory of life." It appeals to the class of individuals who, while unable to accept every thing they have been taught in religion, would not miss the best faiths implied in right living.

—Following in the line of the large English publishers who have opened agencies to the United States comes the announcement that the Religious Tract Society of London are also about to establish a depository in this country. Mr. Fleming H. Revell (New York and Chicago) has been appointed sole agent for the society, and will supply both the wholesale and retail trade from both points. The publications of the Religious Tract Society are by no means confined to "tracts." On the other hand, they are among the largest publishers in Great Britain of fine illustrated gift books, works of travel, science, healthy fiction, and popular juveniles, as well as most valuable theological and devotional volumes.

—The University of Pennsylvania has begun the publication of a series of monographs on philosophical themes, the first of which is entitled "On Sameness and Identity," by George S. Fullerton, professor of philosophy in the university. He begins by calling attention to the different senses of the word "same," and the confusion that often flows from not attending to the distinction between them. He then proceeds to distinguish what he believes to be seven different meanings of the word, explaining each of them at such length as seems to him necessary. Having thus set forth his own views, he devotes the rest of his work to a criticism of other thinkers for their ambiguous use of the term, dealing with various writers from Heraclitus to the present day. For our part, however, if we wanted examples of the confusion of thought resulting from a misuse of the word in question, or from want of attention to its different meanings, it is to the pages of Mr. Fullerton's work that we should go. For instance, there is no difference between the second and fourth cases of sameness that he enumerates, while in the seventh case there is no sameness at all. The grand defect of the book is that its author has no consistent theory of the *ego* and the external world. He denies that we have any immediate knowledge of these things, but whether the things themselves really exist or not is a point about which he does not seem to have made up his mind; and in consequence of this his discussion of sameness and identity is full of mistakes and inconsistencies.

CALENDAR OF SOCIETIES.

New York Academy of Sciences.

June 9.—George F. Kunz, The Pulaski County (Virginia) and the Butte (Montana) Meteoric Irons.

Appalachian Mountain Club, Boston.

June 11.—F. O. Carpenter, The Appalachian Mountain System in North Carolina; F. H. Chapin, The San Juan Mountains, South-western Colorado; the president spoke concerning the meeting held May 24, for the preservation of natural scenery and historical sites in Massachusetts.

Engineers' Club, St. Louis.

June 4.—Col. Meier, president of the committee on Eads' monument, announced the formation of the Eads Monument Association; Professor Nipher called attention to the fact that rainfall in the State of Missouri was almost exactly equivalent to the river-discharge at St. Louis.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A YOUNG MAN, graduate from an American College, who has studied a year in Germany, and is now studying in Paris, would like professorship in chemistry. References from some of the best chemists. Address CHARLES E. LINEBARGER, Poste-Restante, Paris, France.

WANTED.—An opportunity to study qualitative analysis in or near New York City during the summer. W. J. L., 130 Spring st., Sing Sing, N.Y.

WANTED.—At the Bryant Summer School, Roslyn, L. I., a Professor to teach the botany and zoölogy of the sea, marine life, etc., etc. July 8–Sept. 8. Also, a six months' term beginning now. Other papers please copy. E. HINDS, A.M., Principal.

ARCHITECTURAL DRAUGHTSMAN, of four years' practical experience, wants employment during the four months' summer vacation of the Mass. Institute of Technology. Best of references, including former employer. Address I. M. BARROWS, 50 Union Park, Boston, Mass.

AN OHIO STATE UNIVERSITY graduate desires a position for next year as laboratory assistant or instructor in chemistry and physics. Three years' special preparation for such work. Two years' experience in teaching. References as to character and scholarship. Address C. S. ARNOLD, O. S. U., Columbus, O.

WANTED.—At the BRYANT SUMMER SCHOOL, Roslyn, L. I., THREE professors to teach Sciences, Languages, Mathematics, etc. July 8–Sept. 8. Also, a six months' term beginning now. Other papers please copy. E. HINDS, A.M., Principal.

A GRADUATE of Princeton, for several years university student and Fellow in Biology, desires a position either to teach biology or as assistant in a biological laboratory. Would prefer the latter and be satisfied with a moderate salary if the position afforded time for the prosecution of original research. Address, O. S., BOX 86, Princeton, N. J.

THE ADVERTISER—A Third Year Student in Honor Sciences at Toronto University, is willing to take position as Science-Teacher or Tutor until next October. Enthusiastic and practical instructor in Biology, Chemistry, Physics, Mineralogy and Geology. Latin and Greek and other branches additional if required. Young, good family. References as to character and ability. CHEMIA, UNIV. COLL., TORONTO.

WANTED—Information concerning the production of Mushrooms in caves and other places. Address M. H. CRUMP, care Ky. Geological Survey, Frankfort, Ky.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Thorough knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Wanted.—To exchange land and fresh-water mollusca, (principally *Helices Achatinellae*, Clausiliae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

To exchange for other books: Meek's Invertebrate Paleontology, Cope's Cretace us Vertebrata, Leidy's Extinct Vertebrate Fauna, Lesquereux Cretaceous Flora. All being volumes of the Hayden Final Reports. Address, giving lists, T. N. Glover, Suffern, N. Y.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia, Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

For Exchange—Fourteen volumes Encyclopedia Britannica (Stoddard's ninth edition), bound in leather—part in original wrappers, all as new—can arrange to furnish volumes required to complete set, and six volumes "American Naturalist" in numbers. Want small screw-cutting foot lathe and testing galvanometer and rheostat. For particulars address A. B. Campbell, McKean Co., Bradford, Pa.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR. Vol. XV. No. 385. NEW YORK, JUNE 20, 1890. SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

THE CHEROKEES IN PRE-COLUMBIAN TIMES.

IV.

HAVING traced back the tribe by the mound evidence thus far along the traditional line of migration with strong probability of being correct, we are prepared to take another backward step. As will be observed by the careful reader, reliance has been placed in this investigation upon what appear to be indications of peculiar customs. Connection with the group of which the great Grave Creek tumulus forms a prominent feature seems to be established, thus verifying the ancient "oration," or tradition, of which Haywood speaks. Allusion has also been made to the similarity, in some respects, of the works of the Kanawha group to those of Ohio, but there is more to be added on this point. Not only does it appear that it was a custom in both these sections to enclose the bodies of the dead in bark, to bury in wooden vaults, and to form at the bottom of mounds basin-shaped clay masses which have received the name "altars," but also to arrange wooden vaults the same way in the tumuli, and to build other structures similar to each other in form.

In confirmation of the statement in reference to the wooden vaults, attention is called to the description by Mr. H. L. Reynolds, in a recent bulletin of the Bureau of Ethnology, of a mound he explored in Paint Creek valley, Ohio. This is the "square truncated mound" shown on No. 1, Plate XXI., "Ancient Monuments," which, by its close proximity to the combined square and circular enclosures known as the "Baum Works," is supposed to bear some intimate relation thereto.

As the description has been published, it is only necessary here to allude to such portions as have a bearing on the question before us.

At the time it was measured by Messrs. Squier and Davis it was a hundred and twenty-five feet in diameter, and fifteen feet in height. Since then its annual disturbance by plough and freshet has reduced the height to twelve feet, and increased the diameter to a hundred and forty. The same agencies have likewise destroyed its pyramidal form, so that now it resembles an upturned basin. It was composed, for the most part, of clay mottled with black loam, and in some places with patches of a grayish, plastic lime. The prominent feature is the evidence that two large wooden vaults, or structures of some kind, had been built here, one above the other, as in one of the Kanawha mounds heretofore described. Both of these structures had been built of upright posts, five inches in diameter and ten inches apart, forming a regular circle thirty-six feet in diameter. The lower circle consisted of a single series, but the upper of two, eighteen inches apart, the outer series standing directly over the posts of the lower structure.

Separating the two structures was what the explorer terms "a thin, sagging streak of burnt clay," but which reminds us strongly of the basin-shaped clay beds found in the mounds of East Tennessee and Kanawha valley. Here and there upon its surface were traces of black wood-ashes and a small quantity of white bone-ashes. Horizontal timber moulds, smaller in size than the posts, filled, in places, with charcoal, could be seen distinctly lying against the inside of each line of posts. These appear to have been cross-beams or stays used for bracing-purposes. On the east side there was a break in each circle, of three feet two inches, in which there were no post-moulds. Within each circle, at different depths, and placed without any apparent regularity, were several skeletons Lying on the natural surface of the ground, running from the base of the lower series of posts toward the centre of the circle, were the remains of logs about eight inches in diameter. Directly over these timbers was a horizontal layer of decayed and burnt wood or bark, averaging half an inch thick. Notice should also be taken of the fact that this mound is on the lower level near the creek,—in fact, is one step or terrace below the bridge landing,—and is almost yearly surrounded by water from the overflow.

It is true that this mound shows some indication of being comparatively recent: in fact, Mr. Reynolds found in it a small piece of bone which he thought had been shaped with a steel knife. This supposition, if accepted, would seem to be incompatible with the theory that attributes works of this type to the Cherokees. We give the data, however, as they are, and will present our explanation further on.

We observe in this mound the somewhat unusual arrangement of one wooden structure above another, seen elsewhere only in the Kanawha and Grave Creek groups; we also notice that in each case the walls of these structures are formed by standing the timbers upright. There is, however, one particular worthy of note, in which those of the Ohio mound differ from the others; to wit, the much larger size of the former, suggesting the possibility that they were council-houses, and not vaults. But should this conclusion be adopted, we find parallels in the customs of the Cherokees and mound-builders of the Cherokee district.

Mr. Lucien Carr of Cambridge, Mass., explored a mound in Lee County, Va., in which were found indications of a large circular or oval wooden structure. From his description, as given in the "Tenth Annual Report of the Peabody Museum," we take the following extracts:—

"The mound in question, a truncated oval in shape,

stands alone on a gentle slope; and, having been in cultivation for many years, the wear and tear of the plough and the gradual weathering-away of the summit made it impossible to get at its exact measurements. A careful examination, however, showed it to be about three hundred feet in circumference at the base, and nineteen feet in height. . . . On the top was a level space, oval in shape, the diameters being respectively about fifteen and forty feet. At a distance of eight or ten feet from the brow of the mound, on the slope, there were found buried in the earth the decaying stumps of a series of cedar-posts, which, I was informed by Mr. Ely, at one time completely encircled it. He also told me that at every ploughing he struck more or less of these posts, and, on digging for them, some six or seven were found at different places, and in such order as showed that they had been placed in the earth at regular intervals and according to a definite plan. On the top, in the line of the greatest diameter, and near the centre of the mound, another and larger post or column, also of cedar, was found. . . . The location and regularity of these posts, and their position with reference to the central column, would seem to show that the summit of the mound at one time had been occupied by some sort of a building, possibly a rotunda or council-chamber, as the ground plan answers to the description of one which Bartram found in the town of Cowe on the 'Tanase' River among the Cherokees, the very people who formerly held all this section of country."

In the mound, and within the circle of posts, several skeletons were found placed irregularly and at different depths, as in the case of the mound opened by Mr. Reynolds. Mr. Carr further remarks that "there were found scattered about everywhere, throughout the whole of the upper half of the excavation, in different places and at various depths, beds of ashes, burnt earth, and charcoal,—usually cedar or chestnut,—sometimes one above and overlapping the other, with an intervening stratum of earth of greater or less thickness."

This is an important and interesting fact in comparing the works of the different sections alluded to.

Indications of similar structures were found in some three or four mounds explored by the bureau assistants in East Tennessee. In one case the series of posts was found at considerable depth, showing that earth had been added subsequent to its erection.

Adair says that "every town has a large edifice which with propriety may be called the mountain house in comparison of those already described. But the only difference between it and the winter house or stove is in its dimensions and application. It is usually built on the top of a hill, and in that separate and imperial state-house the old beloved men and head warriors meet on material business, or to divert themselves and feast and dance with the rest of the people."

The winter houses referred to were, according to his statement, made as follows: a sufficient number of strong, forked posts were fixed deep in the ground "at a proportional distance, in a circular form, all of an equal height, about five or six feet above the surface of the ground; above these they tie large pieces of the heart of white oak. . . . In the middle of the fabric they fix very deep in the ground four large pine posts in a quadrangular form."

According to Mr. Mooney,—who has furnished the writer with some particulars on the subject in addition to what are found in his paper heretofore mentioned,—on account of the sanctity attached to the location in the minds of the people, a new town-house was usually built upon the site of the old one. The Cherokee town-houses were necessarily located in the immediate vicinity of a stream, and where there was about it a level area. The reasons for this were (1) that the dances were held around and about these public houses, frequently beginning inside, and ending on the level area around them; and (2) ceremonial bathing formed an important part of the proceedings connected with their sacred dances, such as the green-corn dance and the medicine dance, where the whole body of the performers came out of the town-house to the water, and, after certain ablutions, returned thereto. It was necessary, therefore, that the building should be near a stream. As the level areas in their narrow mountain valleys are often overflowed, it is quite probable that in order to place these sacred houses above the floods, they were, as stated in tradition, located on artificial mounds. "Moreover," adds Mr. Mooney, "the town-house was the depository of numerous ceremonial objects which could not readily be removed in a sudden emergency. And, as it is said traditionally that a sacred fire was kept burning on a peculiar hearth excavated in the centre of the earthen floor, this could not be removed from the hearth-place, and hence some provision for its protection was necessary."

Whatever may be the opinion entertained in regard to the relation of the mound-builders of the different sections to each other, or be thought of Mr. Mooney's suggestions, it must be admitted that the above statement gives a satisfactory reason for placing the pyramidal mound of the Baum Works, Ohio, on the lower level near the creek, rather than on the higher level occupied by the square and circle.

In confirmation of Mr. Mooney's statement, we find the following in Adair's "History." Speaking of the Cherokees, he says, "Their towns are always close to some river or creek, as there the land is commonly very level and fertile, on account of the frequent washings off the mountains, and the moisture it receives from the waters that run through their fields. And such a situation enables them to perform the ablutions connected with their religious worship."

Another respect in which the Kanawha works resemble those of Ohio is the presence among them of enclosures, some of which are approximately true circles. There is also among the former a true "hill-fort," located on the top of a bold and partially isolated headland, overlooking the valley for some miles up and down the river.

We have now, as before stated, travelled back along the path of migration to the Ohio region, the mound testimony agreeing substantially at every step with the traditions. As we now enter a well-known field which has been somewhat thoroughly cultivated by archæologists, and which is considered, in the minds of many antiquarians, sacred ground, we are aware that we must move with cautious steps, as any attempt to bring forward a new theory in regard to the ancient works of this region is attended with more than ordinary risk. It will therefore be appropriate to introduce at this point some general considerations which have a bearing on the questions at issue.

One result of the more recent explorations and study of the ancient works of the mound region is the conviction that the mound-builders were divided into numerous tribes, though belonging substantially to the same culture state, which was of a lower grade than that attained by the people of Mexico and Central America, and apparently somewhat less advanced than that of the Pueblo tribes of New Mexico and Arizona. However, there are no data to justify the belief that they pertained to different "races," using this term in its broad and legitimate sense. This assertion will, of course, be questioned by some of our archæologists who base their conclusions in reference to this subject on the forms of the skulls. Without entering into a discussion of this question, which would draw too heavily on our space, and is not appropriate at this point, it may be asserted, with the assurance of being sustained by the facts, that the study of the forms of mound-builders' skulls has not been productive of any satisfactory results bearing upon the question of races or nationality. This is shown by the remarks of Mr. Lucien Carr, in his paper on the "Crania from Stone Graves in Tennessee," published in the "Eleventh Annual Report of the Peabody Museum:"—

"Names, however, are of but little import: the one central fact is to be found in the presence in these graves of skulls, which, after excluding those tabulated as distorted or much flattened, are shown by their measurements to belong to the two extremes of classification, and which cannot be brought into the same group without doing violence to all ideas of craniology. If the terms 'dolichocephalism' and 'brachycephalism' mean any thing, then these two forms of skulls are to be found here, and there is no method of measurement sufficiently elastic to include them both under one head. This fact is by no means new or novel, though it has not been many years since Dr. Morton and anthropologists of his school stoutly maintained the uniform brachycephalic type of crania among all the American aborigines except the Eskimo. Of late years, however, the contrary opinion, so ably advocated by Dr. D. Wilson, has been steadily gaining ground, and to-day there is little hazard in saying that it is generally received. But the evidence furnished by this collection seems to lead still farther; and we are required not only to admit the existence of different forms of skulls, as there well might be in different tribes, but also to conclude that they are to be found among the same people or peoples living under the same tribal organization, much after the fashion in which they are to-day known to exist among the composite peoples of our great commercial cities. This is hardly in accord with the opinion generally held as to the purity of race in prehistoric times; but it seems impossible to avoid the conclusion, if it be admitted that the fact that these skulls were found buried together indiscriminately in the same style or set of graves in the same mound, and so far as we can judge at or near the same time, is any proof that they belonged to people of the same tribe and race."

It will be seen from this conclusion of one best qualified to express an opinion on this subject, that a classification of the mound-builders upon the forms of the skulls is not only unsatisfactory, but is misleading and valueless. That the people found inhabiting the continent at the time of the Columbian discovery may have been, and probably were, derived from different races, is not denied. Possibly the mound-builders of the section herein designated the "mound region" may have been derived from different races; but, if so, this cannot be determined by the crania found in the mounds of the Mississippi valley. Indications of tribal peculiarities, of variations in local customs depending on environment, and perhaps traces even of customs peculiar to certain stocks or families, are observed in the ancient works of the region indicated, but nothing whatever to suggest different races. This is a bold and venturous statement to make, in view of what has been published on this subject; nevertheless the writer feels justified in making it, and believes that the data, when thoroughly studied, will sustain him.

The evidence of division into tribes is found in the numerous indications of intertribal warfare, such as the works of defence of various kinds met with in different sections. For instance, there are the hill-forts of Ohio, of which Fort Ancient is a well-known example. No one has ever doubted that these were constructed for defence. Nor is it likely the other enclosures, such as the circles, squares, and octagons, would have been ascribed to any other object but for the introduction of the theory of a semi-civilized, mound-building race, with its priesthood and religious ceremonies. Assume that the authors were the ancestors of the Indian tribes found inhabiting the country, and the idea of this overpowering religious influence vanishes at once. The enclosures of New York, Michigan, Kentucky, Tennessee, south eastern Missouri, and the Gulf States, are admitted to be defensive works. In addition to these, there are in many places defensive walls and embankments across projecting spurs, peninsulas, and river bends. Village sites are also often found in positions which could have been selected for no conceivable reason except that they might be easily defended against attack.

The only reasonable explanation of these facts, and of the evidences of different customs found in the mounds, is that the mound-builders consisted of different tribes. Even in the comparatively limited area of Ohio are found abundant evidences of the presence of different tribes, and of successive occupation by different peoples. The same thing is true also of the areas embraced in eastern Iowa, Wisconsin, Illinois, Indiana, and Kentucky; but, on the other hand, western New York, a strip along the lake border of Ohio, and the Cherokee region of East Tennessee and western North Carolina, appear to be exceptions to this rule.

As the connection indicated between the works of the Kanawha valley and those of Ohio relates primarily to the sepulchral and so-called "sacrificial mounds," and secondarily to the geometric enclosures of the type found in the Scioto valley, attention is called to the latter.

Forty years ago, Messrs. Squier and Davis, while admitting that some of the enclosures of this State were built for defence, advanced the theory that a large number of the earth-works were designed for sacred or religious purposes, and places for performing superstitious rites,—a view which has generally been adopted by subsequent writers. That this theory was based upon a preconceived notion held by these authors, is apparent from the following statement in "Ancient Monuments:" "We have reason to believe that the religious system of the mound-builders, like that of the Aztecs, exercised among them a great, if not a controlling,

influence. Their government may have been, for aught we know, a government of the priesthood,—one in which the priestly and civil functions were jointly exercised, and one sufficiently powerful to have secured in the Mississippi valley, as it did in Mexico, the erection of many of those vast monuments which for ages will continue to challenge the wonder of men."

Dr. Daniel Wilson not only takes the same view in his "Prehistoric Man," but expands and emphasizes it. He even goes so far as to assert that the earth-works of the Iroquois present, in some respects, a greater contrast to those of the mound-builders (of Ohio) than the latter do to the elaborate architecture of Mexico and Yucatan. "They form groups," he continues, "of symmetrical enclosures, square, circular, elliptical, and octagonal, with long connecting avenues suggesting comparisons with the British Avebury, or the Hebridean Callernish; with the Breton Carnac, or even with the temples and sphinx avenues of the Egyptian Karnak and Luxor."

If we lay aside all preconceived notions of a highly cultured race of mound-builders with a priestly hierarchy, and study these remains in the light of such data as we possess, instead of looking at them through the halo of a finely wrought theory, the inappropriateness of such comparisons becomes apparent. What shall we say of the attempt to compare the dirt walls of these groups of combined circles and squares with the great temple of Karnak, termed by Fergusson "the noblest effort of architectural magnificence ever produced by the hand of man"? of likening the simple earthen parallels, thrown up perhaps with wooden spades, to the avenue of crio sphinxes, and the magnificent, columned hall of the Egyptian temple? In what respect do these earth-works of the mound-builders resemble the palace at Palenque, or Casa del Gobernador and House of the Nuns at Uxmal? It is only necessary to put the question: the reply is self-evident. Yet the writer just quoted, who may be taken as the leading representative of the school to which he belongs, sees, in some respects, less contrast between these two classes of structures than between the earth-works of the Iroquois and those of the mound-builders of Ohio.

Omitting, perhaps, a dozen geometrical works, the enclosures of Ohio, New York, and other sections, are admitted to be for defensive purposes, and are of a character conformable to savage life. And in reply to Dr. Wilson it may be truly affirmed, that if we compare the larger work on Plate XIX. of "Ancient Monuments"—which is in the immediate vicinity of the celebrated "Mound City," Ross County, O.—with that on Plate II. of Squier's "Aboriginal Monuments of New York," the similarity is so marked (except in size) that one might be substituted for the other without bringing into, or omitting from, the former group any important character. Yet here is what was considered by the authors of "Ancient Monuments" pre-eminently the sacred or religious city of the Ohio mound-builders; and, what is worthy of mention, the accompanying enclosure, so like that of New York, has a central mound, which was examined by Messrs. Squier and Davis, and pronounced by them "clearly a place of sacrifice."

A number of such general resemblances between the works of the two sections could be pointed out; yet it is admitted that the two classes of remains bear evidence of being the works of different tribes, but not of different races, or of peoples in such widely different culture states as to justify Dr. Wilson's extravagant statement.

The complicated group, consisting of circles, a square, octagon, and parallels at Newark, is unquestionably the most noted, as well as the most extensive, of its class in the mound section. As these cover an area estimated at two miles square, what, it may well be asked, must be the estimate of the size and population of the village that required such an extensive system of works devoted to religious services and superstitious rites? The great circle at Avebury, England, the most extensive of the so-called druidical structures of Europe, embraces only about thirty-six acres; while here is an octagon enclosing fifty acres, one circle including twenty, another thirty, and a square embracing twenty acres. The race-track, buildings, and other appurtenances of the Fair Association of a county containing probably a hundred thousand inhabitants are enclosed in a single one of these circles. If these were but places where games were held and religious ceremonies performed, where are we to find the indications of the immense village that required such vast amphitheatres?

It is remarkably strange that the mound-builders of central and southern Ohio alone, of all the ancient peoples of the mound region, should erect such extensive structures devoted to religious observances; that here alone the priestly influence should have been sufficiently powerful to produce such results. How is the development of this sacerdotal element in this limited area to be accounted for?

It is true that a few of these enclosures are remarkably correct geometrical figures, and present a puzzling question to the archæologist; but the usual explanation, that the authors were a people in a much higher state of culture than the Indians, serves but to increase the difficulty. On the one hand, it is only necessary to suppose that they were built for defence, and that the Indians of a certain tribe and era had learned the art of laying off correctly circles of large size, and the problem is solved. But, on the other hand, the supposition of a highly cultured race, capable of forming these figures by means not within the reach or capacity of the more advanced Indians, introduces a host of still more troublesome questions. That the ancient works of the Southern States and of New York are to be ascribed to the Indians, is too clearly established by historical and other evidence to be longer denied; and it is even admitted, that associated with the prehistoric monuments of the valleys of the Muskingum, the Scioto, Brush Creek, the Little Miami and Big Miami, are mounds and works of later times, some of which were made by the historic tribes or their immediate ancestors. Notwithstanding this supposition of a much earlier occupation by a veritable mound-building people of advanced culture, there are works here ascribed to this people which present no indications of greater age than some of those attributed to Indians. How is this to be accounted for on the latter theory?

The fact, well known to all archæologists, that minor works of art are found in these typical monuments of the same character as those obtained from mounds attributable to the Indians, presents another question difficult to answer on this theory. The "Monitor" pipe, or pipe with broad base running out in front and behind the bowl, is considered

typical of the people who built the "sacrificial mounds" and "sacred enclosures" of Ohio; yet, according to Adair, the Cherokees made pipes of precisely this pattern, as he says "the fore part of each commonly runs out with a sharp peak, two or three fingers broad and a quarter of an inch thick, on both sides of the bowl lengthwise; they cut several pictures with a great deal of skill and labour." This seems not only to connect the builders of these typical Ohio works with the Indians, thus presenting a difficult problem for the advocates of the above theory to solve, but forms another strong link in the chain of Cherokee history we are trying to follow. There are other difficulties in the way of this hypothesis which our limited space will not permit us to present. There are other questions, however, relating to these enclosures, which require notice here, as they have some bearing on the theory advanced in this paper, and must affect to some extent the conclusions reached.

This is probably implied in the Walam-Olum, where it is stated that "the Talega towns were too strong."

If the enclosures are defensive works, they present nothing incompatible with the theory herein advanced, but rather tend to confirm it. Even supposing they were intended for sacred or superstitious uses, they must have been constructed for the purpose of defending the gathered assemblies from sudden attack by enemies. Take, for example, the Baum Works shown in Fig. 1, Plate XIX., of the "Ancient Monuments," and copied in our Fig. 9. For what purpose were the walls built, except for defence? Is it to be supposed that they were intended solely as sitting-places for the spectators? Those around the square alone would have seated eight or ten thousand persons, and the wall of the circle as many more; yet the remains present no indications of an extensive village. We may also ask, with good reason, why one enclosure was square and the other

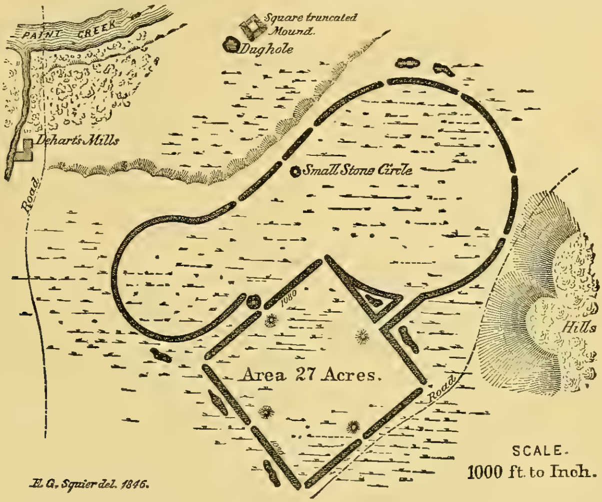


FIG. 9.

It is believed that the evidence presented will be accepted as sufficient to justify the supposition that the Tallegwi of tradition must be identified with the Cherokees, and that they formerly lived in the Ohio valley. Having shown that the people of this tribe built mounds in their historic seat, and were in all probability the authors of the Kanawha and Grave Creek works, it is reasonable to conclude that they built mounds and constructed other works during their residence in Ohio. If this be admitted, their identification with the Tallegwi would indicate that, during their long contest with the Delawares and Huron-Iroquois, they built defensive works, as it is stated in Heckewelder's version of the tradition, that "the enemy [the Tallegwi] fortified their large towns and erected fortifications, especially on large rivers and near lakes, where they were successively attacked, and sometimes by the allies" (the Delawares and Iroquois). Although it is to be presumed that this is somewhat colored to conform to the interpretation of the narrator or author, there can be little doubt that the Tallegwi erected defensive structures in order to resist their enemies.

circular, when the builders must have known that the latter afforded the better chance of observing the ceremonies. Are we to assume that different enclosures were made for the different kinds of rites and games? The only reasonable conclusion, even under the supposition that these were "tabooed" or sacred places, is, that the walls were built for defence, and, as Atwood judged from his discoveries, were stockaded. But this brings up the inquiry, "Why were the sacred grounds enclosed, while the village remained without defensive walls?"

Although it is not probable that all the mystery connected with these structures will be explained away, yet the supposition that they were defensive works of people in the same culture grade as the Indians simplifies the problem, and enables us to present at least a partial explanation which is consistent with other data susceptible of interpretation.

Referring again to the Baum group shown in the figure, what is more likely than that the square enclosed the village, and the circle the maize-field? On the pyramidal mound was the council-house, within and around which the cere-

monial dances were held: and near by was the creek in which the ablutions were performed. The council-house in this case was not in the village; the latter being built near the hills, contiguous to cool springs of water, thus rendering the distance from it to the creek too great for the convenience of the bathers. The writer is aware that this explanation will not apply in full to all the enclosures of this type, as the conditions are not the same in all the localities; and it is more than likely that the customs of the villages varied to some extent, although pertaining to the same tribe. The probable differences in the age of the villages, and the modifications of customs, are also to be taken into consideration; nevertheless this supposition gives us a key that will unlock most of the mystery of these works. They are in most cases located near a stream, and consist of a square or octagon with its gateways and protecting mounds surrounding the village, and a circle enclosing the corn-field. As a rule, the small circles, which may have been places of amusement and ceremony, are outside of the large enclosures. Even at Fort Ancient, which no one doubts is a defensive work, the supposed race-track and principal mounds are outside, though the crescent, in front of which the ceremonial rites were performed, is within the fort.

[Continued on p. 372.]

NOTES AND NEWS.

SOME curious electrical phenomena were observed, according to a writer in the *Chemische Zeitung*, in a stearin and ceresin manufactory in Italy. One evening four vats of white ceresin (which is a paraffine obtained from ozokerite) containing about 500 kilograms each, were being stirred to cool. When the point of solidification was nearly reached, the electric light of the place accidentally went out; and, to the surprise and alarm of the rather ignorant workmen, the mass of ceresin was observed to give pale sparks on the slightest motion. If the hand was brought near, loud sparks nearly two inches long were obtained. The phenomenon lasted over half an hour.

— Some interesting explorations have been made in connection with the famous Adelsberg Cave. The Vienna correspondent of the London *Daily News* says that various citizens of Adelsberg, wishing to ascertain whether the Ottoker Cave, discovered a year ago at some distance from Adelsberg, was in any way connected with the great cave, followed the course of the subterranean river Poik. It was known that forty years ago a party of explorers had their progress barred by a large lake, and the present adventurers therefore carried with them a boat. Having successfully crossed the body of water mentioned, they came to lofty galleries through which the river flowed. It was possible to walk on the banks of the stream, but at intervals it expanded into small lakes, and the boat had to be used. At last the gallery branched into two corridors, one of which the stream rendered impassable, while the other was high and quite dry. The boat was dragged up, and the party proceeded. After crossing a fourth lake, the largest they had met, they found that the Ottoker Cave had been reached. The journey through the galleries lasted six hours. The explorers saw that they had by no means penetrated to the remotest parts of the grotto, and there is evidently still a wide field for discovery.

—We learn from *Engineering* of May 30 that the Chatillon-Commentry Steel Company have for some time past been experimenting with gun-tubes, projectiles, and armor-plates of steel tempered in lead. The process is simple, the steel being raised to a red heat and then plunged in a bath of molten lead, where it is allowed to cool gradually. The beneficial effects of this treatment are very marked, the elastic limit, breaking stress, and percentage elongation of the material being all increased. Actual tests of an armor-plate thus tempered, 10 8 inches thick, which was tested at St. Jacques by firing at it with a 3.75-inch gun, showed that the penetration in the tempered plate was much less than in an untempered one. The value of this test is, however, somewhat discounted by the fact that the power of the gun was much below that required for penetrating the plate, as the striking velocity of the shell was only 1,300 feet per second, and its penetration in wrought iron would therefore be only about 4.85 inches.

—At the instance of Professor Otto Pettersson of Stockholm, a hydrographic expedition has been arranged; the professor himself and Baron Oscar Dickson finding the necessary funds, with some assistance from two Swedish marine insurance companies. The expedition, which will start from Gothenburg, comprises the salvage steamer "Skandinavien," the gunboat "Alphild," the pilot steamer "Goteborg," and the two steamers "Themis" and "Iris." Men of science will be found on board all these steamers, and samples of water and measurements of temperature will be taken. The Skagerak and the Kattegat, which are to be the places of operation, have been divided into different sections. The appliances were tested at Stockholm the other day, says *Engineering* of May 30, and gave great satisfaction. They comprise an apparatus constructed by Professor Ekman for bringing up water from a depth of up to three hundred feet, furnished with a warmth-isolator; a turbine apparatus by the same gentleman for bringing up samples of water from any depth, and fitted with one of Negretti and Zambra's deep-water thermometers; and several appliances for similar purposes constructed by Commander Arwidsson, very quick in their mode of operating, but not intended for any great depth nor for very large samples.

— Some sea-urchins are known to live in cavities in rock; and the diameter of the cavity is often wider than that of the entrance, so that the animal could not leave its home or be taken out without injury. On the French coast of Croisic (Lower Loire) may be seen thousands of urchins thus ensconced in the granite rock, which is rich in felspar and quartz. The animals, it is not doubted, make and widen the holes for themselves; but the question how has not been satisfactorily answered. Chemical solution of the rock seems excluded, considering both the nature of the latter, and also that no acid which could be thus used has been proved to exist in the urchin. The matter has been studied lately by M. John, and in an inaugural dissertation he explains the effects by mechanical action. With the so-called "lantern of Aristotle," as given in *Nature* of May 29, the animal probably bites the rock. The sucker feet are also attached, and a rotatory motion is imparted to the body; the prickle-points, with the lantern, gradually wearing down the surface. These cavities afford a shelter to the urchins against the action of the waves. An attempt is made to conceal them by means of mussel and other shells. The rocks in which the cavities occur are in general thickly covered with calcareous algæ. It has been thought that possibly these decompose the rock, and so facilitate the work of the urchins. M. John, however, finds no such chemical relation; but atmospheric agencies, he considers, may help the work of boring. A number of other animals are known to penetrate rock, and it is supposed that they do it also in a mechanical way. M. Forel described to the Vaudois Society of Natural Sciences how, in the hard limestone of Constantine, Algiers, *Helix aspera* was found in holes four to five inches in depth.

—It was natural to suppose, that, as heat weakens the strength of a steel magnet, the susceptibility of a magnetic substance would increase with a fall of temperature, as also that bodies which in ordinary thermal conditions are neutral to magnetic influence, would exhibit magnetic properties if cooled down sufficiently. This point, says *Engineering* of May 2, was dwelt upon by Dr. Hopkinson in his remarkable address to the Society of Electrical Engineers, and was also made the subject of experimental demonstration by Mr. Shelford Bidwell in his recent discourse on magnetic phenomena at the Royal Institution. The substance used was an alloy of nickel and iron. Both these metals are magnetic at ordinary temperatures, but the alloy is perfectly neutral. A permanent magnet is unable to lift a strip of it; but, if cooled a few degrees below zero, the strip is at once strongly attracted by

the magnet. It is inferred that all metals would exhibit magnetic properties if cooled below this critical temperature; but of this, in the words of Dr. Hopkinson, "we have at present no indication." Mr. Bidwell also used on this occasion the very delicate apparatus which he has constructed for accurately studying the effects of a varying magnetizing force on bars of iron. He took up the subject where Joule left it in 1845, and showed that the bar lengthens at first, then contracts, becoming ultimately shorter than its original length. Joule's greatest magnetizing force was 120 C.G.S. units; Mr. Bidwell has carried his to 1000 C.G.S. units. The corresponding elongations and contractions were rendered plainly visible to a numerous audience in the usual optical way by the motion of a spot of light upon a distant screen.

— *The Engineering and Mining Journal* of June 14 is authority for the statement that small metallic articles, such as buttons, buckles, clasps, etc., have different colored films produced on them by various methods. Some of these are known as oxidized silver. Rainbow colors are produced on brass buttons by stringing them on a copper wire by the eyes, and dipping them in a bath of plumbate of soda freshly prepared by boiling litharge in caustic soda, and pouring it into a porcelain dish. A linen bag of finely pulverized litharge or hydrated oxide of lead is suspended in the solution, so as to keep up the original strength of the solution. While the buttons are in this solution, they are touched one after the other with a platinum wire connected with the positive pole of a battery until the desired color appears. The galvanic current employed must not be too strong. The colors are more brilliant if they are heated after they have been rinsed and dried. Colored films are more conveniently produced upon bright brass by different chemicals, by painting with them, or by immersion. For example: golden yellow is obtained by dipping in a perfectly neutral solution of acetate of copper; dull grayish green, by repeatedly painting with very dilute solution of chloride of copper; purple, by heating hot, and rubbing over with a tuft of cotton saturated with chloride of antimony; golden red, by covering with a paste of four parts of prepared chalk and of mosaic gold. In covering an article with any colored bronze in powder, it is first rubbed with a very little linseed-oil, and the bronze dusted evenly over it from a dust-bag. It is afterward heated in an iron pan to about 480° F. In recent times, small articles are also roughened by dipping in strong nitric acid; and, after washing and drying, they are coated with a rapidly drying alcohol varnish that has been colored yellow with picric acid, red with fuchsine, purple with methyl violet, or dark blue with an aniline blue. This gives the desired color with a beautiful metallic lustre. The latter colors are not very durable, and are for inferior goods.

—The report of Arthur W. Winslow, State geologist of Missouri, states that the detailed mapping of the coal-fields has progressed with little interruption. Field-work has now been extended over nearly four hundred square miles, and the results have been plotted on the preliminary sheets, and are now being transferred to the final sheets. On May 3, Mr. Gilbert Van Ingen reported at the office of the Missouri Geological Survey. He is detailed by the United States Geological Survey to assist in paleontologic work in Missouri. He has been at work during the greater part of April in Pettis County. Detailed mapping was prosecuted during the early part of the month in south-eastern Missouri, and about seventy square miles have been covered. Work on the building-materials and clays of St. Louis was vigorously pushed during the latter half of April. Along with a study of the origin and distribution of the clay deposits and of the economically important limestones, inquiry has been made into the nature and extent of the dependent industries. About two-thirds of the stone-quarries have been visited, and nearly all of the clay-works. An idea of the magnitude of the interests involved may be gathered from the following approximate statement of the number of works in and about St. Louis: eight fire-brick and sewer-pipe manufactories, forty common and pressed brick manufactories, six potteries, one terra-cotta manufactory, two terra-cotta lumber manufactories, forty stone-quarries. The value of the annual output of the clay industries is at present in the vicinity of three million dollars, and that of the stone-quarries cannot fall far short of one million. In the laboratory nearly all of the samples of mineral waters collected during April have been analyzed, and the results will soon be ready for publication. In addition, some seventeen lots of specimens sent in by outside parties have been identified and reported upon, and a few analyses of coals and iron ores for survey purposes have been made. Preliminary inspections have been made in Platte, Clinton, Crawford, and Morgan Counties. In Platte and Clinton Counties are coal-beds of economic value, but their mineral waters and clays also deserve attention. There is every probability that the 22-inch coal-bed mined at different points in the vicinity of Leavenworth, Kan., as well as others found at different depths, extends under these counties. Its depth below the surface at Leavenworth is about seven hundred feet, but eastward into Missouri it must rise progressively towards the surface. The exact determination of these points, as well as the definition of the limits of the bed, cannot be made until systematic and detailed work is done in these counties. In view of the extensive development of the coal industry at Leavenworth close to the Missouri line, and in view of the probable establishment in the future of a similar industry in Missouri near the Kansas line, provisions should be made in the near future whereby encroachment of mining operations from a property in one State upon a property in the other State shall be prevented. In Crawford County iron ore still occupies a prominent place among its mineral products. Some of the deposits of this ore are, however, exhausted, and others are approaching that condition. The demand will before very long be urgent for new sources of supply. The conditions are such, in this and adjoining counties, as to justify the expectation that systematic and thorough geologic work may lead to the discovery of other deposits; and it is the intention to institute such work as soon as the means and the demands upon the force of the survey will permit. Operations looking to the development of zinc and lead mining are also in progress. In Morgan County there are prospects of a revival in lead-mining, and this in a more thorough manner than has been the case in past years. A profitable industry may be built up there if the developments are made cautiously and under competent direction, such as will lead to a knowledge of the origin of the ore, and such as will guide one in selecting localities for prospecting. The survey is not at present in a position to give specific advice on such matters, however, and cannot do so until detailed local work is finished. Zinc-mining is also being started in Morgan County, notably at the "Big Three Shaft," about five miles south-west of Versailles.

—A petition was lately presented to the Medical Assembly of the Grand Duchy of Baden by the German Women's Association of Leipzig, praying that women might be admitted to study medicine. The assembly passed a resolution declining to take any step in the matter, on the ground that women are unfit for the learned professions, and especially for that of medicine, and, moreover, that the latter is already overcrowded. Herr Arnsberger, the ministerial councillor representing the government, said the question was not yet ripe for solution. He also pointed out that the matter was one for the decision of the imperial authorities, not for that of the individual states. A similar petition has recently been presented by the same association to the Weimar Landtag, in which the ladies ask to be admitted to the University of Jena, not only to study medicine, but with the view of qualifying for appointment as scientific teachers.

—Duffield Osborne, author of "The Spell of Ashtaroth," has written an article on surf-bathing for the July *Scribner*, which will contain practical directions and sketches showing how to avoid the dangers of the surf, and how to get the most pleasure out of it.

—Messrs. John Wiley & Sons announce as in preparation "Mechanics of the Machinery of Transmission," being Vol. III., Part I., Section II., of "Mechanics of Engineering and Machinery," by Dr. Julius Weisbach, edited by Professor Gustav Hermann, and translated by Professor J. F. Klem, Lehigh University, Bethlehem, Penn.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE CHEROKEES IN PRE-COLUMBIAN TIMES. IV.

[Continued from p. 370.]

In some cases, as at the Liberty Township Works ("Ancient Monuments," Plate XX.), a special arrangement seems to have been made for this purpose. Here we see a connected third circle, much smaller than the other two, in which is a crescent and mound; there is, however, a little exterior circle. We notice here that the square or village site is near the bluff from whence springs issue.

The square of the Seip Works ("Ancient Monuments," No. 2, Plate XXI.) and of that figured in No. 3 (same plate) are next the stream, as there were no springs in reach.

The complicated group at Newark, of course, presents features difficult to explain; but it is apparent that there were two villages, probably established at different times, but both occupied from the time the latter was built until the whole was abandoned. The octagon is near the creek, but its position was doubtless selected on account of the spring near its northern corner. The southern circle, *E*, was possibly a place devoted chiefly to ceremonies and games. One line of parallels seems to have been a passage-way from one village to another. It is apparent from their courses and the topographical features of the area that none of these guarded ways were intended for race-tracks. That the small, circular enclosure *F*, known as the "Observatory Circle," was not sufficient in extent to supply the villages with bread, is admitted: hence it was necessary to assume that there were unenclosed fields, probably on the land north of the group, between the parallels running east and west, and in the area east of the pond. It is possible that the space between the two lines of parallels, running east and west, was partially occupied by dwellings, especially that portion on the upper, level land. These suggestions are of course largely speculative; nevertheless, if there be any truth in the tradition of the Tallegwi, it is probable that here they made their first determined stand after defeat in open battle. The people of other villages, not enclosed, probably fled thither, and joined in erecting fortifications and defensive walls. Be this as it may, it is apparent that they belong to the same type as those in the Scioto and Paint Creek valleys, and may be ascribed to the people who built the latter. That they were defensive seems to be established by the considerations presented, and others which might be urged did space allow us to offer them. It is apparent to any one not biassed by a preconceived theory, who will study these works carefully, that their characteristics are essentially aboriginal: in other words, there is nothing in their form or construction contradictory to the theory of their Indian origin, except it be the single fact that a few of them approach very nearly to true geometrical figures. That it was a custom among the Indians north and south to build circular enclosures and forts, is fully attested by the historical records; it is also known that some of the Indian forts in the northern section were polygonal, especially those built by the Iroquois tribes. Numerous instances can be cited where villages were surrounded by fortifications in both these forms.

The suggestion that the circles adjoining squares were built around maize-fields is not original with the writer, as it had already been presented by Lewis H. Morgan, in his "Houses and House Life of the American Aborigines." He remarks, that "with respect to the large circular enclosures, adjacent to and communicating with the squares, it is not necessary that we should know their object. The one attached to the High Bank Pueblo contains twenty acres of land, and doubtless subserved some useful purpose in their plan of life. The first suggestion which presents itself is, that as a substitute for a fence it surrounded the garden of the village in which they cultivated their maize, beans, squashes, and tobacco. At the Minnitaree village a similar enclosure may now be seen by the side of the village, surrounding their cultivated land, consisting partly of hedge and partly of stakes." Whether these dirt walls were mere supports to stockades is a question not yet settled; nevertheless it is probable they were surmounted by stakes, or supported a wooden fence or screen of some kind. The fact that the ditch is here usually on the inside cuts but little figure in the discussion, as we find this to be the case in many works which are undoubtedly of a defensive character, as Fort Ancient, and the circular enclosure in Iowa shown in Plate II., "Fifth Annual Report of the Bureau of Ethnology." In fact, this was consistent with the Indian mode

of warfare. Long tells us, in the account of his expedition, that sometimes they would hastily dig a trench, throwing the dirt on the danger side, and thus form a defensive barrier.

Whether the hill-forts are to be attributed to the authors of the circles and squares is doubtful: in fact, the indications appear to lead to the opposite conclusion. Certainly there is no reason for supposing that Fort Ancient, Fortified Hill, and other works of this character in the Miami valleys, were built by this people. The writer is inclined to the belief that they are the work of the Shawnees, but cannot undertake at this time to give his reasons for this opinion.

As the so called "altars" form a link in this historic chain, we may as well remark here that the names "sacrificial mounds" and "altars," implying human sacrifice, have been brought into use without even the shadow of evidence therefor. As Morgan has truly observed, "there is no propriety in the use of either of these terms, or in the conclusions they would force us to adopt. . . . These clay beds were not adapted to the barbarous work." Possibly they may have been places where prisoners were burned, which was the chief sacrifice offered by Indians. The basin-shaped clay beds of the Kanawha and East Tennessee mounds seem to have grown out of them, and their uses were probably similar. CYRUS THOMAS.

[To be continued.]

THE ROYAL SOCIETY OF CANADA.

THE eighth annual meeting of the Royal Society of Canada is just over; and, from the interest manifest in the four sections into which that society is divided, no better proof of the growth, usefulness, and success of such an organization can be desired.

Of forty-three papers which were presented, either read *in extenso*, in abstract, or by title, no less than twenty of them treated on scientific topics, while the remainder were devoted to historical, political, and literary subjects.

Sections III. and IV. of the Royal Society are specially devoted to the sciences: the former embracing the mathematical, physical, and chemical sciences; the latter, the geological and biological sciences. A list of the papers read in these sections was published in *Science* of June 6.

The character of the papers read in the section of the geological and biological sciences were all of a high order, and interesting discussions took place. Dr. G. M. Dawson, assistant director of the Geological Survey, was president, and for his inaugural delivered an address upon the "Mesozoic and Tertiary History of the Rocky Mountain Region of Canada," in which the geological history of the Cordillera is traced from the triassic period to the close of the tertiary, and special reference is made to the process of development of the surface features of the region, together with the changes in elevation of the land at different periods. Another paper by Dr. Dawson, which can be regarded as a supplement to the foregoing, gave a very succinct sketch of the glacial history of the Rocky Mountain region of Canada, bringing the subject-matter to date. These two papers were followed by another from the pen of Principal Sir William Dawson, on "Fossil Plants from the Similkameen River and other Places in the Southern Interior of British Columbia." The following is an abstract of this paper: —

The deposits affording these plants have been described by Dr. G. H. Dawson in the "Report of Progress of the Geological Survey of Canada for 1877-78" (pp. 130B, 166B). They are of lacustrine origin, and underlie basalt and other volcanic materials. The beds holding well-preserved remains of plants are chiefly those composed of fine laminated clayey or silty material, which in some cases has been hardened by silicious matter which appears to have been derived from springs contemporaneous, or nearly so, with the date of formation of the beds. These deposits have been approximately assigned to the period of the miocene tertiary. They contain a number of species of fossil insects which have been described by Scudder (report above cited, p. 175B), and fossil plants, of which a provisional list was given in the same report (pp. 186B-187B). The present paper relates to additional collections of plants from the Tulameen or North Fork of the Similkameen, Tranquille River, etc., and which, while they extend our knowledge of the flora, tend strongly to confirm the miocene age of the formation, and to connect it with similar deposits farther north in Alaska.

The object of the paper, "Stratigraphical Notes on the Citadel Hill, Quebec" (in French), by L'Abbé Laflamme, was to determine the structure of the beds constituting the cliff at the citadel near the Dufferin Terrace, Quebec, where the "land-slide" occurred in September, 1889, and thereby to ascertain the cause of the disaster. Professor Laflamme pointed to imminent danger even at present, and the probable sliding-away of several feet of strata, which sooner or later must take place. A very interesting and animated discussion followed.

The paper on "Illustrations of the Fauna of the St. John Group, No. V.," by G. F. Matthew, M. A., was a continuation of the paper of last year which described the fossils of the "Basal Series" (beneath the St. John group), and the new ones of Band C of Division 1 of the St. John group. The following points were discussed in this paper: (*a*) a description of the structure of the St. John basin, (*b*) a description of the new series in Division 1 of the St. John group and of newly recovered parts of others, (*c*) a description of the tracks and organisms of Division 2, and (*d*) a description of the fossils of Division 3. Peculiar tracks have been detected, which appear to be those of radiate animals. A good many tracks have been observed in the sandstones and shales of Division 2, which are like those of the Eophyton sandstone in Sweden; but it is thought that this resemblance is due to a similarity of conditions under which the above sandstones and those of Division 2 were deposited, as the *Paradoxides* fauna undoubtedly intervenes.

Mr. E. Gilpin, commissioner of mines for Nova Scotia, in his paper on "The Evidence of a Nova Scotia Carboniferous Conglomerate," referred to the nature, source, and extent of the modern drift of Nova Scotia, and to the shingle beaches formed from it He described the carboniferous conglomerates of Cape Breton as consisting usually of detritus derived from local sources, and in Nova Scotia proper cited the conglomerates of the south side of the Cobequids, and of New Glasgow, as good examples of conglomerates formed from subjacent strata. The auriferous conglomerates of Gays River, Colchester County, were described, and the occurrence in it of bowlders referrible to pre-carboniferous measures lying to the north was noticed. The inference suggested was that the modern drift-transporting agency, carrying to the Atlantic shore bowlders referrible to the Cobequids, was paralleled, at the opening of the carboniferous period, by a similar agency furnishing bowlders found in lower carboniferous conglomerates at Gays River.

The paper on "Southern Invertebrates of the Shores of Acadia," by W. F. Ganong, was submitted to the Royal Society, and read by Professor L. W. Bailey of New Brunswick University. It opened with a sketch of the progress of knowledge of the distribution of marine invertebrate animals on the east coast of North America, from the time of the establishment of Milne-Edwards's "Pennsylvanian Region" in 1838, down to its division into the Syrteusian, Acadian, Virginian, and Carolinian faunæ, as accepted by students to-day. Attention was then called to the well-known occurrence of southern or Virginian forms in the Gulf of St. Lawrence, at Sable Island, and at other points on the coasts of Acadia and Maine; and a table was given showing the twenty-five undoubtedly southern species of mollusca. At least three *Echinodermata* occupy these localities, mingled with the more northern forms. This anomalous condition cannot date far back, since post-pliocene deposits show no trace of it. Indeed, there is evidence to show that changes are still going on; and facts drawn from Indian shell-heaps, from dead beach and dead dredged shells, and from old books, all show that these southern forms had for-

merly a wider range than now, and that they are gradually disappearing. The physiography of the coast of Acadia was then discussed, the distribution of currents considered, and evidence given to show that the land in all this region is steadily sinking. The effect of this depression on the currents of this coast was discussed, and the views of Verrill and Dawson considered. The conclusion was arrived at, that the known facts as to currents, the sinking of the land, etc., explained the phenomena under discussion. The relation of these facts to post-pliocene conditions was referred to, and a sketch given of what remains to be done in this field.

At the closing meeting of the society, the following officers were elected for the ensuing year in the Geological Section: viz., president, Professor W. Saunders, director of the Central Experimental Farms, etc.; vice-president, Professor L'Abbé Laflamme; secretary, Mr. J. F. Whiteaves. For the whole society, Very Rev. Principal George Munro Grant of Queen's University, Kingston, was elected president, and Rev. L'Abbé Laflamme of Laval University, vice-president. The honorary secretary is Dr. J. E. Bourinot.

HEALTH MATTERS.

Sterilizing Water.

IN a paper published in the *Medical Record* of June 14, 1890, Dr. C. G. Currier of New York states that unless extraordinarily resistant, water becomes sterilized if it be at or near the boiling temperature for fifteen minutes. If the same degree of heat be maintained for five minutes, all harmful micro-organisms will have been destroyed. Still less time serves to destroy the disease-producing varieties which are recognized as liable to occur in water. Thus merely raising to the boiling-point a clear water containing the micro-organisms of malarial disorders, typhoid, cholera, diphtheria, or of suppurative processes, and allowing it to gradually cool, insures the destruction of these germs. They are also destroyed by keeping the water for from a quarter of an hour to half an hour at a temperature of 70° C.

Occasionally, however, very resistant but harmless bacteria may get into water. The brief heating renders them safe for drinking-purposes; but, when it is desired to destroy every micro-organism that may be present in a contaminated water, it should be heated for one hour, and allowed to cool slowly. Then it may be used for cleansing wounds or for alkaloidal solutions, which will keep indefinitely if no germs be introduced after the solution has been heated.

Coffee Inebriety.

Dr. Mendel of Berlin has lately published a clinical study of this neurosis, his observations being made upon the women of the working population in and about Essen. He found large numbers of women who consumed over a pound of coffee in a week; and some men drank considerably more, besides beer and wine. The leading symptoms were profound depression of spirits, and frequent headaches, with insomnia. A strong dose of coffee would relieve this for a time, then it would return. The muscles would become weak and trembling, and the hands would tremble when at rest. An increasing aversion to labor and any steady work was noticeable. The heart's action was rapid and irregular, and palpitations and a heavy feeling in the præcordial region were present. Dyspepsia of an extreme nervous type was also present. Acute rosacea was common in these cases. These symptoms constantly grow worse, and are only relieved by large quantities of coffee, generally of the infusion. In some cases the tincture was used. The victims suffer so seriously that they dare not abandon it, for fear of death. Where brandy is taken, only temporary relief follows. The face becomes sallow, and the hands and feet cold; and an expression of dread and agony settles over the countenance, only relieved by using strong doses of coffee. In all these cases, acute inflammations are likely to appear any time. An injury of any part of the body is the starting-point for inflammations of an erysipelatous character. Melancholy and hysteria are present in all cases. Coffee inebriates are more common among the neurasthenics, and are more concealed because the effects of excessive doses of coffee are obscure and largely unknown. Many opium and alcoholic cases have an early history of excessive use of coffee, and are always more degenerate and difficult to treat. A very wide field for future study opens up in this direction.

LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Dr. Hann's Studies on Cyclones and Anticyclones.

IN your issue for May 30 I have with much interest noticed a letter by "W. M. D.," entitled "Dr. Hann's Studies on Cyclones and Anticyclones." It contains a passage which I am unable to comprehend; and, with your permission, I should like to ask the writer, through your columns, to enlighten me on the subject.

Mr. D. declares himself an advocate of the convectional theory of cyclones, and states, "There is unquestionably an ascending component of motion in cyclonic areas, and a descending component in anticyclones." This is what I do not understand. The question is apparently that of a body of air moving in a certain direction, but in what direction it is moving I don't quite see; and neither do I understand what is meant by a "component of a motion."

To put my question more precisely, I noticed once, in a book called "Weather," by the Hon. Mr. Abercrombie, that the author had observed that the waves on the North Sea differ in shape, when caused by a north-east wind under high pressure, from that when caused by a south-west wind with low barometer; and he considered this a proof that the air in an anticyclone is a descending current, and the air in a cyclone an ascending current, of air.

As an engineer, I am in the habit of always making a diagram on paper whenever I have a mechanical or dynamical problem before me; and it is a safe rule in applied mechanics that whatever cannot be thus represented does not exist. But in this case I came to the result that a supposed descending current of air in an anticyclone, having once reached the surface of the sea, must needs afterwards follow this surface,—that is, blow horizontally, or come to a standstill,—and also that a supposed ascending current must instantly, the moment it starts, come out of contact with the surface of the sea, and henceforward be unable to materially affect the shape of the waves. In other words, a body of air moving over the surface of the sea must necessarily have a horizontal direction; and the only cause I can imagine of the supposed difference in the shape of the waves is the difference in friction between air and water surface when the air-pressure is high or low.

I therefore beg to ask Mr. D. to give me some kind of a graphical representation showing the direction of the motion of the air in cyclones and anticyclones; say, for example, in the North Atlantic anticyclone at horse latitudes; and if he is unable to do so, he will allow me to believe that his statement is far from being unquestionable.

Mr. D. further states, "The convectional theory is merely a local application of a theory that is universally accepted to account for the general circulation of the atmosphere between equator and poles." But is it, after all, necessary to account for such a circulation? Has there ever been found the faintest actual proof to show that such a general circulation really takes place?

As to the other parts of Mr. D.'s letter, he will excuse me for saying that I cannot share his apprehension that Dr. Hann's studies will much alter the views held on cyclones and anticyclones, as the doctor's observations merely deal with temperatures at the earth's surface, which, as is well known, are local, and perfectly independent of the temperatures of the air at some considerable distance from the surface; which latter, however important in this kind of investigations, are unattainable unless by balloon ascents. A body of surface air moving over the ground must necessarily follow the shape of this latter; and consequently the air which is to-day at the summit of the Alps was yesterday

at the bottom of the Rhone valley, and will to morrow be sweeping over the Rhine, or *vice versa*, according to the direction in which the surface wind blows. Hence Dr. Hann's observations, however valuable otherwise, can have only small bearing on the question of the cause of cyclones and anticyclones.

FRANZ A. VELSCHOW, C.E.

Jones Point, N.Y., June 2.

On the Determination of Parallax by the Spectroscope.

IN the winter of 1883–84 it occurred to the writer that the spectroscope might be made use of in the determination of the parallaxes of certain double stars. As there were no data at hand that would allow a numerical example to be worked out, the method was not published at the time, but was withheld until such data should be available. Recently my attention was drawn to the systematic measures carried on at Greenwich since 1876; and, although these are very unsatisfactory on account of their large probable error, it may be of interest to apply them to an actual parallax determination.

The method about to be proposed is based upon the well known fact that the positions of the lines in a star's spectrum depend not only upon the substances to which these lines are due, but also upon the velocity of the star's motion in the direction of the line of sight. So far as the writer can see, it is applicable only to double stars; and it may be made use of in two different forms, the first of which is applicable when both components of the star are bright enough to be observed spectroscopically, and the second when only one component is bright enough to be so observed.

In the first case, both components being bright, let S be the one to which the orbit is referred, and let C be the companion; ω is the angle that the tangent at C makes with $C\,S$, and θ the angle that it makes with the line of sight. V_0 is the velocity with which S is receding from the earth at a given moment, and V_1 is the velocity with which C is receding at the same moment, both being expressed in miles per second. The orbital velocity of C at this moment we will call v, the unit of length being that length which subtends an angle of one second at the star's distance from the earth. If π is the parallax of the star (supposed unknown), and D is the radius of the earth's orbit, v can be expressed in miles per second by multiplying it by $\frac{D}{\pi}$. Expressing it in this manner, we have

$$(V_0 - V_1) = v \,.\, \frac{D}{\pi} \,.\, \cos\theta \qquad (1)$$

But

$$v = \frac{2\,A}{p\;r\;\sin\omega} \qquad (2)$$

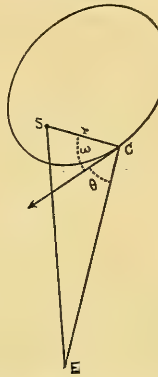
where p is the period of the star in seconds of time, r is the radius vector of the component in seconds of arc, and A is the area of the orbit, the unit of length being the same as in the case of v. Substitution in (1) gives us

$$(V_0 - V_1) = \frac{2\,A\;D\cos\theta}{p\;r\;\sin\omega} \cdot \frac{1}{\pi} \qquad (3)$$

The first member of this equation is to be observed by the spectroscope, and the co-efficient of the second member is to be computed from the elements of the star's orbit The only quantity remaining is the parallax of the star, which is found by simple division. If it is desired to make a number of observations at different times, and combine the whole by the method of least squares, the normal equation will be, of course, $[a^2]x=[al]$, equation (3) being now of the form $ax=l$.

Undoubtedly the best way to determine the absolute term in equation (3) is to photograph the spectra of both stars on the same plate, and measure the intervals between the corresponding lines in the two. The probable error of a determination so made will be less than if V_0 and V_1 were measured separately and their difference taken. I do not find that this has been done in the case of any star whose orbit is known; but that the lines in the spectrum of a double star can be so photographed and measured, at least in certain cases, is well shown by Professor Pickering's recent work on *Beta Aurigæ* and *Zeta Ursæ Majoris*, which stars were not known to be double until the spectroscope showed them to be so. It is true that the proximity of the components of these stars, and their consequent short periods, make the measurement particularly easy in these cases; yet I trust that it is not unreasonable to hope that measures may be made on other stars sufficiently good to afford us some idea of their parallax.

When one of the components of a double star is so faint that its spectrum cannot be observed, it becomes necessary to modify the foregoing mode of procedure somewhat. Let S be the principal star, as before, and C the companion. Let V be the velocity of recession of the principal star, and V_0 the velocity of recession of the centre of gravity of the system (V_0 being appreciably constant for many centuries). Let a be the semi-axis major of the orbit of the companion, when referred to the principal star, and let a_1 be the semi-axis major of the smaller ellipse described on the heavens by the larger star, in consequence of its having a companion (this



may be determined by comparing the position of the principal star with smaller stars in the vicinity, not physically connected with it). Then we have the equation

$$V = V_0 + \frac{a_1}{a} \,.\, \frac{D}{\pi} \,.\, v \,.\, \cos\theta \qquad (4)$$

(this is obtained by resolving the velocity of the component along the line of sight, multiplying the result by $a_1 \div a$ to find the corresponding differential velocity of the principal star, and adding to the velocity of the centre of gravity of the system). Substituting in (4) the value of v as given in (2), we have

$$V = V_0 + \frac{a_1}{a} \cdot \frac{2\,A\,D\cos\theta}{p\;r\;\sin\omega} \cdot \frac{1}{\pi} \qquad (5)$$

This is the form of the observation equation. V is observed, at intervals, by the spectroscope, and corresponding values of the co-efficient of $\frac{1}{\pi}$ are computed. The normal equations are, then,

$$[p\;V] = [p]\;V_0 + [p\;F]\;x\,,$$
$$[p\;F\;V] = [p\;F]\;V_0 + [p\;F^2]\;x,$$

(5) being of the form $V = V_0 + F\,x$.

As already intimated, the writer has applied this method to a particular case, using the spectrum observations made at Greenwich since 1876, together with one measure obtained by Huggins in 1868. Sirius was selected for the purpose for several reasons. Its orbit is fairly well known, the spectrum observations on it cover an interval of twenty years, the period of the star is short, and various determinations of its parallax have already been made by the direct method. The elements of the star, according to Mr. J. E. Gore (*Monthly Notices of the Royal Astronomical Society* for June, 1889), are as follows:—

$T = 1896.47$	$\Omega = 49°\ 59'$ (1880.0)
$P = 58.47$	$i = 55°\ 23'$
$a = 8''.58$	$\gamma = 216°\ 18'$
$e = 0.4055$	$\mu = -6°.157$

It appears also, from Auwers's work, that the semi-axis major of the orbit that the principal star describes about the centre of

gravity of the system is $a_1 = 2''.33$. Computing the co-efficients of $\frac{1}{\pi}$ for the thirteen years for which I have spectroscopic results, the following observation equations are obtained:—

No.	Equation.	Date.
(1)	$V_0 - 0.342 \frac{1}{\pi} = +29$	1868.1
(2)	.447 = +24	1876.11
(3)	.453 = +12	1877.16
(4)	.456 = +24	1878.16
(5)	.455 = +16	1880.18
(6)	.450 = +12	1881.14
(7)	.440 = +16	1882.21
(8)	.426 = − 5	1883.17
(9)	.408 = −20	1884.11
(10)	.384 = −23	1885.09
(11)	.354 = −24	1886.00
(12)	.311 = + 4	1887.05
(13)	.271 = +35	1887.82

Giving the weight unity to each of these, the following normal equations result:—

$$13\ V_0 - 5.2 \frac{1}{\pi} = +\ 100$$

$$-\ 5.2\ V_0 + 2.124 \frac{1}{\pi} = -\ 39.86$$

Hence $\pi = 0''.34$.

The only direct determinations of the parallax of Sirius that I have at hand are those of Henderson and Peters (0″.150), Gyldén (0″.193), and Gill and Elkin (0″.39). The agreement between this last result and the one deduced above by the spectroscopic method is of course purely accidental, the Greenwich measures being too rough to furnish us with a result even passably good. It is to be hoped that measures may be made, with improved apparatus, that will enable us, in the course of time, to apply the spectroscopic method to a large number of double stars. Dr. Vogel's photographic measures, taken at Potsdam, are far superior to any thing else the writer has seen in this line, unless the Harvard College measures are excepted. They have a very small probable error, and the measures on Venus seem to indicate that his work is not materially affected by constant errors. As a matter of fact, constant errors are of no importance in deducing parallax by the spectroscope, since they affect V_0 only, and not π.

It is plain that the method set forth in this article is open to many objections. It is beset with difficulties, but it should not be discarded or lost sight of for that reason. The fact is, that we must either forever give up the effort to determine the distances to the more remote stars, or we must seek them by this method. Very few stars are near enough for us to measure their parallaxes directly; but the spectroscopic method is still applicable when there is no indication of parallax to the micrometer. The velocity of motion in the line of sight may be measured with equal ease, whether the star is near or remote; and the only limit to the power of the method lies in the increasing closeness of the double star as the distance grows greater, and the corresponding difficulty of determining the orbits. By photographing binary systems at intervals of a few years, and measuring distances and position angles on the negative, much better orbits might be computed than we have at present.

While at work on the numerical example in this article, I have endeavored to find out whether others have not worked at this same problem. My attention has been called to several papers that apparently relate to it, though I have been unable to gain access to more than two of them, and then only for a moment, so that I could give them only a hasty examination. The first paper that I find reference to was by C. Dufour, the title being "Utilisation de l'analyse spectrale pour déterminer la distance de certaines étoiles doubles" (Lausanne, Bulletin des séances de la Société vaudoise des sciences naturelles, vol. xiii., 1874, p. 452). The second paper, by Edward C. Pickering, is entitled "Dimensions of the Fixed Stars, with Especial Reference to Binaries and Variables of the Algol Type," and is in the "Proceedings of the American Academy of Arts and Sciences," 1880, vol. xvi. This paper, as its title indicates, relates more particularly to the dimensions of stellar systems than to their parallaxes. The third paper was read before the Royal Irish Academy on May 24, 1886, by Arthur A. Rambaut, the title being "On the Possibility of determining the Distance of a Double Star by Measures of the Relative Velocities of the Components in the Line of Sight." The method here proposed is not applicable unless both components are bright enough to be observed spectroscopically. It appears to be identical with what I have called the "first method." Finally, Herr J. Palisa published an article on the subject while the present one was in preparation, entitled "Ueber die Bestimmung der Parallaxe von Doppelsternen" (*Astr. Nach.*, No. 2,941, Dec. 12, 1889). I have not seen this paper, but I understand that in it he refers to a dissertation by one Hans Homann, the title of which is "Beitrage zur Untersuchung der Sternbewegung," which presumably touches upon the same subject. A. D. RISTEEN.

Hartford, Conn., June 13.

Temperature in Storms.

IN the "Smithsonian Report for 1865," beginning at p. 340, there is a detailed account of a balloon ascension at Paris on July 27, 1850, during a severe storm of rain with some strong wind gusts. The most interesting point is the severity of the cold encountered, the temperature falling to —39° C. at an elevation of seven thousand metres. It is stated that at the beginning of the ascent "a deluge of rain was falling," which shows that it must have been made near the centre of precipitation, if not at the exact storm-centre. It would seem that these observations are confirmatory of those noted by Dr. Hann, to which reference is made by Professor Davis in *Science* for May 30. M. A. VEEDER.

Lyons, N.Y., June 9.

BOOK-REVIEWS.

The Criminal. By HAVELOCK ELLIS. London, Walter Scott; New York, Scribner & Welford. 12°. $1.25.

MR. ELLIS, the editor of this promising series of scientific monographs, has contributed to it in this volume a well-planned and ably executed *résumé* of modern criminology. So little of this science has hitherto been accessible in English, that this compilation is especially timely. It is an outcome of a pedantic and unscientific view of crime, that we are obliged to speak and accustomed to think of all persons liable to punishment as criminals. There are certain very well marked distinctions between classes of criminals, that should be generally recognized. There is the criminal by passion, the insane criminal, the occasional criminal, the instinctive criminal, the habitual criminal, the professional criminal. While the existence of some of these is rather the crime of the society that breeds them, others are distinctly diseased forms of humanity, which we must study in order to understand and to treat. It is the biological, sociological, and psychological study of the criminal classes, so vigorously pursued in Italy and other countries of Europe, that is described in the present volume. On the physical side, the shape of the cranium, the tendency to asymmetry, the peculiarities of face, the details of the ear, nose, and so on, anomalies of the hair and pigmentation, hereditary characteristics, motor inertia and sensory insensibility, fondness for tattooing, and the like,—these characteristics have been made the subjects of special monographs, and in many cases class distinctions between the criminal and his more normal fellow-being have been successfully laid down. While it is not yet possible to describe accurately and briefly the results of these methods of study, and still less so to apply them to individual cases, enough has been done to indicate that all kinds of abnormalities are more common among criminals than among normal people, and to give interesting glimpses into the nature of these differences. These physical differences are connected with and lead up to moral and intellectual differences, and the studies of the two have advanced together. The moral obtuseness, the lack of sympathy, the selfish and thoughtless satisfaction of sudden and strong impulses, the keen cleverness in certain limited directions but general stupidity in every thing else, the emotional

instability, the peculiar combination of a kind of sentimentality with apathy,—these characteristics seem to mark the criminal in all countries; and interesting illustrations of these are to be found in Mr. Ellis's book. Apart from the interest in the facts themselves, this study is important for the analysis of the factors that cause crime. Is it biological, an atavistic reversal to outgrown habits? Is it purely the anti-social instincts coming to the front? Would not the hero of former days be regarded as a criminal to-day? Such are the questions that arise when we pass from description to analysis. In this discussion the many points of analogy between the criminal and the savage deserve especial attention. The mental and moral habits present many points of identity, and lead to the perpetuation of many customs, such as the love of tattooing, the sudden breaking-out of excessive emotions, the indulgence in orgies, and the like. There thus seems to be marked out a class of recidivists, or backsliders, who are unable to keep up with the complex requirements of modern life, and fall back into the habits of less civilized conditions.

The practical bearing of this study is unmistakable. The common prison system, with the sentence meted out for the crime and not for the criminal, is evidently unsuited to the needs of the criminal classes. If the object is to restore these unfortunates as far as possible to places in a social community, the treatment of criminals must be a far different one from that now in vogue. This sentiment is becoming more and more widely appreciated, and some important reforms have already been put into practice. Of these, the reformatory at Elmira is the most noteworthy, and receives the place of honor in Mr. Ellis's chapter. Here, under the indeterminate sentence law, a prisoner works out his own release, and is prepared, by a carefully planned system of physical, mental, and moral training, to fit himself for citizenship. The whole man is considered, and the ideal is as different from the notion of punishment for the crime as it well can be. And this system is avowedly based upon the anthropological and psychological analysis of the criminal character. Practice necessarily hobbles along after theory, but it is certainly high time that the discrepancy between scientific knowledge and legal practice be reduced.

In addition to the aspects of the criminal here lightly touched upon, Mr. Ellis gives very interesting illustrations of less typical points, such as their peculiar slang, their literary productions, prison inscriptions, prisoners' views of life and religion, and the statement of the case from the criminal's point of view. The volume thus fills a real need, and may be recommended to all who have an interest in one or other of the many aspects of this important study.

AMONG THE PUBLISHERS.

THE Religious Tract Society, London, announce for immediate publication through their American agent, Mr. Fleming H. Revell of New York and Chicago, the following: "London Pictures," being the last addition to the popular Pen and Pencil Series; a new book by Sir J. William Dawson, entitled "Modern Ideas of Evolution as related to Revelation and Science;" "Home Handicrafts," by Charles Peters, editor of "The Girls' Own Indoor Book," etc.; and "Stanley's African Expeditions."

—The first number of the *Annals of the American Academy of Social and Political Science*, a new review of politics and economics, will shortly appear in Philadelphia. It will contain, among other articles, one on "Politics in Canada and the United States," by Dr. Bourinot; another on "Decay of Local Government in America," by Professor Patten; and a third on "Cheaper Railroad-Fares," by J. J. Wetherell. The *Annals* is the organ of

Publications received at Editor's Office, June 9–14.

ABEL, W. J. School Hygiene. London and New York, Longmans, Green, & Co. 53 p. 12°. 30 cents.

BEARD, W. S. Longmans' Junior School Algebra. New York and London, Longmans, Green, & Co. 220 p. 12°. 60 cents.

CHISHOLM, G. G. A Smaller Commercial Geography. London and New York, Longmans, Green, & Co. 208 p. 12°. 90 cents.

CONNECTICUT State Board of Health. Twelfth Annual Report of the, for the Year ending Nov. 30, 1889, with the Registration Report for 1888. New Haven, State. 195 p. 8°.

DE GUIMPS, R. Pestalozzi: His Life and Work. Tr. by J. Russell, B.A. New York, Appleton. 438 p. 12°. $1.50.

NEW JERSEY Geological Survey. Annual Report of the State Geologist for the Year 1889. Camden, F. F. Patterson, Pr. 112 p. 8°.

OTT, I. Fever, Thermotaxis, and Calorimetry of Malarial Fever. New York, Journ. Mental and Nervous Disease. 54 p. 8°.

THORNTON, J. Advanced Physiography. London and New York, Longmans, Green, & Co. 338 p. 12°. $1.40.

UNWIN, W. C. The Elements of Machine Design. Part I. General Principles, Fastenings, and Transmissive Machinery. 11th ed. London and New York, Longmans, Green, & Co. 459 p. 16°. $2.

WESTBROOK, R. B. A Few Plain Words regarding Church Taxation. 2d ed. Philadelphia, Lippincott. 15 p. 12°.

——An Open Letter to Hon. Edward M. Paxson, Chief-Justice of Pennsylvania. Philadelphia, Lippincott. 36 p. 12°.

the American Academy of Political and Social Science, and will appear quarterly.

—*The Chautauquan* for July presents among its contents "Summer Health: How to keep It," by Felix Oswald, M.D.; "The Newer Parts of Canada," by Cyrus C. Adams; "The House of Representatives," by Eugene L. Didier; "Altruism and the Leprosy," by Frances Albert Doughty; "How to conduct a Round Table," by Edward E. Hale; "What Women should wear," by Mary S. Torrey; "Homesteads for Women," by Kate Carnes; "Madam Blavatsky," by Frances E. Willard; and "New Birds for the House," by Olive Thorne Miller.

—President Jordan of the University of Indiana will contribute to the July *Popular Science Monthly* an article on "Evolution and the Distribution of Animals," in which he shows what bearing the fact of certain animals being found or not found in certain localities has on the origin of species. The ninth of Dr. Andrew D. White's new chapters in the "Warfare of Science" will be published in the same number. Its subject is "The Antiquity of Man and Prehistoric Archæology;" and it tells how step by step "thunder-stones," or "heaven axes," came to be recognized as flint implements of human make, and how their discovery, together with bones of men and of extinct animals in the drift, established the very early appearance of man upon the earth. This number will also contain an article by August Weismann on "The Musical Sense in Animals and Men," in which he argues, that, "as man possessed musical hearing-organs before he made music, those organs did not reach their present high development through practice in music;" and an article entitled "Concerning Corporation Law," by Amos G. Warner. This last points out the main defects in the hotchpotch of laws regarding corporations in the United States, and gives four particulars in which our corporation law could be reformed so as to prevent frauds and secure greater responsibility.

—In the July issue of the *Quarterly Journal of Economics* (published for Harvard University by George H. Ellis, Boston), H. Higgs of London will write on Fréderic Le Play, the French social writer and reformer, and will give a specimen of that writer's monographs on workmen's lives. Horace White of New York will discuss the silver situation with reference to pending legislation, and F. B. Hawley will write on the "Residual Theory of Distribution." Edward Cummings, holder of the Paine Fellowship of Harvard University, will have an article on "Co-operative Production in France and England," giving an account, among other matters, of the extraordinary mismanagement of the legacy left by Benjamin Rampal to the city of Paris for the purpose of aiding co-operation. There will be notes by Thomas L. Greene of New York on changes in the form of railway capital, with special reference to the growing use of income bonds; by T. E. Jevons, on the "Mathematical Treatment of the Theory of Distribution;" and by A. C. Miller of Harvard University, on the "Recent Conversion of the English Debt from 3 to 2¾ Per Cent Interest." The number will contain the usual general notes and memoranda, and list of recent economic publications.

—Messrs. Ginn & Co. announce a revised edition of the "Hand Book of Latin Writing," by Preble & Parker. The revision extends to almost every page, and includes the results of five years' experience with the book, and of the growth of composition study at Harvard.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—By a lady-graduate of Cornell University, position as teacher in high school-seminary or college; prepared to teach the following branches, employing, so far as is practicable the laboratory method: Geology, Botany, Zoölogy, Physiology; also, if desired, Physics, Chemistry, Logic and Psychology. References to heads of above-named departments in Cornell University. JENNIE T. MARTIN, care Cornell University, Ithaca, N. Y.

A GENTLEMAN of experience, highly recommended, liberally educated at home and abroad, desires to correspond with parties needing an instructor in the classics or modern languages in a high grade institution. Address EARLHAM, Germantown, Pa.

WANTED.—At the Bryant Summer School, Roslyn, L. I., a Lady to teach Sea-Life, and other Sciences. July 8–Sep. 8. Ten weeks to six months according to her convenience. Other papers please copy. E. HINDS, A.M., Principal.

WANTED—Information concerning the production of Mushrooms in caves and other places. Address M. H. CRUMP, care Ky. Geological Survey, Frankfort, Ky.

A YOUNG MAN, graduate from an American College, who has studied a year in Germany, and is now studying in Paris, would like professorship in chemistry. References from some of the best chemists. Address CHARLES E. LINEBARGER, Post-Restante, Paris, France.

WANTED.—An opportunity to study qualitative analysis in or near New York City during the summer. W. J. L., 130 Spring st., Sing Sing, N.Y.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Thorough knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

AN OHIO STATE UNIVERSITY graduate desires a position for next year as laboratory assistant or instructor in chemistry and physics. Three years' special preparation for such work. Two years' experience in teaching. References as to character and scholarship. Address C. S. ARNOLD, O. S. U., Columbus, O.

A GRADUATE of Princeton, for several years university student and Fellow in Biology, desires a position either to teach biology or as assistant in a biological laboratory. Would prefer the latter and be satisfied with a moderate salary if the position afforded time for the prosecution of original research. Address, O. S., BOX 86, Princeton, N. J.

THE ADVERTISER—A Third Year Student in Honor Sciences at Toronto University, is willing to take position as Science-Teacher or Tutor until next October. Enthusiastic and practical instructor in Biology, Chemistry, Physics, Mineralogy and Geology. Latin and Greek and other branches additional if required. Young, good family. References as to character and ability. CHEMIA, UNIV. COLL., TORONTO.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Wanted.—To exchange land and fresh-water mollusca (principally *Helices Achatinellae*, Clausiliae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

To exchange for other books: Meek's Invertebrate Paleontology, Cope's Cretaceous Vertebrata, Leidy's Extinct Vertebrate Fauna, Lesquereux Cretaceous Flora. All being volumes of the Hayden Final Reports. Address, giving lists, T. N. Glover, Suffern, N. Y.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia, Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

EIGHTH YEAR.
VOL. XV. No. 386.

NEW YORK, JUNE 27, 1890.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

THE CHEROKEES IN PRE-COLUMBIAN TIMES.

V.

THE close agreement between the testimony of the mounds and the traditions of both Cherokees and Delawares is somewhat remarkable, and justifies us in believing that they have a basis of truth. We are at least warranted in accepting the theory that the first-named people formerly dwelt in Ohio, and built some of the noted monuments of that State. The number and character of the defensive works indicate that there was a long contest and an obstinate resistance on the part of the original inhabitants. The geographical position of these works makes it apparent, as has often been remarked by writers on this subject, that there was a pressure by northern hordes which finally resulted in driving the inhabitants of the fertile valleys of the Scioto and Muskingum southward. Some of these writers take it for granted that they fled through Kentucky and Tennessee into the Gulf

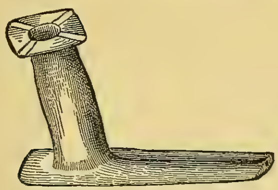


FIG. 10.

States, and became incorporated with the tribes of that section. If this be assumed as correct, it only tends to confirm the theory of an Indian origin.

A study, however, of the pipes alone, makes it evident that this conclusion cannot be maintained. That the mound-builders of Ohio made and used pipes is proven by the large number found in the tumuli, and that they cultivated tobacco may reasonably be inferred from this fact. Although varied indefinitely by the addition of animal and other figures, the typical or simple form in use among them appears to have been that known at present as the "Monitor" pipe, shown in Fig. 68, "Ancient Monuments," and Fig. 177, Rau's "Archæological Collection of the National Museum." The peculiar feature is the broad, flat, and slightly curved base or stem, which projects in front of the bowl to an extent equal to the perforated end. This form is so peculiar that it must be considered ethnic or local. However, as will be seen by reference to the "Proceedings of the Davenport Academy of Natural Sciences" and the "Smithsonian Report for 1882," it is found in eastern Iowa and northern Illinois, and appears to be the only form found in that region: hence it cannot be considered local.

Now, it is somewhat remarkable that nearly all the pipes of this form and the modifications thereof, ending in the modern form shown in Fig. 6, are found in a belt commencing in eastern Iowa, running thence through northern Illinois, eastern Indiana, southern Ohio, and thence bending south through Kanawha valley, and ending in western North Carolina. The first modification is seen in Fig. 8, and found in Ohio, the Kanawha valley, and North Carolina; the second, shown in Fig. 10, is found in Ohio and the Cherokee district; the third, shown in Fig. 5, is found in East Tennessee; and the last, shown in Fig. 6, is found in the North Carolina mounds.

Although specimens, chiefly of the first modification, have been discovered in New York and Massachusetts, it is not known that the "Monitor" or any of its manifest modifications prevailed, or was even in use, at any point south of the belt mentioned. Pipes in the form of birds and other animals are not uncommon, as may be seen by reference to Plate XXIII. of Jones's "Antiquities of the Southern Indians;" but the platform is a feature wholly unknown in the Gulf States or middle Tennessee, as are also the derivatives from it.

This fact stands in direct opposition to the theory that the mound-builders of Ohio fled southward across Kentucky and Tennessee, and became incorporated with the tribes of the Southern States, as it is scarcely possible that such sturdy smokers as they must have been, would have abandoned all at once their favorite pipe. The change, as it was in the other direction, would have been gradual. This evidence, however, has a very significant bearing on another point; for, if the testimony introduced justifies the theory advanced in this paper, then it is probable the Cherokees entered the immediate valley of the Mississippi from the north-west, striking it in the region of Iowa. This supposition is strongly corroborated, not only by the presence of the "Monitor" pipe and its derivatives along the belt designated, but also by the structure and contents of many of the mounds found along the Mississippi in the region of western Iowa and eastern Illinois. So striking is this resemblance, that it has been remarked by explorers whose opinions could not have been biassed by this theory.

Mr. William McAdams, in an address to the American Association for the Advancement of Science, remarks that "mounds such as are here described, in the American bottoms and low lands of Illinois, are seldom found on the bluffs. On the rich bottom-lands of the Illinois River, within fifty miles of its mouth, I have seen great numbers

of them, and examined several. The people who built them were probably connected with the Ohio mound-builders, although in this vicinity they seem not to have many earthen embankments or walls enclosing areas of land, as is common in Ohio. Their manner of burial was similar to the Ohio mound-builders, however, and in this particular they had customs similar to mound-builders of Europe." Two mounds in Calhoun County, Ill., one of which was opened by Mr. McAdams and the other by one of the Bureau assistants, presented the clay mass in the regular form of the Ohio "altar." But what is strange, though not without parallel, is the fact that we find the structure and contents of some of the eastern Iowa mounds similar to what is seen in the Cherokee district of North Carolina and East Tennessee. Here, among other things, are seen the cubical piles or "altars" of unhewn stone with bones about them, precisely as found in some of the North Carolina burial-places, pottery bearing a strong resemblance to that of Ohio, and mounds with stone strata. A mound in Franklin County, Ind., described and figured by Mr. Homsher in the "Smithsonian Report for 1882," presents features strongly resembling those observed in tumuli attributed to the Cherokees. Here we see the rectangular heaps of cobblestones like those in the North Carolina mounds, and stratification and arrangement of skeletons as in the East Tennessee mounds, also the stone stratum observed in the Iowa works.

Having now traced the tribe back to the western boundary of the mound region, we are prepared to take a glance downward along the line of migration, bridging by deduction such breaks as appear in the testimony.

According to the data presented, we find them first on the west bank of the Mississippi, a tribe of comparatively limited numbers, slowly extending their settlements or shifting up or down the stream between the mouth of the Des Moines River and what is now the northern boundary of Iowa. If we may judge by their works, it would seem that it was necessary only at this northern point of their extension to fortify against enemies. A suggestion as to who these enemies were will be offered a little further on. It is impossible to give any satisfactory estimate of the length of time they occupied this locality; it was long enough, however, for them to acquire certain peculiar customs, some of which were not wholly dropped until they came into contact with the whites many centuries later. It is possible that here they began to build mounds, but explorations westward of this area have not been carried on to a sufficient extent to speak with certainty on this point. It was here, no doubt, that the platform pipe with animal figures came into use. The ornamentation of their pottery, and the forms of their vessels, suggest the possibility of contact or intercourse with southern mound-building tribes. There is also abundance of evidence that they had acquired the art of manufacturing cloth, and were acquainted with copper. The evident admixture, however, in these mounds, by intrusive burial, of articles of more recent times with those of the original burials, renders it somewhat difficult to decide positively as to the advance made in art by this people while residing in this locality.

After passing to the east side of the river, it appears that they moved some distance farther to the south, their utmost limits in this direction being in Calhoun County, Ill. The reason for this may have been the presence of the same enemies who opposed their northward movement on the opposite side of the river. Of course, without the knowledge of all the mound testimony, any attempt to descend into details of the movements of the tribe would carry us wholly into the realms of speculation.

All that the mounds teach us in regard thereto is the extent of the area occupied, and the encroachments of works of other types which may or may not be contemporaneous.

It is a fact perhaps worthy of notice, that, while the remains of the effigy-builders on the west side of the river reach but little south of the fortified point before alluded to, they are found on the Illinois side as far south as the latitude of Peoria.

Passing on eastward, we next find indications of their presence in eastern Indiana, whence it seems they gradually moved into central Ohio, finding, as we judge from some works along the southern border of their line of migration, some opposition. Their stay in this attractive region must have been long, and for most of the time a period of peace. The reasons for this conclusion are, first, the indications of the growth of the tribe, judging by the number of works and the statements in the Delaware tradition, which imply that it had spread northward near to the lakes; and, second, the localities of the defensive works, which indicate that their chief contest was with a northern foe. If the latter supposition be correct, it would seem to imply that until this contest they had not found it necessary to build defensive structures.

These, of course, are speculations, and only advanced as such; but there is one thing in relation to their removal from this region for which there appears to be historical, traditional, and mound testimony, and which has some bearing on the preceding suggestions. This is, that their departure was in separate bodies, and at intervals of considerable length.

That some were in their historic seat before the time of De Soto's expedition, and possibly as early as the thirteenth century, has been shown. On the other hand, we have the statement of Bishop Ettwein, in a communication made to Gen. Washington, that the last of them did not remove from the region of Ohio until about the year 1700. We also find in the mounds of Ohio indications of intercourse with people residing in the mountain region of North Carolina.

It has been objected, with some show of reason, that the theory advanced in this paper cannot be correct, because there are no such enclosures in North Carolina and East Tennessee as those in Ohio, because no true "Monitor" pipes have been found in the mountain section, and because no engraved shells have been found in the Ohio mounds. The first of these objections has already been alluded to; but we may add, that this people found themselves able, in their mountain fastnesses, to protect themselves against all their Indian foes without erecting artificial defences. The second objection, as we have already shown, is answered by a somewhat remarkable historical statement by Adair. When he speaks of pipes "full a span long, with the fore part commonly running out with a short peak, two or three fingers broad and a quarter of an inch thick, *on both sides of the bowl lengthwise*," he can refer to no other known pipe than the "Monitor," or the very slightly modified form with

straight base, found also in the Ohio mounds. As the author quoted wrote before any specimens had been unearthed from mounds, he must have seen in use that of which he speaks. This, we repeat, is somewhat remarkable, and forms a link connecting the Cherokees and mound-builders of Ohio sufficient to warrant the theory here advanced, were there no other evidences bearing on the question.

The fact that no engraved shells bearing designs like those found in North Carolina and Tennessee have been discovered in Ohio forms no objection to the theory. Arts and customs are not always ethnical or tribal: some are acquired by contact and intercourse with other tribes. The custom of carving and wearing these shell gorgets did not originate with the Cherokees, but was acquired by contact with other tribes, after they had reached their southern home.

These objections do not militate against the theory, which is established on too broad a basis of facts and resemblances to be set aside by its failure to account for all the discoveries made. Investigations in regard to the origin and use of these ancient monuments must be made chiefly by comparisons and deductions, as historical evidence is in most cases wanting, and absolute demonstration impossible.

Attention was called in the first part of the paper to the conclusion reached by linguists, that the language of this tribe belongs to the Huron-Iroquois family, thus necessitating the inference that we must look to the same locality for the origin of both. This throws a faint ray of light on the history of our tribe preceding their arrival on the banks of the Mississippi. But before attempting to follow this slender clew, attention is called to some general considerations drawn from a comprehensive study of the monuments of the mound section.

In entering upon a discussion of the routes by which the mound-builders came into this section, an examination of the general distribution of the prehistoric remains is necessary. At present we are concerned only with what may be considered the boundaries thereof. Although the data are not sufficient to determine these limits accurately, enough has been ascertained to indicate what will probably be found in the end to be true.

Limiting the consideration to what are usually classed as the genuine works of the mound-builders, the eastern boundary extends from central New York along the Appalachian range to Virginia, diverging thence south-eastward so as to strike the Atlantic coast in South Carolina. The Gulf coast, west of Florida, appears to be generally bare of mounds (with the exception of shell and refuse heaps) for some distance toward the interior. On the north, the lakes and Rainy River form a tolerably well defined border, but west of the source of the Mississippi there is a northward extension into Manitoba which has not been fully traced; yet the indications are that but few ancient works will be discovered north of the Assiniboin region. Most of the mounds of this section which have been explored appear to be somewhat recent, though others bear evidence of being contemporaneous with the works of Wisconsin. On the west the plains appear to form the boundary from North Dakota to Texas, a line of recent works along the Missouri River forming the only exception, so far as known.

The statement frequently made, that the works of the mound-builders continue across Texas into Mexico, appears to be without any foundation; for up to the present time but few have been discovered south of Red River, except in the eastern part of Louisiana.

So far, therefore, as the facts ascertained are concerned, the distribution of the works of the mound-builders affords but little evidence on which to base a theory in regard to the lines along which the authors of these works entered the mound section. The exceptions, if any, are to be found in Florida and the North-west. But this statement must not be taken as indicative of a theory held by the writer, for he is not inclined to the opinion that the mound-building element, except possibly that of southern Florida, entered through this peninsula. Although he has reached no settled conclusion on this subject, he has been inclined to look more to the north-west and west for the lines of immigration than elsewhere, but freely confesses that he finds but little in the works along the border on which to base any theory on this subject.

While this is true considering the section as a whole in its relation to the other comprehensive archæological divisions of the continent, there are, on the other hand, decided indications of movements within the mound section.

The works of the effigy-mound district, confined chiefly to the southern half of Wisconsin and the immediately adjoining sections, are peculiar, and formed a puzzling factor to those holding the theory of one great nation of mound-builders. The study of these appears to lead all those who have devoted attention to them to the conviction that the more elaborate forms, are, as a rule, older than the simpler ones.

Following up the slight clew thus afforded, and using the faint rays of light thrown on the history of the builders by the distribution of the mounds, we are led to believe that their entrance into the district was most likely at its south-western corner, about what is now the north-eastern part of Iowa, and that the area longest occupied was the south-western portion of Wisconsin. The indications are, that they shifted back and forth between the Mississippi River and Lake Michigan, and finally made their exit at the north-western boundary of the State, a part going as far north as southern Manitoba. From there they at length passed southward into Dakota, where the mounds fade out, and the presence of the descendants of the builders—who, we are inclined to believe, pertain to the Dakotan stock—is indicated only by surface figures.

Another movement, traced by certain classes of works and vestiges of art which we ascribe to the ancestors of the Cherokees, was that already mentioned, extending from eastern Iowa through Illinois, Indiana, Ohio, and West Virginia, to the mountain region of North Carolina and East Tennessee.

A third line is indicated by certain types of prehistoric remains extending from Michigan, along the southern shore of Lake Erie, into New York; but nothing has been found in these remains by which to determine the direction of the movement. There is little doubt, however, that the works along this line are attributable to one or more tribes of the Huron Iroquois family.

Another class of works forms an irregular line extending from southern Illinois, through Kentucky and middle Tennessee, to the north-east corner of Georgia; the area of chief

occupation, and position of longest quietude, being that portion of the Cumberland valley in middle Tennessee. The works along this belt, which we attribute to the Shawnees, consist chiefly of stone graves of a particular type, and mounds; they fail, however, to give any satisfactory evidence as to the direction of the movement. Nevertheless there are, along portions of the line, some evidences of a shifting back and forth; and the minor vestiges of art prove beyond question that the authors were contemporaneous with the builders of the mounds of East Tennessee and North Carolina.

Although the banks of the Mississippi are lined with prehistoric monuments from Lake Pepin to the mouth of Red River, showing that this was a favorite section to the ancient inhabitants, yet a study of these remains does not give support to the theory that this great water highway was a line of migration during the mound-building age, except for short distances. It was, no doubt, a highway of traffic and war-parties, but the movements of tribes were across rather than up and down it. We do not assert this as a theory or simple deduction, but as a fact proven by the mounds, whatever may be the theory in regard to their origin or uses. The longest stretch, where those apparently the work of one people are found on one bank, is that from Dubuque to the mouth of the Des Moines. As we move up and down, we find repeated changes from one type to another. In addition to this, is the intermingling of other types, and indications in most places of successive occupation by different tribes. It is a very natural supposition that the people first reaching the bank of this broad stream, or of any of the other large streams of our country, would continue their course along it, but the mounds give no support to the theory.

A study of this subject ought to lead us to the proper conclusion, for it is evident that the natural condition of a mound-building people is one of permanency: hence their movements are governed largely by pressure from other tribes, and not by choice. No evidence has yet been found in the mounds pointing to the first-comers into the section. On the contrary, all the evidences of migration point at the same time to pressure or obstacles in one or more directions. For example: the mound-builders of Wisconsin must have found some obstacle which prevented them from continuing their course eastward around the southern end of Lake Michigan, while the pressure which drove them from the area they had occupied so long seems to have come from the north-east.

The singular course of the people who buried in the stone graves south of the Ohio, whether moving eastward or westward, can be explained only on the theory of the presence of other tribes to the north and south; and this is probably true, as has been suggested, in regard to the people who travelled from eastern Iowa to Ohio.

Indications of movements are found in other portions of the mound section, but those mentioned are all which have any immediate bearing on the subject under consideration at present.

Returning now to the point where we paused in our journey backward along the pathway of the Cherokees, the inquiry arises, "From what point, or along what line, did they come to their halting-place on the banks of the Mississippi?" As has already been stated, it is now conceded by linguists that their language is an offshoot of the Huron-Iroquois family,—a relationship long ago surmised by Dr. Barton and Mr. Gallatin. We may therefore, in answer to the above inquiry, though in a somewhat broader sense than given, adopt the language of Mr. Horatio Hale in speaking of the more closely allied branches of this family: "There can be no doubt that their ancestors formed one body, and indeed dwelt at one time (as has been well said of the ancestors of the Indo-European populations), under one roof. There was a Huron-Iroquois 'family pair' from which all these tribes were descended. In what part of the world this ancestral household resided is a question which admits of no reply except from the merest conjecture." He adds, however, "that the evidence of language, so far as it has yet been examined, seems to show that the Huron clans were the older members of the group; and the clear and positive traditions of all the surviving tribes, Hurons, Iroquois, and Tuscaroras, point to the Lower St. Lawrence as the earliest known abode of their stock."

If the evidence presented in this paper be considered sufficient to justify the belief that the Cherokees entered the Ohio valley from the west, we are, then, forced to one of two conclusions, which may be stated briefly as follows: 1st, That this tribe, breaking away from the family in its eastern home, wandered westward, passing between Lake Superior and Lake Huron into what is now Wisconsin, and onward to the border of the plains, turning thence southward to the point on the banks of the Mississippi where we first find them; or, 2d (which is fare more likely), the original stock was at one time in the distant past located in the region north-west of Lake Superior, and while here the Cherokees separated from their brethren, and moved southward to the banks of the Mississippi, while the latter, being pressed onward, moved eastward, north of the Lakes, to the banks of the St. Lawrence. If this supposition accords with what really was the direction of the movement, then it is highly probable, that, when they reached the Ottawa River, a portion followed down its course, while others turned southward into what is now Ontario, and were in that section when the Lenape appeared on the scene.

The first of these suppositions presents a movement so unlikely, though not entirely without a parallel in Indian history, that we feel constrained to reject it, so long as there is a theory consistent with the known data that is more simple and reasonable.

The evidence presented by Mr. Hale in the "Iroquois Book of Rites" leaves no doubt that the earliest known seat of the Huron-Iroquois family was on the Lower St. Lawrence; but it is scarcely presumable that their first appearance on the continent was in this eastern region. It is more likely that they had reached this point from some western section, and as they increased in numbers were forced to partially retrace their steps.

Although it is apparent that the authors of the ancient works east of the Rocky Mountains were substantially in the same culture state, and belong to the same race in the broad sense, yet there are some reasons for supposing (if we include the ancient works of New York under the general term "mounds") that the custom of building mounds origi-

nated independently in some two or three different sections. This is inferred from the fact that there appear to be at least three comprehensive classes of works: first, those of the Huron-Iroquois region; second, those of the Dakotan district; and, third, those of the southern section. These are not limited by ethnic lines, as the people who built the works along what we have designated the Cherokee and Shawnee belts probably derived the custom from the southern mound-builders.

The southern Dakotans, as the Quapaws and cognate tribes, also built mounds of the southern type. It is possible, however, that future discoveries in the north-west and south-west may throw additional light on these questions, and modify the views here advanced, which are based, as a matter of course, only on the data so far obtained.

The attempt to estimate the time that has elapsed since the arrival of the Cherokees on the banks of the Mississippi (assuming the theory advanced to be correct) or since their meeting with the Lenape must be almost wholly conjectural. Mr. Hale says the time which has elapsed "since the Tallegwi were overthrown" is variously estimated, but that the most probable conjecture places it at a period about a thousand years before the present day, which would carry it back to the ninth century. Basing the estimate on the traditional evidence, for mound evidence gives but little aid in this respect before contact with the whites, it would seem to be more nearly correct to place the event in the eleventh or twelfth century. How long they had remained in this region when the war with the Lenape occurred is a question that must be left wholly to conjecture until other data than those we now possess are obtained; but it must have been a stay of some centuries, during which, as before said, they had lived in comparative peace. There are some reasons for believing that during this time another tribe had pushed its way up the Ohio River to the region about the mouth of the Miami. It is even probable that bands had crossed to the north side of the Ohio, and established themselves along the banks of the two Miamis. These I am inclined to believe, as heretofore remarked, were Shawnees who probably entered the Mississippi valley after the advent of the Cherokees. There is some evidence, however, in this region, of the presence of another small tribe which must have been driven out or destroyed. The remains which indicate the presence of this tribe are peculiar stone heaps and stone graves. It is possible that the presence of other people in this part of the Ohio valley caused the Cherokees to retreat up the Kanawha instead of southward across Kentucky.

The importance archæologically of the questions here discussed does not end with their bearing upon the history of a single tribe, for at almost every point there are side connections with other peoples. If it be admitted that the Cherokees were mound-builders down to the appearance of the white race on the continent, the mystery of the builders of our ancient monuments is virtually dispelled; for the lines which radiate from this point are so numerous and so far-reaching, that, when traced out to their utmost extent, the whole realm of mound-builders will have been traversed. This is a view of the subject which has not received due consideration on the part of those who admit that some of the works are attributable to Indians, yet claim that others are due to a different and more highly cultivated race. An illustration by partially tracing one or two of these lines will serve to impress the reader with the importance of investigation in this direction.

Reference has already been made to the fact that engraved shells similar to those found in the mounds of North Carolina and East Tennessee have been discovered in stone graves of a particular type, and that stone graves of this type often occur in mounds assigned, even by disbelievers of the Indian theory, to the true mound-building age. As the designs on these shells are peculiar, it is reasonable to conclude that the builders of the two classes of works were contemporaneous, or that there was an overlapping to some extent chronologically. Following up this line, which is traceable by other indications than merely the form of the sepulchres in which the dead were buried, we are led in one direction to the banks of the Delaware, where, history and archæology inform us, the Indians of that locality were burying their dead in tombs of the peculiar type mentioned, as late as the time of William Penn. It carries us in another direction, to southern Illinois, where links are found connecting unmistakably with the historic tribes of that section.

Going back to the Cumberland valley, the chief seat of these stone-grave builders, other lines start out which lead to the ancient works of south-eastern Missouri. Speaking of objects taken from "the peculiar stone graves of the Southern States," especially those of the Cumberland valley, Professor Putnam states that he has classed these "as belonging to the southern mound-builders, from the fact that the careful exploration of thousands of the graves, under the direction of the Museum, shows that their contents, including the human remains, are of the same character as those of the burial mounds in general, in the same region. . . . We have conclusive evidence, in the objects here arranged, that the stone-grave people of the south-west, and at least one group of the mound-builders, were one and the same people."

In another place he says, "Many of these carved disks of shell have been found in the graves and mounds of Tennessee and Missouri, and, with the identity of the associated pottery from the two localities, go far to prove the unity of the people, notwithstanding some slight differences in burial customs."

Although it is probable that Professor Putnam is not justified in concluding that the people of the two sections were tribally identical (if this be his meaning), yet the strong similarity in the forms, ornamentation, and character of the pottery leaves no doubt that they were contemporaneous, and, in consequence of contact or intercourse, had adopted in some respects similar customs.

Thus it is seen, that, commencing with the mounds of the Cherokee district, the connecting lines lead to the modern and non-mound-building tribes of the Delaware valley, to the historical tribes of Illinois, and to the veritable mound-builders of middle Tennessee and south-eastern Missouri. Nor do these complete the list of points to which the branches of this single diverging line lead us. As there are other diverging lines, it is apparent, that, when all have been traced out along their various branches, a large portion of the mound area will have been traversed.

This renders it highly probable that there was no manifest break in the mound-building age. It may have continued,

and probably did, for many centuries, but there is no satisfactory evidence found in the monuments that there were two distinct mound-building ages. On the contrary, the historical, traditional, and archæologic testimony is decidedly in favor of the theory that our prehistoric works are attributable to the Indian tribes found inhabiting this country at its discovery, and their ancestors. CYRUS THOMAS.

NOTES AND NEWS.

SINCE the article on the Kiowa County meteorites was published (*Science*, June 13, 1890), we learn that another mass, weighing 219 pounds, has been found at Brenham Township, Kiowa County, Kan.

—We learn from *Nature* of June 12 that the measurement of the Rhone glacier in a comprehensive and systematic way has been carried on since 1874 by the Swiss Alpine Club, and the abundant data obtained will shortly be published in separate form. It appears that the glacier was in recession till 1888, but since last year it has been advancing.

—By the new law on education of 1891, Sloyd is made obligatory in all the schools of Norway. The Norwegian Government has invited Mr. Akkel Mikkelsen, director of the Danish Sloyd-training College, to give a course of instruction at Christiania to the teachers of all the training-colleges in Norway. The courses for Sloyd at Nääs, in Sweden, will be held from May 27 to July 8, from July 29 to Sept. 8, and from Nov. 4 to Dec. 15.

—The Appalachian Mountain Club has issued a special circular relating to the twenty-fifth field meeting, at the Deer Park Hotel, North Woodstock, N.H., July 1–8, and excursion to Randolph July 8–14. Further information may be obtained by addressing John Ritchie, jun., Box 2725, Boston, Mass., or J. Allen Crosby, 70 Boylston Street, Jamaica Plain, Mass. Members of the club who would be interested in a trip to the Dead River region, Maine, in September or October, visiting Mounts Abram Bigelow, Snow, and Parlin Pond Bald, are invited to communicate with R. B. Grover, 11 Durham Street, Boston, Mass.

—A noteworthy event in the movement for the higher education of women, as we learn from the London *Journal of Education*, was the laying of the foundation stone of the Janet Clarke Buildings at Trinity College, Melbourne, Australia, on March 17. In 1883, Trinity College authorities decided, with some misgivings, to admit women students to their lectures. The next step was the establishment of a collegiate home, and a house in the neighborhood of the college was rented as a residence for lady students. To put this home on a permanent basis, Lady Clarke promised a donation of £5,000, which will go far towards defraying the cost of the new building. Sir M. H. Davies has given £2,000 as the nucleus of an endowment fund. Miss Hensley, a former student of Newnham College, has been engaged by the council as lady principal of what will be the first Australian women's college.

—In the *Journal of the Bombay Natural History Society* (vol. iv. No. 3) Mr. E. Giles records a curious fact, which ought to have some interest for entomologists. In June, 1888, he was standing one morning in the porch of his house, when his attention was attracted by a large dragon-fly of a metallic blue color, about two inches and a half long, and with an extremely neat figure, who was cruising backwards and forwards in the porch in an earnest manner, that seemed to show he had some special object in view. Suddenly he alighted at the entrance of a small hole in the gravel, and began to dig vigorously, sending the dust in small showers behind him. "I watched him," says Mr. Giles, "with great attention; and after the lapse of about half a minute, when the dragon-fly was head and shoulders down the hole, a large and very fat cricket emerged like a bolted rabbit, and sprang several feet into the air. Then ensued a brisk contest of bounds and darts, the cricket springing from side to side and up and down, and the dragon-fly darting at him the moment he alighted. It was long odds on the dragon-fly, for the cricket was too fat to last, and his springs became slower and lower, till at last his enemy succeeded in pinning him by the neck. The dragon-fly appeared to bite the cricket, who, after a struggle or two, turned over on his back and lay motionless, either dead or temporarily senseless. The dragon-fly then, without any hesitation, seized him by the hind-legs, dragged him rapidly to the hole out of which he had dug him, entered himself, and pulled the cricket in after him, and then, emerging, scratched some sand over the hole and flew away; time for the whole transaction, say, three minutes."

—In a lecture on "Foam," Lord Rayleigh insisted that foaming liquids were essentially impure, for pure liquids will not foam. For instance: neither water nor alcohol can be raised into a froth, although a mixture of the two may be to a certain extent. The addition of gelatine to water in the proportion of 1 in 100,000 develops the foaming quality quite noticeably. Of course, the best-known foaming liquid is a solution of soap, such as the children use for blowing bubbles. A liquid foams when its films have a certain durability. In all liquids these films exist, since a bubble as it rises is covered with a thin film. Now, the most striking property of films is their tendency to contract, and they may be regarded as being in the condition of a stretched membrane, as of India-rubber, with the difference that the tendency to contract never ceases. An air-bubble will force the air back through the pipe, and a loop of silk floating on a film will be forced into a circle the moment the film inside it is ruptured. Oil forms a film on the surface of water, and covers it entirely, even if the mass of the oil be collected into drops. This is well shown by dropping a particle of oil on to a vessel of water lightly covered with sulphur flour. The sulphur will be immediately driven to the edge by the spreading film. The reason of this is that the tension of the water-air film is greater than the combined tensions of the water-oil and oil-air films, and consequently pulls out the oil-film. It is possible to reduce the surface tension of water by mixing it with various substances, such as ether and camphor. Camphor scrapings placed on the surface of pure water enter into vigorous movement, because the dissolved camphor diminishes the surface tension of the water; but, if the water be contaminated by the least quantity of oil or grease, the motion ceases. Lord Rayleigh made several experiments to find what thickness of oil-film would accomplish this: he found it to be about 1½-millionth of a millimetre. This thickness bears to an inch the same ratio that a second of time bears to half a year. Lord Rayleigh explains the calming action of oil on the sea as follows: as the waves advance, the surface has to submit to periodic extensions and contractions. At the crest of a wave the surface is compressed, while at the trough it is extended. So long as the water is pure, there is no force to oppose this; but, if the surface be contaminated, the contamination strongly resists the alternate stretching and contraction. It tends always, on the contrary, to spread itself uniformly, and the result is that the water refuses to lend itself to the motion which is required of it. The film of oil may be compared to an inextensible membrane floating on the surface of the water, and hampering its motion.

—The visit of the Iron and Steel Institute of Great Britain to the United States in the autumn is likely to be in every way most successful. There will be three different sets of meetings,—the meetings of the American Institute of Mining Engineers, which take place in New York on Sept. 29 and 30; the meetings of the Iron and Steel Institute of Great Britain, which take place in the same city on Oct. 1, 2, and 3: and the international meeting promoted jointly by those two societies, which will take place about the middle of October at Pittsburgh. The excursions which have been planned by the American reception committee, of which Mr. Andrew Carnegie is chairman, provide for about three thousand miles of free transportation through the United States. According to *Nature*, the principal excursions will take place to the iron ore and copper regions of Lake Superior; to Philadelphia, Harrisburg, and Chicago, where there are large iron and steel engineering works to be inspected; and to the new iron-making district of Alabama. About three hundred members of the Iron and Steel Institute and one hundred German iron-masters have intimated their intention of taking part in the meetings; and already many have booked passages in the Hamburg-American Company's

steamer "Normannia," leaving Southampton on Sept. 12. The meetings and excursions will last altogether over a month, and will practically embrace every point of interest in the United States within a distance of fifteen hundred miles of New York. Papers have been promised for the meetings by Sir Lowthian Bell, Sir Nathaniel Barnaby, Sir Henry Roscoe, and others. Among those who have intimated their intention of being present at the meetings are Sir James Kitson (president of the institute), Lord Edward Cavendish, Sir John Alleyne, Sir James Bain, Mr. Hingley, M.P. (president of the Iron Trade Association), Mr. Theodore Fry, M.P., Sir J. J. Jenkins, Sir Thomas Story, Mr. Windsor Richards, Mr. Snelus, F.R.S., and Mr. Edward P. Martin.

—We learn from the *Journal of Education* (London) that a model school has recently been built at Mannheim, Germany, at a cost of £45,000. It contains 42 school-rooms, 2 drawing-rooms, 2 singing-rooms, 2 rooms for manual instruction, and a gymnasium; further, a large hall, 2 private rooms, 2 sets of rooms for the servants, and 4 subterranean prisons. The latest hygienic improvements and precautions against fire have been introduced. Iron has been used instead of wood, except in the roof. The ceilings are all of beton. The floors are parquet floors laid in asphalt. The accumulation of dust and the development of bacteria are hereby minimized. Underground there are two bathrooms, one for boys and one for girls, with a dressing-room for each; also a large dining-room where 700 poor children can be fed in winter. The number of children in the *Volksschule* at Mannheim has increased from 4,650 in 1880, to 9,220 in 1890.

—The next meeting of the American Society of Microscopists, instead of being held at Louisville, Ky., will be held at Detroit, Mich., Aug. 12 to 15 inclusive. The outlook for the meeting is most encouraging, from the papers already promised. The subjects for discussion are "Representation of the Society at the World's Fair, Chicago, 1893," to be opened by Ex-Gov. Jacob D. Cox, Cincinnati, O.; "Micrometry," by Professor William A. Rogers, Waterville, Me.; "Proposed Standing Committee on Medico-Legal Microscopy," by Professor Marshall D. Ewell, Chicago, Ill.; "Uniformity in Tube-Length," by Professor Simon H. Gage, Ithaca, N.Y.; "The Advisability of adding more Members to the Publication Committee," by Professor D. S. Kellicott, Columbus, O.; "Proposed New Constitution," by Dr. William J. Lewis, Hartford, Conn.; "The Advisability of meeting at Same Time and Place of the American Association for the Advancement of Science," by Professor W. H. Seaman, Washington, D.C.; "Advisability of sending Copies of the Publications to Some of the Great Colleges and Libraries of the World," by Dr. Lee H. Smith, Buffalo, N.Y.; and "Fees of Experts with the Microscope," by C. M. Vorce, Esq., Cleveland. The general session for the reading of papers will be held in the new building of the Detroit College of Medicine, corner of St. Antoine and Catherine Streets and Gratiot Avenue. The mayor of Detroit will deliver the address of welcome, to be followed by the response of the president of the society, George E. Fell of Buffalo, N.Y. On Wednesday the forenoon and afternoon sessions will be devoted to the reading and discussion of papers and special topics; and in the evening the president will deliver the annual address, the subject being "The Influence of Electricity on Protoplasm." Thursday forenoon will be devoted to the reading and discussion of papers and special topics; and the afternoon, to the various technological features of microscopy, as preparing, staining, mounting of specimens, section-cutting, manipulative methods, etc. These demonstrations will be conducted by experts in the different branches of work, and will form a valuable feature of the meeting. In the evening there will be an exhibition of microscopes and objects, popular in character, and tendered by the society to the citizens of Detroit. Friday will be given over to the reading of papers, discussions, etc., until 4 P.M., when, by invitation, the members and friends of the society will take a trip on the Detroit River, followed by an inspection of the laboratories of Park, Davis, & Co. The headquarters of the society will be at the Hotel Normandie, and the Russell House and Hotel Cadillac will also be open to the guests. Negotiations relating to reduced railroad fares have been in progress. Should they be successful, due notice will be given. The local committee of Detroit will issue circulars relating to the working session and the exhibition. They will supply badges, and look after the general welfare of those attendant upon the convention.

—The January number of Flecheisen and Masius' *Neue Jahrbücher für Philologie und Pädagogik* contains a short but interesting report by E. Vogel on Spanish *Gymnasia*. The writer commences with a few details on the Spanish *Volksschule*. He says that elementary education is not compulsory, but that the *Volksschulen*, whether conducted by the municipality or the Church or other societies, are not so bad as might be expected. The Spanish child is unusually sharp, and, not being burdened with several alphabets or a complicated orthography, learns to read and write easily in a few months. After this, he makes some progress in arithmetic and geography, and other branches of instruction; while the German teacher is still laboring, in the sweat of his brow, "seine buben durch die disteln und dornen eines sogenannten lesebuchs zu lavieren." There are some establishments for higher elementary teaching; but these are little patronized, children being usually put out apprentices at the age of twelve. Secondary education is given in the *institutos*, organized some thirty years ago. The curriculum covers five years, with a very singular time-table: viz., First year, Latin and Spanish, 9 hours weekly; geography, 4½. Second year, Latin and Spanish, 9; Spanish history, 4½. Third year, rhetoric and poetic, 9; arithmetic and algebra, 9; history, 4½; French or English, 4½. Fourth year, geometry and trigonometry, 9; psychology, logic, and ethics, 9; French or English, 4½. Fifth year, physical science, 9; biology and hygiene, 9; agriculture, 9. The school-year is 37 weeks. The text-books are said to be good, all except those on Spanish grammar, the best of which is ludicrously incorrect and antiquated. The teachers lecture, but the boys cannot understand the words they are obliged to use. The leaving-examination is ridiculous; so much so, that a moderately clever boy can become "bachiller" at fourteen, and most boys do so at fifteen. The *instituto* is consequently, in popular opinion, "ein humbug." Mr. Vogel, with the true German belief in pedagogy, concludes his observations with the remark that "a good middle school would, in twenty-five years, make this talented nation one of the first in Europe."

—Professors F. W. Clarke and H. W. Wiley, representing committees appointed by the Chemical Society of Washington, the Chemical Section of the American Association for the Advancement of Science, and the Association of Official Agricultural Chemists, respectfully submit the following statement: During the past two years the formation of a national, or rather continental, chemical society has been much discussed. A committee, of which Professor A. B. Prescott was chairman, presented a report upon the subject at the last meeting of the American Association, and that report was in the main favorable. A new committee, however, was appointed to secure fuller information, and will report at the next meeting of the association, in August, 1890, at Indianapolis. A larger attendance of chemists is there expected. The plan which has so far been chiefly considered is in brief as follows: to organize a continental chemical society, representative of all North America, by affiliating together as far as possible existing local organizations; the society as a whole to hold an annual meeting at such time and place as may be agreed upon from year to year; while local sections, like the sections of the British Society for Chemical Industry, shall have their regular, frequent gatherings in as many scientific centres as possible, all publishing their work in one official journal. The opinions of chemists are sought as to whether they regard the project favorably; and, if modifications or objections occur to them, it is desired to have them formulated. Upon the basis of the replies, the committees named will prepare their reports to the organizations which they represent. Other existing societies, having appointed similar committees, may take action independently; if so, their views will be considered also, as it is desirable to secure the fullest co-operation among the chemists of America. Complete unity of action is essential to success. Replies should be addressed to Professor F. W. Clarke, United States Geological Survey, Washington, D.C.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE TORNADO: ESPY'S EXPERIMENTS.

THESE investigations of Espy upon what actions may be considered as taking place in the upper air, as has been already said, are of the highest importance, and demand a special consideration. A proper interpretation of his results will help us in all our studies and reasonings. One of the most serious difficulties that we shall encounter, however, is in the fact that in the open air we are not dealing with a limited confined space, but we have to do with unlimited space and a well-nigh frictionless medium. The apparatus which he used has been sufficiently described already. The earlier investigation with the nephelescope was made without the use of a condensing syringe; and in this we are able to comprehend clearly just the action which took place, while in the later researches the results were quite complex. Mr. Espy first carried his jar into air the temperature of which was quite low, at freezing or below; and, after it had attained the temperature of its surroundings, the stop-cock was closed, and the jar was taken to a room with high temperature, 70° to 80°. The air inside was expanded by the heat, and the amount of this expansion was measured on the gauge. He then opened the stop cock, and closed it at the moment the mercury reached a level in the gauge. The rising of the mercury in the gauge after explosion, he thought was due to the gradual heating of the air which had been cooled by the sudden expansion. In the same way the jar was left in a high temperature for a time; then the stop-cock was closed, and it was carried to a low temperature. In this case, of course, the mercury in the gauge had the opposite motion to that it had before. The same experiments were tried with both moist and dry air.

One of the more important results from these researches, Espy does not seem to have thought of, though it dimly foreshadowed the epoch-making experiments of Mayer and Joule, in England, on the mechanical equivalent of heat. It is plain that in this confined space used by Espy there must be a relation between the amount of rise or fall in temperature and the corresponding change in air-pressure under a constant volume, and this will enable us to determine the expansion of air per degree of heat applied. In moist air the average difference of temperature between the cold and warm room was 45°, and the rise of the gauge 2.97 inches; in moist air, going from a warm to a cold room, the fall in temperature was 45°, and the fall in the gauge 2.60 inches: while with dry air these quantities were 57° and 3.34 inches and 63° and 3.30 inches respectively. The amount of change per degree in the four cases was .066, .057, .059, and .052 of an inch, or a mean of .059 of an inch in all the cases. The reading of the barometer is not given; but, if we assume it to be 29.80 inches, we find that the increase of temperature required to double the pressure in the jar was not far from 505°,—a result which is remarkably close to the 490° found by the more careful and extended researches of others. We now see the important bearing of this first work on our studies. If we compress air 5 inches by the gauge, we would heat it 83°; and if 10 inches, 167°; and so on, provided no heat was lost or dissipated in the operation. We ought also to be able to calculate from the reading of the gauge, after any operation of either condensation or expansion, exactly how much the air was heated or cooled, provided always that no heat was lost or gained.

In the light of this interpretation, let us examine some of Espy's experiments. In one instance he compressed the air 10 inches. We may suppose that he waited long enough to allow the jar to attain the air temperature before explosion. After the explosion the gauge reading was 2.15 inches, which would indicate that the cooling was not far from 36°, provided the only influence on the gauge was through the rise of pressure consequent upon the heating of the air by surroundings. It would appear that the theoretical cooling from such an expansion should be much greater than this; and, in fact, we cannot reason or theorize upon this result in any way, without first learning the probable loss of heat during compression, and its gain during expansion, to and from the environment. Espy's nephelescope was duplicated in its different parts, with the addition of a most delicate thermometer loaned by Professor Russell. This instrument has a bulb .06 of an inch in diameter and 1 inch in length, and would change one degree in from two to three seconds. It is plain, that, in observations with any degree of speed in *change* of temperature, any instrument will be liable to lag behind the existing temperature. This difficulty, how-

ever, may be partially avoided by conducting operations at variable rates of speed, because, if we obtain the same result with different rates, we can conclude that the lagging is inappreciable. Again: the amount of this lagging may be approximately computed by using two thermometers with different rates of lagging. Whatever may be this lagging, however, it is plain that it would be exactly the same in moist as in dry air, so that our comparative results will be entirely free from any error due to the instrument. In saturated air, moisture collects on the bulb; but this can make no difference, since in saturated air the dry and wet thermometers read alike.

Experiments.

On rapidly compressing the air and suddenly releasing it, the amount of rise and fall in temperature was the same, about 7° for 10 inches of compression. We shall be entirely within the limits of error if we assume the lagging to be 1°. Since the air at the side of the jar was at very nearly the air temperature, we can consider that the average heating and cooling of the whole air was not far from 4°. This shows what an enormous loss of heat was sustained by the air in compression to one-third its bulk. The theoretical heating should have been 163°, while the actual heating was one-fortieth of that. But the most important fact in this connection is that Espy, under the same conditions, found the cooling after expansion to be nine times that found above. Espy emphasizes the great necessity that exists in closing the stop-cock at the moment the mercury reaches a level, or at the exact moment when we may suppose the cooling by expansion is greatest. On repeating these experiments, it was a matter of great astonishment to find that the delay of a few seconds only in stopping the expansion, after the columns in the gauge were at the same level, almost entirely obliterated the subsequent rise. This would seem to show that heat from the environment had little or nothing to do with this rise, and this is an exact corroboration of the indication of the thermometer; for a rise of 4°, which was found, would represent less than .25 of an inch on the gauge. Does the mercury in the gauge reach a level before the air inside the jar is in equilibrium with the outside air? Professor Marvin has suggested that the momentum of the mercury in the latter part of the expansion would cause it to reach its level sooner than the air its equilibrium. On performing the experiment at different speeds of expansion, it was found that a definite relation existed between the rapidity of fall of the mercury and the subsequent rise after arresting the expansion. For example: the air each time was compressed to 400 millimetres, and expanded in 5, 10, and 20 seconds. The amount of rise in these cases was approximately 41, 21, and 12 millimetres respectively. It might be thought that this was due to the greater accession of heat to the air during the slower expansion (that is, the cooling would not become as great), but in all these cases the thermometer indicated the *same* cooling at the end. It must also be plain that this effectually disposes of the question of lagging, as suggested above. The evidence is cumulative and conclusive, that the rise noted by Espy was not due to a heating, from outside, of the air cooled by expansion; and his whole theory regarding the difference in cooling, of dry and moist air, falls to the ground.

As regards the fact that there is only an exceedingly slight rise after waiting a few seconds, Professor Seaman has suggested that the air may be heated in these few seconds, and therefore there is no rise. But it takes time to heat the air under these conditions, and in these few seconds the amount of heating is exceedingly slight: in fact, this one thing is a strong argument against the view that the rise noted after expansion is due to heat; for the rise is very rapid, and is accomplished in a few seconds. Still another point is to be noted: by making the compression to 400 millimetres very rapid (that is, in 10 seconds), and then expanding in 5, 10, or 20 seconds, we have heated and cooled our air by very nearly the same amount, and it has come back to just a degree or two below the outside air temperature; so that the subsequent rise cannot be due to the accession of heat from outside. There is an exceedingly interesting matter right here that I leave for physicists to consider. We are told that the only way in which air can lose its heat is by performing work. Now, is it possible for us to consider that the amount of work done in compressing the air to 400 millimetres is exactly counterbalanced by the work done by the air in forcing aside the outside air as it rushes out of the jar? It would seem as though the former must be a thousand or more times greater than the latter, if we take account of all the circumstances. One more experiment was tried to determine the cause of the rise in the gauge after explosion. If this rise were due to the behavior of the gauge, rather than to outside heat, we ought to be able to obtain it at any moment after expansion, and long before any marked cooling had taken place. When the expansion was arrested after one or two seconds, there was a marked rise in the gauge. This arrest must have been long before the cooling could possibly have brought the air to the outside temperature, for the just previous compression had heated it 4° above the air, and the expansion could not cool it down before 5 seconds had elapsed. Whatever may have been the cause of this rise, there is one point about which there is not the slightest doubt, and this is the principal point that we are to consider. Under all conditions of slow or rapid compression and expansion, the final cooling after explosion was almost identically the same, whether moist or dry air were used. This was determined by the thermometer; and in this experiment it must be admitted that the lagging of the thermometer had no influence, for it would be precisely the same in both moist and dry air. The rise of the gauge after explosion with dry air was slightly greater than with moist air, but this may have been due to a difference in the whirls which the explosion always produced inside the jar. It seems almost incredible that this fatal slip should have occurred at such an extremely critical point in Espy's work; and I am impressed with the conclusion thus reached, not so much by my interpretation of Espy's doubtful results, but far more because the two sets of experiments dovetail into each other so perfectly, and the one serves as a check on the other.

It is not a little remarkable that we have obtained somewhat the same result as this by another method of reasoning. The condensation of the moisture or the appearance of the cloud, even in thoroughly saturated air, is exceedingly evanescent in a jar of this kind. It is next to impossible, except with very high compression (15 to 20 inches), to get

a particle of mist to settle to the bottom. Under the compressions employed by Espy, the cloud or mist entirely disappears in a few seconds, and not an atom of moisture reaches the bottom of the jar. Suppose, now, that, at the instant of expansion, latent heat were liberated by the formation of the cloud, which would prevent a further cooling. It is very plain that it would be used up immediately in the evaporation of the cloud; and the disappearance of the mist proves that the sensible heat has again become latent, and can have absolutely no effect in expanding the air or in causing a final higher gauge reading, as Espy thought.

A note should be made of the condition of Espy's moist air. The presence of a haze or cloud is no evidence of saturated air, for such cloud has been produced in air having only two per cent of moisture. When air is pumped in from the room, it has an enormous number of dust-particles in it, and these give the semblance of fog on sudden expansion Espy tried to saturate his air by putting a little water into his jar, but it is certain that this expedient would be of little or no effect. Bubbling air through three inches of water will not saturate it, and it was found that nearly all expedients failed to do so. The only satisfactory saturation could be effected by passing the air through a bottle full of small pieces of sponge saturated with water. While we cannot think that Espy's air was saturated, yet it is certain that the experiments in 1889 were with saturated air, and hence must have shown a difference between dry and moist air, if any could have done so. The delay of several days in some of Espy's experiments after compression before explosion should have served, and probably did serve, to increase the moisture in the air, and not to diminish it, as he thought, and as his researches seemed to indicate. It might be thought essential, in order that this question may be settled beyond all doubt, that there be some explanation of Espy's results showing a slightly greater rise in the gauge after expanding dry air than when moist or partly moist air was used. Undoubtedly, if all the conditions were known, the difference could be easily explained. It is absolutely certain that it was not due to any latent caloric of elasticity that was given out by the moist air.

I think this discussion will enable us to reason more or less effectively as to what are the probable heating and cooling effects in the free atmosphere from descending or ascending currents, and the resultant liberation or production of energy. It is well known that the most perfect locomotive makes use of only five to ten per cent of the total energy developed. We have just seen, that in condensing air to 10 inches, instead of obtaining an increase of temperature of 163°, as theory seems to indicate, we have barely reached 4°, or one-fortieth of the theoretical amount. It is plain that this is due to the loss of heat into the environment of the air. Suppose, now, we take away this confining jar; suppose we make steam in the open air instead of our locomotive boiler; or suppose, instead of trying to compress air in our jar, we had the total horse and steam power of the whole earth engaged in compressing the free air by forcing it through syringes or force-pumps into the atmosphere. What would be the result? The utter absurdity of all this is most plainly manifest, but is it any more so than the attempt at developing effective energy in the free air, as has been theoretically accomplished by some? If there is this enormous dissipation of heat under conditions which we can control, must there not be a very much greater dissipation of heat in all out-doors? Is it not highly probable that many of the theoretical deductions find their only shadow of support in the fact that the assumptions call for a perfect engine without loss of a particle of energy? Has theoretical meteorology ever produced even a single essential effective element or part of this perfect engine? If the considerations herein set forth are borne out by subsequent researches, we must most certainly come to the conclusion that thus far theoretical meteorology has not had a single well-supported fact on which to base its profoundest theories of tornado generation and movement. Professor Wild of St. Petersburg has well said, "Without exact and satisfactory data, meteorology cannot develop as a science, but will be, as heretofore, mainly a tumbling-ground for vague speculations and dilettanti investigations." H. A. Hazen.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Ohio Meteorites.

Under date of June 13, Mr. George F. Kunz, in an article in *Science* upon meteorites, mentions two copper ear-rings found by myself in an Ohio mound as partly composed of meteoric iron. Mr. Kunz is in error as to the locality of the find. It was made at Frankfort, Ross County, O., and not in the neighborhood of Fort Ancient, as stated in the article.

The ear-rings are coated with a heavy plate of the iron, and are splendidly preserved, the iron having resisted atmospheric agencies remarkably well. It is slightly corroded in one place only.

The state of preservation is due to the placing of the objects in a layer of fine, dry gravel by the builders of the mound. The nearest skeleton was distant five feet, and the ear-rings did not accompany any remains. However, there were three copper hatchets placed alongside these ear-rings, and five other spools or ear-rings, too; but these latter were not covered with meteoric iron, or any other substance. The mound was examined in April, 1889. Warren K. Moorehead.

Xenia, O., June 18.

Vertical Components of Motion in Cyclones and Anticyclones.

In saying that there is an ascending component of motion in cyclonic areas, and a descending component in anticyclones (*Science*, May 30), I meant that the winds in these areas of low and high pressure do not move horizontally, but obliquely upwards or downwards. The evidence of this has been presented and discussed by Loomis, in his "Contributions to Meteorology," in the *American Journal of Science;* and an abstract of these has been prepared by Clayton for the *American Meteorological Journal.* Hann and others have also discussed the matter. If Mr. Velschow, who makes inquiry on this point in *Science*, June 20, is not already acquainted with the writings of these authors, a reference to them would perhaps satisfy him. W. M. Davis.

Cambridge, Mass., June 21.

BOOK-REVIEWS.

Locke. By Alexander Campbell Fraser. Philadelphia, Lippincott. 16°. $1.25.

This the latest volume of Blackwood's "Philosophical Classics" is one of the best of the series. It opens with a quite full account of Locke's early life and education, with brief sketches of his family and the various persons with whom he came in contact in those years, and by whom he may be supposed to have been influenced. It then recounts his entrance into political life, and the

various vicissitudes he experienced in consequence of the frequent changes of government, culminating in a ten-years' exile in Holland. These ten years were quite probably the most important in his whole life; for it was chiefly during this time that he thought out and composed his "Essay on the Human Understanding," and also some of his most important political treatises. The later events of his life, together with the history of his various works, are related by Professor Fraser with care, and with as much fulness as most readers will desire.

The account of Locke's life, however, is kept subordinate to the analysis and criticism of his philosophy,—a task which Professor Fraser has performed with great clearness and philosophical acumen. He remarks in his preface how great has been the influence of Locke's "Essay" upon subsequent thought, and that it "seems in excess of the author's speculative depth and subtlety or grandeur of character,—a remark with which most readers of the work at the present day are likely to agree. Professor Fraser shows, however, in another place, to what this influence is really due. Locke was the first thinker to place at the very portal of philosophy the question as to the "origin, certainty, and extent of human knowledge;" and, though he failed to answer the question himself, it has been recognized ever since as the main problem in human thought. When Professor Fraser comes to inquire why it was that Locke failed to solve the problem, he shows plainly that it was due to an insufficient comprehension of the intuitions of reason and of their philosophical importance. Locke did not deny their existence,—on the contrary, he expressly recognized their truth and self-evidence,—but he assigned them a subordinate place in his scheme, and therefore failed to give a satisfactory account of our ideas of substance, infinity, causation, and others, which cannot be derived from external or internal sense. Professor Fraser's discussion of this point is very able; and all who wish to understand Locke's work, and his place in the history of philosophy, will do well to read this book.

Russia: its People and its Literature. By EMILIA PARDO BAZÁN. Tr. by Fanny Hale Gardiner. Chicago, McClurg & Co. 16°. $1.25.

THE object of this work is to give an account of the present state of society and opinion in Russia, with a more particular examination of the works of the Russian novelists. Señora Bazán tells us at the outset that she is not acquainted with the Russian language; but she has read largely of the works in other languages that treat of Russia, together with all the translations from Russian literature that have appeared. She has also associated considerably with Russian authors and revolutionists in Paris, and by all these means has obtained materials for an interesting book. Of course, in a small book prepared in this way, we cannot expect any thing specially new or original; but the reader will find in it a clear and instructive delineation of the more important phases of Russian life and literature as the authoress understands them. She begins by briefly noting the leading points in Russian history, and then gives us a study of nihilism, which to our mind is the most interesting part of the book; while the rest of her remarks relate mainly to the new school of Russian novelists, beginning with Gogol, and ending with Tolstoï. Nihilism, she thinks, as others have thought, is in great part the product of the atheistical and pessimistic philosophy of Germany, though political discontent has had a share in forming it; and she shows clearly that it is confined to the more active and educated classes, the peasantry and workingmen generally showing thus far no sympathy with it. The characteristics of Russian fiction are attributed partly to nihilism, and partly to the spirit of "realism" which pervades all the fiction of the age. After spending several years, however, in the study of her subject, Señora Bazán confesses herself somewhat baffled, and ends with the remark, "Russia is an enigma; let those solve it who can—I could not."

Pestalozzi, his Life and Work. By ROGER DE GUIMPS. Tr. by J. Russell. (International Education Series.) New York, Appleton. 12°. $1.50.

ABOUT a year ago we had occasion to notice a translation of De Guimps's "Life of Pestalozzi," by Miss Crombie, and we are now favored with another by a different hand. Of the two, the rendering by Mr. Russell seems to us the best. We have not the French original at hand to test the accuracy of the work, but this is vouched for by Rev. R. H. Quick, who writes a brief introduction; and the translation reads like an original composition in English, thus making an interesting book. Moreover, it is complete, the narrative being given entire, with very copious extracts from Pestalozzi's own writings. It is therefore the best account of his life and work to be found in English, and is well worthy of a place in the series to which it belongs.

Of Pestalozzi himself we have perhaps said enough in former articles; but we may cite a few remarks by Mr. W. T. Harris in the "Editor's Preface," which he contributes to the volume. He holds, and rightly, that the Swiss educator's importance consists not so much in his method of teaching as in his ardent desire for the education and elevation of the poorer classes, who, previous to his time, had had virtually no education at all. According to Mr. Harris, "he is the first teacher to announce convincingly the doctrine that all people should be educated,"—a doctrine now held and more or less effectively practised in all civilized countries. It was to this end that all his labors were directed, and he had thus the honor of leading the movement for universal education. Of his method of teaching, Mr. Harris does not speak so highly, believing in particular that he laid too much stress on the mere training of the senses, and too little on the development of the thinking faculty. With these views we agree; and we cannot help adding, that, in our opinion, an efficient practical method was just what Pestalozzi lacked, the failure of all his educational experiments pointing strongly to this conclusion.

AMONG THE PUBLISHERS.

IN the *Atlantic* for July, Professor Shaler writes about "Science and the African Problem." Mr. Albert Bushnell Hart's paper on "The Status of Athletics in American Colleges" may be called "timely."

—Messrs. Ginn & Co. announce a revised edition of "Our Government," by Jesse Macy, professor of constitutional history and political economy in Iowa College.

—Edward Heron-Allen, the well-known expert in palmistry, has an article upon "The Cheiromancy of To-Day" in *Lippincott's Monthly Magazine* for July.

—The July number of the *Contemporary Review*, issued in this country in the original English form by the Leonard Scott Publication Company, New York, will contain a paper by Edward Bellamy.

—Any of our readers who are planning a trip to Europe should look at the "Guide to Europe" published by Houghton, Mifflin, & Co., and edited by the well-known Stoddard. The book is of convenient size, is well made for its special purpose, and contains just the information required by the vacation tourist. A new edition appears each year.

—The contents of the first number of the fourth volume of the *Journal of Morphology* (Boston, Ginn & Co.) are as follows: "The Origin of the Cerebral Cortex and the Homologies of the Optic Lobe Layers in the Lower Vertebrates," by Isaac Nakagawa, B.Sc., Princeton College; "The Skeletal Anatomy of Amphiuma during its Earlier Stages," by O. P. Hay; "The Segmentation of the Primitive Vertebrate Brain," by Charles F. W. McClure, fellow in biology at Princeton; "The Life-History of the Formed Elements of the Blood, especially the Red Blood Corpuscles," and "Observations upon the Occurrence, Structure, and Function of the Giant Cells of the Marrow," by W. H. Howell, Ph.D., lecturer in physiology and histology, University of Michigan.

—Some weeks ago we noticed the proposed series of popular science books to be published in this country by Macmillan. The first of this series, which appears under the general title "Science in Plain Language," is by William Durham, a fellow of the Royal Society of Edinburgh, and consists of a number of short essays on evolution, antiquity of man, bacteria, the basis of life, ancient lake-dwellings, etc. The titles would lead one to suppose the book to be of a somewhat disjointed character, but the author's aim was to

show a connection between all the subjects, illustrating the principle of evolution. The volume proposed to follow in this series will contain various papers on astronomy and physics, including "The Sun and Solar Energy;" "The Moon;" "Weighing the Sun and Moon;" "Size and Mass of the Earth;" "Planet Worlds and Suns;" "Fixed and Variable Stars;" "Star Clusters, Nebulæ, and Comets;" "Contents of Space;" "Formation of the Heavenly Bodies:" "Tides;" "Light;" "The Spectroscope;" etc.

—Two of the recent publications of the Johns Hopkins University may interest some of our readers. One is on "The Study of History in Germany and France," by Paul Frédericq of the University of Ghent, translated by Henrietta Leonard, and gives a somewhat minute account of the methods now pursued in teaching history in the universities of Germany and in the various higher schools in Paris. The historical courses in the German Universities are of two kinds, theoretical and practical, of which the former are like those in our own colleges, while the latter are intended to teach the student how to investigate and criticise the original authorities. It is these practical courses, as pursued in the historical seminaries, that M. Frédericq most esteems; and he devotes many pages to an account of the way they are carried on, the students doing most of the work, and the teacher making suggestions and criticisms. Some foreign observers have thought that this mode of investigating history was degenerating into a mere criticism of texts and study of trifles; but M. Frédericq thinks otherwise, though he admits that it might do so. The French historical courses in general he esteems less highly, but speaks with enthusiasm of those at the Practical School for Advanced Study (L'École Pratique des hautes études), founded in Paris a few years since, and which resemble to some extent those of the German universities. On the whole, M. Frédéricq's monograph, though too minute for most readers, is well prepared, and will doubtless be suggestive to American educators. The other pamphlet to which we alluded is "Notes on the Progress of the Colored People of Maryland since the War," by J. R. Brackett. This author had previously published an account of the negroes and of slavery in Maryland before the war, to which the present work is therefore a supplement. He speaks first of the political action of the negroes, which, in his opinion, has not helped them much, and then goes on to state what they have done in accumulating property and otherwise improving their condition. He reports, that, according to the best information obtainable, not more than two thousand of the Maryland negroes own any property, though the number of negroes in the State is over two hundred thousand. Considerable difficulty has been experienced by them in gaining admittance to the professions of law, medicine, and teaching; but they have finally succeeded in all these cases. Some prejudice and caste feeling still prevails; but, on the whole, the status of the negro in Maryland seems to be improving as fast as could reasonably have been expected.

— The Shakespeare Society of New York announces that it will immediately resume its publications (temporarily discontinued, pending the establishment of "The Bankside Shakespeare") with a second series, to consist of unexpurgated reprints of the Old English Miracle Plays, Mysteries, and Moralities, as illustrating the growth of the drama up to Shakespeare, besides the least known and edited English plays contemporary with Shakespeare's own work. This second series will discard the black and gold cover and 16mo. page heretofore used, and hereafter all of the society's publications will be issued in "Bankside" style, in the best work of the Riverside Press; laid paper, boards, parchment backs, 8vo.; uniform with "The Bankside Shakespeare." Two hundred and fifty copies of this series only will be printed, and the type will then be distributed, not to be reset under any circumstances. These impressions will be sold at $2.50 per volume, payable on delivery, plus postage. No. 1 of this second series will be "Iacke Drvms Entertainment, Or The Comedie of Pasqvil and Katherine. as it hath beene sundry times plaid by the Children of Powles. Newly corrected, London, printed by W. Stansby, for Philip Knight, and are to be sold at his shop in Chancery-Lane ouer against the Roles. 1616. (With notes, and Introduction touching the origin, growth and decadence of the Children's Companies.)" Address L. L Lawrence, clerk Publication Committee, N.Y.S.S., 21 Park Row, New York City.

—Welch, Fracker Company have published a work entitled "In Western Levant," by Francis C. Sessions, illustrated by Henry W. Hall. It is a record of travel in Spain, Morocco, Algeria, and Tunis, with brief descriptions of the most noted cities and architectural works, as well as of the character and habits of the people. There is nothing of much scientific interest in the book, the author having evidently sought for entertainment during his travels rather than for information; and the work is marred by a too florid rhetoric. Nevertheless those who are fond of books of travel will find many items of interest in this one. It is printed on good paper, suitable for the illustrations, which are pleasing.

—The fifth volume of the new edition of "Chambers's Encyclopædia" has been issued, and deals with the various topics from "Friday" to "Humanitarians." The scientific articles are quite numerous and important. Professor Geikie treats of geology; John S. Keltie, of geography; J. S. Mackay, of geometry; P. G. Tait, of heat; J. Arthur Thompson, of heredity; and there are many other articles that would demand notice in a minute survey of the work. Among the articles of a political and historical character are those on Germany, Great Britain, Holland, and Ancient Greece; while Charles I. Elton, M P., contributes a paper of several pages length, on government. Mr. Gladstone furnishes the article on Homer, while Justin M'Carthy sketches the life of Gladstone himself. Other biographical papers are those on Gen. Grant, written by Gen. Wilson; on Goethe, by Professor Dowden; and those on Grote, Hooker, and Hegel; while Henry George contributes a sketch of himself. This encyclopædia is, in our opinion, the best for the mass of reading and thinking men. The "Britannica," of course, gives a much larger amount of information on the details of the subjects treated; but then its articles are often too elaborate for a busy man to read, yet not elaborate enough for thorough students of their respective subjects. Besides, Chambers's has now the advantage of being the latest work of the kind in the market. It is published in this country, in agreement with Messrs. Chambers, by the J. B. Lippincott Company, Philadelphia.

— We have received a small pamphlet entitled "An Open Letter to Hon. Edward M. Paxson, Chief Justice of Pennsylvania." It is written by Richard B. Westbrook, who describes himself as both a bachelor of law and a doctor of divinity, and is a criticism of certain remarks of Chief-Justice Paxson in an address before the law school of the University of Pennsylvania. In that address Judge Paxson had affirmed that the law of Sinai was "the first law of which we have any knowledge," and that Moses was "the greatest statesman and law-giver the world has ever produced" These statements Mr. Westbrook disputes, and gives in an argument of moderate length very good reasons for doing so. He has no difficulty in showing that Egypt and some other countries had elaborate systems of law long before the date assigned to Moses; and he also shows, on the grounds now universally accepted by biblical scholars, that the legislation attributed to Moses is, for the most part at least, of very much later date. Exceptions may be taken to some of his statements; but, on the whole, every one whose eyes are open to the results of historical investigation will agree that he has proved his case. The pamphlet is published for the author by the J. B. Lippincott Company, Philadelphia.

— The Exchange Printing Company, 47 Broad Street, New York, has issued a book entitled "How to preserve Health," by Louis Barkan, M.D. The claim is made that this work is published with the purpose of bringing to public attention the results of the latest medical investigations. The objection to the author's plan that naturally occurs to one reading the pages is that a little knowledge is a dangerous thing, and that the author has gone too far in recommending certain courses of treatment for ailing humanity which shall be resorted to without consultation with a competent physician.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

AN EXPERIENCED TEACHER desires to hear of a town in which he can establish a high school. Or, he will lease an academy. Address, G., Lock Box 19, Suffern, N. Y.

WANTED.—By a lady-graduate of Cornell University, position as teacher in high school, seminary or college; prepared to teach the following branches, employing, so far as is practicable, the laboratory method: Geology, Botany, Zoölogy, Physiology; also, if desired, Physics, Chemistry, Logic and Psychology. References to heads of above-named departments in Cornell University. JENNIE T. MARTIN, care Cornell University, Ithaca, N. Y.

A GENTLEMAN of experience, highly recommended, liberally educated at home and abroad, desires to correspond with parties needing an instructor in the classics or modern languages in a high grade institution. Address EARLHAM, Germantown, Pa.

WANTED.—At the Bryant Summer School, Roslyn, L. I., a Lady to teach Sea-Life, and other Sciences. July 8–Sep. 8. Ten weeks to six months according to her convenience. Other papers please copy. E. HINDS, A.M., Principal.

WANTED—Information concerning the production of Mushrooms in caves and other places. Address M. H. CRUMP, care Ky. Geological Survey, Frankfort, Ky.

A YOUNG MAN, graduate from an American College, who has studied a year in Germany, and is now studying in Paris, would like professorship in chemistry. References from some of the best chemists. Address CHARLES E. LINEBARGER, Post-Restante, Paris, France.

WANTED.—An opportunity to study qualitative analysis in or near New York City during the summer. W. J. L., 120 Spring st., Sing Sing, N.Y.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Thorough knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

AN OHIO STATE UNIVERSITY graduate desires a position for next year as laboratory assistant or instructor in chemistry and physics. Three years' special preparation for such work. Two years' experience in teaching. References as to character and scholarship. Address C. S. ARNOLD, O. S. U., Columbus, O.

A GRADUATE of Princeton, for several years university student and Fellow in Biology, desires a position either to teach biology or as assistant in a biological laboratory. Would prefer the latter and be satisfied with a moderate salary if the position afforded time for the prosecution of original research. Address, O. S., BOX 86, Princeton, N. J.

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[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

For exchange—14 volumes (1883–1889) American Journal of Science, 10 volumes (1880–1889) American Naturalist, 21 volumes (1879–1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Wanted.—To exchange land and fresh-water mollusca, (principally *Helices Achatinellae*, Clausiliae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

To exchange for other books: Meek's Invertebrate Paleontology, Cope's Cretaceous Vertebrata, Leidy's Extinct Vertebrate Fauna, Lesquereux Cretaceous Flora. All being volumes of the Hayden Final Reports. Address, giving lists, T. N. Glover, Suffern, N. Y.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia, Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

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