the TECHNOGRAPH

for november 1929

ember of the engineering college magazines associated


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The TECHNOGRAPH

UNIVERSITY OF ILLINOIS

Member of the Engineering College Magazine Associated

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George A. Goodenough

George A. Goodenough

May 3, 1868 September 29, 1929

In the loss of Professor George A. Goodenough the University has received a great blow; one from which it will take a long time to recover. Professor Goodenough was an integral part of the University activities; he was an essential factor in the daily functioning of this institution; and his passing is keenly felt by those who have had occasion to become closely acquainted with him and upon whom falls the stupendous task of filling the vacancy which he has left. Being, as he was, deeply interested in all phases of undergraduate activity, Professor Goodenough was well known and profoundly admired by the University faculty and by the student body.

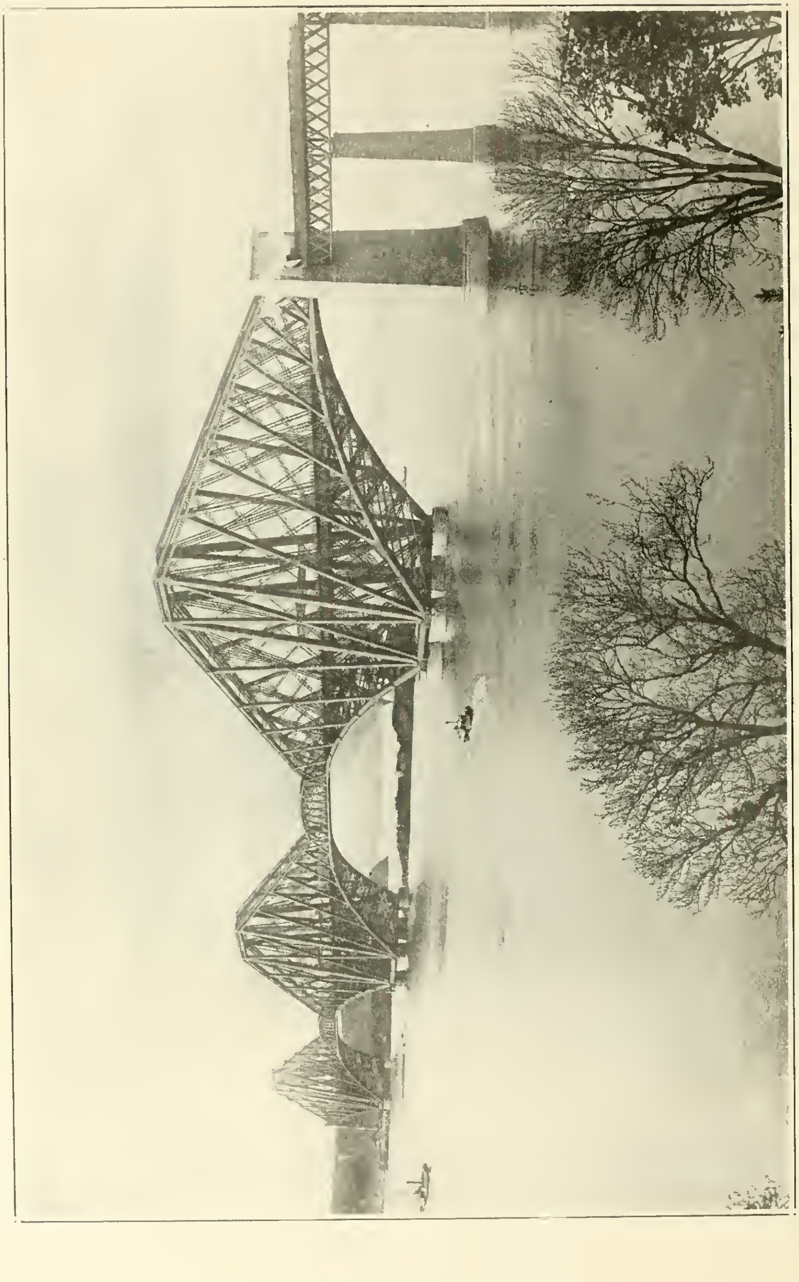
As an instructor he was noted for his far-sighted teaching methods, his fair criticisms, and his earnest endeavors to impart his knowledge to others. His clear, concise manner of presenting subject matter, and the quiet sympathetic way in which he helped his students won for him their lasting affection and served as an inspiration and incentive for them to penetrate deeper into the intricacies of the fields in which they were studying.

As a member of the council of administration's disciplinary committee for men and later as a member and chairman of the Big Ten eligibility board, Professor Goodenough was an arbiter, admired for his keen, sound thinking ability, his disinterested viewpoint on questions which came up for his decision, and his strength of will-power and determination in upholding his convictions and beliefs. The record of his work on the Conference eligibility board as the representative of Illinois is one of which we may well be proud.

Among engineers he was regarded as one of the foremost authorities in his field, and many successful major commercial projects have been the results of his ability. He was the author of several widely used text-books as well as numerous articles in technical publications. He was called upon countless times for advice of a technical nature, and he always willingly contributed his part toward the betterment and advancement of the sciences and of engineering practice.

While Professor Goodenough devoted the greater part of his life to developments in engineering fields, he always had time for his students, his colleagues, and his fellow-beings. He will be missed by people throughout the country, wherever his dynamic personality has penetrated.

To quote President Kinley: "Professor Goodenough was one of the greatest authorities in the field of thermodynamics, and he has made many important contributions to this field. He held the respect and affections of all his colleagues. As a man, he was fair minded, kindly, lovable. His passing is a great loss, difficult to provide for."



Famous Forth Bridge, Scotland

THE TECHNOGRAPH

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VOLUME XLII URBANA, NOVEMBER, 1929 NUMBER 1

Train Operation in the British Isles

H. IVAN ANDREWS, R.M.E., '29

(A.C.G.I., D.I.C., B.S., Traveling Fellow, University of London)

THE celebrated American who, on visiting England, declared that he was afraid to walk far lest he should fall into the sea, was only expressing in an exaggerated manner the feeling of limitation experienced by all Americans on landing in the British Isles. Not only do they represent the most thickly populated and industrially congested area on the globe, but the country of North America is so spacious as to afford tremendous contrast. Rightly called "the country of big things," America has, from its geographical stimulus, built up a system of civilization on a scale whose magnitude is incomprehensible to the less ambitious inhabitants of Europe. As Tagon remarks, "America is like seeing life through a magnifying glass." The enormous natural resources of the country could not but engender a national characteristic of business capacity in the minds of the settlers, who, inspired by their surroundings, have developed a commercial system of surprising magnitude. The huge corporations which now dominate the markets are directly the outcome of this system, coupled with the democratic tendencies of the nation at large.

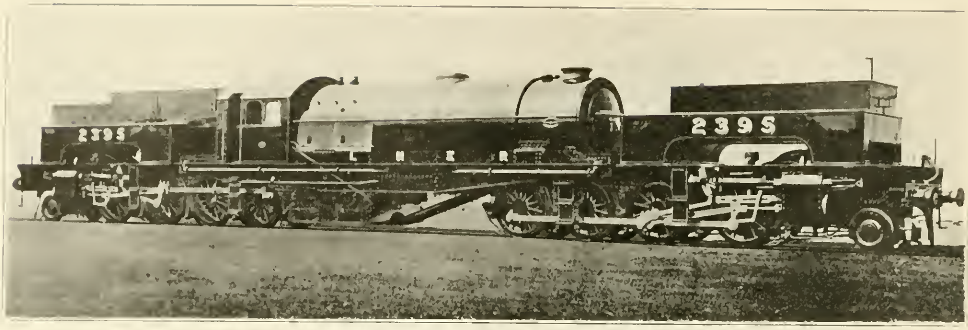
At first it may seem somewhat unreasonable to claim that their national tendencies could have had any effect on such remote subjects as locomotive design, booked schedules, and general train operation, yet such is the case. The general method of application is best considered by the use of a simple example. The state of Minnesota is a production area, but the nature of its production tends to the raw, the heaviest haulage being that of grain. On the other hand Massachusetts is concerned mainly in the production of manufactured articles, equally essential to human life, but of a totally different nature to those of Minnesota. In order that civilization may continue it is necessary that exchange of produce take place between Minnesota and Massachusetts, which exchange can only be effected through the medium of the railway. Since these states are over a thousand miles apart, it is convenient to dispatch the freight from a marshalling centre at each end, say from Minneapolis and Boston. The networks of railways already converging on these towns are already adequate for the collection and distribution of the individual cars within the respective areas, hence the problem resolves itself into that of handling the through freight between the two centres as economically as possible. Since only one pair of tracks are involved, high traffic density is obtained even from areas with a low density of production, while sometimes single track provides the necessary capacity. In either case it is essential that the cars be made up into the heaviest possible trains, often to several thousand tons, while the distance involved demands high speed transit that the capacity of the track may be fully employed. It is readily seen that the greater the capacity of the locomotive, the more economical will the system of transportation be, and that the true criterion of locomotive design is haulage capacity in gross ton miles per hour.

The corresponding European situation can most clearly be visualized by imagining Minnesota not merely adjacent to, but even overlapping Massachusetts. In this case, while the total tonnage carried is probably considerably greater, the distances involved are extremely small in comparison, while the establishment of large despatch centres is obviously ridiculous. The combined states would probably be covered by a single network of lines, practically all double tracked, while the trains

A Common Type of British Locomotive

themselves would be limited to a few hundred tons of the local order. In England the situation is further complicated by the existence of London, which, being out of all proportion to the size of the island, completely dominates the railway system, forming a hub from which practically all lines radiate.

British locomotives have therefore been developed with the view to handling enormous volumes of traffic in comparatively small units over short distances. For the passenger traffic the public demand the highest pos-



The "Garratt" Type Used for Heavy Freight Service

sible speed compatible with safety, though with the exception of perishable goods, the excellent network of track available enable the goods (freight) trains to be run at the most economical speeds, that is about six to twelve miles an hour. Express trains have usually about twelve cars, in the neighborhood of four hundred tons behind the tender. The cars themselves are much lighter than those in the U. S. A., but carry about the same number of passengers, who however, are arranged in separate compartments seating 8-10 and interconnected by a corridor down the side of the coach. No loaded passenger train is allowed to consist of more than 136 wheels. Maximum loads are frequently stipulated for given trains taking into account the class of locomotive and the gradients of the line. Unfortunately, however, the correct class of locomotive may not always be available, yet, time is rarely lost for these occurrences. The goods trains average about 600-800 tons, and usually consist of small trucks of 10 tons capacity weighing 16 tons loaded. Heavier vehicles are of course available, but they are very little used. Enormous variety of wagons is also available for the handling of special loads as required.

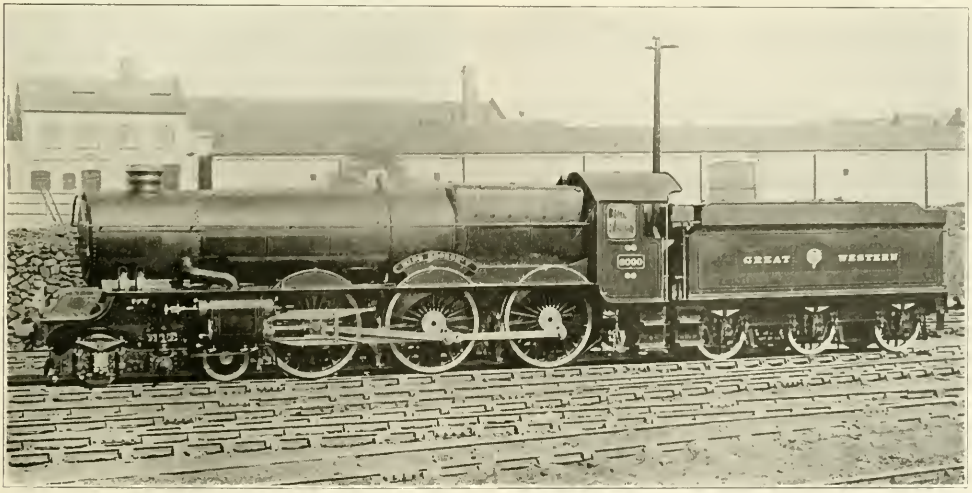
The great diversity among the various classes of traffic has naturally resulted in a corresponding variety amongst classes of locomotives. Probably the most common types are the four coupled engine with leading bogie (4-4-0) for passenger service, and the plain six coupled locomotive (0-6-0) for goods work, both of these classes having inside cylinders. This latter feature is so unknown in America as to give the American the impression of a complete lack of "works" which appears ridiculous to his practical mind. However a short footplate trip on one of these engines would soon convince the critic that not only are there some "works," but that they can function when called upon, while he would be agreeably surprised at the smooth riding of the engine. There are many other advantages to inside cylinders, but their comparative inaccessibility renders them unfavourable in democratic America, apart from various difficulties in present dimensions. Outside cylinders are quite common, but only on the larger engines where usually more than two cylinders are employed. In this connection the photographs added to the collection of the Railway Engineering Department have been criticized as non-representative in that all the locomotives shown have outside cylinders; the answer to which is that the photographs were intended to represent recent designs, and naturally the larger and more spectacular types were chosen. Amongst the seven locomotives can be counted no less than twenty-seven cylinders, though this is including the "Garratt" which has six. To any one having a genuine interest in locomotive design these photographs, which are on view in the hall of Transportation building, should amply repay a few minutes of careful study.

An economic development of recent years peculiar to British railways has been the introduction of what are termed "mixed traffic locomotives" to which no particular duty is assigned, but which may be relied upon to make reasonable effort upon service, passenger or goods, to which it may be assigned. A typical type of this class of locomotive would be a six coupled locomotive, with a single pair of leading wheels, having two or three cylinders. Many and varied are the tales told of exceptional performances put up by these locomotives when called upon for emergency, notably the occasion when one hauled the "Flying Scotchman" herself to time, or perhaps the even more remarkable occasion when one was placed at the head of the Great Western's crack 62 miles an hour Bath express, and maintained schedule including once touching 80 miles an hour. Indeed one sometimes wonders whether the expensive express locomotives employed are such an absolute necessity as generally assumed. A class of traffic rarely handled in America, is the congested outer suburban traffic which occurs around the principal cities. Practically all of this arrives in the two "rush hours" when enormous numbers of passengers all desire accommodation, at or about the same time, on the same services. These are all handled by "tank" locomotives, that is locomotives carrying thus food and water supply on their own frames; having no tender they are equally capable of running in either direction, and do not need reversing at the termini. These engines are also capable of very varied operation since they are frequently utilized for other services out of the rush hours, notably for shunting (switching) or handling empty passenger stock, or local trains. Occasionally the longer distance trains obtain clear runs over the last ten miles into the city, when the little engines will often provide speeds up to 60 miles an hour in order to minimize their occupation of the line, a most desirable function of this class of locomotive. As with the longer distance locomotives the class of traffic to be hauled varies considerably, and the designs vary in size and power from the minute engine serving some local town, to the magnificent express tank locomotive that hauls the frequently stopping expresses in the more congested industrial areas. They all have the common feature of complete reversibility and the avoidance of the tender, which renders this initial cost much lower for a given power.

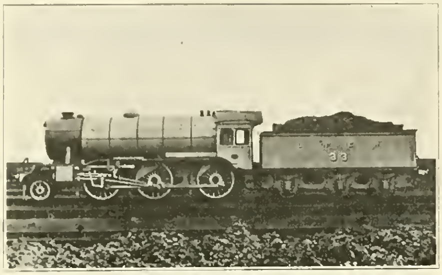
In contrast to the U. S. A., where almost all locomotives are designed upon practically the same standards, British locomotive designers fall into two distinct "schools," the predominating differences in their work being the proportion of the boiler, and the manner in which the coal is burnt. On the London and North Eastern Railway (L. & N. E. R.) large capacity boilers are fitted, and the coal is burnt on a large wide grate comparatively slowly, both of these conditions being similar to those occurring in America. The other lines however, fit for smaller boilers in proportion, while the coal is burnt fiercely upon a long narrow grate of comparatively small dimensions. This may be done economically owing to the very good quality coal obtainable in England. In 1925 a most interesting trial took place between locomotives of each class, resulting in a marked economy for the small boilered locomotive. With a poorer grade of coal however, it is probable that the position would be reversed, since it is well known that the "King George V" which was sent over for the Baltimore and Ohio Centinary Exhibition, failed to steam up to her usual standard on the grade of coal provided. On the other hand it was observed that the running of the large boilered locomotives was quite unimpaired by the poor quality of coal available after the general strike of 1925.

One of the most interesting developments of recent years on British Railways has been the gradual conversion of all lines except the Great Western Railway (G. W. R.) to the practice of left hand driving. At first sight the mere change of position of the driver might not appear of any great significance, but the various changes implied with the change of position have been found of considerable benefit, and are conducive to greater safety particularly in connection with the running of fast trains through congested areas. It must be remembered that the system of signalling employed is far more complicated than any system in use in America, and that this complication is extended continuously over the whole route. An enormous variety of signals and aspects are employed, each having its own special significance. It is nothing unusual for the express driver to find himself confronted by a huge gantry of signals exhibiting some fifty or sixty aspects, from which he has to select those which apply to him and act accordingly. During recent years the system has increased in complexity, till, at the instigation of the Institution of Locomotive Engineers, left-hand driving was introduced to alleviate the situation. Owing to the limitations of the British loading guage it can well be imagined that, with the present size of boilers, the view ahead from the cab windows has become extremely limited. Generally it is impossible to see the track ahead, while many of the previous arrangements of signals would be completely invisible. Now as in England all trains run upon the left-hand track it is seen that the new position occupied by the driver is upon the outside where signals may most conveniently be erected. On this system, the old marts, which were sometimes up to 60 feet high have been removed entirely, and new posts about 15 to 20 feet high, not infrequently in ferro-concrete, have been erected in their places. Incidentally this has effected a great economy in signal maintenance, but the advantage to the driver is enormous. In place of the old complicated vision the particular signals applying to his track occupy the central position in the driver's limited vision, and on approach appear to pass directly over his head. Thus there is far less possibility of a mistake upon the part of the drivers, most of whom greatly appreciate the advantages of the new system. The system is also peculiarly applicable to the new high power colour light system now coming into popularity. This is very similar to the systems of colour lighting employed in America, except that four aspects are frequently exhibited by a single signal, and the lamps themselves are specially designed with a view to fog penetration. At complicated junction points, route indicating signals, in which a number appears corresponding to the road provided, are also placed in advance of the facing points (switches). With this system it is believed possible to run trains at schedule speed in perfect safety through fog of such density that the driver may be unable to distinguish his own buffer beam.

The majority of English express trains are run at what would be considered in America extremely high speeds; for instance several trains, particularly on the Great Western, are scheduled at average start-to-stop speeds of over sixty miles an hour. These bookings of course make no allowances for speed restrictions, permanent way checks and gradients, all of which losses



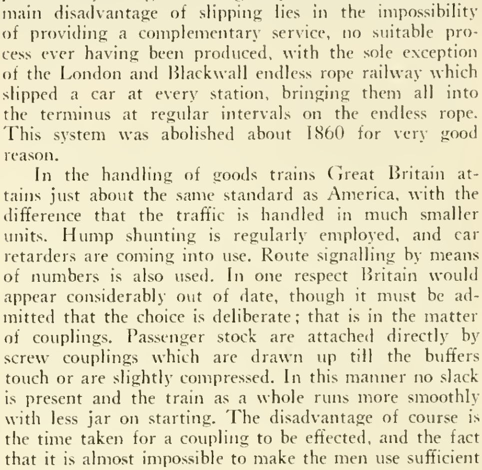
Four Simple Cylinder "King George V" which was Exhibited in America have to be made up by engine performance. Many more trains maintain averages of over fifty-five miles an hour. Probably even more difficult to maintain are the short distance expresses whose runs are not of over an hour's duration, as so little opportunity is available to make up time for any unforseen delay. An excellent example of this is the famous Southern Bell Limited which is required to cover the 51 miles between London and Brighton, inclusive of a continuous speed restriction through London suburbs, in exactly one hour. In England the term Limited, when applied to an express, implies that the total load must not exceed a certain stipulated allowance, so that the running department have little or no excuse for not running the train to exact schedule; indeed the late arrival of a limited train is an extremely rare occurrence. Recently considerable interest has been attached to the operation of non-stop runs, several of which have been considerably extended during the past year. Notably the introduction of the corridor tender has enabled the distance of 394 miles from London to Edinburgh to be accomplished non-stop. Coal sufficient for the journey is carried on the tender, which is a part of the train rather than of the locomotive, while water is scooped up from the troughs on the route and a relief crew travel with the train, and pass up to the footplate through the corridor in the tender. This of course is a more spectacular run, and must not be misunderstood as a means of speeding up traffic. Indeed no cut has been made in the famous 8 1-2 hour booking, so that the task of the locomotive has actually been eased by the innovation. The real reason for the change was the avoidance of the exchange of passengers and baggage, and the consequent commotion entailed by the intermediate stops, then having been estimated enough through passengers to justify the change for their convenience. A second train making the usual stops follows after a ten minutes' interval, even when the "Scotchman" is run in several sections. In the winter season the usual stop at Newcastle is reverted to, when both locomotive and crew are changed. From the passengers' point of view, an equivalent non-stop service is provided by the West Coast route, though technically a running stop is made at the village of Carnforth for a change of crew. Here, incidentally, the "Royal Scot" express is split into two sections, one for Glasgow and the other branching off to Edinburgh, except in the season, when the two sections are hauled separately. There are many other trains running distances of over one hundred miles non-stop, the next longest being the Cornish Rivera Limited which covers the 225 3-4 miles from London to Plymouth, frequently slipping cars of Exeter. The practice of slipping a car, or even a train is still maintained on the Great Western when as many as three sections may be slipped. Slipping



The Common 2-6-0 Type

is accomplished by a special guard traveling with the section. Before the station is reached, travelers are warned that the train does not stop, and the passengers for that destination are segregated to the rear car or cars. The guard then disconnects the brake and steam lines and breaks the corridor connection and awaits the moment for uncoupling. This is intimated to him by the driver who slows the train down a trifle by applying the engine brake, thus causing the cars to "bunch" and relieving the couplings, when the slip guard uncouples by means of a special mechanism known as the drop hook. After a suitable interval the train speeds up again, leaving the slip coaches to run into the station under their own momentum where they are brought to a standstill at the platform by the guard using a special brake valve. The main disadvantage of slipping lies in the impossibility of providing a complementary service, no suitable process ever having been produced, with the sole exception of the London and Blackwall endless rope railway which slipped a car at every station, bringing them all into the terminus at regular intervals on the endless rope. This system was abolished about 1860 for very good reason.

In the handling of goods trains Great Britain attains just about the same standard as America, with the difference that the traffic is handled in much smaller units. Hump shunting is regularly employed, and car retarders are coming into use. Route signalling by means of numbers is also used. In one respect Britain would appear considerably out of date, though it must be admitted that the choice is deliberate; that is in the matter of couplings. Passenger stock are attached directly by screw couplings which are drawn up till the buffers touch or are slightly compressed. In this manner no slack is present and the train as a whole runs more smoothly with less jar on starting. The disadvantage of course is the time taken for a coupling to be effected, and the fact that it is almost impossible to make the men use sufficient care, with the result that loss of life still occurs, though far less frequently than formerly. Since most of the stock is run in complete trains the necessity for uncoupling is comparatively rare, while the corridor sections must be separated anyway so that the time taken is of little consequence. A feature which is now receiving much attention is the Grisley articulated bogie, on which the adjacent ends of two coaches are permanently attached and carried on a single bogie. Common examples are presented by double or even triple sleeping cars, or two restaurant cars separated by a kitchen car, while occasionally whole trains may be run so arranged. It is most popular on suburban stock where trains are usually composed of two sets of five or four cars, only one set being used in the slack periods. The chief advantages claimed



A Typical Tank Locomotive

(Continued on Page 38)

Setting Forms and Preparing Subgrade for Pouring

Widening State Bond Issue Road Into City Pavement

ELLIS DANNER, R. C. E. '29
Schaefer Prize Competition Essay, 1928-1929

ILLINOIS State Bond Issue Route Number 98 was completed through Main street in Ipava, Illinois, in the summer of 1927. The village board of Ipava had proposed a plan of building a standard city pavement throughout Main street in cooperation with the state work. Favorable action on the proposal was delayed and the eighteen foot pavement was put in place. Later, however, the citizens voted to complete the paving of the east half of Main street and the contract was let to a local lumber dealer in July, 1928. The writer, as resident engineer for the Canton Engineering Company, was in charge of the work from the beginning until its completion, a period of about six weeks.

The plan of the work was comparatively simple, since the state engineering department had considered the probability of such a project and had established a grade and alinement best suited to the existing sidewalks and cross streets. The project was staked out just as needed to avoid duplication of work, because the stakes were soon moved or knocked out by careless workmen. Alinement stakes, offset two feet from the form line, were ser at fifty foot stations, at the ends and centers of the arcs, and at the back of the intersection wings. The grade for the top of the curb was marked on the alinement stakes and was established from the edge of the state pavement by allowing a fall to the gutter line of two hundredths feet per foot and six inches for height of curb. The grade of the state road was sufficiently steep to eliminate any serious problems in drainage.

The only excavation necessary was that of cutting the existing shoulders down to subgrade and removing about a foot of dirt for the intersection wings. The ground was loosened with a ten ton Best pulling a scarefire and plow and was removed with teams and scrapers. The dirt was piled along the edge of the street to be used later in backfilling. A grader finished the excavation roughly to subgrade. Nine inch steel forms with four inch base, eight feet in length, and held in position by iron stakes, were used for the pavement slab proper. They were placed and set for grade and alinement and rigidly fixed by locking to the stakes and tamping the earth firmly under them. A wooden templet, cut for the proper subgrade and made to ride on the form and edge of the slab, was pulled along and the subgrade was finished to it with shovels. The ground was then compacted with an eight hundred pound hand roller and thoroughly wetted. The subgrade was checked once more just ahead of the pouring and wetted again.

The six catch basins were put in while the excavation was being done. The holes were dug in the proper position four feet square and about four feet deep. The base and walls were at least eight inches thick and were made of brick laid in Portland cement mortar. The well was twenty-four inches square and thirty-six inches deep, inside dimensions. The outlet was a ninety degree elbow of eight inch vitrified pipe, set in the wall with the face of the opening horizontal and facing downward. The face of the opening was about four inches below the flow line and the flow line twelve inches below the top of the well. The elbow was connected to an eight inch sewer drain with eight inch vitrified pipe. The covering for the well was a cast iron box and grate, weighing about four hundred pounds. The box was six inches high at the back, seven inches high at the front, and had a grate opening twenty-four inches square. It was fitted with an adjustable curb box with a radius corresponding to the arch in which it was to be placed. The grade of the well base had been set such that the top of the cast iron box was one tenth of a foot below the normal pavement grade at that point. In finishing, the concrete was sloped down to the edge of the box to form a pocket into which the water would drain.

Washed sand and gravel were used and were inspected by the state materials inspector at the shipping plant. The aggregate was hauled from the cars in trucks and piled on the state pavement where it was to be used. The Atlas cement was stored in a lumber storage shed and hauled out as needed. The water was piped to the mixer from the nearest city hydrant. The aggregate was measured in wooden hoppers built high enough that a wheelbarrow could set under them. Each of these was checked several times throughout the work with a one cubic foot box. The amount of mixing water was adjusted for the existing conditions to get the desired consistency and maintained constant as long as other conditions remained the same by use of a graduated tank on the mixer. A 1:2:3½ by volume mix was used and minimum mixing time was one minute. The one bag Jaeger mixer was placed on the state slab in convenient positions and the dry materials hauled to the skip in wheelbarrows.

The slab sections varied in width from six and one-half to sixteen and one-half feet. The pavement had a thickness of six inches from the slab to a point two and one-half feet from the form, from which it changed uniformly to a thickness of nine inches at the form. One-half inch by five foot deformed steel reinforcing bars which had been placed at five foot intervals in the state slab were straightened and embedded in the new concrete. Seven-eighths inch longitudinal steel bars, which had been painted with red paint and thoroughly dried, were placed along the edge of the pavement four inches from the form and four inches above the subgrade. One-half inch bituminous expansion joints were placed in the slab and curb every thirty-five feet. The gutter line was carried directly across all intersection wings which did not have catch basins. The wings without catch basins sloped uniformly from the back to the gutter line and those with catch basins sloped uniformly from the back to the edge of the eighteen foot pavement. The back of the wing was set just high enough that the water would drain toward the Main street gutter line and was given a crown of one hundredth of a foot per foot of width. On one short fourteen and one-half foot section on the north side which came between two six and one-half foot sections, the gutter line was carried straight through six feet from the edge of the state road, forming a V-shaped section with the same slope on both sides of the gutter line.

Curing with Calcium Chloride

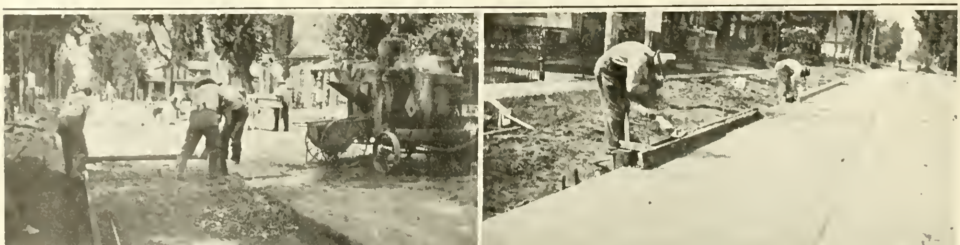
The forms and longitudinal bars were oiled ahead of the pouring. The concrete was hauled into place in a buggy. One man distributed the concrete in the forms and thoroughly spaded it along the forms. A two by six inch plank with handles on the ends was used to tamp the concrete and strike off the top surface. It was necessary to put steel plates on the ends of the straightedge to prevent their wearing off with the continual sliding on the forms and slab. The surface was belted once, checked for smoothness with a ten foot wooden straightedge, and finished with a long handled wooden float. The surface water was drawn off with the ten foot straight-edge and the surface was belted again once or twice as needed to produce the desired finish.

As soon as a short section of the slab was finished the curbers began their work. The integral curb was six inches high, had a flat top three inches wide, and a face in the form of a reverse curve with three inch radii. The curb form was a two by six inch wooden form set on top the steel form and held in place by clamps and braces. The body of the curb was of standard mix except with some less water, was tamped in, and held in place by a clamped face form until it would stand up. Then the face form was removed and a mix with the coarse aggregate left out was put on to finish the shape of the curb. The desired shape was obtained with a wooden templet cut to the specifications. The finishing was done with trowels made to fit the parts of the curb and a brush. At private driveways twelve feet of lip gutter replaced the regular integral curb. The lip was two inches high at the back and sloped down to the pavement in eight inches. The curb was rounded off to meet the lip at the sides of the driveways.

At the end of each day's paving the new concrete was covered with burlap and wetted down. The next morning the burlap and forms were removed, the pavement checked for high spots, and those above one-quarter of an inch rubbed down with a carborundum brick. All high spots found were removed before the coarse aggregate was exposed to any great extent. A great deal of care had to be used by the finisher at the expansion joints or bumps would result between the two sections of the slab. A special straightedge with a notch in the center for the joint was used at these points. The curing was done with flaked calcium chloride. A minimum of two and one-half pounds per square yard of pavement was spread evenly over the surface as soon as the pavement was checked.

Marginal curbing was constructed at the back of the intersection wings to protect the edges of the pavement. It consisted of a slab of concrete, six inches wide, seven inches deep, with one edge flush with the edge of the pavement, and sloping away with a pitch of one inch. This curbing was built after the pavement had set so

(Continued on Page 42)



Pouring Concrete and Building Integral Curb

India and Way Stations

Howell H. Reeves, *r.e.e.* '10

THE steamship "George Washington" of the United States Lines took me from New York to Plymouth on the southern coast of England. Plymouth is a beautiful harbor, and, as you know, was the scene of Admiral Drake's game of bowls at the time the Spanish Armada appeared off the coast of England. But of more interest to us is the thought that some three hundred years ago there sailed forth, past the green hills of this picturesque harbor, a band of brave-hearted men and women who have immortalized the name of Pilgrim throughout the world, and whose courage may still be found, I hope, in the hearts of some of us. As I travel on the palatial liners of today, with every comfort and convenience that modern science can provide and observe my fellow passengers, I often wonder how many of them have ideals high enough and courage sufficiently great to face the dangers that the Pilgrims braved in their search for freedom, liberty and justice. That they did not always accord to others the same freedom which they demanded does not detract from their courage.

"India and Way Stations," is the title of a talk given by Mr. Reeves before the Illini Club of the General Electric Company this past summer. The account of the trip is of such interest, and shows so well the unusual work an engineer may be called upon to do, that the Technograph has put his words into the printed form.

When Mr. Reeves graduated, he was asked by the school his preference of locations for work. His reply was "Earth." Since then he has been with the General Electric Company, and his work has been confined, in the most part, to the earth. The trip to India is the second of this type that he has taken, the first one being to Japan to investigate, there, the possibilities of expansion of the electrical field.

From Plymouth I went by train to London, passing through a beautiful section of English countryside where three centuries ago thousands of venturesome souls preferred to remain in the comparative comfort and safety of their green fields and substantial brick farm houses. During the week spent in London I visited the British Thomson Houston factory at Rugby. Rugby, the place made famous by Tom Brown and his school exploits, still has its school boys with their various caps representing the different forms and doubtless among them may still be found venturesome spirits, for boys are much alike from age to age. Rugby, situated as it is in what is known as the Shakespeare country, gave me the opportunity of seeing Warwick Castle, the original seat of the Guy family. The founder of the family was one of the Crusaders, the scene of whose exploits I saw later in my trip. Not far from Warwick Castle is the old Mill and pond that inspired Charles Kingsley to write the "Water Babies," and the story is no more delightful than its setting. In the stones of the old mill are carved the names of dear friends of ours: George Elliott, Charles Kingsley, Bobby Burns and others.

A few miles beyond the old mill stands Kenilworth Castle, one of the most picturesque ruins I have ever seen. Most of the battlemented towers still stand to remind one of the golden age of English history. Far below are the dungeons that were well known to those who crossed the will of Robert, Earl of Leicester. The spacious courtyard where many a gorgeous pageant flashed across the page of history; the stables where the stamping stallions fretted for the combat; the old tilt yard where brave knights in gleaming armor strove for victory and the favor of fair ladies, watching from the balconies above; the remains of the moat that held Cromwell at bay in later years, for Kenilworth was the last stand of the Cavaliers; the room in the Castle occupied by good Queen Bess when she visited her famous admirer; the banquet hall where lords and ladies drank each other's health and intrigued for the favor of Queen and Earl — all these scenes and more present themselves as our imagination wanders through the years that are gone.

From Kenilworth to Stratford-on-Avon is but a short distance. The birthplace of Shakespeare was reached as the afternoon's shadows were stretching across the Avon. One's senses are keenly alert to feel those cosmic forces that must have touched responsive chords in Shakespeare's soul, for how otherwise could he have written with such a philosophically keen perception of the complexities of life.

Back in London I saw the usual points of interest, such as St. Paul's and Westminster Abbey, the Tower of London, and London Bridge which is still falling, but not fallen. I had a very delightful trip to St. Alban's with its oldest inhabited house in England, and another along the Thames past the house where the Magna Charts were signed, to Windsor with its castle. It was at Windsor that I saw the Eaton College boys with their tall silk hats that would have been the delight of every American boy, providing there was a stone or other missile handy. I could hear their remarks in my imagination: "Cheese it kid! pipe the hat!"

From London I went by the Imperial Airways to Brussels in Belgium. England is a most delightful country to fly over. Its roads with their neatly trimmed hedges, the substantial red brick farm buildings, the red cattle and white sheep on the background of green pastures and meadows, with an occasional grey stone castle projecting its towers and battlements into the peaceful and verdant landscape, make a most delightful picture.

Brussels I found rather quaint in some respects, with its market place surrounded by the old guild halls. The Roman Catholic Cathedral in Brussels gave me my first impression of what I might term the medieval religious atmosphere. The Cathedral of Notre Dame in Paris is more gorgeous and more beautiful, but hardly more impressive in a religious sense. The Church of Le Madelaine in Paris has the most exquisitely beautiful altar I have ever seen. Paris reminded me much of Washington, D. C. in its general characteristics and the layout of its streets. Washington of course, was planned by Le Enfant, a French engineer, and he probably modelled it somewhat after Paris.

From Paris to Milan, where again I was to feel that

Large Underground Reservoir Built by Romans

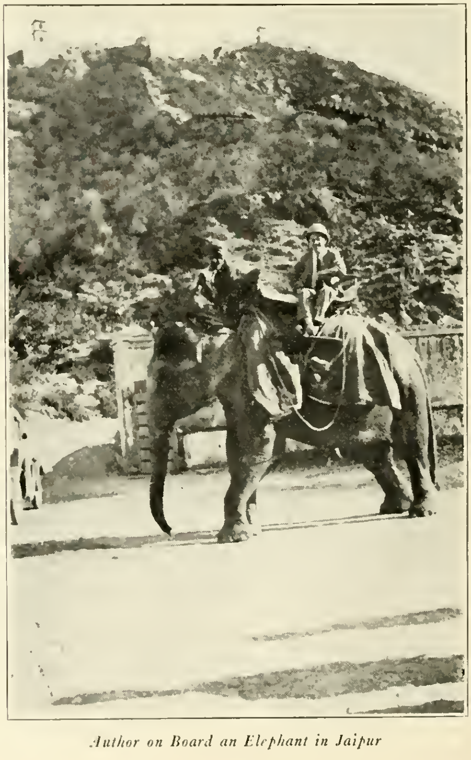
overwhelmingly impressive grandeur of the early Christian Churches. As one stands by the Galleries in Milan and gazes across at the Cathedral, that super-edifice of all time, with its hundreds of spires and minarets, its thousands of exquisitely carved statues, its gorgeous windows and beautiful doors and main steeple with its statue of the Mother of Christ 365 feet above the pavement, one begins faintly to realize the wonderful faith that dominated the lives of the early Christians. The names of the architects, painters, sculptors, and artists of all kinds who have contributed to this magnificent structure would constitute a hall of fame in any land at any time. The church is of white marble in Gothic style and its total length is over 500 feet, being exceeded only by St. Peters in Rome. But it was the tremendous amount of minute detail that filled me most with admiration. As one clambered over the roof, marble statues exquisitely carved appeared in most unexpected places, scores of feet above the ground. Inside, the whole atmosphere was one of awe. The mammoth pillars of marble 8 feet in diameter reaching up to dim heights to support the vaulted roof 164 feet above, the beautiful stained glass windows through which an occasional shaft of sunlight would come as a rainbow from the sky, the remarkable paintings, sculptures, carvings, draperies, seen too dimly to disturb the thoughts of the worshippers, the dimly lighted altar far in the distance, all blended together to produce the most awe-inspiring, worshipful atmosphere that human mind can imagine.

It was also my privilege to see while in Milan the original painting of the Last Supper by Leonardo di Vinci. Words of mine cannot describe it, but probably no picture has been more frequently reproduced or more widely distributed than this. Hours and hours would be needed to analyze it and to get the feeling of the artist as he painted the expression in the faces of Christ and his Apostles. As one gazes at the painting his thoughts fade back two thousand years to Jerusalem with its narrow crooked streets, to this little room (for it could not have been large) where these men are gathered about the table. One of the Apostles is leaning across to Christ, their faces become alive, you almost hear their words, your attention is concentrated, for you must not miss them, the words that have given life and hope to humanity. Faith is in their faces. Oh, how simple and how sublime is faith to those who possess it. Love is in their faces. The love that makes all men brothers. Charity is in their faces. The charity that refrains from judgment. Faith, love, charity, the trinity that makes men divine.

From Milan I returned to France sailing from Marsailles for Bombay. Across the Mediterranean, past Sicily to Port Said and the Suez Canal, then down the Red Sea past Mt. Sinai and into the Indian Ocean. The trip was without particular interest except for the beautiful sunsets in the Red Sea and the fascinating electric storms on the Indian Ocean. During one of these we had the good fortune to see a water spout, a not very frequent sight so old India hands tell me. It formed directly ahead of the vessel and we passed it not a hundred yards to starboard. The twisting, writhing column looked like a giant elephant's trunk reaching from clouds to water.

On the last day of November I landed in Bombay in a white suit and topee for any other kind of a hat is not worn during the day time in India. It just isn't done and that is reason sufficient for the Englishman.

India (whose name is derived from the Sanskrit term for the River Indus) lies in the central peninsula of Southern Asia, and is, after China, the most populous country in the world. It has for its natural boundaries the Himalaya Mountains on the north which separate it from Tartary, China, and Tibet; the Sulaiman Mountains on the west, separating it from Afghanistan; and on the east the hill ranges which border upon Burma and the Bay of Bengal. From the mouths of the Bramaputra on the eastern side and of the Indus on the western side the two coasts incline towards the same point in the



Author on Board an Elephant in Jaipur

south and meet at Cape Comorin, thus producing the form of an inverted triangle.

India has a diversified surface and scenery. Mountains whose peaks extend far above the line of perpetual snow, broad and fertile plains bathed in intense sunshine, arid deserts, and impenetrable forests.

The area of India is 1,805,332 square miles, 1,094,-

Old Amber, Jaipur

200 square miles in the British provinces and 711,032 square miles in the Indian States.

The coast line of India is broken by very few inlets or harbors. The sea washing the coasts of India is very shallow and the shores are usually flat and sandy.

Little is known of the history of India prior to 600 B. C. at which time the Aryan races who had entered from the north had established in parts a civilization far superior to that of the Dravidian aborigines. About this time Gautama Buddha promulgated the religion that bears his name and numbers among its adherents today more people than any other of the world's religions.

Darius, King of Persia, invaded India somewhere about 500 B. C. and annexed the Indus valley. In 326 B. C. Alexander the Great invaded India and subdued the northwestern part of the country.

Early Indian history contains the names of Chandragupta who revolted after Alexander's death and established the first really great Indian Kingdom, and the name of Asoka, the founder of Buddhism as a national religion.

The period up to 100 A. D. is a kaleidoscope of various Indian rulers rising and falling with more or less rapidity. From 1000 A. D. to 1736 it centers chiefly around the Mohommedan invasions culminating in the rise and fall of the great Mogul Empire. This short space of Indian history made famous forever in the history of the world by the names of the Great Moguls, Akbar, Johangir, Shah-Jahan, and Auringzeb marked the pinnacle of Indian achievement. Never again will this people rise to the relative height in the world's affairs that they occupied at that time. Their day is done. They do not possess the mental, moral, or physical strength to reclaim the enviable position that once was theirs.

In 1498 Vasco do Gama, the Portuguese navigator, made his famous voyage to India. From that time until 1756 Portugal, Holland, France, and England played their parts in India's history. In 1757 the battle of Plassey established Britain's power in Bengal and through the next century the name of the East Indian Company ushered in by Clive and Warren Hastings was a power in the land. In 1857 the great Indian mutiny shook Britain's power to the foundation and marked the end of the East India Company. Since then the Imperial Government has ruled direct through a Viceroy and Governors.

In recent years the names of Lord Reading and Gandhi together with the Swaragist Party have held the center of the stage.

The caste system which is a more potent factor in the life of Indians than in the life of any other people does not appear to have been a part of the Vedic religion originally. It was subsequently established with a religious sanction which is still maintained and it is interesting to note that it has held sway through all the religious, economic, and political changes of over two milleniums. Caste is the first institution of Hindu Society that forces itself upon the attention of the stranger. Originally four great divisions were established, the Braham or priest, the Kshatriya or warrior, the Vasiya or merchant, and the Sudra or laborer. Those not belonging to one of these four classes were Nihlecha or pariahs. At the present time these castes have been subdivided until there now number hundreds of caste divisions. However, the Brahmins still maintain their arrogant pride and priestly hold upon the other castes.

The population of India has increased in the past 50 years from 206 million to 319 million or about 65 per cent. The average density is 177 per square mile.

From Bombay my journey continued directly across India to Calcutta on the Eastern side. From Calcutta I came back across northern India, stopping in all of the important cities.

Bathing Ghat at Benares

The first stop was at Benares, the holy city on the Ganges with its bathing ghats, its burning ghats, its thousands of Vedic temples, its beggars palace, its age, its superstition, its glory, and its filth. The native city is distinctly oriental and its life fundamentally religious. Religious in a sense, however, that we would hardly recognize—physically religious or so it would seem to us. But who is to say where the physical stops and the spiritual begins or to what extent they intermingle or even if they be two separate things?

But superstition as we know it is rampant in Benares for here the old come to die, and the sick to be healed.

The Pearl Mosque, Agra

To die in Benares is to go direct to heaven. All kinds of diseases are bathed in the Ganges, the water is taken home to drink and the ashes from the burning ghats on the banks float serenely on the water of the river. Many of the temples are filthy holes of depravity and Miss Mayo has not overdrawn the picture.

It was at Benares that I began to realize that India's day was done forever, that she had spent early in history her vitality as a nation as her people do as individuals. She is like a firecracker — starting the world with the gorgeous empire of the Great Moguls and then fizzling slowly out.

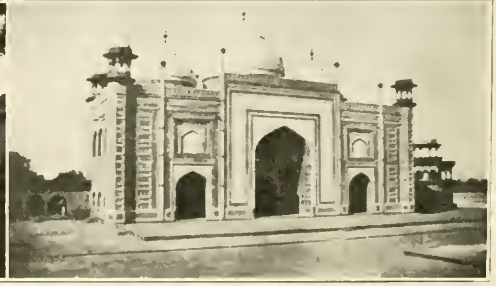
After Benares come Cawnpore and Lucknow, two of the three centers of the great Indian mutiny of 1857 that marked the passing of the East India Co. Then Agra with its famous Taj Mahal a dazzling tomb of polished white marble built by Shah Jahan for his favorite wife. A magnificent structure, yet it is after all but a tomb with no living associations, and for that reason it lacked the interest to me that I found in the old palaces at Agra and Delhi. These marked the highest splendor of the reigns of the Great Mogul Emperors. They were marvelous structures for their time and indicate a lavishness perhaps unequalled.

From Agra my wanderings took me north to Labore towards the border of Afghanistan. Labore was at various times the capital of the Indian Empire and was always the first place captured during the raids of the northern invaders, Alexander, Timerlane and others.

From Labore I went southwest across the Sind desert to Karachi, the seaport of the Punjab or northern provinces. From Karachi back across the desert to Delhi, the capital of India, then south through Jaipur and Ajmer to Bombay again. Stopping but a few days in Bombay I continued my journey south through Bangalore and Madras to Colombo in Ceylon. From Ceylon I crossed to Singapore at the southern end of Malaya. Five days this took, almost as long as to cross the Atlantic. From Singapore I went north through the rubber plantations and by the tin mines of the Federated Malay States to Kulalumpur, Ipoh, and Penang. Parts of Malaya are still unexplored and very wild. A few herds of wild elephants still inhabit the valleys of this region and one is occasionally seen near the cities as we saw one on a Sunday afternoon near Ipoh.

From Penang I again took ship to Rangoon in Burma and then again from Rangoon to Calcutta. Once more across India to Bombay and I was soon ready to start my return trip.

As I sailed out past the Gateway of India I was thinking of my impressions of the country and its people. I had travelled over India from east to west and north to south. From Bengal where the tigers roar way down to Bangalore, from the Punjab and Labore to far off Singapore. I had spent one whole Sunday afternoon in Bangalore discussing philosophy with Iaya a high-caste Brahmin; I had spent many hours with Gangoole, Professor of Economics at Calcutta University, discussing the economic condition and outlook of India; I had talked of Hindoo art with Bose, an Indian artist; I had drunk tea in the home of Ghose, an Indian engineer and listened to Mrs. Ghose sing in Hindustani. I had talked to Englishmen and coolies. I had spent several hours with a Baptist



Garden of Palace at Agra and the Gateway to Taj from Agra missionary in Benares. I had shared my cabin from Penang to Rangoon with a French Catholic missionary priest. I had spent half a day on a rubber plantation and the other half at a tin mine. I had watched the women working on the roads, carrying baskets of dirt on their heads, and on their arms and ankles solid silver bracelets. I had seen the child mothers in Karachi and elsewhere. I had seen the mosques of Mohammed, the Jain temples, and the Hindu temples dedicated to Brama, Vishnu, and Siva with their phallic application of the Vedic philosophy. I had seen the camel caravans crossing the desert and the sacred cows in the native streets. I had been in a Rajah's palace and the squalid shops of the native bazaars where rice and tea, silks, brocades, and jewels mix in endless confusion. I had seen the fanatical hatred of Mohommedan and Hindu break forth in riots in Bombay. I had seen reminders of the past splendor of India and I had stepped over the bodies of sleeping men and women on the sidewalks. Clothed in rags and dirt they indicate the standard of living of the great mass of Indian people.

India has produced a court in the days of the Great Moguls whose splendor has seldom been equalled. She produced at the same time a civilization that was relatively high.

Today she hoards her gold and silver preferring to live in squalor to buying the comforts that would raise the standard of her social life. A staggering precentage of the world's production of gold and silver goes each year into India and never comes out. One year it reached the colossal figure of 14 per cent of the gold and 39 per cent of the silver production.

What of the future?

You will hear many Englishmen say that "India is living on her past glory." I have no argument with this statement. It is easy to say, perfectly true in a limited sense, and readily accepted. But what is its significance —where does it lead you? Nowhere that I could ever discover.

It seems to me that India is the victim of self-hypnotism. She has concentrated on the ocult so intently and so long that she cannot now distinguish between the spiritual and the physical, or refuses to acknowledge the existence of the physical altogether. She is trying to revitalize a caste-incrusted philosophy on a filthy and diseased condition of national life as well as of individual life. She does not realize that there is a physical philosophy, and a political philosophy, as well as a metaphysical philosophy nor that one cannot be developed to a high degree without a corresponding progress in the others. She does not realize that straight, clear thinking cannot come from crooked, diseased bodies, nor that the mind cannot function without the body. "Ah!" the Brahman says, "but it can and has. Men have been known who projected their minds out of their bodies and while the body lay inert the mind functioned and later returned to the body." When I asked him for his proof he replied "Proof, proof, you always ask for proof." To this I replied "why not? until you can prove your statement I must consider it the emanation of a mind hypnotized by the gleam of the abstract."

So it seems to me that India's present thought effort is like a man trying to ride a velocipede on one wheel. The future seems to offer but little of promise. You may well ask what Christianity has to offer. It has much to offer but so far its impression has been practically confined to the pariahs and as Abbe DuBois said it will probably take other thousands of years for it to break through the Brahmin veneer built up through three thousand years.

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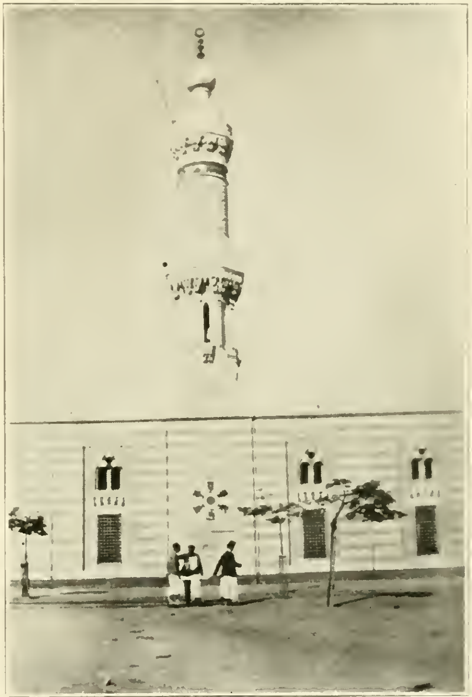
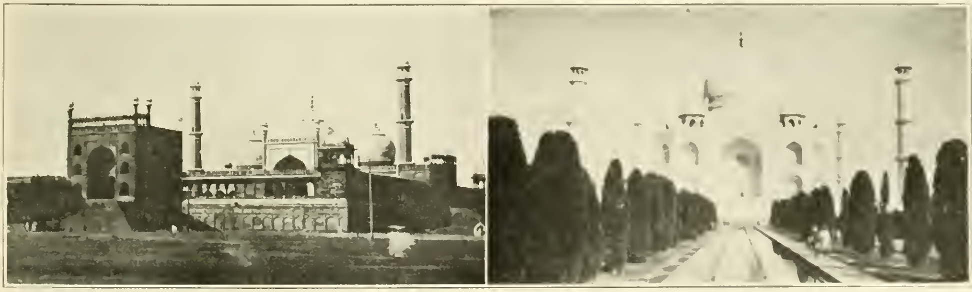
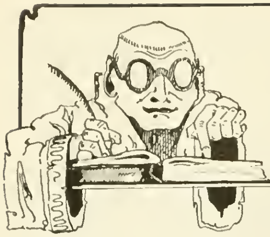


Port Said Mosque



Friday Mosque at Delhi and the Taj at Agra



EDITORIAL

Specifications for a Good Engineer

A good engineer must be of inflexible integrity, sober, truthful, accurate, resolute, discreet, of cool and sound judgment; must have command of his temper; must have courage to resist and repel intimidations, a firmness that is proof against solicitations, flattery, or improper bias of any kind; must be energetic, quick to decide, prompt to act; must be fair and impartial as a judge on a bench; must have experience in his work and in dealing with men, which implies some maturity of years; must have business habits and knowledge of accounts. Men who combine these qualities are not to be picked up every day. Still they can be found, but they are greatly in demand, and when found, are worth their price; rather they are beyond price, and their value can not be estimated by dollars.—*Starling.*

(The foregoing is taken from a framed notice in The Engineers Club at Dayton, Ohio).

This Year

At the beginning of each year, a magazine staff should review its past year's work—praise its past editor and staff—and then tell just what *this year's* staff will do to improve the magazine. It is difficult, terribly so, to determine how a magazine of this sort should be improved, and then to improve it in that way. Some say the stories should be more readable, and less engineering—implying that the two terms are different. Others say that the magazine should be one of purely engineering material—to be referred to as a text. To please both, articles of both types are run, whereupon, both factions complain that the magazine should be made either one way or the other.

So, in laying out the policies this year, the staff has attempted again to displease both factions and present a little bit for everybody. They have attempted to introduce something new by presenting to the new-comers here a brief review of three of the fraternities on this and other engineering campuses—their national organization, their local organization, and their requirements for membership. Other fraternities, professional and engineering, will be reviewed later. In editorials, the staff has tried to give the reader its viewpoint on developments of engineering projects, and engineering functions both on and off the campus. Doings of the students, and the graduates, are reviewed.

A new cover has been designed this year—one in which the staff has tried to present a pleasing, and at the same time, a fitting design. It feels that the combined simplicity and ruggedness well fits an engineering publication. The oil painting as well as the cover design is original with this magazine, both having been made by an engineering student, Forrest Drake.

If we have made faults in this issue, bear with us, for we are new and still learning. If you dislike the arrangement, tell us, and we will try to change it. If you think there is some improvement, tell us, for we, too, like encouragement. And if you are ambitious, drop around and we can keep you busy.

False Alarms

Readers of current magazines and newspapers are periodically excited over the immediate prospects of television. Many ultra-optimistic discussions of this new development have been published in the past two or three years, and the emphasis has usually been placed upon the application to which it will be put. Writers have painted elaborate pictures of the television set of tomorrow, receiving a ball game, a prize fight, or an entire stage production. They have shown how the cabinet which is to house the mysterious mechanism will look and how large it will be; some writers have even given the cost of the receiver. The result of such unwarranted predictions is that many people think that next week they will be able to go to the neighborhood radio store and buy a television receiver which will perform as the ones described. A secondary and perhaps more disastrous result accompanying the delay in appearance of the television receiver is the increasing skepticism on the part of the general public.

There is one thing that will be necessary for television to reach the comparative state of perfection in which we find radio today. That is the interest of the so-called amateur. The amateur of radio nursed that development through the early stages of its infancy, content with results that were really of little or no practical value. In the same way television will have to secure a portion of its development. When there are a sufficient number of amateurs who will sit up at night and try to imagine they see an image in their improvised television receivers and feel encouraged by minor successes, then the development of television can be expected to proceed as did radio during the years just before and after the World War.

That the possibilities of television are great is scarcely to be doubted. The scientists and engineers who have contributed toward the development in the past and those who are working at present upon some phase of this problem, as a rule, have optimistic views regarding it. With hardly an exception, however, these men agree that the practical-utilitarian television is still some distance off. The actual experimenters, inventors, and engineers are not responsible for the deceiving articles which find their way into print. These men are content to strive for the improvements which will some day bring the realization of the new dream. But the development needs the sympathy and backing of the public. People must take a whole-hearted interest in it, and realize that a radical development is taking place, the success of which will, in a large measure, depend upon collective effort. If the public could be kept informed of the actual state of television rather than the revised dreams of current writers, this interest would come more nearly to be realized, and the day when we may sit in our homes and watch a New York stage production or a great artist, would undoubtedly be brought into the nearer future. —*W. E. B.*

Another Criticism

College engineering courses have been criticized for being too much "engineering," for not being liberal enough, for being merely trade schools. And they have been denounced because they are too liberal, because they require too many subjects which do not help in the least in procuring a livelihood. So faculties have merely smiled and continued the courses in the same general way.

But there is a fault in the education given here—an omission which would help in both earning a living, and living upon what is earned. For too many times students leave college without the proper appreciation of money values, whether it be the values of the equipment he handles, or the value of the money he spends weekly on his laundry—and until he learns that, as he must to continue in the industries, he is severely handicapped.

America has been called the land where the dollar is almighty—where money is king. And be that true, or be it false, in industry money does play the big part. For companies are organized to make money, and to return this profit to the shareholders. As long as they do this, operation continues. Should they all, or any one of them forget that side of the case and spend their energy in merely helping humanity, the organization would soon cease to exist. For a man to become a part of this organization, he must prove to them that he, too, is willing to help them earn dividends.

It is in this way that engineering theory, as it is taught in schools should be revised. For the best is not always the best, and the cheapest may sometimes be the most expensive. The science of relative values is not taught as it should be. A more efficient motor or power plant is sometimes very undesirable, because of the initial investment—and in more cases than not, the best costs far more than it is worth.

Economics are the basis of sales—and they are not taught the engineer while in school. Too little is said about "fixed" charges, and far too much about "efficiency." The electrical engineer learns that to drive a locomotive by electricity requires about half the power at the coal pile that is required for a steam locomotive. And in addition to this, moving "storage" is eliminated by doing away with the tender and coal car. Therefore all railroads will electrify as soon as they can accumulate enough capital for the original investment! But, it is forgotten that much less than half the cost of electrical power is in cost of the coal and water—that one of the biggest delays or obstructions in the way of railroad electrification is the higher cost of electrical fuel—for there are, here, "fixed" charges which are greater than fuel charges.

And the mechanical engineer finds that feed-water heaters, superheaters, stokers, crushers all increase the efficiency, of the boiler. But he forgets that often the increased cost more than offsets the saving.

Whether the engineer is to handle problems involving millions of dollars, or whether he is to handle only his own small problems as to what priced suit he is to wear —why not help him by teaching him the importance of money, and of the "stand-by" losses of this money? —*J. W. D.*

The Schaefer Prize Competition

What engineer has not had occasion to admire a well-written technical article, or curse some carelessly prepared affair which leaves only a haze over the whole subject it treats? And what engineer has not seen the time when the ability to explain some operation or mechanism clearly and logically would have been an invaluable asset?

To the student engineers of the University of Illinois comes each year the opportunity to gain proficiency in such writing. John V. Schaefer, an alumnus of the University and president of the Cement Gun Construction company of Chicago, offers annual prizes of $50 and $25 for the best two papers by students describing some practical engineering experience. The following are the conditions governing the competition:

The writer must be a student of the University of Illinois beyond his freshman year in the College of Engineering, and he must present his paper early in January. The awards will be made during the second semester. No student can receive the prize more than once.

The essay must describe an engineering project on which the writer has been personally engaged, and shall be accompanied by photographs and drawings made by the writer. It must contain not less than 1500 words nor more than 2500 words, and it must be written by the contestant himself either in legible longhand or on a typewriter. No amanuensis or stenographer may be employed. It is to be written on one side of standard 8 1-2 by 11 inch (letter size) paper, with 1 1-4 inch margin on the left. Each essay must show the name and address of the writer.

The papers will be graded by three judges to be appointed by the Dean of the College of Engineering. In making the awards consideration will be given to diction, grammar, spelling, logical arrangement, completeness of description, excellence of sketches, drawings, and photographs, and accuracy of detail.

Papers must be submitted to the Dean of the College of Engineering not later than 5 p.m. on Wednesday, January 8, 1930.

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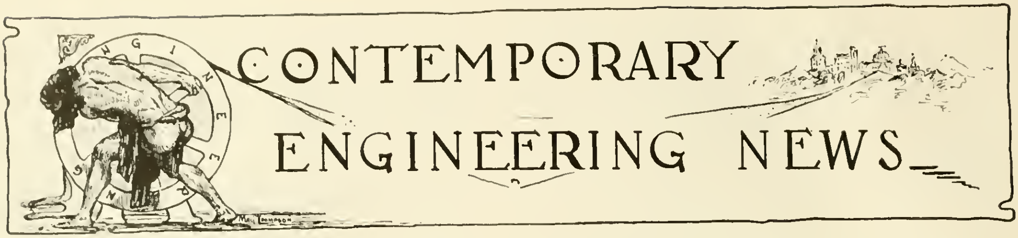


New Features of Design in Bellanca Plane

Several novel features of airplane design are combined in the new Bellanca tandem monoplane, which has been going through a series of tests at New Castle, Delaware, preliminary to the projected endurance flight under the sponsorship of the Chicago Daily News. The September issue of "Aviation," carries a complete description.

The name is due to the location of the two Pratt and Whitney Wasp engines, which are located back to back on the center line of the plane. The forward propeller is connected in the customary manner; a four inch shaft from the rear engine transmits power to the rear propeller, a three blade type, located back of the sharply streamlined fuselage. The tail surfaces are attached by outriggers to the wings, and the controls pass through the wings and outriggers to the rudder and elevator groups.

The primary purpose of the design is "to provide a multi-engined airplane which will retain the efficiency and manouverability of a single-engined craft." The tandem arrangement, it is easily seen, keeps the frontal area of the plane practically the same as that of a single engined craft, at the same time increasing its power, while an accident to one of the engines does not produce the "drag" that the failure of an engine mounted to one side of the center line has on other two-motored ships.

Every possible attempt has been made to derive lift from all major units. Struts and bracings are similar to those of the Bellanca Model K plane Roma, produced over a year ago.

The interior arrangement of the present craft differs from that of possible future ones of the same design because of the special purpose to which it is to be put. The gasoline tanks have a combined capacity of over 1800 gallons, and occupy the front and lower portions of the fuselage. They are of aluminum, and contain bulkheads to prevent the liquid from swashing about and disturbing the balance of the plane. The dashboard contains all of the instruments necessary for blind flying, including two earth inductor compasses arranged in parallel, so there can be no possibility of failure. The shaft of the rear propeller passing down the center of the fuselage divides it into an upper and lower "deck"—in the present model the lower deck is used for auxiliary gas tanks, while the pilot and copilot are seated in the upper half. The rear part is for the use of the radio operator, who has nine feet of clearance, allowing him to stand if he so desires.

The overall width is 83 feet 2 inches, and the length 44 feet 2 inches. The fuselage is 25 feet long and nine feet high. Weight empty is 7000 pounds, and the plane is designed to carry a load of 14,000 pounds additional. There are 912 square feet of wing surface.

The tandem system should prove to be a valuable safety device, as it will practically eliminate forced landings due to motor failure.

The World's Largest Electric Generator

The largest generator of electric power in the world has been placed in operation at Hell Gate station of the United Electric Light & Power company, 134th street and East river, New York City.

This machine, built by the Westinghouse Electric and Manufacturing company, has a capacity of 165,000 kilowatts, or approximately 222,000 horsepower. The next largest unit, which is located in the same station, is rated at 214,000 horsepower, while the next in size develops less than 150,000 horsepower. In comparison, the world's largest waterpower generator develops about 80,000 horsepower.

With 222,000 horsepower, a million homes can be lighted simultaneously, or excellent illumination could be provided for a highway running twice around the world.

Though massive in construction and imposing in appearance, the great Hell Gate unit is remarkable, rather for its compactness than its size. Close by, in the same station, is a 67,000 horsepower machine which was installed a few years ago and was the engineering marvel of its time. Although the new unit develops more than three times the power of the older one it is less than twice as large.

The unit is of the cross-compound type; that is to say, it consists of two turbines, one operated by high-pressure steam and the other by steam exhausted by the first. Each turbine drives an electric generator rated at 80,000 kilowatts, and in addition, the low-pressure turbine drives a third generator, which is rated at 5000 kilowatts and supplies power for use in the station. The two main generators are enclosed in a single semi-circular housing into which cooled air is blown for ventilating purposes and which gives them the appearances and which gives them the appearance of a single machine.

Steam is supplied at 265 pounds gage pressure and 700 degrees Fahrenheit total temperature and is discharged into the condenser at a pressure of one inch mercury absolute. To condense it, 155,000 gallons of cooling water are pumped through the condenser every minute—an amount of water that is about equal to the daily consumption of the Borough of Brooklyn.

The dimensions of the unit are: length 91 1-2 feet, width 40 feet, height above floor line 27 1-2 feet, weight 1300 tons, speed 1800 revolutions a minute.—*Westinghouse College Press Service.*

Determining Bed Rock Depth by Electricity

A recent issue of the Canadian Mining Review carries the description of a method for determining the depth of bedrock by means of electrical apparatus used on the surface of the ground. The method was devised by Conrad Schlumberger, m.e., a former professor in the School of Mines at Paris. It has recently been used in connection with a survey of conditions at the Fifteen Mile Falls development of the New England Power association.

The method is based on the difference in resistivity of various kinds of soil and rock. A current passing through perfectly homogenous soil would set up a regular electric field, and the potential at any point could be calculated. If a mass were present, however, with a different resistivity, the field would be distorted. The resistivity of this foreign mass being known, its location could be determined by a sufficient number of observations.

The field operations consist of passing a current between two grounded, movable electrodes, and observing the potential between the two points. A graph is prepared, plotting resistivity of soil against the depth. The abscissa corresponding to the ordinate whose value is the resistivity of the bedrock is thus seen to be the depth of the bedrock.

In actual practice, at the development mentioned above, the electrical operator took observations at ten points where drillings had already been made, but he was kept ignorant of the results of the borings. His estimates were compared with the actual results of boring, and found to agree in five cases within five per cent. In the two cases which varied more than 18 per cent from the drill findings, an explanation was found in that at one point the drill had struck a high point in the bedrock, and that at the other there was a glacial deposit of rock similar to the bedrock and between it and the surface.

After these checks were taken a survey of 250 acres was made from 200 observation points, and a contour map of the bedrock surface prepared. From one to three observations were made per day, at a cost of $50 to $100 each. The cost of the entire survey was very little more than the cost of some of the individual drill holes used in the check, which had to penetrate glacial deposits of gravel, etc.

The application to general civil engineering work is obvious. The development of the process should prove invaluable in the case of location of dams, bridge piers, and tunnels. At present, of course, it has many limitations, and would be entirely useless where there are a great variety of soils and rocks at various angles, but in regular formations it has already been used to great advantage, as shown above. Another point in favor of this method is that the entire equipment weighs only a few hundred points and can be transported easily by Ford. It may be used in the winter, when frozen ground would hamper or prevent drilling.

Nicaraguan Canal Again to the Fore

It appears that the long-talked-of Nicaraguan canal is soon to be a reality, if the recently appointed Nicaraguan Canal commission reports favorably on the results of a survey of the territory which will commence next month.

Maj. C. P. Gross, for two years district engineer in the Los Angeles district, will leave Washington in about a month to superintend the survey, which will be in the hands of the army engineers. He will encounter formidable problems in surveying from the start, it being necessary to carry the line through tropical jungles and marshes where in most places the transit will scarcely be able to shoot 50 feet without a line being cleared. Maj. Gross will follow the course of the San Juan river to Lake Nicaragua, and from there will go to Brito on the Pacific coast.

The canal plan under consideration at present was proposed first in 1901. Briefly, it includes: (1) building harbors at both terminals—Graytown on the Atlantic and Brito on the Pacific, (2) a 40 mile canal with a series of four locks, from Graytown to a point on the San Juan River, (3) a dam a quarter of a mile long to make the locks effective, (4) Preparation of the channel of the San Juan from the canal entrance to Lake Nicaragua, (5) a canal with a series of four locks from the west side of the lake to Brito on the Pacific. The estimated cost is in the neighborhood of $250,000,000, and the construction will cover a period of from eight to ten years. The building of almost 100 miles of railroad from the Atlantic side will be necessary for transportation during construction, and airplanes will be used for rapid communication between the terminals.

One of the most interesting features of the work will be a cut with a maximum depth of 297 feet, and over 3,000 feet long, through the Tamborcita ridge in eastern Nicaragua.

The canal under consideration has long been discussed. In addition to supplementing the Panama canal as a trade route (which will be necessary within the next few years) it will furnish the United States another valuable defense in time of war, and despite its great length will reduce steamer time from New York to San Francisco by more than 24 hours.—*Adapted from a news feature in the Kansas City Star.*

Prequalifications of Bidders

Contractors have been paying considerable attention recently to various plans of protection against irresponsible bidders on contracts for public works. The question has become exceedingly important as the amount of such work has increased enormously in the last two or three years.

It is obvious that the less a bidder knows of costs, overhead, incidental expenses, and the like, the lower he can make his bid. The experienced contractor is handicapped, therefore, and is often forced out of the bidding by one of this class. He is also forced to compete with contractors whose inferior equipment permits of a smaller allowance for operating expense, and with that class of unscrupulous bidders who either gamble for the breaks or go into the work with the idea of "making theirs" off the sub-contractors.

From the standpoint of the public official, too, the situation is troublesome. He is either forced to go to the expense and delay of calling for new bids, if an irresponsible contractor is low bidder, in which case he runs the risk of having the same contractor low the second time, or he awards the work to some other than the lowest bidder — a proceeding which press and public would be slow to understand and which might delay the work with lawsuits—or the incompetent contractor is given the job as the best way out of the difficulty.

The committee on ethics of the Associated General Contractors of America has set about to remedy the situation by some form of pre-qualification, so that responsible contractors may be given an advantage. They define responsibility as knowledge, ability, and will to do, and would require contractors to have done work previously similar to that on which they are bidding, to have enough equipment available to handle the work, to have a clean record of building jobs behind them, and to have assets totalling at least twenty per cent of the cost of all pending work with which they are connected, before they would be entitled to bid on public works. Qualified contractors would be listed following investigation by a board, at stated intervals. Financial standing and other information of a personal nature would be treated with strict confidence.

The objection might be raised that this plan would bring about a great opportunity for favoritism and monopoly. Other professions, such as law and medicine, have their "entrance requirements," however, without favoritism, and monopoly could hardly exist as long as there remained the option of construction of public works by hired labor. Wisconsin has had a pre-qualification system for two years in regard to highway work, and reports it successful. Kentucky and New Jersey have similar regulations, and other states are rapidly following suit.—*Adapted from an article by Phillip Beatty in "Public Works."*

Moving a Mountain Into the Sea

Moving a mountain into the sea is the task engineers in Seattle have imposed on themselves, and the work, abandoned after a former attempt in 1910, seems now on the road to completion.

The obstacle being removed is Denny hill, located in the heart of the city and containing some 4,223,000 cubic yards of material, ranging from wet sand to hardpan. At its highest point it is 89 feet above grade. It covers 32 city blocks.

The most interesting feature of its removal is the use of an enormous belt conveyor, which carries the dirt for over half a mile from the hill to Puget Sound. It is supported by a wooden trestle 18 feet above street level. In its entire length it crosses eight streets, and the maximum trestle span at one of these crossings is 72 feet. The belt is a yard wide, and moves with a velocity of 600 feet per minute, giving it a capacity of 500 to 600 cubic yards of dirt an hour.

The actual work of cutting down the hill is accomplished by six shovels, four of two yard capacity and two of one and one-half yards. They dump into metal hoppers which run on wooden rails to a portable belt conveyor. This belt is moved ahead as the work advances, so the haul in the hoppers is always short. It lifts the dirt from ground level to the elevation of the main conveyor line, and transfers it to the latter.

Disposal of the dirt removed is also unusual. From the conveyor, which terminates at the Sound, the dirt passes down a chute onto barges, which when loaded are towed to a deep part of the bay. Valves to eccentric tanks are then opened, and in three minutes enough water has been admitted to capsize the barges. Eight more minutes are required to empty the tanks again, and the barges return bottom side up to receive the next load, when the operation is repeated.

The 1910 project for removing the hill employed hydraulic methods. Engineering News-Record, which carries the account of the present plan, does not explain why it was abandoned.

New Alloys for Automobiles

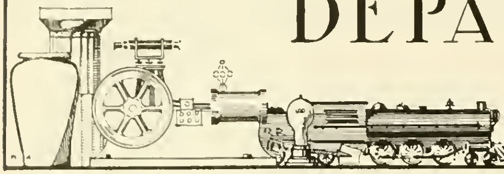
The American Machinist reports several important developments in the use of alloys in automobile manufacture, which were brought out at the national exposition held recently at Cleveland.

High chromium steel and iron are coming more into use as the price declines. Sheets and strips of these alloys are replacing chromium plate in decorative parts, and from 2 1-2 to 15 pounds are used in each car. A ductile high chromium iron manufactured under the trade name of Defirust is used in thin sheets on round radiataor caps, bolt heads, hub caps, handles, etc., to give a fine, lasting finish at a reduced cost.

A larger use of the chromium alloys than in decorative parts may eventually be found in structural members, however. Due to their noncorrosive properties and high strength they can be used to advantage in pump shafts and wire wheels, where the old plating process would leave joints weakly protected against water.

Two steel companies are producing Nitraloy, a hard non-corrosive steel for use in shafts, cylinders, tappets, and gears. It is made by a patented process involving heat treatment in an ammonia bath, and the product is said to compete favorably with high chromium steels, and to be less expensive. There has recently been developed, also, a nickel and chromium iron alloy for castings. It has been used for brake drums and tests have shown it to be more resistant to wear than forged steel drums.

Two interesting exhibits of the Aluminum Company of America were a new piston alloy and a duralumin girder. The piston alloy has a lower co-efficient of heat expansion and higher heat conductivity than metals in use at present, which of course allows for closer fit. The chief objection lies in the machining, which must be done with special tools. The alloy contains about 14 per cent of silicon. The duralumin girder was developed for use in the Goodyear Zeppelin. It is made of thin sheets riveted together in the form of a hollow rectangular prism. The chief feature of interest is that a flange, turned inward, is made about each of the holes punched in the sheets to reduce the weight. The flanges strengthen and stiffen the girder, thereby decreasing the necessary weight.



DEPARTMENTAL NOTES

Architectural

The Department of Architecture was awarded the medal given each year by the American Societe des Architectes Diplomes par le Gouvernement Francais. Only one medal is awarded each year and we got it! It is awarded for general excellence in teaching architecture. We have equalled any other school of design in the United States this past year. The medal is to be formally presented at a meeting of the Department of Architecture to be sponsored by Scarab, the professional architectural fraternity.

Heinie Wolf was elected President of Scarab at a meeting held last spring. The other officers elected were: Glenn Lyon, vice-president; Ed. Gorman, treasurer; Charles DeTurk, secretary; Lou Buttner, sergeant at arms. Plans for meetings and department smokers are now being formed.

Granville Keith, who taught here for a year before he won the XV Plym Fellowship in Architecture, returned after a year abroad to resume his duties as instructor in design.

Max Abramovitz, who graduated last June, spent last summer doing post-graduate work at Lake Forest, Illinois, on an appointment offered by the foundation of Architecture and Landscape Architecture for outstanding work in design. He has complete all requirements for a certificate from Beaux Arts Institute of Design. Abramovitz is now teaching design here.

Morris Kleinman, also of June '29, is working here with Max. He spent the summer at the School of Architecture at Fontainbleau, France. He received the Fontainbleau Scholarship last year, in addition to many other awards in B. A. I. D.

Pierre Bezy, because of his outstanding record in design, has been appointed assistant in architecture.

Bob Lavicka was elected president of Gargoyle recently. The other officers are: vice-president, Ed Slygh; treasurer, Carl Scheve; secretary, Don Laidig.

Norman F. Brunkow '17, spent two days here this fall collecting material for a speech on Fireproofing of Modern Steel Frame Buildings to be given for Underwriters'. He is assistant to the chief engineer for Graham, Probst, & White. The structural design of the Foreman Bank Building in Chicago was in his charge.

The Hall of Casts, occupying the west wing of the first floor of the Architecture Building, has at last been rounded into exhibition shape.

Ceramics

The activities of the department of Ceramic Engineering at present are confined mostly to research. Graduate research assistants are working on several things including measuring of the fatigue strength of electrical porcelain; the thermal expansion of Portland cement and the volume change of Portland cement upon being exposed to the atmosphere; the preparation and properties of spinels; the effect of furnace gases on enamels; and the determination of the physical and chemical properties of sewer pipe clays.

Two graduate assistants, R. D. Rudd and A. J. Monack have become full time research assistants, while L. Shardlow, C. G. Harmon and H. W. Alexander have been made half time assistants.

The Utilities Research Committee met here on November 8.

Civil

The usual fall smoker given by the Central Illinois Section of the A. S. C. E. at the Illinois Union Auditorium was not just another smoker, but was a meeting of engineers and student engineers. There were several hundred in attendance.

Prof. Pickles welcomed the young engineers in behalf of the Central Illinois Section, and pointed out that one of the reasons for the smoker was to have the students meet the outstanding engineers in the field and to get acquainted among themselves. He also told of the activities and the purpose of the Student Chapter of the A. S. C. E.

Mr. Ross, contractor, consulting engineer, and member of the Illinois Section at Chicago delivered the address. Mr. Ross told what the A. S. C. E. represented, its purpose and ideals, and pointed out the wonderful advantages the young engineer would avail himself of by becoming a member of the student chapter. He said it was the first step on the road to membership in the Society. The student chapter, he continued, affords an excellent opportunity for the student to gain material profit and a closer contact with the profession and professional brothers. All members of the senior class are eligible for Junior Membership upon graduation and should send in their applications some time before leaving school.

This was followed by a talk by Mr. Benedict, President of the Illinois Central Section of the A. E. C. E., September 26th. 221 Engineering Hall was packed to the gills on October 10th, when Prof. Huntington gave an illustrated lecture on "Bridges in Switzerland." There were so many there that Prof. Huntington had to give his lecture over again.

On October 24th, Mr. T. Chalkley Hatton, consulting sanitary engineer from Milwaukee, Wis., gave an exceedingly interesting talk on "The Engineer as a Pioneer." But this is not all—there are more to come. Below is schedual of the meetings of the society for this semester:

November 7th—Mr. L. F. Harza, consulting engineer, Chicago, Ill., who will speak on "Business Knowledge for Engineers."

November 21st—Mr. Herman Von Schrenck, consulting timber engineer for the N. Y. C. R. R. Co., St. Louis, Mo., who will tell us the part timber plays in the engineering profession.

December 5th—Mr. Bartholomew, who will speak on "City Planning in the Field of Civil Engineering."

December 19th—A film released by the Du Pont people entitled, "Hydroelectric Power Production in the New South."

January 9th—Prof. T. T. Quirk of the Geology Department, who will talk on the new experiments he has been conducting.

On looking over the schedule, the thing that stands out most is the variety of the program—the speakers cover nearly every part of the field that a civil engineer would be interested in, and those who are to speak to us next semester will cover even more.

Prof. C. C. Wiley gives us the following about his summer:

My summer's work was quite interesting. I spent it trying to do the things no one else would do with the firm of Barker, Flavin, Sheets and Wallace, Consulting Engineers, Chicago.

Our office was on the 34th floor of the Pure Oil Building where the view of the city and lake was was magnificent, and we could watch the progress on the Civic Opera and especially the Merchandise Mart. The offices were quite comfortable but about the time it began to feel warm up there I would be sent out to Tessville, or Maywood or some such place where the street temperature gave Chicago its claim as a summer resort.

My work consisted in helping along the regular routine work of sewers, pavements, etc., and of undertaking the numerous odd jobs always coming to such offices and which the regular engineers could not devote time to and which could not be trusted to the younger and less experienced men in the drafting room or in charge of field work. This work ranged from checking sidewalk grades to revamping the entire water supply system of a suburban village. A pleasant diversion was a trip to Springfield to examine and report on one of the boulevards in need of improvement.

One of the interesting features lay in connection with the water supply of one suburb. The population was about 5,000. The water was obtained from three wells, each delivering slightly over 200 gallons per minute or combined output of about 850,000 gallons per day. Records for 1928 show an average daily consumption of only about 250,000 gallons per day so that the three wells easily supplied ample water. During the hot weather, however, the peak load took a big jump with rather astonishing results. The residents would begin to return from the city and between domestic use and yard sprinkling the use of water was enormous. On numerous occasions the three wells barely kept the 80,000 gallon storage tank filled, meaning a consumption of 850,000 gallons per day or about three and one-third times the average. But on at least three occasions during the summer on very hot days the tank was emptied in about three hours in spite of the efforts of all three wells. This increased the rate of consumption to a peak of 1,500,000 gallons per day or six times the average. This high rate would end about dark or 9 o'clock after which the tank would fill and perhaps be idle for two or three hours preceding daylight.

It can be readily seen that the fire protection in this village was extremely precarious. Had a fire occurred on any evening between 5 and 9 there would have been available only the reserve in the tank, generally less than 80,000 gallons on the hottest days. There was absolutely no water for fire fighting. Fortunately no fires occurred, but the happiness of the Village Board was not increased by my report.

Of course I went to the Annual Convention of the American Society of Civil Engineers in Milwaukee, July 10-12 and had a fine time.

Chi Epsilon, honorary civil engineering fraternity, has elected the following officers for the year:

D. H. Murphy, president.

G. C. Lewis, vice-president.

S. McCune, secretary and treasurer.

L. A. Dollahan, corresponding secretary.

A very active program has been laid out for the year, and it will be gotten under way, very soon, with the pledging of several new men.

Electrical

This being the year of the biennial E. E. Show, much interest has been shown in the Electrical Engineering Society meetings. There has been some talk this year of discontinuing the Show, but a recent meeting of the Society voted unanimously in favor of the Electrical Show.

The first meeting of the Society was held in the E. E. Lab. Sept. 20th, and was attended by two hundred potential electrical engineers. After President Wenzel had outlined the history and achievements of the Society, members of the Department Staff spoke of past shows. R. J. McClenchie was presented with a Standard Electrical Engineers Handbook in recognition of his high scholastic average in his freshman year. Cider and doughnuts were enjoyed by all.

The juniors had a special program during the absence of the seniors on the inspection trip, which proved very successful.

Last year, the proceeds of previous E. E. Shows were combined to form a Students Loan Fund which benefits junior and senior E. E.'s. It is hoped that the fund may be enlarged upon after the Electrical Show next spring.

Alpha of Eta Kappa Nu, honorary electrical engineering fraternity, celebrated its twenty-fifth anniversary at its convention, held November 7, 8, and 9.

The officers directing the activities of the organization this year are: C. A. Huebner '30, president; W. H. Formhals '30, vice-president; C. E. O'Donnell '30, recording secretary; S. R. Jordan '30, corresponding secretary; and L. G. Ramer '30, treasurer.

This year's activities began with the smoker held October 3 for juniors and seniors, eligible to membership in the organization. Students in the department of electrical engineering are looking forward to the bi-annual E. E. show.

General

The formal initiation of Phi Alpha Lambda was held at the Inman Hotel on May 21st last semester.

The new members are: W. C. Schulte '30, H. R. Lissner '30, S. P. Langhoff '31, R. H. Anderson.

We are certainly glad to welcome these recently initiated men into our organization.

"Bill" Julian acted as toastmaster at the initiation banquet, and a hearty welcome was given by President "Neb." Burnam, followed by a response from the initiates by R. H. Anderson.

Dean Jordan gave a short address on the scholastic ideals of Phi Alpha Lambda, and Prof. Hall spoke on the opportunities open to general engineers after graduation.

Mechanical

The installation of the new generating unit in the University Power House has been completed, and the equipment has been in operation 24 hours a day since September 16. The 1250 K. V. A. generator has a direct connected exciter and is driven by a single stage General Electric non-condensing steam turbine.

The turbine is of the latest design and has incorporated in it many interesting features. It was designed for 140 pounds per square inch gage pressure and 15 pounds back pressure. The operation is non-condensing because of the need for exhaust steam in the heating system. The turbine runs at 3600 r. p. m. and is directly connected to the 3 phase, 2300 volt, 60 cycle, alternating current generator.

The installation employs the closed system of cooling generator windings in which the air is cooled and recirculated. The oil tank capacity is unusually large, holding 550 gallons of oil. The oil is also subjected to cooling in order to dissipate the heat of the bearings. An auxiliary oil pump is used to supply oil for starting and stopping the generator and turbine because of the high speed. The oil pump is steam driven, and develops 40 pounds per square inch pressure. It is automatically cut out when the turbine comes up to speed, and a worm driven pump developing 50 pounds pressure delivers oil during normal operation. Oil is supplied to the main bearings at a pressure of 12 pounds and is also used in connection with the governor.

Military

Members of the engineering advanced corps of the R. O. T. C. enjoyed the smoker October 16, sponsored by Tau Nu Tau, honorary and professional military engineering fraternity. The organization will also give a formal dance this year, date to be announced later, and will install additional charters.

Previously known as the Engineer Officers club with unrestricted membership, the fraternity changed its name one year ago and decided to enroll only men of the advance corps, selected on a basis of their merit and proficiency in military engineering.

It is organized with the purpose of promoting interest in affairs pertaining to military engineering, and for this reason it is customary to have some regular or reserve army officer speak at each meeting. Through this contact with the officers and among themselves, a spirit of military brotherhood is fostered.

The officers elected last May are D. V. Johnsen, president; C. A. Nelson, vice-president; S. G. Weinberg, secretary; and E. R. Bear, treasurer.

Railway Club

The first meeting of the Railway Club was attended by the largest group that has been to a function of the club in the past two years. Plans were made, in the rough, at this meeting, for the functions of the club during the remainder of the semester. Cider and doughnuts concluded, very fittingly, the program.

The second meeting was held some two weeks later, and at this meeting a moving picture, "Power Development in the South" was shown—a very interesting film released by DuPont, showing the construction of the new hydroelectric development of the North Carolina Power and Light Company in the Great Smoky mountains.

Meetings were temporarily suspended during the period of the engineering inspection trip, and the first meeting after the trip was held with a talk by E. B. Stover, r.e.e. '20, who talked on "What Lies Behind the Ticket." This last meeting proved to be the most interesting of the year thus far, and was attended by an even larger crowd than was the first meeting.

The Railway Club is looking forward to helping the E. E. Society in the biennial electrical show, and providing exhibits of miniature trains, signal operation, and other subects covered under railway work.

Senior Inspection Trip

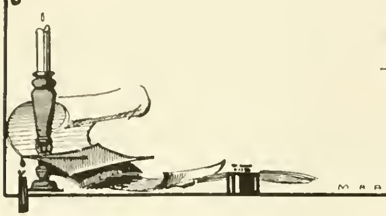
Engineering seniors made their annual inspection trip from October 30 to November 2, and are still talking about it. It proved to be interesting and valuable as the following itinerary suggests:

Civil engineers visited the Illinois Steel company of Gary, Indiana, American Bridge works at Curtis, Indiana, the cement plant at Buffington, Indiana, sewage treatment plant, bridges on the Chicago river, and the Midland terra cotta plant at Chicago. In charge of the civil engineering group were Profs. W. C. Huntington (head of the department), J. S. Crandell, Hardy Cross, J. J. Doland, and F. E. Stubbs.

The sanitary engineers took a trip through the north shore towns inspecting the water supply and sewage plants. The highway group inspected the city and county highways in and about Chicago.

The electrical engineers inspected the Hawthorne plant of the Western Electric company, Allis-Chambers and Westinghouse lamp works at Milwaukee, the State Line Generating company power station, the hydro-electric plant at Joliet, the

(Continued on Page 30)



ALUMNI NOTES

WILLIAM LAMONT ABBOTT, who received a certificate in mechanical engineering in 1884, was one of three alumni who were granted honorary degrees at the commencement in June. Abbott is the president of the Alumni Fund Board under whose auspices the Alma Mater group by Lorado Taft '79, was presented.

In presenting Abbott to receive his degree, Professor A. N. Talbot '81, said:

"Mr. Abbott was a pioneer in electric lighting and electric power generation and distribution forty years ago. For thirty-five years he has been chief administrative operating official in furnishing light and power to the homes, the industries, and the transportation companies of one of the great cities of the world, and responsible for the economical, safe, and certain operation of this great agency.

"Mr. Abbott has been instrumental in promoting the public welfare through advancing the art of the utilization of coal and the making of steam and in the production and transmission of electrical energy by greatly improved methods and on a gigantic scale. He has distinguished himself by advancing the science and art of engineering, and has been honored for his accomplishments by many national engineering societies.

"Mr. Abbott was a trustee of the University of Illinois for eighteen years, serving as president and member of the executive committee. His breadth of vision, his business acumen, the wisdom of his counsel, his loyal and devoted service at the sacrifice of personal interests, exercised through a period of the University's great development, have made a most notable contribution to the life and well-being of the University."

While on a tour of the American Society of Mechanical Engineers this July, Abbott was made a member of the Blackfoot Indians, his name being Ome-sa-ga-me, meaning Chief Big Lake. The initiation ceremony took place at Glacier Park hotel, Montana. Besides being a member of numerous engineering societies, Abbott is a member of Adelphic, Tau Beta Pi, and Sigma Xi.

MORGAN J. HAMMERS, m.e. '99, is now vice president of the Petroleum Heat and Power company of Stamford, Connecticut, which was formed by the merger of the Petro company and the American Nokol corporation of which he had been president.

ARTHUR C. HOBBLE, e.e. '01, is now the chief engineer for the Ebro Electric company in Spain. This is the largest electric company in southwestern Europe, running a large number of plants and utilizing the water power from the mountains.

After graduating in 1901 Hobble worked for the General Electric company at Schenectady, N. Y. He was then sent to southern India where he supervised the installation of a large hydro-electric plant and the operation of the unit.

Hobble returned to the University to do graduate work and obtained the degree of master of science of electrical engineering in 1911. He was put in charge of the installation of electric plants in Mexico where he stayed until the revolution stopped work on the plants. Hobble is now in Barcelona, Spain.

JOSEPH G. WORKER, m.e. '04, assistant to the president and director of the American Engineering company of Philadelphia, is an authority on mechanical stokers, having been busy with fuel-burning devices for the last twenty-five years. For the last six years he has specialized on the underfeed type of stoker. He was with Westinghouse for fifteen years, some of the time as manager of the stoker department at East Pittsburgh. Worker was formerly president of the Stoker Manufacturers' association.

H. CARL WOLF, e.e. '13, has resigned as chief engineer of the Public Service commission of Maryland to become associated with the Central Public Service company, with headquarters at Chicago, where he will act as assistant to the operating vice-president in charge of gas operations. The company owns gas, electric, and other properties in twenty states and in Canada.

Following his graduation, Wolf returned to the University in 1920 to receive a professional engineering degree. He has served as assistant engineer of the Illinois Commerce commission and later took over the management of the Edwardsville, Illinois, water supply. During the war he served two years in the army, eighteen months of that abroad. In 1920 he went to Baltimore to make a study of the organization and personel conditions of the state for the governor. He was appointed assistant chief engineer of the Public Service commission in 1921 and became chief engineer the following year. He is president of the Engineers club of Baltimore and a director of the local section of the American Institute of Electrical Engineers.

LIEUT.-COL. JOHN T. STEWART, c.e. '09, of the engineers reserve, was buried with full military honors on June 13, 1928, at Arlington National cemetery. Born on January 13, 1868, near Loda, Illinois, he attended the Paxton academy and Grand Prairie seminary. Entering the University, he received a degree of bachelor of science in 1893 and his engineering degree in 1909.

His home was in St. Paul, Minnesota, where for many years he practiced as a consulting engineer. For several years he was professor and chief of the division of agricultural engineering at the University of Minnesota, resigning at the outbreak of the war. From 1922 to 1928 he was state game and fish commissioner for Minnesota. At other times he had served in the United States Geological Survey and the United States Department of Agriculture.

Stewart was active in military work in the University and was major in the Officers Reserve Corps in 1917, when he was made lieutenant-colonel of engineers in the regular army. He was honorably discharged in 1919 and later was appointed lieutenant-colonel in the reserve.

He is survived by his widow, the former Ida Belle Wilson. He was a member of Sigma Xi, Alpha Zeta, and Tau Beta Pi, and numerous professional societies.

F. B. MALTBY, c.e. '82, as chief engineer of the New York Airport corporation, is building airports in various places around the country. Soon he will leave for Germany to get new ideas on airports there. He was recommended for his new position by John F. Stevens, former chief engineer of the Panama Canal. Maltby worked on the Canal from 1905 to 1907. A few years ago some work for the Firestone Rubber company took him to Monrovia, California.

ROY I. WEBBER, c.e. '06, died in May at State College, Pennsylvania, where he had been on the staff of Pennsylvania State college for twenty-three years. For the last eleven years he had been superintendent of grounds and buildings, supervising all new building projects of the college.

From 1902 to 1906 Webber was an instructor in civil engineering at Illinois. Born on August 27, 1876, at Warsaw, Indiana, he attended the local schools and went to Purdue university where he received the degree of bachelor of science in 1899. He was a member of Acacia and Tau Beta Pi.

The first award of the Lamme Memorial Scholarship, founded by the Westinghouse Electric and Manufacturing company as a tribute to its late chief engineer, Benjamin Garver Lamme, has been made to L. F. LUDWIG, e.e. '25.

This scholarship is to be awarded annually to an engineer in the employ of the company who has shown outstanding ability in his work, according to L. A. Osborne, chairman of the committee of award, to carry on a year's post-graduate study in a school which he may select, either in this country or in Europe. Ludwig has chosen the Techniche Hochschule at Charlottenberg, near Berlin, and will leave early in September for his year's work abroad.

Ludwig, who is a railway motor engineer, will specialize in a study of the conduction of electricity in gases, which includes vacuum tubes and mercury arc rectifiers. There, among others, he will study under Dr. R. Ruderberg, chief engineer of Siemens Schuckert, Germany's great electrical company. That Ludwig has thought before of the desirability of study under him is shown by the fact that he is now engaged in translating into English, one of his books, "Schaltvorgange," which will be published early in 1930.

Born in Kansas City, Missouri, in 1904, Ludwig received his early education in the public schools there, being graduated from Central High School. Later he entered the University of Illinois and received the degree of bachelor of science in electrical engineering with the class of 1925.

During his last years in the University, Ludwig had given vent to his creative talent by designing buildings and apartments. This, too, had been of financial benefit. In the spring of 1925, he went back to Kansas City, and there designed and built two apartments before entering the field of electricity.

In September of 1925 he joined the Westinghouse company in East Pittsburgh. His first nine months were spent in the engineering and design school, then he spent a year and a half under R. E. Hellmund, chief electrical engineer, in development work on switches, induction furnaces and high frequency relay systems. During the past year and a half he has been in the railway motor engineering department, spending most of his time studying problems relating to commutation and flashing.

Despite his work with the Westinghouse company, and despite the fact that he is engaged in an arduous task, the translation of an engineering text from the German, Ludwig has found time to design a few apartment buildings in Pittsburgh. His chief sport, tennis, he finds he must neglect, for his wife and daughter, who will accompany him to Germany, demand some attention.

Another activity previously unmentioned, is that of teaching two courses in the Westinghouse design school. As this is managed in co-operation with the University of Pittsburgh, Ludwig is an associate member of the faculty of that school. By doing this he enters the famous field of "dollar a year men."

Ludwig is a member of the American Institute of Electrical Engineers and has presented two papers before that body. He is a member of Sigma Tau, Phi Delta Epsilon, and Sigma Epsilon, honorary fraternities, and Theta Kappa Nu, national social fraternity.

ALBERT M. SAXE, arch. '11, specializes in a field of design which is not of the usual type. GEORGE L. RAPP, arch. '99, has become known for his design of theaters; JOHN H. FREDERICK, c.e. '91, has specialized in building state capitols; and J. W. ROYER, arch. '95, pays special attention to school buildings. Saxe, however, deals with the designing of prisons.

The firm of Zimmerman, Saxe, and Zimmerman, Chicago, of which Saxe is a member, have for their most recent project the construction of the Eastern Penitentiary of Pennsylvania, at Graterford,

Albert M. Saxe

Pennsylvania. The Illinois State Penitentiary at Stateville was designed by the firm after months of study and research throughout the United States and Europe. From the data obtained, a new type of circular cell house was planned, making possible new sanitary standards.

This circular cell house, with the guard tower in the center, makes it possible for one guard to control two hundred and forty-eight cells. The skylight lets in some sun to all the prisoners. Each cell is an outside room, provided with a window. Since the cells are under constant supervision by the guard, there is little incentive for an inmate to break out through the cell front.

The complete prison plant at Stateville includes a group of five of these circular cell houses, arranged around a central dining hall which seats two thousand. Further out from the cell houses are the administration building, the hospital, and the power house. The entire group of buildings is surrounded by a thirty-three foot wall which is one and one-quarter miles around.

WALTER L. NICHOLS, c.e. '15, is assistant engineer for the New York Central railroad, located at Cleveland, O.

J. M. SILKMAN, min.e. '15, is a captain in the corps of engineers of the United States army. He is stationed at Manila, Philippine Islands.

HARVEY CULLEN ESTEP, c.e. '74, died unexpectedly of heart failure on March 20, 1929, at Long Beach, California. His home was at Port Orchard, Washington, but he and Mrs. Estep were spending the winter in the warmer climate. His passing marks not only the loss of a valued classmate and alumnus, but also that of a pioneer railroad, locating, and construction engineer prominently connected with the construction of various northern transcontinental lines. He was one of the band of courageous railway explorers and locators, of whom only a few remain, whose work was fundamental in the winning of the west.

Graduating from the first class of civil engineers turned out at Illinois he immediately went west and engaged in railway location for the Oregon Railroad and Navigation company, now part of the Union Pacific system, in western Idaho and eastern Oregon. About 1880 he was in charge of exploration and locating parties for the Northern Pacific Transcontinental line down Clark's Fork river between Missoula, Montana, and Spokane, Washington.

In 1885 and 1886 he was resident engineer in charge of construction of the original line of the Northern Pacific over the Cascade mountains into Tacoma and Seattle. His work included the famous switch-back before Stampede tunnel was built. Following this he was prominent in the construction of the original Seattle terminals, Northern Pacific, and other railroad location work in Puget Sound Basin, including the original Seattle Belt Line east of Lake Washington. The Spanish war found him division engineer in charge of construction of a section of the Astoria and Columbia river railroad between Westport and Astoria, Oregon.

Following this he became principal assistant engineer of the Minneapolis and St. Louis railroad in charge of the construction of the Storm Lake branch and later the extension from Watertown, South Dakota, to the Missouri river. In 1905 and 1908 he was division engineer in charge of location and construction of an important section in the transcontinental extension of the Chicago, Milwaukee, St. Paul and Pacific railroad between St. Maries, Idaho, and Tekoa, Washington. Finally in 1910 he became chief engineer of the Southern New England railroad, a subsidiary of the Grand Trunk system, which located and partially constructed the line from Palmer, Massachusetts, to Providence, Rhode Island.

Estep was born August 13, 1852, at Paris, Ohio. At the University he was a member of Delta Tau Delta. He married Gertrude McClausland of Olympia, Washington, in 1885. She died in 1909. They had two sons, Adrian, a Diesel marine engine builder, of Seattle, and H. Cole, vice-president of the Penton Publishing company, Cleveland. In 1910 he married Jennie Allen Hobbs who survives him along with his sons, and a brother, Ezra, of Long Beach, California. Ida May Estep '78, and Jessie Estep '78, both deceased, were sisters.

WILLIS A. SLATER, m. and s.e. '06, is now at Bethlehem, Pennsylvania, where he is research professor of engineering materials and director of the Fritz Engineering laboratory at Lehigh university.

E. R. MATH, arch.e. '11, is an architectural and structural engineer with the Western Electric in New York.

(Continued on Page 30)

NO, INDEED!

"Low bridge," shouted the bus conductor. "Everybody keep his seat and face to the front."

A gay little flapper up forward turned around, smiled sweetly, and said, "My dear, you know that can't be done."

Boss: "Rastus, you good-for-nothing scamp, where have you been loafing all day? Didn't I tell you to lay in some coal?"

Rastus: "Yessuh, Ah's been layin' in de coal all day, but dere is lots of softer places whar Ah'd ruther lay."

Even his best friends wouldn't tell him —so he flunked the course.

—*Armour Engineer.*

He: "Oh, she's not as old as all that."

Ha: "Old! Why, that woman remembers the Big Dipper when it was just a drinking cup."

—*Michigan Technic.*

The Hero: "You're a bright boy, all right. Is your sister apt, too?"

Little Brother: "Sure. If she gets a chance, she's apt to."

—*Ohio State Engineer.*

There had been a train wreck, and one of two traveling authors felt himself slipping from this life.

"Goodbye, Tom," he groaned to his friend. "I'm done for."

"Don't say that, old man!" sputtered the friend. "For God's sake, don't end your last sentence with a preposition."

—*Goblin.*

"Nurse," said the amorous patient, "I'm in love with you. I don't want to get well."

"'Cheer up, you won't," she assured him. "The doctor's in love with me too, and he saw you kiss me this morning."

—*Ohio State Engineer.*

Sambo: "Did Brudder Brown gib the bride away?"

Rastus: "No, sah; he gwine let de groom fin' her out for himself."

—*Kansas Engineer.*

Professor: (addressing medical students) "The muscles of the patient's left leg have contracted till it's much shorter than the right. Therefore he limps. Now what would you do in such circumstances?"

Student: "I'd limp too."

—*Pathfinder.*

NO FORWARDING ADDRESS

The mate had fallen overboard. He sank out of sight, then rose to the surface.

"Ahoy, there," he yelled, "drop me a line!"

The captain appeared at the rail and shouted back: "All right, but what's your address going to be?"

—*Detroit News.*

It is easy enough to look pleasant
When you're looking and feeling quite flip,
But the man that's worth while is the man who can smile
When his girl has a sore on her lip.

—*Iowa Enginer.*

He: "Do you know the secret of popularity?"

She: "Yes, but mother says that I musn't."

—*Ohio State Engineer.*

Jones: "His father died from hard drink."

Bones: "He did?"

Jones: "Yes, a cake of ice fell on him."

—*Michigan Technic.*

Prof.: "What is a tissue?"

Stewed: "A tissue is a collection of similar cells."

Prof.: "Illustrate."

Stewed: "Sing Sing!"

—*Kansas State Engineer.*

Father Kangaroo: "Oh, Ma, where's the baby?"

Mama Kangaroo (feeling in pockets): "Gracious, I must have left him in my other clothes."

—*Web Foot.*

Ali Baba stood before the door of the stone cavern and repeated the words that had been told to him.

"Open Sesame!" he said loudly. Nothing happened.

"Open Sesame!" he said, more loudly. Less than nothing happened.

Finally he fairly bellowed: "Open Sesame!" This time the great stone door rolled aside, and a weazened old man peeped from the opening.

"Come around tomorrow night, son," he said; "the place has just been raided."

—*Pennsylvania Punch Bowl.*

Pretty Nurse: "Every time I take the patient's pulse, it gets faster. What shall I do?"

Doctor: "Blindfold him!"

—*Rose Technic.*

"Why all the bandages on Jones' head?"

"Rotten bridge."

"Break through?"

"No, trumped his wife's ace."

—*Iowa Engineer.*

Hot: "Mistah Jones, Ah came ter ask foh yo' daughter's hand."

Poppa: "Nigga, yo' eider gotta take all of her or nuffin."

—*Sibley Journal of Engineering.*

Spark (being served elaborate dessert): "What do I use on this, the midiron?"

Park: "Oh, no, you just putt it in."

The jury had been out on the case all morning and was still deadlocked. The vote stood 11 to 1 for acquital, but an old codger stubbornly held out for a verdict of guilty.

The sheriff came in at dinner time and inquired what they would have to eat.

"W-a-l," said the foreman digustedly, "you can bring us eleven dinners and a bale of hay."

—*Auburn Engineer.*

"Did you hear about Mr. Goofus, the the bridge expert, being the father of twins?"

"Yes. Looks like his wife doubled his bid."

—*Black and Blue Jay.*

"The jig is up," said the doctor, as the patient with St. Vitus dance died.

—*Log.*

Frosh, reading Caesar: "Begone—"

Professor: "Why is there a pause after 'begone?' "

Frosh: "To give him time to run."

—*Armour Engineer.*

Georgia lawyer (to colored prisoner): "Well, Rastus, so you want me to defend you. Have you got any money?"

Rastus: "No, sir, but I got a nineteen twenty-two model Ford."

Lawyer: "Well, you can raise some money on that. Now, let's see; just what do they accuse you of stealing?"

Rastus: "A nineteen twenty-two model Ford."

—*Kreolite News.*

Reformer: "Young man, do you realize that you will never get anywhere by drinking?"

Stewed: "Ain't it the truth? I've shtarted home from 'ish corner five times already."

—*Aggievator.*

Tau Beta Pi

To one engaged in the arduous occupation of obtaining an engineering education, the three words, *Tau Beta Pi*, should, in themselves, suffice to state the goal of his college career. Those acquainted with the ideals and aims of the society will accept this statement without qualficationtion or discussion, but there may be some to whom the Bent means nothing; to them Tau Beta Pi is just another organization — it can signify nothing, or at least, not as much as the above statement implies. It is to those that these few words are addressed.

Tau Beta Pi is an honorary society; as such its first aim is scholarship. However, scholarship, important as that is, is not the whole reason for the existence of Tau Beta Pi. Look around for the men wearing the Bent and note them carefully. They are intelligent, perhaps some of them brilliant, but they are not a collection of grinds who seem interested only in their books and studies. On the contrary, they possess pleasing personalities, are men of unimpeachable character, are just as well acquainted with the arts as with the sciences, and are interested in a great variety of activities. All these points are considered before a man is offered a bid to the society. After his initiation, the organization attempts, and, I may add, succeeds, in developing the man further along these lines. This development of the man is the big aim of the society — surely a most worthy one.

Even the insignia of the fraternity connotes the qualities demanded in a member. Look at the cut of the key shown on this page; study it carefully; and then analyze your re-actions. Does it not give you an impression of dignity, of quiet simplicity, great strength, character, and solidity? The Bent itself proves an inspiration to the wearer and to the onlookers. If the insignia alone is of so great a value mentally, should not membership in the society and association with other members prove of much greater value?

The question may now arise as to what one must do in order to merit membership in Tau Beta Pi. As stated before, the first necessity is, of course, a high standard of scholarship — one much higher than for most honorary societies — must be maintained during his first few years of college life. The man whose grades are sufficiently high to meet the scholarship requirements is then considered and rated as to his character, loyalty, personality, leadership and participation in school activities. Those ranking highest in these essential characteristics are extended the bid to membership.

Other questions have been asked, as to the number eligible for the organization and as to the time of choosing. Each year there are initiated into the organization, two groups; one during the fall, and the other during the spring. In the fall, the men chosen are all seniors, with the exception of the "honor" junior, usually the junior with the highest average in his entire class. In the spring, then, juniors, only, are chosen, and it is these men who carry the organization on during the first part of the next year. Approximately five per cent of the seniors, or less than one per cent of the engineering school are eligible, from the standpoint of grades, alone, to membership in Tau Beta Pi.

Tau Beta Pi is a national organization, being founded at Lehigh in the nineteenth century, and since, having established chapters at all the leading engineering schools. It is an organization which is represented in practically all engineering industries — and everywhere it means the same thing — the best.

Theta Tau

Theta Tau was founded at the University of Minnesota on October 15, 1904. It was originally known as Hammer and Tongs fraternity, but because the purposes of the organization were often misunderstood, it was decided to use the Greek letters, which had always been on the badge, as its future name. Kappa chapter at this university was established on March 25, 1916, and since that time has enjoyed an active part in the affairs of the national fraternity.

The units of this fraternity consist of 21 active chapters and seven alumni associations. The members are chosen by reason of personal worthiness as manly men, and because of engineering ability. Membership is confined to juniors and seniors not affiliated with any other engineering fraternity declared to be competitive to Theta Tau. Each year a limited number of outstanding sophomores are chosen together with upperclassmen.

Theta Tau, being a professional engineering fraternity, does not exclude men belonging to the academic social fraternities. In its membership are included all regular engineering students.

It is the policy of the fraternity that chapters maintain permanent headquarters and six chapters are at present living in their own houses. Kappa chapter holds its regular bi-weekly meetings at various fraternity houses on the campus. The meetings are proceeded by a dinner, and about once a month talks are given on professional subjects by students and members of the faculty.

Industrial enterprises of many types require large staffs of engineers who must work together in professional harmony, and who often must live together in closest personal intimacies. Engineering in this respect differs from most other professions, for engineers seldom work alone. For this reason Theta Tau encourages its members to be together while in college in order that closer fraternal contact may be acquired, which in later years will prove helpful. Students of today will be the engineers of the future, guiding the destinies of industry. Close friendships made during college days ripen with the years and are essential to a fully successful career. The object, therefore, of Theta Tau, is to unite its members in fraternal fellowship, to endeavor by thought and deed to maintain high ethical and technical standards among engineers, and especially as to its memberships.

The fraternity occasionally chooses honorary members from among worthy practicing engineers or teachers in the profession. At the second meeting of the semester, Prof. J. J. Doland of the civil engineering department was formally initiated into Kappa chapter. The following men are vested with authority for the current year; John F. Schroeder, m.e. '30, Regent; Bruce Eaten, e.e. '30, Vice Regent; Charles Luckman, arch. '30, Scribe; Richard C. Oeler, m.e. '30, Treasurer.

Sigma Tau

Sigma Tau was founded at the University of Nebraska, February 22, 1904, after a year and a half of sub rosa organization. Its organization was due to a feeling among the engineering students at that institution that the engineering students of merit should be bonded together by fraternal ties as well as ties of classroom friendships.

National expansion was discouraged, until 1908, when the second chapter was established. From that time on, a rapid, but rather conservative expansion has been carried out. There are now nineteen active chapters and four active Alumni Associations.

CHAPTERS OF SIGMA TAU

Alpha, University of Nebraska; Gamma, University of Pennsylvania; Epsilon, Kansas State College; Zeta, Oregon State College; Eta, Washington State College; Theta, University of Illinois; Iota, University of Colorado; Kappa, Pennsylvania State College; Lambda, University of Kansas; Mu, University of Oklahoma; Nu, Swarthmore College; Xi, George Washington University; Pi, University of North Dakota; Sigma, Oklahoma A. and M. College; Tau, South Dakota State School of Mines; Upsilon, University of Florida; Phi, Municipal University of Akron; Chi, University of New Mexico.

ALUMNI ASSOCIATION

Chicago, Schenectady, New York City, and Portland.

Theta chapter of Sigma Tau was chartered at the University of Illinois in 1914.

Members are selected from the junior and senior classes. They are judged according to "Scholarship, Practicability and Sociability, the three requirements of a successful engineer." About equal emphasis is given to scholarship and practicality. A man must have completed at least four semesters of work with a minimum average of four point (4.0). Until a few years ago a man must have had some practical experience in the engineering field in order to be considered a candidate for membership, but as engineers have become more numerous this requirement has been abandoned and the judgment of the faculty men has been relied upon to determine a man's general makeup for a successful engineer.

In the early days of Theta Chapter a gold medal was given to the freshman making the highest grades; this custom is to be revived this year, as Sigma Tau plans to present a gold medal to the freshman making the highest average in the college of engineering.

The publication of Sigma Tau is called "The Pyramid," and is issued quarterly. The national organization is controlled by a council which is elected at the conventions.

The active chapter meets for dinner every two weeks, usually at the fraternity house of one of its members. The selection of members is made both in the spring and fall semesters.

The officers of the present chapter are: President, B. F. Rose; secretary, A. G. Lindberg; treasurer, M. F. Carlock; corsecretary, D. G. Bennett.

Inspection Trip

(Continued from Page 23)

Volmer Road sub-station, and the Illinois Steel plant. They were under the supervision of Profs. E. B. Paine (head of the department), A. R. Knight, and E. H. Waldo, and J. C. Peed and M. A. Faucett.

Mechanical engineers, under the guidance of Profs. O. A. Leutwiler, C. H. Casberg, and J. A. Polson, visited the Wisconsin Steel company, the State Line plant, the Corwith plant of the Crane company, the Hawthorne works of the Western Electric company, and the tractor works of the International Harvester company, all in Chicago, and the Falk corporation and Allis-Chambers in Milwaukee.

Prof. R. A. Hall was in charge of the general engineering students, who inspected the Illinois Steel works and American Bridge works with the civil engineers, Allis-Chambers and Westinghouse lamp works with the electrical engineers, and the Hawthorne plant of Western Electric with the mechanical engineering department.

Civil railway engineers were under the direction of Prof. E. E. King. They made the trip to the Illinois Steel company and the American Bridge works, and in addition visited the Burnside shops, Markham yards of the Illinois Central railroad, the Union station and the Pennsylvania railroad. While in Chicago they inspected building construction in the loop, and the Chicago tunnel system.

Mining engineers went to southern Illinois and southeast Missouri, visiting mines in that territory. In charge of their group was Prof. D. A. Mitchell.

Prof. J. K. Tuthill supervised the railway electrical engineers. They inspected the Illinois Steel company plant at Gary, the electric shops of the Burnside yard and Markham yards of the Illinois Central system, Allis-Chambers and Westinghouse lamp works, Milwaukee, the State Line plant, Joliet hydro plant, Volmer Road sub-station, and the car shops of the Chicago surface lines.

Prof. C. K. Hursh took ceramic engineering students to Indianapolis, Brazil, Peru, and Kokomo, Indiana, and points near Chicago.

The architectural engineers, under the direction of Prof. C. E. Palmer, went to the Universal Portland Cement company at Buffington, Indiana, the Inland Steel company at Indiana Harbor, Morava works of the McClintock Marshall company, the Midland terra cotta company plant at Cicero, Wolf manufacturing company, Chicago, the unfinished construction jobs in the loop district, the new Merchandise Mart at No. 1 LaSalle street, the Wacker building, and the new Board of Trade building. They also inspected the Strauss building and were given a plant talk by the planning expert of the Strauss company on "Fixing Rents and Building Management." The last place to be inspected was the laboratory of the Portland Cement association.

Prof. J. C. Dillenback was in charge of the group of architectural students, who visited buildings in Chicago.

The Illinois committee on co-operation with educational institutions held a dinner at the Edison building in Chicago, to which all those making the trip were invited. A good program was provided by K. Y. W. entertainers.

While in Chicago the Illini engineers made the Stevens hotel their headquarters.

Alumni Notes

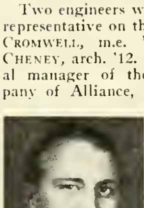
(Continued from Page 25)

Two Illini engineers, Harry F. Glair, m.e., '12, and P. J. Sweeney, a.e. '15, have added more honors to their name. For each of them have received promotions in the Standard Oil company of Indiana, and are located at the Whiting refinery, the largest production unit of the company in Indiana. Glair, who was the former general superintendent of the Whiting refinery, has now been made manager of the whole refinery. Sweeney was the former superintendent of the light oils department, one of the largest of the departments. He has been transferred, and is now one of the three assistant general superintendents.

P. J. Sweeney

H. F. Glair

Two engineers were candidates for class representative on the alumni council, J. C. Cromwell, m.e. '86, and Howard L. Cheney, arch. '12. Cromwell is the general manager of the Steel Sanitary company of Alliance, Ohio, which manufactures bath tubs, sinks, and similar products, following a new process developed by him. His first work after graduation was as a draftsman, and at one time he was chief engineer for the Illinois Steel company at Joliet. For many years he was a partner in the Garrett-Cromwell Engineering company at Cleveland, and last year he became interested in the manufacture of plumbing fixtures with headquarters at Alliance.



H. L. Cheney

Cheney has been in architectural work ever since his graduation, except for the time he spent in the army. As advisory architect for the Tribune Tower competition he was accorded notable recognition, and he was associated with the *Tribune* during the construction of the building. Just recently he and the noted Finnish architect, Eliel Saarinen, were selected to prepare the design for the "Memorial Temple of the Republic," the great war memorial for Chicago.

Included in the memorial resolutions passed by the Alumni Association at the annual meeting in May were the names of the following engineers:

Harvey Cullen Estep, c.e. '74, pioneer railway construction engineer;

Vantile William Coddington '75.

James H. Gunder, min.e '79, railway construction engineer;

Albert Fowler Robinson, c. and min.e. '80, nationally known railroad bridge engineer and authority;

Edward Spencer Keene, m.e. '90, dean of the College of Engineering at North Dakota Agricultural college;

Benjamin Asaph Wait, c.e. '92, member of engineering staff of the Rock Island railroad;

Harley Edson Reeves, c.e. '95, United States engineers' staff, specializing in river and canal work;

Henry Jackson Burt, c.e. '96, structural engineer, specializing in steel skyscrapers; and

Henry Childs Morse, c.e. '04.

Charles C. Carr, e.e. '06, is telephone engineer for the Bell Telephone company in New York.

Lawrence B. Barker, m. and s.e. '08, is senior assistant engineer of the sanitary district of Chicago.

C. C. Hubbart, c.e. '09, is chief engineer of the Superior Coal company at Gillespie.

Frank Goodspeed, arch.e. '09, is with the Illinois Engineering company.

E. S. Hight, e.e. '10, is assistant vice-president in charge of operations and chief engineer of the Illinois Light and Power company.

J. G. Mench, e.e. '11, is with Frank D. Chase, Incorporated, Chicago.

Harry Y. Carson, m. and s.e. '11, directs research for the National Cast Iron Pipe company, and is president of the Birmingham Galvanizing company, incorporated, at Birmingham, Alabama.

I. W. McDowell, e.e. '11, is an electrical and mechanical engineer with Western Electric at East Orange, New Jersey.

Harold C. Deane, ry.e.e. '09, of Long Island, is general superintendent for the New York and Queens Electric Light and Power company.

P. B. Glassco, arch. '04, has specialized in designing and building bank buildings for the last ten years. One of his sons enetred the University this year.

Robert C. Elder, c.e. '14, is superintendent of construction in the state highways office at Carrollton, Illinois.

Farmer Corntassel had just retired and moved to town. In the morning, after spending the first night in his new home, his wife said, "Well, Pa, hain't it about time to git up and start the fire?"

"No, siree," replied the old gent. "I'll call the fire department. We might as well get used to these city conveniences right now."

—*Idaho Engineer.*

May: "I don't like Charles; he knows too many naughty songs."
June: "Does he sing them to you?"
May: "No, but he whistles them."

—*Punch Bowl.*

"Watchagotna packige?"
"Sabook."
"Wassanaimuvit?"
"Sadickshunery, fullinaims. Wife's gonna gattepeleecedog angottagettanaimferim."

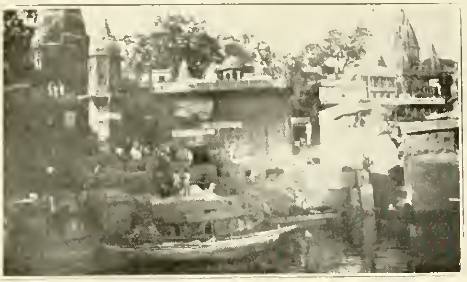
—*Ad Age.*

India and Way Stations

(Continued from Page 17)

What has the economic philosophy being developed in the United States to offer? It, too, has much to offer, but here again it cannot take its proper place in the life and thought of the people until their distorted conception of the values of life are corrected and properly focused. Who can guess how many centuries this will take?

The political philosophy that Britain has laid over India like a blanket resting on the points of her bayonets has undoubtedly been of temporary benefit, but it



Ghats at Benares

is philosophically unsound because it is based upon selfishness and the Indian knows it. He, therefore, refuses to learn the lesson that he might learn from contact with the British.

These thoughts and others passed through my mind as we steamed northward past Karachi and other parts of the Persian Gulf on our way to Basrah on the Euphrates. We at last entered this ancient river and sailing on between its low banks lined with date palms and flat roofed villages whose mud walls had been baked by the suns of centuries came to the port of Basrah. From here a train took us up the valley of Euphrates for many miles before cutting across to Bagdad on the Tigris. Through Ur, in Chaldea, where Abraham started his journey to the land of promise, past the problematical site of the Garden of Eden, over miles and miles of the great Arabian desert with its endless sand and blazing sun, where the proverbial shiek materialized, riding furiously like a phantom against the sky, or sitting quietly on his stallion with rifle handy across the saddle, watching from beneath his turbaned brow the passing of the train.

On through the cradle of the world to Bagdad famous through milleniums as the city of silk and spice, the starting place and destination of caravans innumerable. Between east and west she stood and stands, still watching the muddy Tigris smiling sphinx-like on its way. In the midst of ancient civilization Bagdad had her place and she stands today with the ruins of these about her, Nineveh to the north, Babylon and Kish to the south. She has survived them all. She was old in history when Sinbad the sailor flew his carpet, she is young today in the midst of ruins. Bagdad is probably with one exception, the oldest city in the world.

Over sixty miles of desert sand we drove from Bagdad to Babylon. We clamber among the ruins, we see the ancient wells and baths in Nebuchadnezzer's palace, the banquet hall where Belshazzar, Neb's captain, saw the handwriting on the wall, the pillars, and brick embossed walls, and over beyond the stone lion of Babylon. We climb to the top of a hill of excavated sand and gaze across a half mile of desert to the ruins of the tower of Babel. We walk across and stand beside the remains of what was started as a tower to heaven. An out hill in the desert, scarcely more. Today an engineer would smile at the method of its undertaking as well as at the futility of its conception. It was not difficult to imagine the thousands of straining, sweating bodies in the heat of the desert sun, the confusion of command, the calls and curses that rang on every side as day succeeded day on this stupendous task four thousand years or more ago.

Back again to Babylon along what may have been the ancient bed of the Tigris for in those ancient days the river most certainly rolled its lazy way beneath the city's walls. Once more I stood and looked at all that remained of the glory of long ago. Not a single human habitation within sight, nothing but the desert sand. Not a thing that breathed except the lazy lizards basking in the last rays of the sinking sun. I should have liked to stay until the sun had set and the moon rose o'er the desert's ruin, softening the desolation of countless ages, for then, in the blending shadows, it would have been easier to slip back to the glories of the past, to see the soldiers camped about discussing the possibility of overthrowing Nineva and their Assyrian rivals, or the possible results of the Egyptian messenger's visit, to see the Jewish slaves at their menial tasks, preparing for the gorgeous banquet, to walk along the brick-paved passage past the great stone lion that seems to come to life with the drawing down of darkness, into the great banquet hall where the feast is enlivened far into the night by the various vintages of the valley.

> "They say the Lion and the Lizard keep
> the Courts where Jamshyd gloried and
> drank deep."

Rousing ourselves from the spell of the ages we retrace our tracks to Bagdad. At least we retrace them in a general sense, for there is no road and a driving sand storm has obliterated the tracks we made coming out. As I sit in the car with my handkerchief over my face I realize that the long, black camel hair cloak of the Arab is a most useful garment.

The next morning at six o'clock by the light of the moon twelve ghostly figures take their silent places in the "City of Jerusalem," the three-motored plane of the Imperial Airways that is to take us over 600 miles of Arabian desert to the land of "milk and honey." We take off easily and are soon flying along 2000 feet above the dusty desert, dimly discernable in the moonlight. Gradually the moonlight fades and the sun appears above the desert's edge. Still we roar our tractless way now at a height of 3000 feet.

At ten thirty we descend at Rutba, a desert station for breakfast, two hours late. A terrific head wind has slowed our one hundred miles an hour through the air to fifty miles an hour relative to the ground. At eleven o'clock we are again soaring through the air. At two o'clock, when we should have been at our destination on the Mediterranean coast, we can barely see the edge of the desert. We now descended at Ziza, a little village near the border of Palestine to transfer the gasoline from the emergency tanks to the feeding tanks. In a few minutes we are again in the air and about five o'clock are flying over the Dead Sea a little south of Jerusalem. The hills of Moab have been past and the hills of Judea lie before us. Desolation Supreme. Red, brown, barren mountains defying even a blade of grass to grow. Twisting their tortuous way from base to summit not a foot of level ground could be seen. My past-time of searching for a place to land was brought to an end by the plane passing into a bank of clouds. We rose to about

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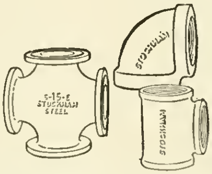

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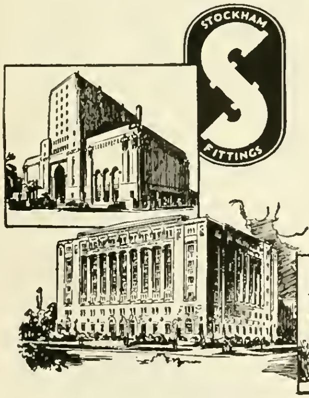

CAST AND MALLEABLE IRON:

Chanin Building........ New York City
Liggett Building..... New York City
Graybar Building....... New York City
Metropolitan Building........ New York City
Park Central Hotel........... New York City
Shelton Hotel .... New York City
Stock Exchange Annex........ New York City
Brooklyn Towers............. Brooklyn, N. Y.
Belden Hotel........ ..Chicago, Ill.
Campbell Soup Company's Plant, Chicago, Ill.
Straus Building................ Chicago, Ill.
Pure Oil Building............... Chicago, Ill.
Shoreland Hotel................ Chicago, Ill.
Cook County Jail.............. Chicago, Ill.
Fisher Building............... Detroit, Mich.
Masonic Temple.............. Detroit, Mich.
Union Trust Building......... Detroit, Mich.
Wolverine Hotel............... Detroit, Mich.
City Hall................ Los Angeles, Calif.
Lord Baltimore Hotel........ Baltimore, Md.
S. W. Bell Building........... St. Louis, Mo.
Bachelor Apartments......... St. Louis, Mo.
Bellrieve Hotel................ St. Louis, Mo.
Chase Hotel and Apartments.. St. Louis, Mo.
Coronada Hotel..... .... St. Louis, Mo.
Federal Reserve Bank......... St. Louis, Mo.
Melbourne Hotel.............. St. Louis, Mo.
Scottish Rite Building...... St. Louis, Mo.
Theodore Roosevelt High School, St. Louis, Mo.
St. Mary's Hospital........... St. Louis, Mo.
Clark Building .... Pittsburgh, Pa.
Southern Ry. Building.... Washington, D. C.
U. S. Chamber of Commerce, Washington, D. C.
Miramer Apartment Hotel, Minneapolis, Minn.
Lowry Hotel................ St. Paul, Minn.
Paxton Hotel.................. Omaha, Nebr.
Bellevue Hotel............. Kansas City, Mo.
Kansas City Athletic Club.. Kansas City, Mo.
Canal Bank Building....... New Orleans, La.
Jung Hotel................ New Orleans, La.

Indemnity Building........ New Orleans, La.
Roosevelt Hotel............ New Orleans, La.
A. I. U. Building............ Columbus, Ohio
Neil House................. Columbus, Ohio
Auditorium Hotel............ Houston, Texas
Post Dispatch Building...... Houston, Texas
Warwick Hotel.............. Houston, Texas
Bankhead-Leland Hotel... Birmingham, Ala.
Thomas Jefferson Hotel.... Birmingham, Ala.
Public Library............ Birmingham, Ala.
Pizitz Department Store... Birmingham, Ala.
Dallas Sanatorium .... Dallas, Texas
Shrine Temple............ Des Moines, Iowa
Read House............. Chattanooga, Tenn.
Hotel Carling............. Jacksonville, Fla.
Post Office Building........ Lancaster, Pa.
Alden Park Manor.......... Brookline, Mass.
Buena Vista Hotel .... Biloxi, Miss.
General Motors Yellow Truck Plant, Pontiac, Mich.
Senior High School........ Little Rock, Mich.
Reynolds Office Building, Winston-Salem, N. C.
New Eastern High School..... Lansing, Mich.
Nansemond Hotel........... Ocean View, Va.
Armory and Theater Bldg., Hopkinsville, Ky.
The Singing Tower..... Near Lake Wales, Fla.
The Pioneer Rubber Mills Plant, Pittsburg, Calif.
The President Hotel.......... Waterloo, Iowa
Court House............... Milwaukee, Wis.
Post Office Building.......... Lancaster, Pa.
City Hospital and Nurses Home, Atlanta, Ga.
Saline County Court House.... Wilber, Nebr.
Eastern High School.......... Lansing, Mich.
Philtower Building.............. Tulsa, Okla.
Crownsville Hospital...... Crownsville, Md.
Villa Riviera Apartments, Long Beach, Calif.
World Herald Addition .... Omaha, Nebr.
510 Graveland Apt. Hotel, Minneapolis, Minn.
Baker Building.......... Minneapolis, Minn.
Shrine Temple and Consistory, Des Moines, Iowa
Wausau Hotel................. Wausau, Wis.
John Deere Tractor Plant..... Waterloo, Iowa
Bondi Building............... Galesburg, Ill.
Teachers Training School..... Kutztown, Pa.
Teachers Training School.... Lock Haven, Pa.
Olds Hotel.................. Lansing, Mich.
Masonic Temple.............. Lansing, Mich.
Walter French High School... Lansing, Mich.
Olds Motor Co. Administration Building, Lansing, Mich.
Ohio Bell Telephone Co...... Cleveland, Ohio
William Penn Hotel.......... Pittsburgh, Pa.
Fort Shelby Hotel .... Detroit, Mich.
Orpheum Theatre.... .... Omaha, Nebr.
Union Pacific R. R. Office Bldg. Addition, Omaha, Nebr.
Irving Junior High School..... Lincoln, Nebr.
U. S. Army Barracks .... Fort Riley, Kans.
Turner Hotel................ Superior, Nebr.
Yancey Hotel .... North Platte, Nebr.
Woodrow Wilson Junior High School, Cedar Rapids, Iowa
Coliseum................. Cedar Rapids, Iowa
Pennsylvania R. R. Building, Philadelphia, Pa.

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4000 feet and flew on in clouds that almost hid the tip of the wings. This was hardly entertaining and soon I dropped into a doze through which I could faintly hear the hum of the motors. I do not know how much time passed before I faintly felt the plane descending. Slowly I roused to consciousness and glanced out of the window. Still clouds impenetrable as before. A glance at the altimeter showed 100 feet and going down. Another look from the window—grey clouds—and then the rocky side of a mountain not fifty feet away and we going a hundred miles an hour. "Here is where I shake hands with St. Peter" was the thought that flashed through my mind as I waited for the crash. But St. Peter was evidently not home that day, for the plane took a sudden upward shoot—so sudden was the change in direction that I almost pushed a hole through the floor. I was just gettiny my spinal column unkinked when the plane levelled off and I floated up to the roof. Once more the process was repeated until the altimeter showed over 5000 feet. For another fifteen or twenty minutes we flew through the clouds until we found an open space and then down again, but this time we are over level ground and a gentle landing was made in a barley field by the light of the wing flares.

In a surprisingly short time several wild-looking natives appeared around the plane. The pilot persuaded one of these to take a note to Gaza. My first night in Palestine seemed one of the longest I ever spent, for it was not until six o'clock the following morning that rescue automobiles from Gaza found us.

Gaza is most interesting in its reminiscent possibilities for it stood for centuries between the frontiers of the Egyptians on the one side and the Babylonians, Assyrians, and Persians on the other. Caravans from east and west passed its walls and many a famous and interesting character must have rested within its shadow. Some hundreds of years ago Crusader swords and Turkish scimitars clashed round about its walls and back and forth through the narrow streets. For some years Gaza was under the control of these Crusading knights. Once again in later years, only a decade ago in fact, Gaza was to witness a struggle between the followers of Christ and Mohammed. It was in the vicinity of Gaza that General Allenby undertook the conquest of Palestine, and for the second time Gaza was occupied by Christian soldiers.

From Gaza a fine, new road, built by the British, leads to Jerusalem. It passes through Bert Sheba and by the city of Bethlehem. In this latter city the practical earnestness of the Crusaders is evidenced by the doorway which they built in the Church of the Nativity. It is so low that a person must stoop very low in order to enter. It symbolizes Christ's saying that it is easier for a camel to pass through the eye of a needle than for a rich man to enter the kingdom of heaven.

Jerusalem and its surroundings, in fact the whole of Palestine, is so replete with the history of the Jewish nation and the life and activities of Christ that they can not even be described short of many volumes. The old city of Jerusalem with its narrow bazaars and small oriental shops is probably much as it was 2000 years ago. Fortunately modern buildings, stores, street lights, and other earmarks of western progress have encroached but little upon the old Jerusalem.

I have no patience with those visitors to the Holy Land who express disappointment. They either expected a country and city full of modern conveniences, or were too much interested in details and give vent to their disappintment when they realize that historically, but little can be proved. To me it seems better so, for if we knew for an historical certainty that Christ uttered certain words on a certain spot, there would be nothing left for the imagination. If we could prove all the tenets of religion, religion would cease to be. It would become a fact, and faith would cease to function.

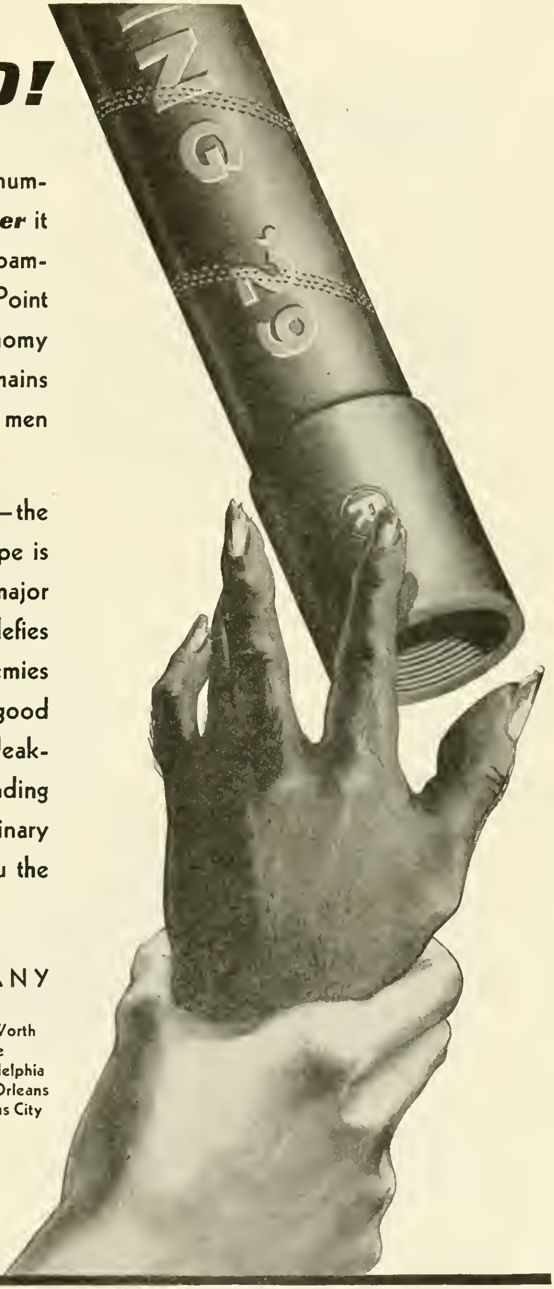
As one walks along the Via Dolorosa, or Avenue of Sorrow, from St. Stephen's Gate to the Church of the Holy Sepuchre, one gradually, if psychically reactive, becomes detached from the present and feels oneself in close contact with the infinite. What matters it then, if the sixth Station which is at the house of St. Veronica, where that Saint wiped the sweat from the brow of Jesus, is placed at the historically correct house or another? It is not the house that matters in the eternal scheme of things, but the act of kindness. Whether the Church of the Holy Sepulchre is Calvary or another hill some rods distant, matters little. It is not the hill we are interested in, but the sacrifice supreme that we are told occurred there.

For those who cannot thus abstractly think of the things that give to life its value, some visible evidence is required, hence, the house, the hill, the tomb, and other things to associate more intimately the meaning of the message with their lives.

The brush mark of the artist is not looked for if the satisfaction that comes from a contemplation of beauty is sought, but rather the impression of the painting as a whole. To be sure the brush mark must be there. So in Palestine, the setting that gives us the feeling of two thousand years ago is most desirable, but if we stop to quibble, we strike a discord that instantly breaks the mental picture into evanescent pieces.

Down the Valley of the Apostles from Jerusalem to Jericho one feels His presence passing us as it passed so long ago. On the hills, the sheep are grazing and the shepherds idly watching as one treads the path so often

UNTOUCHED!



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GENUINE PUDDLED WROUGHT IRON

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DIAMETERS RANGING FROM 1/8 TO 20 INCHES

followed by the Prophet of Judea down to where the Jordan, rolling slowly by, fills the soul with peace. Beyond the roofs of Jericho the mountain of temptation stands as a reminder resolute that he who will can conquer.

Jerusalem and Palestine may serve to stimulate destructive wrangling or they may help to lead our thoughts into the realm of beauty and our spirit to that state of tolerance that among all of the things worth striving for is of the greatest value.

From Jerusalem my path lay northwest across Palestine to Haifa on the shore of the Mediterranean. The flowers were in bloom on Mount Carmel back of Haifa (more varieties of wild flowers are found in Palestine than in any other country) weaving gently in the breeze their spell of oblivion for the fallen heroes of Crusader days, though their castle stands, gauntly outlined against the sky as a reminder of past glories.

From Haifa I drove north by automobile to Tripoli in Syria. The road lay along the sandy beach of the Mediterranean, through Acre with its history, where Kings sat in councils with Grand Masters of the Great Orders of Templers and Hospitallers, hardly less than kings, and up along the rocky ledges of the mountains bordering the sea further north. From Tripoli a train runs across Syria and Turkey to Constantinople, the first city in the world to be captured by the use of gunpowder.

Turkey is today a very progressive country and Constantinople a most cosmopolitan city.

Three days I had to "cool my heels" in Para because of the snow in the passes of the Balkan mountains to the north. Finally my journey was completed through Roumania and Yugoslavia, back to Milano, Paris, London, and New York.

Train Operation in the British Isles

(Continued from Page 10)

are reduction of tare weight, smoother running which is undisputed, reduction of starting resistance and resistance on curves.

As can well be imagined, British railways are suffering severely from road competition to a far greater extent than is possible in America. The railways are endeavoring to combat this by fuller employment of their superior organization, and many new facilities, particularly in goods service, are now available such as the new railhead distribution. A typical case would be presented by the manufacturer of Scotch whisky whose factory is of necessity beside some particularly pure supply of water in the western highlands of Scotland, while the demand is spread throughout the country in direct proportion to the population; therefore the greatest density of demand occurs around the great centre of population. As the demand is frequently for single crates (containing six bottles), or for crates not exceeding one dozen, it is obvious that the greatest problem to the manufacturer is that of delivery. The railways are now recapturing much of this traffic by placing this parcel delivery service at the disposal of the despatcher while he is provided with liberal warehouse space at each big centre, and not infrequently within an office for a local agent. There a constant number of crates are maintained in the railways warehouse, and supply orders are transmitted through the local agent to the railway who promptly and automatically delivers the goods from the warehouse to the consumer's door. The task of maintaining the warehouse stock involves only a simple, economical problem of transportation which is handled at considerable profit by the railways concern-

ed. By these and similar devices it is probable that railways will continue to hold their own against both road and air transport. Recent returns indicate that the economy campaign carried out recently by several lines has been a great success and great reductions have been made in running expenses. The introduction of more efficient locomotives particularly has had an enormous effect upon the coal bill, while their more economic utilization by the extension of their individual runs has likewise resulted in economy in both maintenance and labour.

It may be asked how it is that the British railways have gone to such extremes as the maintenance of such high speed and long distance expresses, which, as a system, are equalled by no other nation. The answer may be based entirely upon that most active and most peculiar expression of national sentiment known as British Public Opinion. It must be extremely difficult for an American to understand, not to say sympathize with, a nation in which the man in the street is not only perfectly conscious that he is absolutely an individual fragment of the salt of the earth, but also personally responsible for everything between the management of tides and the prevention of cruelty to white mice. The privilege of a Britisher to grumble, coupled with an exaggerated idea of the enormous importance of the individual citizen, which in some strange and incomprehensible manner is intimately connected with Magna Charta and the Habeas Corpus Act, has produced a peculiarly effective form of national expression. In the case of the railways the public has demanded speed, frequent services and a minimum of stops, and the public has had to have it. Even now the public is far from satisfied, though to quote a greater "British Public Opinion is an ass." Headed by such authorities as Lord Monkswell, and by various newspapers, not to mention the Daily Mail, agitation is continually promoted for better services, while the extreme popularity of the faster trains more than compensates for the additional expense in running them. Even the music hall platform is a really potent factor in development, the reputation obtained by the South-Eastern & Chatham Railway has been sufficient to tinge the whole of the Southern Railway, while to many people the mention of the Hull and Barnsley is usually the supposed prelude to a particularly good joke. It is not surprising therefore that even the intelligent traveler finds much on foreign railways that appears to him as amusing, while those of lesser mental capacity have not been unknown to take the whole system as a colossal joke. This must not be taken too seriously, however; in Britain the most serious sides of national life are usually covered with a veil of humour, in order that truer sentiments should not immodestly be exposed to view. Doubtless the American visitor finds much that is irrational in the islands, but we must ask you to bear with us for the little while you stay, as we are really quite happy in our little kingdom, and don't want to be disturbed too suddenly. Our big grown up children of the Empire have other railways to show you which you will probably like better, but anyway you can always remember that if our lines were, in your estimation, as good as your own, you could no longer claim the finest system in the world.

"And do you mean to tell me you laughed in the face of death?"

"Laugh? I thought I'd die."

—*Annapolis Lof.*

No one has ever complained of a parachute not opening.

—*Rutgers Chanticleer.*

Widening State Road

(Continued from Page 12)

that no strong bond would be formed between the two. At the ends of the improvement triangular blocks of pavement were built to make a more gradual change from the eighteen foot slab to the widened pavement.

Cleanup work began as soon as the pouring was done. The expansion joints which had been left protruding above the slab were trimmed off with a sharp cutting tool flush with the pavement. The aggregate and refuse which had collected on the pavement were hauled away and the pavement was washed with a fire hose. The back-filling was carried level with the curb top back for a distance of three feet and then sloped off to the ground line with a one and one-half to one slope. The intersecting streets were graded up to meet the wings, and the sidewalks were built out to the curb. The pavement was thrown open to traffic fifteen days after the pouring was finished.

The final estimate of quantities and cost follows: 570 cubic yards of excavation at 70 cents per cubic yard, $399.00; 2500 lineal feet of seven-eighths inch longitudinal steel bars at 6 cents per lineal foot, $150.00; 2833.5 square yards of pavement in place at $2.36 per square yard, $6687.06; 2076 lineal feet of integral curb at 36 cents per lineal foot, $747.36; 6 storm water inlets at $40 each, $240.00; 14 standard 8 inch vitrified elbows at $4 each, $56.00; 42 feet standard vitrified pipe at 80 cents per foot, $33.60; 262 lineal feet of marginal curb at 36 cents per lineal foot, $94.32; 1130 pounds of deformed bars in place at 7 cents per pound, $79.10; 800 lineal feet of expansion joint at 14 cents per lineal foot, $112.00; due contractor, $8598.44; engineering costs, $362.32; court costs, $565.23; interest on bonds and vouchers, $459.66; total cost, $9985.65.

The chief benefits of this paving project carried out by the village of Ipava consist of increased value of property along the pavement, increased trade for merchants whose place of business adjoins the pavement, reduction of maintenance costs of Main street, and the elimination of mud and dust on the town's chief thoroughfare. By weighing the total cost of the improvement against its value to the citizens of Ipava it is quite safe to say that a sound investment was made.

A WINDSTORM

College Boy—"I think you are very beautiful."

Working Girl—"But my clothes are against me."

College Boy—"Sure, that's why I think you are so beautiful."

—*Michigan Tech.*

Doctor—"What you need is a little sun."

Sweet Young Thing—"Oh, doctor."

—*Amherst Lord Jeff.*

The play was "Hamlet," and the performance was for one night only. All the townspeople attended the show, and the weekly paper was held open for the notice. The next day the criticism read thusly: "'Hamlet' was played in our Town Hall last night. It was a great social event. There has been a long discussion as to whether Bacon or Shakespeare wrote the plays commonly attributed to Shakespeare. That can easily be settled now. Let the graves of the two writers be opened. The one who turned over last night is the author."

Koehring-Mixed Foundation
for Federal Building

Probably one of the most interesting and attractive of the federal buildings erected during the last year is the United States Post Office and Court House at Madison, Wisconsin. In addition it is one of the first in the building program resumed since the World War.

Situated in the shadow of the state capitol and only a few hundred feet from Lake Monona, one of the four lakes which surround Madison, the three-story building of Bedford stone has an ideal setting.

Employing the latest methods in the interior transfer of mails the Post Office department arranged the rooms, conveying machinery and platforms to bring about greater ease and speed in the handling of all classes of mail.

In the main lobby, marble slabs cover the walls from the floor to a height of eight feet. Quarter-sawed oak is the interior finish throughout the building.

Despite other unique features found in the Madison Post Office, its foundation of dominant strength concrete is similar to that of other well-known building projects throughout the world — concrete mixed by a Koehring.

The ingredients of concrete are the same in all cases but the Koehring re-mixing action — a fundamental principle of Koehring concrete mixers and pavers — coats every particle of sand and gravel with cement to produce dominant strength concrete.

"Concrete—Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, will be gladly sent on request to engineering students, faculty members and others interested.

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KOEHRING

Editorials

(Continued from Page 19)

The staff of the *Technograph* wish to take this opportunity to urge students to enter the competition. We believe the value to be obtained from writing such an article is great in itself, and in addition there is the incentive of the prize, and the honor which comes to the winner. To win the Schaefer competition is one of the highest honors attainable in the engineering school.

Students interested can find some of the successful essays of previous years in back numbers of the *Technograph*, and would do well, we believe, to peruse them before starting their own composition.

Campus Engineering Organizations

Engineering students of Illinois are perhaps not so conversant as they should be with the purposes and organization of the various engineering groups on the campus. The American Society of Civil Engineers, of Mechanical Engineers, and of Electrical Engineers, all have local student chapters, and in addition there are the Railway club and other similar organizations.

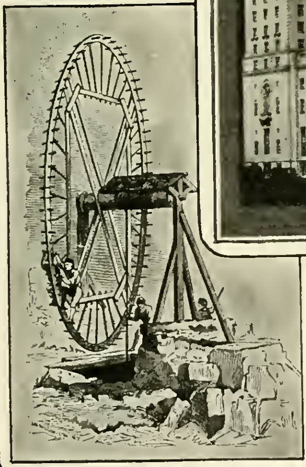
Perhaps the most important feature of their work is the programs they provide. The subjects are current, live, and of general interest; the speakers (many times "imported") are experts, and capable of presenting their topics attractively. During the course of a year students attending these meetings become conversant with a wide variety of projects in their particular branch.

In addition is the value accruing from forming closer associations with fellow students. What is true of cooperation in the business world is also true in engineering. Exchange of ideas and knowledge of other men's methods and aims results in mutual benefit. And the association of persons interested in similar things is stimulating in itself.

We would like to urge students to affiliate themselves with organizations of their respective groups. The cost is small—in most cases it does not amount to more than a dollar a year. And we would also suggest that those who are already members would be doing both their organization and their fellow students a service by seeing to it that their active membership is kept increasing in size through the year.—*D. J.*

THE ROYAL YORK HOTEL, TORONTO, CANADA

Ross & MacDonald, Architects *Sproat & Rolph, Associate Architects*



Reproduction of an old wood-cut showing one of the early phases of Vertical Transportation

KDKA Conducts Tests with Byrd Expedition

Immediately following the musical numbers and messages constituting the regular program of broadcasting to the Byrd Expedition at Little America which was transmitted recently by the Westinghouse Station KDKA, Pittsburgh, listeners heard a long-drawn-out "buzz" which was maintained for five minutes. This buzz constituted the first of a highly important series of tests in which the radio experts of KDKA are co-operating with those of the Byrd Expedition.

The object of these tests is to secure a better understanding of one of radio's most mysterious phenomena—"blind spots," or "dead areas."

As most radio listeners are aware, there are many small areas where certain broadcasting stations can be heard only with difficulty, if at all, although the same stations come in clearly all around these areas. While some of these "dead spots" are caused by pecularities of land configuration, others cannot be explained away so easily, and many scientists now believe that the trouble is chiefly due to the so-called "Heaviside layer."

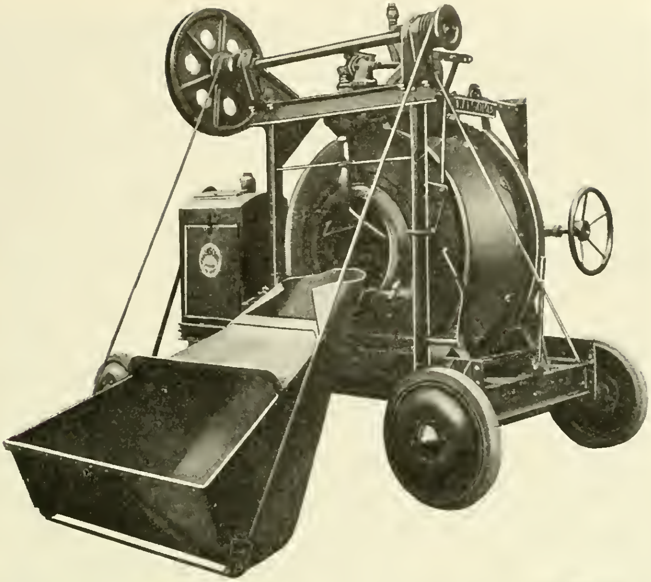
The "Heaviside layer," according to theory, is a stratum, possibly magnetic in character, which surrounds the earth. Radio waves cannot pass through it, but are reflected back to earth by it, just as light rays are reflected by a mirror. In some places, waves thus reflected are the ones chiefly received, and this applies especially to long distance broadcasting; at other places, the waves sent out directly by the transmitter are the ones that convey the messages; but in certain places, both sets of waves are received together, and it is due to the interference of these two sets that dead spots, and possibly fading, are thought to be caused. Tests indicate that the Heaveside layer encircles the earth at an average distance of 350 miles, but there is some reason to think that at either the North Pole or the South Pole, or both, this layer approaches close to the earth or perhaps actually touches it. Definite confirmation or refutation of this theory is the object of these tests.

The investigative work at Little America is in charge of Malcolm P. Hanson, radio engineer of the Byrd Expedition, and the most important instrument he will use is an ingenious and versatile instrument, known as the Osiso, which was invented by the late Joseph W. Legg, oscillograph engineer of the Westinghouse Electric and Manufacturing company. The Osiso makes photographic records of radio signals and other electric waves and is so sensitive that it will measure time-differences of only a few millionths of a second.

By means of the Osiso, Engineer Hanson can record the reception of both direct radio signals and their echoes, as reflected by the Heaveside layer, and by measuring the time difference between them, determines the height of the Heaviside layer near the South Pole.

He has already done considerable experimental work along this line, and as reported by Russell Owen in the New York Times for July 25th, took a trip for this purpose with two companions ten miles outside of camp in weather so cold that the dogs' noses froze. Hanson carried the Osiso on his back and packed the necessary dry batteries inside his shirt to keep them from freezing.

KDKA's radio experts arranged with Hanson to send him a long, powerful signal on exactly 25.4 meters, which enabled him to make more accurate measurements than was possible with ordinary radio signals. This signal was also transmitted on KDKA's regular broadcasting wave so that it could be heard by listeners.—*Westinghouse Press.*



Invention and Progress

Most basic inventions and discoveries were made in prehistoric times by men whom we call savages or barbarians. The list is long: the club, the spear, the lever, the trap, the net, the fish-hook, the needle, the sling, the bow and arrow, the boat, the sail, the rudder, the wheel, the plow, fire, cooking, spinning, weaving, the making of pottery and bricks, and the smelting of metals.

These inventions have been with us so long that the memory of man runneth not to the contrary, and it is impossible to realize what they must have meant to the people who first used them. Before the use of fire, men ate their food raw. Before they used clubs and sharp sticks, they had to fight, with hands and teeth, an unequal warfare against the beasts, or to take refuge in flight. Before the distaff or the needle, only rude plaiting was possible and cloth was unknown. Before the fish-hook and net, men had to catch fish with their hands or pick them up along the shore. Before the boat, the keel, the rudder and the sail, navigation was impossible. The wheel and the cart greatly aided transportation and commerce, although pack-animals, including man, have carried burdens from the earliest times, until the present day. Wild animals were probably first domesticated as pets, later as cattle, beasts of burden and barnyard fowl. Pottery and bricks revolutionized cooking and building; the smelting of metals gave man tools and weapons of bronze and iron in place of wood and stone.

But the greatest of all discoveries was economic: It was the discovery of the fact that a man could produce more than enough for his daily need, and thus have a surplus to be used tomorrow; and also, that he could exchange some of his surplus to some other man, each man profiting by the exchange since each gets things he needs in place of those he can easily spare.—*American Rolling Mill Co.*

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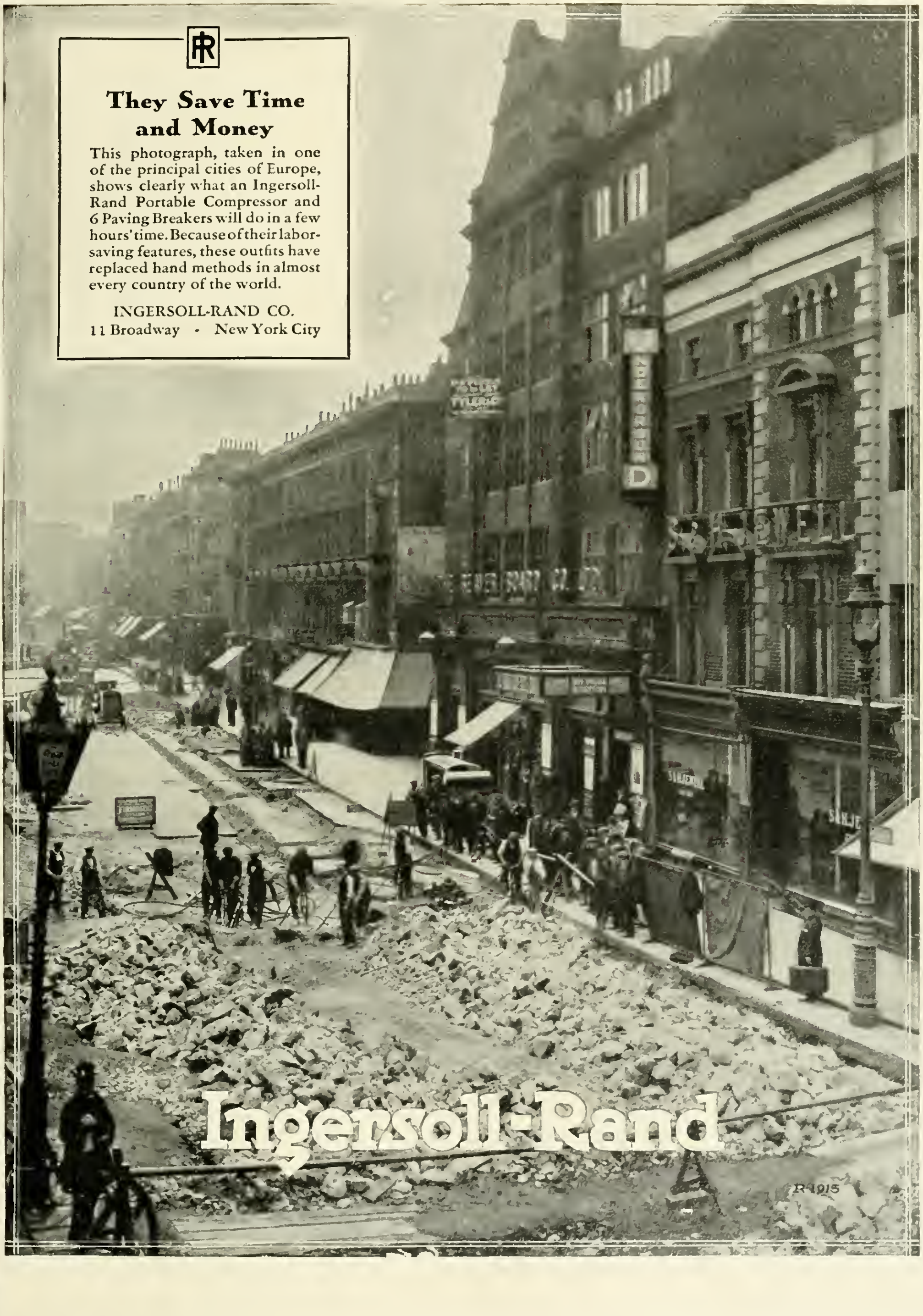
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They Save Time and Money
This photograph, taken in one of the principal cities of Europe, shows clearly what an Ingersoll-Rand Portable Compressor and 6 Paving Breakers will do in a few hours' time. Because of their labor-saving features, these outfits have replaced hand methods in almost every country of the world.
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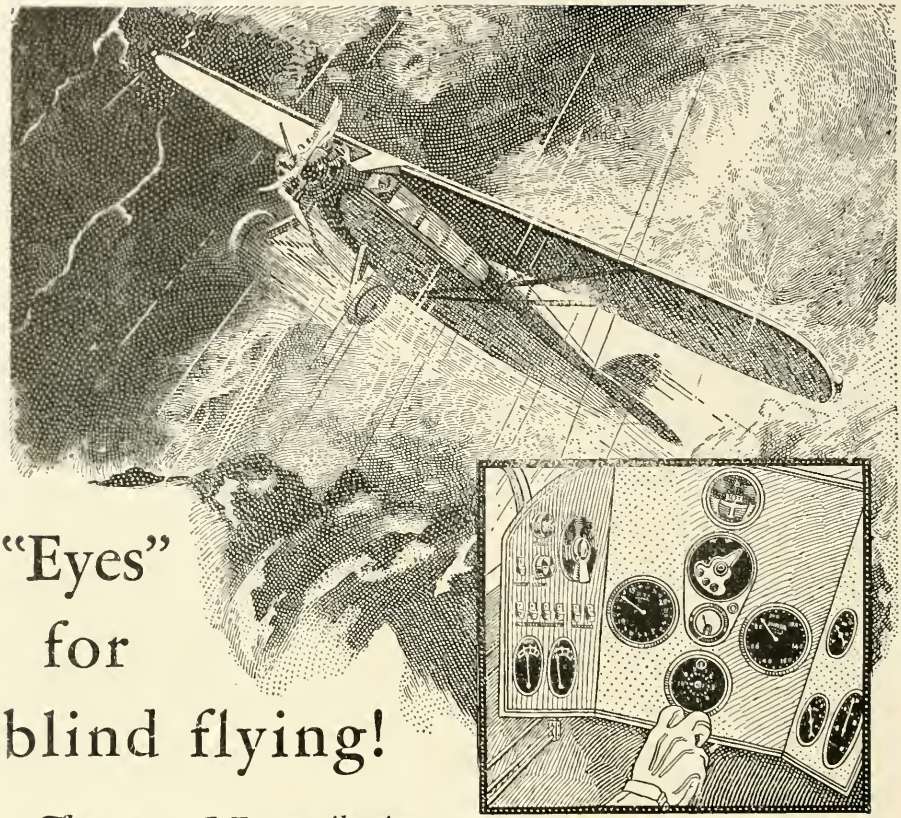
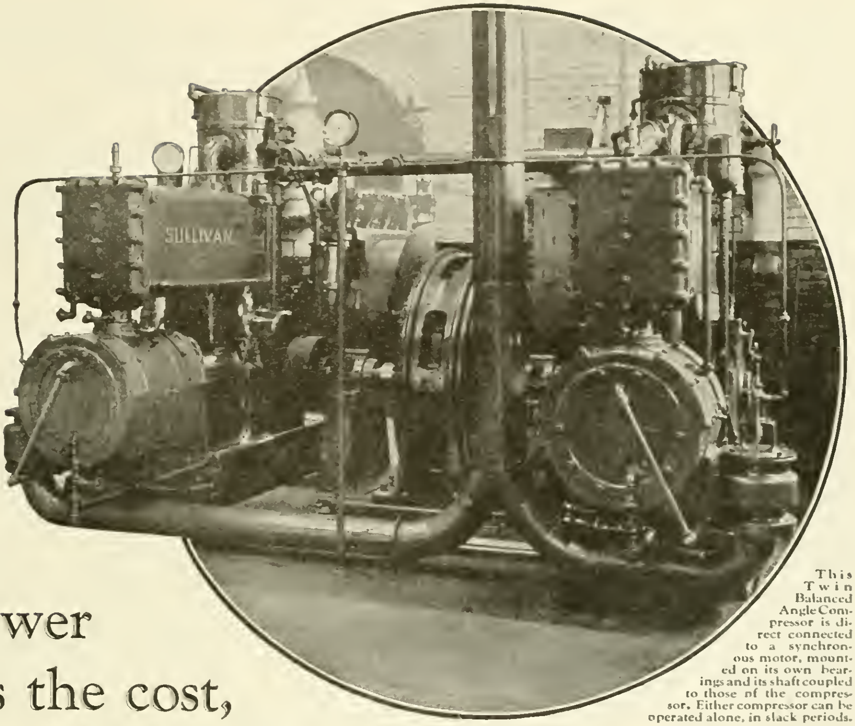


the TECHNOGRAPH

for january 1930

mber of the engineering college magazines associated



This Twin Balanced Angle Compressor is direct connected to a synchronous motor, mounted on its own bearings and its shaft coupled to those of the compressor. Either compressor can be operated alone, in slack periods.

The TECHNOGRAPH

UNIVERSITY OF ILLINOIS

Member of the Engineering College Magazines Associated

VOLUME XLIII JANUARY, 1930 NUMBER 2

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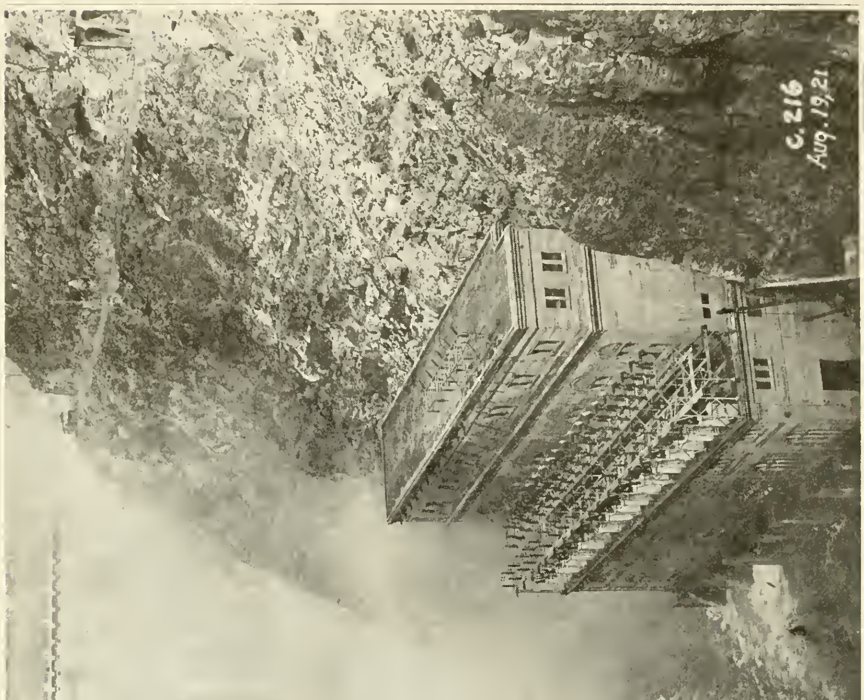


Dam and Power Plant on the Ebro, Spain

THE TECHNOGRAPH

Published Quarterly by the Students of the College of Engineering—University of Illinois

VOLUME XLIII • JANUARY, 1930 NUMBER 2

European Airports

BY JOHN S. CRANDELL
Professor of Highway Engineering

IT REQUIRED the genius of Will Rogers to wake up the American people and make them sense the fact that aviation was making greater headway in Europe than in its birthplace. His series of articles in the Saturday Evening Post in which he told of his trips through Europe by regular flying services was most illuminating. Americans were made aware of the lack of regular scheduled commercial flying over prescribed routes, and also of the lack of suitable airports and airways. It was with the idea of learning from Europe that the writer spent two summers there investigating the subject of airports.

Three great ports stand out from all the others. These are the London port of Croydon, the Berlin port of Tempelhof, and the Paris port of Le Bourget. Many of the lesser ports are distinctly disappointing, in many cases being no more than a level field with a small hangar or two. The three ports mentioned, however, are well worth a visit, and much that we have incorporated in our ports now building has been copied from them. Europe, too, is occupied with building new ports at the moment. Many of the problems to be solved in the selection of site and arrangement of the ports are common to them and us, altho the congestion found around foreign cities is even more pronounced than it is with us. Land areas of suitable size ideally located are all too rare everywhere. One writer urges the building of the city around the airport, and that is all right if the city has not yet been built. City planners can well afford to heed this advice when they are laying out new towns, but such advice does not help New York or Chicago or any other of our large cities.

The American visitor to the European airports is first impressed by the inability of anyone to enter upon the flying fields without permission. High wire fences surround the fields, and entry is possible only through the guarded hallways. This is a feature that we might well copy. Often at our own ports the fields are so crowded with pedestrians that the flyers can find no place to land. In Europe it is quite necessary to allow only passengers and employees to enter upon or leave the field since customs inspection is made of everyone, and immigration officials must see that no one enters or leaves the country without being duly examined. There was once a violation of all rules of immigration, customs and police authorities at Le Bourget. That was when Lindberg arrived. The assembled crowd swept the fence away, tore out the windows of the Administration building and rushed through it, and advanced onto the field taking the powerless police and army officers with them. This crowd was most unruly. Two persons died from injuries sustained, and many were injured slightly. The policeman on duty at that time told the writer that over five hundred hats, three hundred canes, and about a hundred umbrellas were picked up on the field the next day, as well as eleven shoes.

There seems to have been little attention paid toward building paved runways. For the most part the landing fields are only grass-covered, with fair sized aprons of either concrete or tar macadam. Care has been taken however, to provide adequate drainage of the grass fields. At Le Bourget a shepherd and a flock of sheep keep the grass well mowed; the shepherd moves his flock about from time to time, marking off their location on the field by flags mounted on small flag-poles. A shift

Le Bourget Airport

in the wind causes a shift in the location of the sheep, to keep them out of harm's way. It was explained that the cost of mowing is zero since the sale of the sheep from time to time pays for the wages of the shepherd. Some of the smaller fields were not so well taken of. At Tempelhof the large concrete apron had given the authorities considerable annoyance as it dusted badly.

thus damaging motors and creating a nuisance. It was given a surface treatment with a bituminous material which, to date, has proved to be satisfactory. From the looks of the untreated apron it would seem as if dirty aggregate had been used.

Hangars are of all sorts. Almost everything has been tried. Still the search goes on for something better and cheaper, for some of the early hangars were huge and costly. All of the hangars visited seemed to exhibit one grave fault, and that is their inability to be kept warm in cold weather. When the doors are opened to admit or release a plane the warm air rushes out and it takes hours to again warm the hangar to such a degree that the mechanics can work properly. This is a very serious matter where regular and frequent passenger service is attempted. The writer suggests that each hangar be constructed with a vestibule, or air lock, such that the planes entering or leaving can be locked through, as in caisson work. A heavy canvas curtain would serve the purpose.

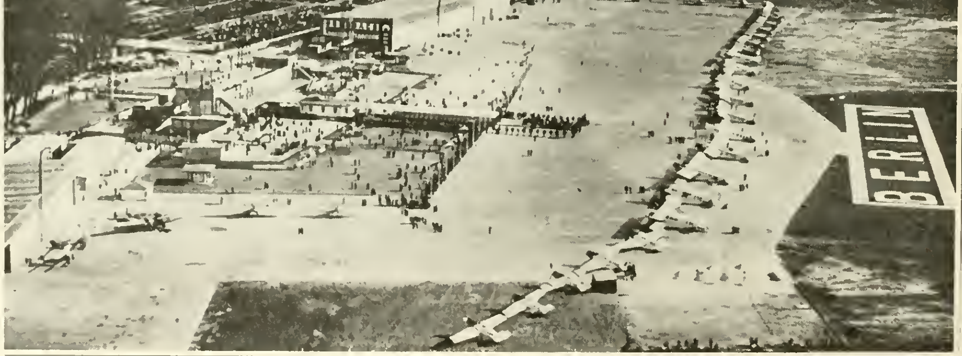
Much is being done to attract the populace to the foreign airport. At the Littorio airport in Rome there is an entrance charge of a lira, about six cents. This small fee keeps out the rabble, but is not high enough to keep out the crowds, so that often as many as 6,000 persons a day are admitted. Sight seeing flights may be indulged in for a very small sum, a tea garden, restaurant, dancing floor, and athletic field are available, and the people can watch the fliers to their hearts' content. Tempelhof and Croyden likewise, have done much to attract the visitor. The Littorio and Tempelhof are each close to the center of town and hence the crowds can readily reach them. The amusements offered, the small entrance fee asked, and the concessions go far towards making these ports self-supporting. One very noticeable feature of the foreign airports is the excellence of the restaurants and their really cheap meals. This is a feature that American ports can well copy if they wish to attract people to them. At Le Bourget the writer had a delicious lunch for 80 cents. A similar lunch at a prominent American port cost $2.10, and the latter was badly served and poorly prepared and cooked.

The published figures of passenger miles flown in Europe are very impressive, and they would seem to indicate that a great number of people are using this means of transportation for long journeys. Yet, if a ticket agent is caught off his guard enough to tell you the truth about the matter you get the idea that many of the lines are operating daily with very few passengers. To sit in the restaurant of one of the big ports for several hours watching from the windows the passengers arriving and departing, one learns that a few of the routes are well patronized, but that many of them seem to carry almost no passengers, but quite a little express matter or "goods." The rapid transportation of perishable goods by plane has found great favor with the European merchants. Cut flowers, fresh butter, fish, and the like are sent in quantities by this means daily between different countries. An advertisement in a Paris paper stated that ladies in England could wire for frocks which would be delivered to them by plane the same day from Paris.

The desire to sell the visitor transportation by plane is most pronounced when the airport is approached. Uniformed pages from the different operating companies swarm about the bewildered stranger telling him in very indifferent English of the merits of their lines, the cost, the time of flight, the safety assured, the excellence of the service, and any other "come-on" that can be thought up. These pests stop short at the entrance to the Administration Building," as the station is called. Once inside you find comfortable surroundings, which, indeed, may sometimes be very ornate. Customs inspectors and immigration officials are to be seen, ticket examiners and their helpers assist you when the time comes to leave the building and enter the field. Outside, the planes are warming up, and if the weather has been dry, there is liable to be much dust. It is here that the foreign fields are lacking for the dust nuisance at many of them is almost intolerable.

Since night flying is not much indulged in as yet on the continent, except in Germany, there is nothing that is comparable to our own lighted airways. The lighting of the fields seemed far less adequate than that of our own. Croyden has a lighthouse equipped with Neon tubes, and this is very effective. Its range is about 40 miles. This port also lights its field well with a special form of floodlight. Tempelhof buildings are well

(Continued on Page 90)



Templehof Airport at Berlin

Fig. 2—Box culvert at Station 4-15

Fig. 4—Thirteen foot cut at start of excavation

State Bond Issue — Route 67, Section 101

B. L. Pickett, c.e. '29

1929 Schaefer Prize Competition Essay

THE project which I am about to describe, is the paving of the State Bond Issue Route 167,, Section 101, between Wataga and Victoria, Ill., some seven miles north of Galesburg, during the summer of 1928. This nine mile stretch of concrete was laid by the Anderson and Empie Construction Co., of Marshalltown, Iowa, under the direction and supervision of the Illinois Division of Highways, District No. 4, at Peoria, Ill. Mr. L. Lamoreaux was the Resident Engineer in charge, with Mr. L. F. Sands as mixer inspector, and myself as plant inspector. The last two were interchanged after a month of construction, however.

Sketch No. I shows roughly the territory in the immediate vicinity of the road. It will be noted that the materials plant was located at Alert, about half way between the two towns. The aggregate from Ottawa, and the cement from LaSalle, Ill., were brought in over the C. B. & Q. R. R. and the G. & G. R. R. to the plant where they were loaded to the shed and stock piles respectively. The method of proportioning the aggregate was different from the usual Illinois one, being that of weight measurement used in Iowa. During my time as plant inspector I ran frequent moisture tests on the stock piles, and on every car of aggregate that came in, and adjusted the scales on the hoppers under the bins, accordingly, so that the amounts of the materials in the batches would be uniform. I believe that the success of this trial of the Iowa method had much to do with the recent change in the Illinois specifications, whereby weight has been substituted for volume as the method of proportioning aggragate.

The order in which the paving was done is also shown in the sketch. This appeared to the contractor to be the most economical distribution, and worked out very well, the first stretch being used to haul over for the construction of the third and fourth stretches. The fourth was so arranged because rain made work in a deep cut at Sta. 700 impossible for a long time.

The plans for the job were made up in the Peoria office, following the location survey, and sent out to Mr. Lamoreaux. The new road was to follow closely an old oiled earth road, and the plans showed the horizontal and vertical alignment of both, giving also the location of all culverts, farm entrances, section corners, and other pertinent data. The road was practically straight the whole distance, the maximum curve being only 1 58, except for its junction with Route 28, a half mile north of Wataga, where one of the curves was 125 08. In general the profile was very flat, there being only four dips or rises where the grade was more than 1.00 per cent, with a maximum of 3.6 per cent, and a total stretch of 5900 ft. of 0.00 per cent grade. This necessitated quite a bit of special slope ditch construction.

Starting at the Wataga end with his stationing, the Resident Engineer ran a line of levels over the route, both for the purpose of checking the original survey, and to establish bench marks about every 1000 ft. to use in setting stakes. He first set a line of right of way stakes on the R. O. W. line, every 100 ft., marking on them the amount of cut or fill at the center line and the side slope, for the use of the "rough grade" men. Then he set location stakes for the culverts along the road, so that the sub-contractors could get as much as possible of their excavation for them done in advance of the grades.

The culvert men excavated to the depth required by the plans, and to the width necessary to get their forms in; this usually taking about three days. Most frequently they dug another narrow ditch so as to divert the stream, if there was one, around their work. After the excavation was done, the footing, or base, was poured, and the forms of wood constructed on it for the barrel and headwalls. The largest culvert on this project was a double 5′ x 6′ box culvert at Sta. 4 15. From sketch No. 2, which is of this culvert, it will be noted that the content of this in cu. yds. of concrete is 94.6, rather a large one. Print No. 1 shows some of the forms of the east end of the barrel and east headwall. On the left is the 2-bag mixer used which took its water from the tank on the near side of the ditch. The cement can be seen piled on the ground near the mixer, and print No. 2 shows the piles of sand and gravel. Boxes, similar to that in the left center of the latter picture, were used to measure out the correct amounts of aggregate for the 1:2½:4 mix.

The long-handled spades which the men are holding, were used to obtain a smooth finish on the sides during the placing of the concrete, and to secure a uniform mixture. In the 8′ x 6′ culvert shown in print No. 3, this was not done adequately, with the result that when the fill over it was puddled, water poured through honeycombed places in the walls. It was immediately condemned, and ordered to be replaced, but for some reason the order was subsequently countermanded and the patches plastered over with a sand and cement mixture instead. The pipe entering the culvert in this picture, is from the pumo to the right of the road at Sta. 306 00, and which furnished water to the mixer from this stream.

Fig. 7—Turntable in operation

After the culvert men came the "rough grade" men, with their excavator and their dump wagons. The excavator was pulled by a 10-ton Mack caterpillar tractor, and the dirt carried up from the blade on a rubber-fiber belt, and dropped into the horse-drawn dump wagons, which traveled alongside it. Pictures 4 and 5 show the start of the 13 ft. cut mentioned above, between Sta. 7 00 and Sta. 12 00. A soft clay was found at a depth of 8 ft., and a clam shell finally had to be brought in and the tractor used to pull the wagons, before the cut was finished. These "rough grade" men were supposed to set the subgrade within .2 ft. of final grade, but seldom did. Usually it was closer to .4 ft. or .6 ft.

The rough graders were followed by the "fine grade" men, as they were called. Their job was to bring the roadway to the exact elevation required by the plans, and they did this by means of the Wir Subgrader, a 5-ton gasoline roller, and, when necessary, men with teams and plows or scoops. The foreman followed the grade or pavement stakes which the Engineer had set in the meantime. These were 22 ft. apart, driven to grade, (less the 1 in. crown), and a tack line run along the top of the right side to assist the form setters in alignment. A portion of the subgrader can be seen at the left of print No. 6, the engine not showing.

When the subgrade was sufficiently prepared for them, the form setters brought up the 9 in., 10 ft. steel forms, and set them 2 ft. and 20 ft. from the tack line on the stakes, with their tops on a level with the top of the stakes. The foreman of the form setters was an old hunchback Swede, fully 80 years old, but who could drive a pin faster and truer than anyone on his gang. These pins were of steel and from 18 to 24 in. long. The forms were held in place by three of these and a lock at the end by which they could be joined. After placing, the sides were tamped to prevent movement when the finishing machine came upon them. The inside face was painted with Summer Black oil so that the fresh concrete would not stick to them.

About 1000 ft. behind the form setters came the paver, or mixer, as it is usually called. The trucks with their 6-bag batches, weighing a trifle over two tons, drove between the forms to a turntable (see print 7), where they were turned around by a boy, and then backed up to the mixer. This prevented turning and backing which might knock the forms out of line. However, even with the turntable, the trucks rutted up the subgrade considerably when it was soft. Print No. 8 shows a truck which has just dumped its load into the skip of the mixer.

The paver used was a Koehring 27-E, and gave very good service over the whole run. The hose shown in No. 8 that comes into the mixer at waist height, is the water intake. From here the water was raised to the cylindrical tank on top, and from there admitted to the drum by an automatic device which was set by the mixer operator. The amount admitted varied from 12 to 23 gallons, depending on the amount of moisture in the aggregate, and condition of the subgrade. This took from 6 to 12 seconds to enter the drum, and then the mixture of sand, gravel, cement, and water for the 1:2:3½ mix used, was mixed for at least 60 seconds; the count commencing when all the water was in the drum. Another device so locked the machine that the drum could not be emptied till the time was up. This was set by the mixer inspector, and checked frequently to prevent tampering.

When the concrete was mixed the set time the lock released, and the operator emptied the drum into the dump which traveled on an I-beam, some 14 ft. long. This bucket then dumped the concrete on the subgrade between the forms. As may be noted from prints 10

(Continued on Page 94)

Fig. 9—Mixer in operation

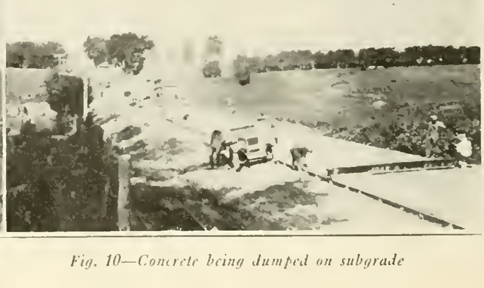


Fig. 10—Concrete being dumped on subgrade

Television Officially Takes to the Air

W. P. Burglund, e.e. '31

In issuing the first permanent television broadcasting license to the *Chicago Daily News*, the Federal Radio Commission has officially installed television as a practical science, and no longer one for solely experimental purposes. Elaborate preparations are being made in the new *Daily News* building for the installation of a television studio and control room for the simultaneous transmission of voice and pictures. The equipment to be installed is being constructed by the Western Television Corporation of Chicago, the developers of the triple-spiral system invented by U. A. Sanabria, engineer for the corporation. At a recent demonstration before representatives of the radio commission and other interests, the Western Television Corporation, through its experimental television station W9XAO and through co-operation with radio station WIBO of Chicago, produced a program of simultaneous voice and picture transmission which promptly met with great enthusiasm on the part of those witnessing it. The signals were received in a hotel room several miles from the transmitting station, and the simplicity of operation of the receiving equipment as well as the clarity and freedom from distortion of the reproduced image met with instant approval. Since this demonstration receiving equipment has been taken fifty miles from the transmitter and with the use of comparatively low power, the signals have been received with no apparent diminution of intensity or clarity. With increased power the radius of picture transmission promises to be almost as large as that of present day radio.

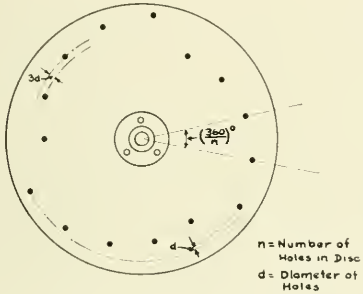


Fig. 1—Scanning disk

The system being employed by the Western Television Corporation in its installations is that of the spiral pin-hole scanning disc type using, as already stated, the triple-spiral disc. The operation of this type of picture transmission has been treated in current technical publications and will be presented only in very general form here, attention being paid particularly to a description of the apparatus being used.

The fundamental principle upon which television depends is that of transmitting the light intensities of the elementary areas which make up the subject being transmitted. By transmitting the light intensities of these elementary areas in definite order and at a rapid rate, a continuous image at the receiving end is formed due to the retentivity of the human eye.

The details of the general construction of the triple-spiral disc which accomplishes this division into elementary areas are shown in figure 1. The three spirals are identical in construction except for the distances from the center at which the holes are located. The radial component of the distance between center lines of two successive holes of any one of the three spirals is slightly less than three times the diameter of the hole. Assuming one spiral at a given distance from the center of the disc, the next spiral on the disc is placed one-third of this radial component closer to the center, and the third is placed two-thirds of this component distance closer to the center. If a source of light were permitted to shine through the holes of such a disc and on to a screen, it is obvious that for each revolution of the disc, a complete field of illumination on the screen would result. The order of scanning of the beam of light issuing from the pin holes as the disc revolves in, therefore, as illustrated in figure 2. (Illustrated for simplicity for a triple spiral disc with five holes per spiral). At present the practice is to use a disc with fifteen holes to each spiral or forty-five holes on the disc. The holes are of a diameter somewhat less than fifty-thousandths of an inch, depending upon the size of the disc and the number of holes per spiral.

For transmitting the signals a disc of this type about eighteen inches in diameter is mounted on the shaft of a special type of synchronous induction motor which is in turn mounted on a specially constructed pedestal upon which is also mounted a high-intensity arc light as shown in figures 3 and 4. The housing shown is used to keep dust from settling on the disc and clogging up the pin holes when the disc is not in use. In figure 4 the disc may be seen as it is mounted for operation with part of the housing removed.

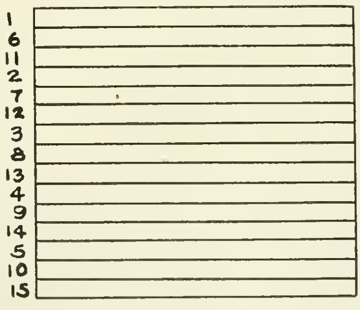


Fig. 2—Order of Scanning

The arc-light is of the common carbon type used in motion-picture projection work with an intensity of five-hundred twenty-five million candle-power at the crater. It is focused on the disc by reflection from a spherical mirror mounted as an integral part of the arc-light and adjusted by the adjusting screws shown in figure 4. A framing device just visible in figure 4 excludes light from more than one pin-hole at a time, the aperture being of a width equal to or slightly less than the tangential component of the distance between successive holes of a given spiral. The beam of light issuing from a hole in the disc is sent through a lens system mounted on the disc housing (see figure 3), and the focusing of the light beam on the object to be transmitted is accomplished by proper adjustment of the size and the position of the lenses in this system in much the same way that a motion-picture projector is focused.

The object or subject to be transmitted is placed in a special studio adjoining the operating room, and the light beam from the revolving disc passes through an opening in the studio wall. Around this opening are grouped a number of photo-electric cells as shown in figure 5. The projection lens and disc housing can just be seen through the opening at the center of the cell box. The light beam strikes the subject being transmitted and a certain amount of light is reflected from the subject into the photo-cells and on the photo-electric surface, causing an emission of electrons, according to the phenomena of photo-electricity. The photo-cell has in addition to the photo-sensitive surface, a metallic element, which, if maintained at a positive potential with respect to the photo-sensitive surface will attract the emitted electrons, thereby causing an electron flow from the surface (cathode) to the positive element (anode). Obviously, since according to experimental determinations, the electron emission is practically a linear function of the light intensity, the electron flow will be proportional to the reflected light, and thus the conversion of light energy to electrical energy is accomplished. However, the photo-cell is acting in the simple capacity of a valve similar to the manner in which a microphone functions in converting compressions and rarefactions of air caused by sound waves into pulsating electrical currents and potentials. As the light spot travels across the subject, the reflected light varies in intensity according to the nature of the subject, and such variation in reflected light intensity causes a corresponding variation in electron emission and thus a variation in magnitude of the electrical current flowing from anode to cathode. The photo-cell current intensity is amplified several million times by use of what is known as a direct current vacuum-tube amplifier. This type of amplifier will respond from stage to stage to constant potential input on the grid of the first tube and will, therefore, produce with greater fidelity, a square wave shape which is important in television transmission and reception. The principle of this amplifier is not new, descriptions having appeared in many technical publications and text-books. The amplifier is shown to the right of the arc light in figure 4. The output of this amplifier is impressed across the grid to filament of the modulator tubes which consist of three quarter-kilowatt air cooled tubes. They are shown in the background at the extreme right of figure 4. These modulator tubes are connected by use of the method of series modulation to the oscillator tube, a single quarter-kilowatt air cooled tube, which is on the next floor in the transmitter proper shown in figure 6. The method of series modulation has proven extremely satisfactory for this work because it is capable of more faithful reproduction than the constant current or Heising system. It has a decided disadvantage, however, in that it requires twice the plate supply voltage that is necessary for the Heising system and in addition requires that the entire transmitter be at a potential of 2000 volts to ground. However, since the plate circuits of both oscillator and modulators are in series, the total plate current is simply equal to the plate current in the oscillator. Consequently the actual power consumption is the same as in the constant current system.

With the exception of a direct monitor and radio monitor to enable the operator to receive the images both directly and by radio in order to check upon the output, the actual transmitter is as outlined above.

Television reception is accomplished by rather simple means. Some of the check receivers used by the Western Television Corporation are of well-known standard make with several minor changes in order to adapt the wave-band and output to television reception. Figures 7 and 8 show two receivers, the first a standard stock receiver which has been adapted for television reception, and the second, a set constructed for the express purpose of receiving television signals. Both of these have been used for continual checking and demonstration purposes and have proven very satisfactory.

The construction of the television receiver is very similar to that of the ordinary radio set except that more attention must be given to the linear amplification of a wide band of frequencies. For good reception linear amplification from thirty cycles to fifty kilocycles is desirable, although variation of as much as six or eight transmission units at either of these extremes will not introduce serious distortion provided that the intermediate frequencies have approximately linear amplification.

With the question of suitable amplification settled, the optical problem of television again comes up. A disc similar to the transmitting disc is used; it may vary in

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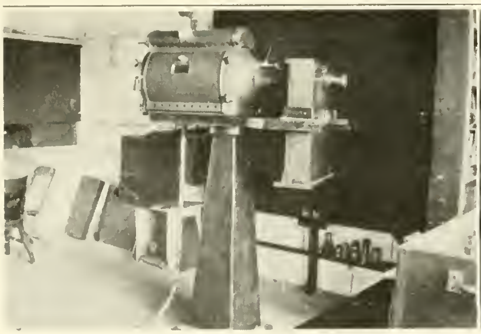

Fig. 3—Scanning apparatus

Fig. 4—Apparatus, showing scanning disk

Some Present Day Trends in Machine Design

C. W. Ham,
(Professor of Machine Design)

SEVERAL years ago the sum of five hundred dollars was offered by an organization connected with the machine tool trade for a slogan appropriately describing the machines, such as lathes, planing machines, milling machines, drilling machines, etc., commonly known as machine tools, which comprise the basic equipment of the typical machine shop. The winning slogan, "The Master Tools of Industry," is a most fortunate one, for truly these machines are the master tools of our great industries, the machines by means of which all other machines are made.

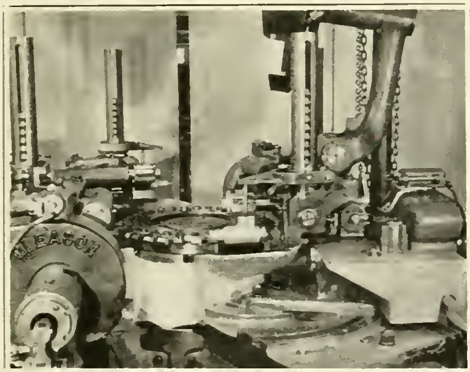

Fig. 1—Gleason gear cutting machine

On September 30 to October 4, 1929, in the public auditorium and annex in Cleveland, an exposition unique in character was held. Assembled there was the most complete collection of modern machine shop equipment that the American machine tool industry has to offer the manufacturers of the world, a complete display of these master tools of industry, without a duplicate in the hundreds of machines exhibited.

This great machine tool exposition, the greatest of its kind ever held, was made possible by the National Machine Tool Builders' Association. Attendance was recruited from all parts of the United States, as well as from foreign countries, with large delegations from several European nations. The first exposition sponsored by this association of machine tool builders was held in the same place in 1927. Previously machine tools were displayed in small numbers in a variety of expositions to separate sections of the industrial or general public. The machine tools were in these instances grouped with miscellaneous industrial equipment, or with displays not directly related to machine tool technique or utilization.

Some statistics which follow may give an idea of the size of the exposition and of the magnitude of the industry, which, it should be kept in mind, is only one branch of our great industrial activity.

Four hundred carloads of machinery, valued at $5,000,000 were displayed over an area of more than three and one-half acres embraced in the exposition hall and annexes. The estimated total cost to the exhibitors was $500,000. There were 244 exhibitors, with 65 more unable to obtain space. It has been estimated that 543 entirely new machines and mechanical devices have been developed during the past year, showing the vast industrial development at present under way in the metal working field. Exhibits ranged in size from giant machines weighing more than 40 tons, to fragile and delicately poised precision instruments used for measuring light waves whose thickness is measured in millionths of an inch.

In evidence were extensive displays of tools developed by the exigencies of the rapidly growing aeronautical industry. These developments are in part due to the fact that aluminum and magnesium alloys and other new alloys are finding numerous aircraft applications.

Notable features of the exposition were the exclusion of the general public, and the fact that the machinery on exhibit was in operation on actual production work. Here was a vast machine shop in operation. The massed product of the industry under one roof, representing the last step in progress, the last word in productive efficiency, the best efforts of the country's master designers. Thus ideal conditions were provided for inspection and comparative study by technical experts of modern machine tools and production methods, and for direct contact with the designers and operators of the very latest products. For manufacturers to thus place their products on exhibition beside that of their competitors in fair and open competition illustrates the fine spirit of the industry, for the bulk of the attendance, estimated at more than 25,000 persons, was made up of buyers, users, specifiers and investigators. It was a show for engineers and executives with minds intent on their problems of efficient production. In the great majority of instances the expenses of those attending were paid by their firms. One manufacturer had as many as 60 men in attendance.

Fig. 2—Senaca automatic lathe

The superiority of American machine tools is recognized the world over, and no one could come away from this exposition without realizing the reason for American industrial supremacy.

Among the present day tendencies shown by the exhibits is the demand for high production machines, with rapidly increasing substitution of automatic operation for hand operation. Much has been accomplished along this line through the application of hydraulically operated mechanisms, which up to about two years ago, were rarely found in machine tool design.

Two examples observed at the Cleveland show will be cited which are typical of the many achievements of the designer in successfully meeting the demands of industry for automatic machinery. The writer recalls a half jesting remark made many years ago, as if speaking of the impossible, "Some one should design a machine so that beveled gear blanks can be poured into a hopper at one end of the machine and finished bevel gears gathered up in a basket at the other end of the machine." This has literally become an accomplished fact just within the past three months. The machine is illustrated in Fig. 1. The gears are fed into the vertical cylinders or hoppers shown, from which place they are automatically moved into positions, chucked, teeth cut all the way around, and ejected into a chute on the other side of the machine. The only hand operations are those of keeping the hoppers filled, and removing the finished product from the chutes. This machine was developed by the Gleason Works, Rochester, N. Y., and is an outstanding example of the recent applications of hydraulic operation. With the exception of the drive to the cutter, the entire mechanism is hydraulically operated.

In Fig. 2 is shown a completely automatic work-feeding device or an automatic lathe recently designed and developed by the Seneca Falls Machine Co., Seneca Falls, N. Y. In the figure the machine is shown in the set-up for the turning and grooving automobile pistons. No operator is required either for placing the work in the operating positions or for removing it from the machine. A push button starts the machine, which will continue to perform its work without any attention until it is stopped. All that is necessary is to place the pistons in a chute or runway. The piston is automatically picked up from the runway to the left by a mechanical hand, moved over to the operating position in the machine, after which the hand is withdrawn. The same cycle is repeated for removing the piston, the two hands shown in the figure operating simultaneously, one removing a piston just as the other brings a new piston into position in the machine. The mechanisms involved are pneumatically operated and controlled by adjustable cams operating the pneumatic valves. An interesting point here, illustrating the ingenuity of the designer, is that if one of the pistons rolling in on the runway happens to be reversed in position, the mechanical hand will refuse to pick it up and the machine will automatically stop.

Increase in electrically operated machines and tools was evident, and much is being accomplished in the way of eliminating complex mechanical drives by the application of individual motor drives to various mechanisms in the same machine.

Of interest also is the rapidly increasing use of anti-friction bearings (ball and roller bearings) and the application of V-belt, Cog belt and silent chain drives. Ball and roller bearings are now being perfected to such a high degree of precision in manufacture that they are being widely adopted in standard designs for spindles of milling machines, gear cutting machines, grinding machines, etc., where extreme accuracy is essential.

Of special interest to the laboratory man and research worker in metal cutting are the application of devices for measuring and recording pressure on cutting tools, and power required to take cuts on different metals and at different points in the same piece of metal.

An outstanding feature of the exposition was the evidence of the influence of the new tungsten carbide cutting tool alloys ("Carboloy," "Widia") on design. In order to gain the advantages of these alloys machines must be massive and sturdy to withstand the heavy duty imposed by the high speeds. The introduction of these new cutting alloys may be likened to the introduction of high speed steel for cutting tools some 30 years ago, and many predict revolutionary changes in machine design due to this influence.

The constant demands of the designing engineer for better materials to produce machines to meet the ever-increasing requirements for stronger, faster and lighter equipment have resulted in stimulating the metallurgist to meet the needs of the engineer. The metallurgist is thus filling an increasingly important part in modern industrial life.

The National Metals Exposition held in Cleveland, September 9 to 13, indicated in a striking manner the many possibilities in metal combinations that are becoming available for the designer in meeting the ever-increasing demands on his product. This exposition indicated, as perhaps nothing else could, the passage from an age of ordinary iron and steel into an age of alloys. The outstanding alloys featured were high-speed cutting alloys, corrosion-resistant steels and irons, high-tensile-strength light-weight alloys, high-test irons, die-casting metals, alloy welding rods, and various alloy tool steels to give almost any desired property. The chief metals that are taking a prominent place in the building up of an almost unlimited number of alloy irons and steels are tungsten, chromium, nickel, cobalt, vanadium, and manganese. It was brought out forcibly at the exposition how careful heat-treatments will vary and improve the physical properties of these alloys.

Due probably to the competition of welded construction, as well as modernization of foundry methods, cast iron has undergone remarkable improvements within a short period of time. Iron castings which were previously obtainable only at great cost, are now commonly available as a result of better technique and through alloying with nickel, chromium, silicon, and other elements.

A new method of hardening steel by the addition of nitrogen instead of carbon to the outer surface and known as the "Nitriding Process" gives promise of bringing about certain changes in methods and equipment. In the usual process of case hardening steel parts, considerable distortion takes place. In the case of automobile ring gears, for example, special machines and dies are necessary in order to hold the distortion to a minimum during the quenching process. Even then there may be sufficient distortion as to call for grinding the teeth on expensive grinding machines in order to secure the best results in operation. In the nitriding process there is no appreciable distortion of the metal. Briefly described, the nitriding process consists in placing the part to be hardened in ammonia at such temperature that the ammonia dissociates into nitrogen and hydrogen. The nitrogen penetrates the surface of the steel, producing a hard case. Since quenching is not necessary, distortion does not take place. Thus, where this new process can be applied, the accuracy of the finished part is not impaired by warpage, whereas, in the ordinary hardening process the accurate machining operations pre-

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Variable Wings

Warren J. Baker, com. '29

(Reprinted from Western Flying)

SINCE the date of the first flight, engineers have sought the perfect wing section, with the result that today we have a multitude of forms, each designed for its particular purpose. We have the slow, thick, high-lift wing, and we have the fast, thin, low-lift wing, and a multitude of variations between. But each has definite limitations that are only too well-known to the airplane designer and pilot.

The greatest limitation set by the conventional wing, regardless of its exact form, is its restricted speed range. If the wing is of the thick, cambered variety, it has the desirable feature of low take-off and landing speeds and high-lift, but its top speed is correspondingly limited. As long as speed is the prime reason for the existence of the airplane, a low cruising speed is not permissible.

The operators ask for higher top speeds, and they are given it by the thin speed wing. But as soon as the higher top speeds are attained, the landing speed becomes proportionately higher. The runways for take-off and landing must be too long for practical purposes, and the dangers of forced landings become correspondingly greater. So, with the conventional wing as we now know it, the speed range—the difference between landing and top speed—remains fairly constant, regardless of the type of wing employed.

The problem, then, is to broaden the speed range—to increase the top speed without increasing the landing speed, or to decrease the landing speed without decreasing the top speed. To achieve such a result, engineers have suggested many revolutionary ideas, few of which have been generally considered feasible by the engineering fraternity.

Excluding the possibility of a radical departure from the conventional (a step which is not considered advisable at this time), the solution to the problem of securing a wide speed range seems to be a mechanism which will enable the pilot in flight to change the form of his wing to conform to the requirements at the particular time—something that will enable him to take off with a slow, high-lift wing; fly with a speed-wing when he has attained cruising speed, and land with the slow wing.

The variable camber feature of a wing can take one of three forms—a variable trailing edge, a variable thickness, or a combination of both.

The idea of a variable camber has been the subject of experiments since 1919. One of the most successful of recent experiments was that of Harry Rocheville of Los Angeles, who designed and built a plane with a variable trailing edge in 1928. Test flights of this plane, a parasol type monoplane with a Clark Y section, showed repeatedly that the landing and take-off speeds were decreased by 15 miles per hour by the mere dropping of the trailing edge 10 degrees.

Another development of the varible camber idea is that of the Dare Airplane Company of Detroit. This company began experiments in 1921, and with the estimated expenditure of a half million dollars, has developed the Dare all-metal variable camber airplane, which is entered in the Guggenheim safe-aircraft competition.

The other alternative, that of varying the thickness of the wing, has been worked on by the Industrial Development Company of Portland, Oregon. In this wing, there is no variable trailing edge section, the only change being in the thickness. Perhaps the chief difficulty with the "swelling wing" would be an uneven airflow, resulting from the expansion being concentrated at one point along the upper leading surface.

The problem of both varying the curvature of the airfoil and expanding or contracting the thickness while in flight seems to have been solved effectively by Rocheville. Since his first experiments with a variable camber wing, he has designed and built an experimental monoplane employing both the deflected trailing edge and expansion rib ideas. The plans has been given its preliminary flight tests with favorable results.

In the Rocheville wing, there are two simultaneous movements of the airfoil; one a change of the camber ratio of the wing section (that is, the maximum thickness of the airfoil to the length of the cord), and the other a variation in the angle of attack of the trailing edge. These two movements are produced by a single control located in the top of the pilot's cockpit.

The basic structure of the Rocheville wing from the leading edge to the rear spar is in the form of the conventional Clark Y. The Clark Y ribs which extend only from the leading edge to the back of the rear spar are immovable and serve as the basic support.

Alternating with the stationary ribs are the expansion or movable ribs which are built up in two sections. The main section, that part extending from the leading edge to rear, only influences the airfoil on the upper side, the lower portion of the wing having the stationary Clark Y ribs as its foundation. The rear section of the movable ribs forms the support of the variable trailing edge. Channel type welded steel ribbing is used to make up all webs.

The variable feature of the wing is operated from the pilot's cockpit by a control attached to a steel tube extending throughout the wing section midway between the front and rear spar. A half-turn of the control tube operates by a cam action the variable mechanism which simultaneously expands and controls the wing section and lowers and raises the trailing edge about 10 degrees.

The result is this:—The wing is changed from the thin, Clark Y section to the thick Gottengen 387 or any desired point between. At both the Clark Y or the Gottengen and at every point between, the center of lift remains the same, assuring stability. It is needless to say that the Gottengen is used by the pilot for his take-offs and landings; the Clark Y in flight with normal load, and some compromise between the two for special purposes.

Now the question properly arises, "How is the covering on the surface of the wing to be kept tight against the airfoil at all times?" All expansion and contraction of the surface is taken care of at a gap in the top of the wing above the row of eccentrics. A heavy strip of rubber feeds out or draws in the two ends of the wing covering as required by changes in the form of the wing.

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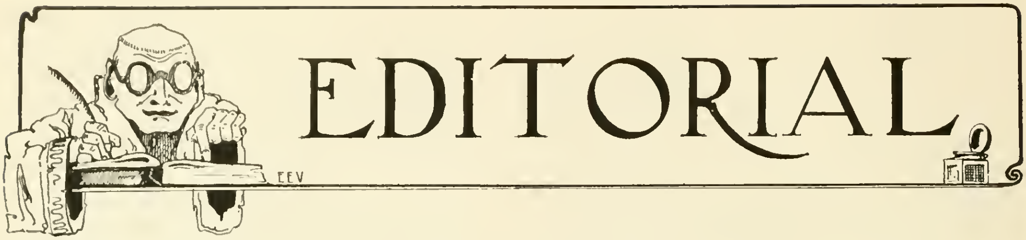

EDITORIAL

Wings

"Air-mindedly yours" closes a recent letter to the Technograph. And thus is expressed the enthusiasm of this generation for that new branch of engineering, and of life—travel by air. Airplanes have come and they have come to stay. The enthusiasm for them, while in part just a fad, nevertheless is earnest, and very essential in the development of aviation. And finally, the enthusiasm is not going to dwindle, but is going to increase until, finally, travel in this manner is accepted as a usual thing.

And such a survey of the problem brings many questions to a university. M. I. T. and Georgia Tech each have their aeronautical schools. Many other large universities have such divisions, or have plans for such already under way. Then how about the University of Illinois. We should not lag behind the rest—we should not be the "last to turn," but yet, we should not merely "follow suit."

A school of aeronautics would undoubtedly have a large following; there would be little trouble inducing students to "seek the opportunity of a lifetime." But what would be taught? Aviation has not been developed far enough along that is separate from all other types of engineering. Nor is it advanced enough that the fundamentals are definitely established. Aviation is still in the experimental stage, and for some time to come experiments must be made for its advancement. Aviation design would be that phase taught as engineering, and design of today may be entirely out of place tomorrow.

No, there is not, as yet, reason to establish a separate aeronautical school, nor does there seem to be sufficient demand to make a degree in such a subject. But there are a great many things that could be done in this respect. Courses should be taught which give the history of aviation, which show the basis of plane design, and which teach the design of the planes of today. And these courses should not be limited to only those students who plan to go with the fast growing aviation industry, but those who are interested in other lines should be encouraged to take them. Aviation will be placed on a much firmer basis when people realize the safety of it—and the surest way of doing this is by giving an unprejudiced course on the subject. Then, as a further help, experimental work on the problems should be encouraged—work by both the faculty and university, and by those students working for their master's degree. Problems in welded tubing for framework are many, and tests to prove these welds would be invaluable. Problems of motor design should perhaps be left to the automobile industry, where the capital is sufficient to take up such work in earnest, but those of body construction, of wind resistance, and of control could well be worked on at an institute of this size.

Finis

At the beginning of a new semester, or at the close of an old one, it should be entirely fitting to think back and see just what has been learned in the past, and just how the future should be tackled. And so—at such a time—let some of us who are looking to the next semester for the last time think aloud.

One should, we suppose, join in with the parties that say grades are everything, or with those who say that it is not the grades that count—it is the bigger things learned. And such a course, if it must be taken, would throw us in the first group, but from a rather commercial standpoint. For grades do mean a great deal at school—they are the standard by which the faculty judge us, and as they judge, so do they recommend; as they recommend, so do we receive. Not always, but usually the man with the higher grades gets the better positions, and often he commands the better salary. It is he who is watched more closely, for it is he that should produce the most. But glancing the other way, and seeing the benefits of high grades while in school, one is more likely to be impressed. It is true in a school of this size, that a great many grades are given out by guess work, by a flip of the coin. And when they are so given, a Tau Bete or a Phi Eta Sigma key is often the charm that throws them to the higher level.

A year ago, the University passed a ruling which gave those with a reasonably high average the privilege of cutting classes as often as desired. Such a privilege is not easily taken advantage of within the engineering school, but even the few times when the right is honored, make it decidedly worth while. Other privileges, less definately set by laws and orders, are much more easily obtained by the man with the high grades, for he has come to have a friendly relation with the instructor. Whether it be a late problem, or whether it be help on a report, the results are always better. But this friendly relationship brings even more of a benefit—it brings on a comradeship between the instructor and the pupil; it teaches the student to see things from the more mature eyes of the instructor; and it gives him a friend to whom he may go in case of need. All these things grades will give—and they are the biggest things that one may get from a school.

But as one faces the last semester of his school career, and contemplates studying and writing reports and taking exams for the last few months, all enthusiasm for grades are lost. His average in school is almost definately established, and there are no more honors to come from high grades. Learning, for the pure joy of learning, has long since faded, and learning for the practical value of the subject seems to become a rather doubtful motive, for after all, one does not graduate to design power plants, or to take over and manage railroads. Activities, if one has engaged in them as he should have, have passed their prime with him, and he has turned over the biggest share of the reins to the younger and more enthusiastic members. He faces the last semester rather tiredly, ambitionless, and with the idea of getting as much out of everything but studies as possible. And probably he is right. For he has earned a rest, if he can simply coast through.

In this last semester, only a few things seem important — only a few things are important. One must locate a job, one must graduate, and finally, one must not slip so far as to disgrace himself completely. But there are things that one could do, which would pay him far above the effort expended.

Survey the past three and one half years, and pick out the weak points. And in this last supreme sacrifice for education, spent the time practicing these points. They are trivial, most of them, but they may be the turning point of something more important. Neatness may be the failing item, or poor writing. Or it may be a social shyness, or the ability to say just the wrong thing at any time. It may be anyone of a number of such small, important points—but if school is boring, the effort, or half-effort in correcting these will be more than repaid.

Humanizing Departments

The fact that universities and colleges have expanded rapidly during the past decade has led to many practices inimical to the best welfare of the student body as a whole. We will admit that certain pernicious factors creep into mass education that are very hard to eradicate, such as uniformity of thought, action, and speech, but the worst of all is the robot-like actions of the departments. After the department has been in existance for a few years, lines of action become fixed, thoughts become stereotyped, and a mechanical-like method of procedure creeps in. All of this is felt most keenly by the student body which is not responsible for this condition. Explanations of theories, methods, and special knowledge pertaining to the individual department are thrown at the students with a careless take or leave it attitude, and often sarcasm is indulged in if any lack of comprehension is shown. Many students with good brains, but who are unable to get off with a flying start in a new field are hopelessly handicapped unless they are given a small, but necessary amount of detailed information. Any upperclassman can recall times when he has explained some rather simple thing to a beginning student that has pulled him out of a near flunk.

This situation seems incomprehensible when one considers the millions spent for education. Why not remedy it? More money will avail nothing in this direction. The ultimate remedy must come from with in the departments themselves. If the instructors would show a more friendly attitude toward their classes as a whole and act like human beings rather than automatic dispensers of canned knowledge, the average student would co-operate heartily. A high scholastic average is the goal toward which all departments are striving. Humanize the departments and a very definite step will have been taken toward it.—*L.L.H.*

Again

Once again reports and essays by engineers bring to mind the struggle between the engineers and the general students—the question of whether or not an engineer is illiterate, and whether or not a general student can think and reason. The second part of the question is beyond our field, for though we may have never found any that appeared to reason, there are undoubtedly some. But in exactly the same way, though it has never been our privilege to meet an engineer who could write intelligently, there may also be some of them.

All sarcasm aside, though, we wonder if the engineer is right when he claims that "he ain't got no use for english." For four years he was taught how to write and how to speak in high school. And graduating from there, he had, apparently learned how to speak. But very few of them have learned to write—and very few of them acquire this knack while being exposed to rhetoric. They simply feel that they have no use for it. Perhaps it may be true—it certainly is true that, having not mastered the art of writing smoothly and easily, they will never be called upon to do much of that type of work—but it is at the sacrifice of rise in position.

It is the hope and ambition of every good engineer, when he graduates from school, to someday rise beyond the point where he is a "slip-stick" artist, to the place where he may command, by the superior knowledge and reasoning power, the respect of all. Did he ever stop to think just what this means. As soon as a man passes the point of being "just an engineer," he is thrown in contact with the production, with the sales, and with the executive departments. And they, knowing nothing about engineering, judge him not by the clearness of his thoughts, but by the clearness of his expression. They judge by what they can understand—and they think, not in terms of numbers, but in terms of words. If he can write smoothly and coherently, they will more than likely believe him.

Senior engineers turn in reports that would be failed in freshman rhetoric, because of their grammar and spelling. "These kind," "most unique," "engines is," and "more smoother" are all typical examples of this—each taken from a report. Monotone reports of "The efficiency was then calculated. These values were then plotted. The curve shows . . . "

We won't suggest that rhetoric should not be required—for though students get very little from it, think of what reports would be like without that. Nor will we advise that reports be done away with entirely so that there is no chance for these mistakes to show themselves. But rather would we suggest that reports be changed.

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CONTEMPORARY ENGINEERING NEWS

Improving Coal Preparations

According to James D. S. Drinkwater, chief engineer of Simon-Carves, Ltd., to make small coal a commercial and paying product has been an ever increasing problem for the coal operator. Coal washeries and cleaning plants have been in operation for the past half century, and in recent years they have become an essential part of the surface equipment of many mines. The demand for clean coal, together with the increasing proportion of small coal now being brought out of the mines, through various causes, and its greater dirt or shale content, have all combined to bring about this condition.

The necessity of cleaning coal led to the invention of many systems or devices, which tackled the problem from various angles. The names of a few of these being as follows: "Trough Washer," "Bash Jig," and the "Draper." The foregoing have been used with varying degrees of success, but have now run their course and are no longer manufactured today. They have been replaced by more up-to-date plants.

There are many reasons why these plants have been discarded, to name only a few: (1) In the trough washers, the frictional and other resistances grind the edges of coal cubes to dust particles — a thing to be zealously avoided. (2) A similar misfortune also results in the operation of an ordinary "Bash Jig." (3) With individual sizes of coal being washed separately numerous units were required, to gain capacity of any one size, with consequent heavy maintenances, due to the large number of working parts.

All these drawbacks to washing have been eliminated by the Simon-Carves Air Pulsation System, which has taken the place of practically all devices of similar nature in the British fields.

This type of washer is now being engineered and built in America by Link-Belt Co., Chicago, is known as the Link-Belt-Simon Carves Washer." It may be helpful before describing this system, to glance at the economics of coal cleaning, and also the relation of cleaning plants to the remainder of the coal handling equipment.

Present-day methods of mining frequently result in coal being brought to the tipple donating 50 per cent of "smalls," that is, coal which is too small to be hand picked; and containing too high a percentage of dirt—often from 20 to 30 per cent—to be salable. It is evident that the market value and outlet for such a large proportion of the mine output, are most vital factors in the paying of non-paying capacity of a mining company; in fact, even if there is a ready market for this large-coal output, it may be most difficult to show a profit unless an outlet can be found for the "smalls" at a reasonable selling price. The ash content of the small coal fixes its selling value. Washing costs vary to a considerable degree, and in order to arrive at an approximate cost, and profit from the separation, it is necessary to ascertain reliable figures from many sources.

It may be pointed out that the prime capital cost is only one of several contributing items to outlay, and should therefore be considered collectively with all others, when deciding which is an economical plant and layout. As an instance, two or three thousand dollars spent on layout that will save the wages of two men, is money well spent, as in a 200 working day year it should show a very appreciable saving. It is most difficult to give definite reliable figures for general use, as naturally the conditions at each mine vary, from many standpoints, such as cost of power, difference in price obtainable for washed coal in different markets. The balance of earning capacity may be arrived at by treating the foregoing items individually for each mine or installation.

In studying new tipple layouts, care should certainly be taken to make satisfactory provision for the installation of a reliable washing plant, as, if sufficient foresight is exercised, the cost of handling may be kept at an absolute minimum, which means less labor, breakage, and power, as well as no inconvenience. If a washery has to be added later, and no provision has been made for it in the original layout, it is not always possible to obtain an ideal arrangement, or one that will cut out the faults named in this paragraph. This appplies very forcibly where restricted sites are concerned.

Continuous running (not intermittent) of an efficient washery means good uniform results. Sufficient siding accommodation should be provided for the ready handling of traffic, as the washing plant should never have to stop for cars, due to congestion. In order to shorten the path of coal to the washing plant, the latter should be as near to the screens as possible. This arrangement generally facilitates the central collection of refuse from pit, screens, and washery, which means less labor. The washery should be designed on sound engineering lines, attention being paid to simplicity, access for lubrication and adjustment, and robustness of machinery; as after all, the machinery is for coal handling. For this latter reason, machinery parts should be slow-moving. Good light, and absolute prevention of dust should be given due consideration, a clean plant being a great aid to reliability of both machinery and washing results. Breakage must be kept down to its absolute minimum as coal passes through the plant, for breakage means loss of revenue.

To satisfy the above conditions the Link-Belt-Simon-Carves W a s h e r y has been developed. The fact that it is so outstanding is quite sufficient proof that it is a worth while invention. At present, there are one hundred and fifty of these washeries which have been placed in operation by Simon-Carves, Ltd. Further, every plant is still working, not one having been discarded or replaced.

The number of these similar plants in the United States is considerably less at the time of this writing, but there is little doubt that within the next year or two the order of this statement will be reversed.

In conclusion it may be said that although the general principle of this washer is very similar to the others named in this article, there are a few details which make this washer outstanding. Compressed air is used as the pulsating medium. This avoids all back suction, and loss of good coal through the bed; allows all necessary adjustment to be made without stopping the plant; discards heavy dirt immediately after it enters the box, thus preventing any possibility of pounding. This washer permits washing 5" to 0" coal collectively in one box, in capacity of over one hundred tons per hour; it also eliminates dry screening and its attendant dust nuisance.

A Robot Flies a Plane

The U. S. War department has only recently announced the perfection of a robot to fly huge transport planes more smoothly than possible by pilot. Coincident with this announcement a successful flight was made from Wright Field, Ohio, to Washington, D. C., with an army tri-motored Ford plane equipped with this device.

The plane arrived at Bolling field after having flown all but the last thirty miles of the way from Ohio by a gyroscopic pilot. The position of the plane is maintained by two gyroscopes, one placed vertically and the other horizontally form the "brain" of the robot. They maintain a definite position, regardless the position of the airplane. If the plane tips to one side from a gust of wind, an electric contact is made by one of the gyroscopes, actuating a clutch which grasps the proper control wire and rights the plane.

There are three clutches to control the three altitudes of the plane—directional, lateral, and longitudinal. The clutches operate from a flexible power shaft from a wind-driven generator.

The device, a development of Elmer A. Sperry, inventor of gyroscopic devices, has been under test for nearly fifty hours in flights in all kinds of weather between New York and New Bedford, Mass., and between New York and Dayton, Ohio.

All that is necessary for the pilot to do is to set the plane on its course, put the automatic pilot in operation and let it go. It has functioned splendidly. This automatic pilot, it was said, is sensitive to a movement of half of one degree of the plane about its axis, which is considerably more sensitive than the average human pilot. Therefore it is plain to see why a smoother operation is obtained by the use of the robot.

Gasoline by Pipe Line

Interest in the petroleum industry has been aroused by the announcement that the Standard Oil company of New Jersey, through a subsidiary, was planning to move seaboard gasoline by pipe line through New Jersey and Pennsylvania as far west as the Pennsylvania border. This project is important from an economic standpoint because of the fact that plans are based on a tariff which will lay gasoline down at the end of a 375 mile line for 45 cents a barrel to contrast with 70 cents a barrel which is the cost of rail transportation.

However, the real importance of the plan is that it will be the first large-scale testing of a theory of gasoline transportation which has been long considered as a possibility in a petroleum trade. The immediate effect of the inauguration of this traffic may not at first be greatly noticed, but the operation of the project undoubtedly will be closely watched and it may be the forerunner of eventual far-reaching changes in the conception of transportation set-ups and markets in the industry. Not long ago a line was proposed between Oklahoma and Chicago for the movement of gasoline, that this product might be laid down in Chicago and nearby markets considerably below the cost of rail shipment. By many this plan seemed impractical, but it is not impossible that they may now meet with more attention.

Packard Aero-Diesel

According to the May issue of the Technograph we are informed that the Packard Motor Car company has performed a successful flight in an airplane with the use of power furnished by a Diesel type motor.

The following is more or less a definite report of this 650 mile trip from Detroit to Langley field, Virginia, on May 13, 1929, as reported by Captain L. M. Woolson, aeronautical engineer of Packard. The trip was made in a Stinson-Detroiter monoplane powered with Packard 200 hp. Diesel engine. The achievement of staying in the air for more than 7 hours with Diesel-powered heavier-than-air craft reveals the Diesel principle as an astonishingly flexible instrument of engineering design, information about which is being eagerly sought. No extensive revisions in the design of stock commercial Diesel engines as now built, are, however, made probable by the new development.

The outstanding technical features of the Packard Diesel—which are organically related both to the essentials of Diesel practice and of aeronautic technology—appear to be the use of but a single valve for the admission of air and the discharge of exhaust gases and the adoption of a practically 100 per cent constant volume cycle. Firing pressures above 1000 lbs. per sq. in. are allowed for in the design, while phenomenally low exhaust terminal pressures and temperatures, and a reduction in weight per horsepower to a figure compatible with airplane requirements are attained.

Operation with air cooling and but a single valve seems to be the really radical departure from current Diesel practice, although the single valve has an apparent prototype in the monovalve radial aviation gasoline motor and in an old patent specification of Dr. Diesel's. These features taken together as the kernel of the Packard Diesel aeroplane design appear outstandingly responsible for the engine's low weight of less than 3 lbs. per hp., and for its consequent ability to propel an aeroplane. High firing pressures, contrary to the now obsolete viewpoint, do not increase specific engine weight, because they add to efficiency and power in greater proportion than to extra metal sections required. Actually a net reduction in specific weight is attained.

The conventional system of injection of fuel is, of course, part of the Diesel engine, but due to refinements embodied in the Packard Diesel engine much better results have been attained. One of the changes being the advancement of the timing to 50 deg. before dead center with ending of injection 10 deg. after dead center for the purpose of insuring substantially constant-volume combustion. This practice has been used in other types of Diesel engines. It meets the requirements not only of high efficiency, but also assists in attaining high capacity per unit cylinder volume and engine weight. A separate fuel pump is used for each cylinder.

In general outward appearance the engine structure closely resembles that of the conventional radial gasoline aviation motor. Crank shaft and piston arrangement is very much like the common type of radial motor except for possibly an enlarged crank journal. However, to the base of each cylinder is mounted also the cam-operated fuel-injection pump, with its injection tube leading up to the side-mounted spray valve and its suction line branching toward the circular fuel supply header concentric with the base.

The engine is said to have no exhaust pipe and no intake pipe, while magnetos and a great complexity of wiring and electrical system of all other motors are conspicious by their absence. Although it seems true that the general mechanical structure of the Diesel engine departs in no essential respect from that of the conventional gasoline aviation motor, the absence of all intake and exhaust manifolding, reduction of the valve gear to a single valve and push-rod, the bareness of electrical trimmings and the inconspicuous appearance of the small fist-size fuel pumps present a picture of utmost simplicity. Flying safety is enhanced by this feature.

From a general thermodynamical point of view the single valve is also far superior because it interferes less with the free movement of air and gases in and out of the cylinder. Exhaust gases can be more completely eliminated while a greater weight of air can be drawn into the cylinder. By appropriately shaping the inlet opening, it is also possible to give the entering air charge a movement of rotation which persists through compression up to the time when the fuel spray is distributed and burnt. A vitally important consequence of the single-valve arrangement also seems to be that it permits the operating of the engine at piston speeds well above 1800 f.p.m. without reduction in volumetric efficiency. It seems very feasible that the single valve will be a vital factor in the raising of maximum permissable speed.

As the elimination of a separate and special exhaust valve with manifold is probably an integral part of the general program of facilitating the charging and discharging of the cylinders little need be added to the considerations stated above. Special attention, however, is called to the fact that from an aero-technical point of view the discard of all inlet and exhaust manifolds, with attendant reduction in weight, head resistance, and mechanical complication is a further benefit uncovered by the Diesel principle.

The discharge of Diesel exhaust gases into the air stream flowing over the airplanes is without noticeable effect because of their extreme dilution. A 5 ft. propeller of a ship traveling 85 miles per hour thrusts back more than 150,000 cu. ft. of air per min., while a Diesel engine of 200 h.p. requires for its propulsion discharges about 500 cu. ft. of exhaust gases per min. Practically half of the mixture is air not used for combustion. Hence the dilution is of the order 600:1, assuming that there is no diffusion of air from currents beyond the zone of the propeller thrust. It is to be noted also that the percentage of carbon monoxide in Diesel exhaust gases is negligible while the high mean temperature of the Diesel combustion process precludes the discharge of appreciable lubrication oil with the gases.

*Aero-Diesel Specification**

Output, rated	200 b.h.p.
Bore	5 in.
Stroke	5:5 in.
Speed, rated	2000 r.p.m.
Cylinders	9
Brake mean pressure	81.5 lbs. per sq. in.
Mean piston speed	1833 f.p.m.
Weight, total	575 lbs.
Weight per b.hp.	2.9 lbs.

*Without official confirmation.

Something New in Television

The telephone has added the use of the "talkie" in order to give better service to its patrons. As yet, this idea is still in the experimental stage. Sergius P. Grace, assistant vice president of the Bell Telephone laboratories, explains the use of this as follows: a new automatic telephone has been devised which 'speaks' its call numbers to central, the patron merely dials the number and then remains silent, while the call numbers are made audible to central only.

Experiments with this idea have been so successful and have been perfected to such a degree that it will probably go into use in the city of New York before the end of the year.

A tourist had stopped for the night at a mountaineer's cabin up in the Smokies and noticed four holes in the door.

Tourist—"Friend, I don't want to be too inquisitive, but what are the four holes in your door for?"

Mountaineer—"Wall, yo' see I has four cats."

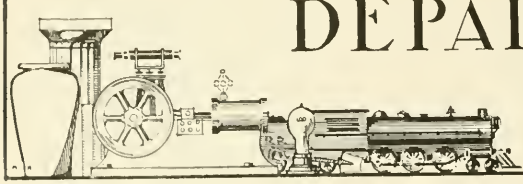
Tourist—"But, wouldn't one big hole do for all four cats?"

Mountaineer—"Hell, when I say 'scat,' I mean 'scat.'

"My gosh, man, you'll scald me. That towel is red hot," said the man in the barber chair.

"I'm sorry," replied the barber, "but I couldn't hold it another second."

—*Iowa Engineer.*



DEPARTMENTAL NOTES

Architecture

Now that the Inspection Trips are over and the souvenirs all stored away, the Seniors are bending their efforts to the task of graduating.

A departmental smoker was held Thursday, December 12, 1929. Mr. Newcomb, our amiable history professor, held forth on his travels this past year. Professor Newcomb has just been appointed the editor of the *Western Architect.* The smoker was sponsored by Scarab, and needless to say, everybody had an enjoyable time.

The Arch Fete of bygone days bids fair to rise from its ashes under a new name. There is nothing definite as yet, but efforts are being made once more to have a Fine Arts Ball.

Ceramics

Keramos, Ceramic Engineering Fraternity, were sponsors at a dinner given at the Lambda Chi Alpha on December 11th, 1929. At this dinner the Ceramic faculty, research staff, and the entire Junior and Senior classes were guests.

Professor Rexford Newcomb of the department of Architcture gave an illustrated lecture on "Ceramics in Architecture." Slides of Indian, Chinese, and other Oriental architecture were shown. Colored terra cotta effects were particularly good.

All of those present voted their thanks to R. R. Thomas, Jr., Ceramic Engineering '30, who so kindly proferred the use of his fraternity house for the dinner.

Research on the effect of combustion gas on vitreous enamel is being continued, This investigation is being continued, but no work is yet to released for publication. However, there will be a paper given on this topic at the American Ceramic Society meeting in Toronto, Canada, next February.

Two papers will also be presented on acid resisting enamels.

The Ceramic Short Course which will be held at the University of Illinois during the last two weeks in January, 1930, will have several new features. The course will be divided into three sections, namely: Heavy Clay Products, Bodies and Glazes, and the third, Enamels. Heavy Clay Products will be taken up during the first week, Bodies, Glazes, and Enamels during the last week. It is thought that by dividing the course up in this way, it will be easier for men in attendance to choose the subject in which they are most interested, and not be required to listen to papers and lectures on meetings in which they are not interested.

Well known authorities in these several fields are being secured for lectures and papers.

It may be of interest to note the field covered by the senior engineers in their thesis subjects. Some of these are as follows:

Rate of Effusion of Moisture Through a Clay Body.

Dry Process Cast Iron Enameling.

Some Properties of High Alumina Refractories.

Refractories for Malleable Iron Furnaces.

Development of a Glaze for Fireplace Fire Brick.

Vitreous Enamels.

Electric Resistance of Clay Bodies.

A great deal of interest is being shown in the new course is Ceramic Microscopy. Two graduate students are enrolled in the course this year, and eight students are taking the necessary prerequisites, that they may enroll next year.

The microscopic equipment is very complete and up-to-date, and a large number of interesting samples are on hand for the student's use.

A few of the samples investigated are as follows: Raw materials; refractories, new, and after use in glass tanks, boilers, etc.: Devitrified glass, and porcelain bodies.

Mr. A. B. Christopher of the class of '18 was a recent caller at the department. Mr. Christopher is with the Chambers Bros. of Philadelphia, makers of clay working machinery. He is a Ceramic Engineer in the Sales and Engineering department.

Civil

The Civil Engineering Department has had as its guest Dr. Von Hecke of the University of Louvain, Belgium. During his stay here Dr. Von Hecke gave a series of talks on "Louvain University," "The Study of Rivers and Harbors from Models," and "The Vierendeel Truss." Dr. Von Hecke is particularly interested in the work being carried on by Professor H. F. Moore on the fatigue of metals.

The Student Chapter of the A. S. C. E. has been very active this year, having for its speakers thus far Professor Huntington, who presented a very interesting set of slides on "Bridges in Switzerland." T. Chalkley Hatton, a consulting engineer, whose subject was "Engineering as Pioneers," L. F. Harza, another consulting engineer, who spoke on "Business Knowledge for Engineers," and Herman Von Schrenk, an author on timber construction, who spoke on "Future Timber Construction." With many more interesting speakers already on the program, this promises to be a big year for the Society.

Some seventy-three seniors have completed the annual pilgrimage in the never-ending (?) quest for knowledge. The inspection trip this year was limited to Chicago and vicinity, the Milwaukee Sewage plant being replaced by the new West Side plant of Chicago. The trip was enjoyed by all and the seniors wish to give a vote of thanks to the Faculty men who helped to make the trip a success.

Professor T. C. Shedd has been instrumental in securing and placing the new pictures of bridges and other structures which have appeared in Engineering Hall recently.

The 1930 Electrical Show

This spring will witness another Electrical Show, and as has been true of each of the past shows, this is to be a bigger and better one than any of its predecessors. The activity which has been manifested at an early date indicates that many new and unique demonstrations will be incorporated in the show as well as those "high spots" of past ones which met with particular enthusiasm and approval on the part of the spectators.

The Electrical Show is sponsored by the Electrical Engineering Society, an organiation of students studying electrical engineering; and all of the administrative and technical details are taken care of by student managers and assistants. Most of the demonstrations and exhibits are provided by students, although a limited number of commercial demonstrations of a spectacular nature are also presented.

The purpose of the Electrical Show is threefold. First, it aims to present the latest developments in the field of electrical engineering as well as other developments with which the general public is not well acquainted. Second, it provides a source of worth while entertainment with its variety of spectacular, freak, and sometimes fake stunts. Third, it provides a means of enlarging a loan fund for students which past shows have established.

Thus we see that there are worth while motives behind the enterprise, and in past years the large crowds which have turned out for the shows have indicated the appreciation of the student body, the faculty, and the twin city residents. The first show was held in 1907, and since that time, eleven others have followed, each one increasing in size and splendor. With the new facilities offered by the addition to the Electrical Engineering Laboratory of the vacated Materials Testing Laboratory and other provisions being arranged for by the management, this show will truly be a bigger one, and practically the entire body of E.E. students is working to make it a better one.

Like all projects of this nature, however, it needs the support of a large student body who will "talk it up" in order that the campus and twin cities in general will know that an enterprise for their benefit educationally and as entertainment is being attempted, and that since it is produced but once every two years, advantage should be taken of the opportunity of seeing the latest developments in the field of electrical engineering and a few of the wonders that are being accomplished. Naturally for the supporters of a show of this type, we would turn to the engineers in other departments, who, by the choice of their profession have shown their interest in technical developments and in engineering practice. Therefore, the E. E. Society solicits the good-will and backing of engineers in this enterprise as it has in past shows, and sincerely hopes that its efforts to provide a real show will be rewarded by a response from them both in general publicity and in attendance at the show.

Although plans have been pretty well formulated by this time, the managerial staff would appreciate suggestions regarding any phase of the show, and assures that anyone desiring to have a part in a demonstration is welcome, regardless of his college. All communications should be made with W. H. Formhals '30, general manager for the 1930 show.

Mechanical

The year opened with the following officers for the year:

G. W. Kessler, president.

M. A. Wilson, vice-president.

G. Mackey, secretary.

E. A. Luscombe, treasurer.

On October 9 the annual smoker was held. Over one hundred and fifty students were present. Talks were made by Prof. Willard and Prof. Leutwiler. "Stam," a film obtained through the courtesy of Babcock and Wilcox Co., was shown and there were the usual smokes, cider and doughnuts.

Some of the outstanding meetings have been those in which films supplied by Stone and Webster were shown. One of these films entitled "Power" was shown October 16 and the other "Conowingo" was viewed November 20.

November 6 we had the privilege of having Mr. E. H. Smedley, a representative of the Link Belt Co., give an illustrated talk on "Application of Chains to Transmission of Power."

On December 4 Mr. Hayes, class of '31, spoke on "My Experiences in the Oil Fields." The talk was very interesting and showed just what could be done along the line of student participation.

For our December 18 meeting we had been very fortunate to secure Prof. H. Moore as our speaker. The talk was an unusually good one such as only Prof. Moore can deliver.

At present we have one hundred and seventeen members and hope to go over the hundred and twenty mark. Meetings are well attended and the student interest seems to be all that could be expected.

Pi Tau Sigma

G. S. Kessler '30, president.

J. F. Schroeder '30, vice president.

V. D. Pullian '30, treasurer.

C. Y. McCown, corresponding secretary.

O. W. Nelson '30, recording secretary.

Pi Tau Sigma was founded in 1915 at the University of Illinois. Its purpose being to emphasize through its membership the high ideals of the mechanical engineering profession, to stimulate student interest in the various departmental activities, and to promote the mutual welfare of its members.

The group of men who organized the fraternity believed that these ideals are best developed and preserved through the bonds of fraternal association. The absence of any similar organization in mechanical engineering which would accomplish this purpose, and to which election would be considered a recognition of scholastic achievement or professional promise, led the founders of Pi Tau Sigma to hope that the organization would become national in scope.

The first step toward the realization of this hope was taken when a chapter of Pi Tau Sigma was established at the University of Wisconsin, March 12, 1916. This chapter had been in existence under the name Pi Delta Phi since November, 1915, and because of the common aims of the two organizations the change of name and coalition was affected. In June, 1916, a convention of the two chapters was held in Chicago, and the national organization of Pi Tau Sigma resulted, a constitution was adopted, and officers elected.

Illinois Alpha Chapter of Pi Tau Sigma opened the present year with a smoker for prospective pledges at the Alpha Chi Rho house on October 23, 1929. Eleven men were pledged to the organization. These men are W. A. Heinze '30, G. Mackey '30, J. R. Alexander '30, R. B. Roman '30, B. L. Wellman '30, H. H. Hottes '30, C. M. Gardiner '31, R. P. Honold '31, L. Corso '31, F. Eklund '31, and S. F. Ehman '31. In additions Profs. Casbug, Severns, and Degler have been pledged for honorary membership.

G. W. Kessler '30, and C. Y. McCown '30, were the Illinois Alpha delegates to the recent national convention. At this meeting Prof. O. A. Leutwiler was elected national president for a three year term.

Mining

Three residents of Urbana, Ill., Prof. Alfred C. Callen, of the University of Illinois, and J. Everts Lamar and George E. Ekblaw, attached to the Illinois Geological Survey, along with many prominent members of the engineering profession throughout the country, representing Federal and State government bureaus, engineering departments of universities, and industrial organiations, have been appointed by Dr. M. M. Leighton, chief of the Illinois Geological Survey at Urbana, to assist him in working out plans whereby the advances made in mining and metallurgy in the United States during the past hundred years can be graphically presented at the Chicago Century of Progress celebration in 1933.

Dr. Leighton's committee will act under the National Research Council's Science Advisory Committee which is collaborating with the Chicago fair trustees in developing a science theme for the exposition.

The science theme will take the form of a moving panorama showing a century of progress in all the sciences both in the pure and applied fields.

The Mining and Metallurgy Committee of the Science Advisory Committee consists of Dr. Leighton, chairman, and the following general advisors: Prof. A. C. Callen, head of the department of Engineering, University of Illinois; Dr. George K. Burgess, director of the U. S. Bureau of Standards, Washington, D. C.; John V. W. Reynders, New York; J. H. Hedges assistant to the director of the U. S. Bureau of Mines, Washington, D. C.; C. C. Whittier, Chicago; Wilford Sykes, Chicago, and L. E. Young, vice-president of the Pittsburgh Coal Co.

Dr. Leighton has divided his committee into two groups, one of which will study the plan with relation to mining and the other to metallurgy.

Members of the mining group are Frederick W. Sperr, Michigan College of Mines, Houghton; J. Uno Sebenius, superintendent of mineral lands and exploration, Oliver Mining Co., Duluth, Minn.; Albert Mendelsohn, Copper Range Co., Painesdale, Mich.; John Garcia, Chicago; and Dr. E. A. Holbrook, dean of the School of Engineering and Mines, University of Pittsburgh; Dr. Heinrich Ries, Cornell university, Ithaca, N. Y.; Arthur J. Hoskin, editor of "Pit and Quarry," Chicago; J. E. Lamar, State Geological Survey, Urbana, Ill.; Max A. Berns, Universal Portland Cement Co., Chicago; Gustav Egloff, Universal Oil Products Co., Chicago; E. T. Lednum, manager, E. I. du Pont de Nemours & Co., Chicago; H. T. Walsh, Chicago, and J. R. Van Pelt, Chicago.

The Metallurgy group consists of Mr. Whittier, vice-chairman; Dr. Burgess, William R. Wright, Chicago; C. E. Williams, Battelle Memorial Foundation, Columbus, O.; William A. Scheuch, Western Electric Co., Chicago; Mr. Reynders, Mr. Sykes, Samuel Eppstein, Illinois Steel Co., Chicago; Robert G. Guthrie, Chicago; Mr. Berns, Dean Edward Steidle, Penn State College, State College, Pa.; Mr. Van Pelt, Mr. Lamar, H. W. Nichols, Field Museum, Chicago; George E. Ekblaw, State Geological Survey, Urbana, Ill.; Dr. William Otis Hotchkiss, president, Michigan State College of Mines and Technology, Dr. Edson S. Bastin, University of Chicago, and W. E. Wrather of Dallas, Tex.

Sigma Epsilon

The Sigma Epsilon, honorary railway fraternity, held its formal initiation in the Locomotive Laboratory, Tuesday evening, December 19, 1929.

The following men were initiated at this time: H. C. Heaton '30, K. F. Kirkman '30, G. T. Sands '31, M. M. Culp '31, C. E. Staples '31, E. W. Hornings '31.

Sigma Epsilon is an organiation for encouraging higher scholarship and greater activity within the railway department. Although being primarily for the promotion of higher scholarship, Sigma Epsilon takes its members from those men, who are particularly interested in the Railway Club. Sigma Epsilon was founded in 1912 and is the only fraternity of its kind in this country.

The initiation banquet will be held sometime in January.

Theta Tau

Theta Tau held a regular dinner and meeting on December 5th at the Phi Kappa Sigma house. Dr. Brown of the department of Economics spoke on the subject "Economic Theory and the Engineer." The talk proved to be very interesting and instructive. The following men were pledged this semester:

F. H. Davis, L. F. Concklin, O. B. Gerlack, M. D. Serblin, W. J. Hoffman, H. C. Lane, H. D. Peoples, W. F. Ridgeway, R. P. Sayers, C. S. Monnier, H. E. Hudson, W. E. DeBerard.

ALUMNI NOTES

Colonel Warren R. Roberts, c.e. '88, chairman of the Roberts and Schaefer company of Chicago, has just sold the Russian government $3,000,000 worth of coal-handling machinery. The contract calls for the designing and supervision of the building of machinery for coal-mining, coal preparation, storage, and loading for four large new coal mines in Russia, one anthracite and three bituminous mines. All the engineering work must be completed in thirteen months. The designing will be done in Chicago by the company's engineers. All this new construction planned will increase the annual output of the Don mines by 3,500,000 tons.

Roberts attributes the economic improvement in Russia to the policy of the government. "Formerly," he said, "the money went into the erection of palaces and churches. Now every dollar that can be scraped up is devoted to economic development. The Russian worker, however, is not as efficient as the American worker, but under the new and better social conditions the standard of efficiency is improving every year."

Roberts has been in engineering and construction work since graduation. He was engineer of bridges for the city of Chicago. He was president and general manager of the company that build the old University library, now the Law building. During the World War he headed the construction branch of the cantonment division, now construction division of the war department. E. C. Barrett, c.e. '93, is president of the Roberts and Schaefer company, which has offices in the Wrigley building.

B. W. Hilgard, ex'13, assistant general manager of the Illinois Terminal railway, assumed his present position a year ago when several railroads in the St. Louis area were consolidated to form the present company. Immediately previous to that time, he had been general manager of the St. Louis, Troy, and Eastern railway.

In 1907 Hilgard started to work for the Illinois Traction system in Decatur. On transferring to the office in Champaign, he decided to enter the University, so, in 1908, he left his job. He entered Illinois the following autumn, but could only remain two years because of financial limitations. Returning to the Illinois Traction system, he was sent to Clarksville, Tennessee, to get some real experience in a combination gas, electric, and street railway property.

Hilgard was then transferred to McAlester, Oklahoma, where he worked up to a superintendency. In 1914 he was back in St. Louis on coal mine operations and utility engineering. The war interrupted his work, and he served overseas in several of the major offenses.

Major Paul T. Bock, of the United States Air Corps, c.e. '13, commander of the 24th pursuit squadron, was killed instantly August 1, when his plane crashed during bombing practice at France field, Panama. He had been in the army since 1914 and led an expedition to Mexico in 1915. During the war he was an instructor at Camp Humphrey, Virginia. He was graduated from the air service school in 1921 and the bombing school in 1922, and had been stationed in Panama since March, 1927. He was a member of Tau Beta Pi and Sigma Xi and received honors in scholarship.

R. W. Owens

R. W. Owens, manager of industrial motor engineering department of the Westinghouse Electric and Manufacturing company, graduated from Illinois in 1914 with a degree of bachelor science in electrical engineering. A year later he received his master of science degree.

Upon graduation he elected the Westinghouse graduate student course, and entered the D. C. section of motor engineering department in the spring of 1916. In 1919, he was appointed section engineer in charge of the D. C. section and in 1927 was appointed manager of the industrial motor engineering department, which position he still holds.

Owens is a member of the American Institute of Electrical Engineering. Several of his articles have been published in the *Electrical Journal.*

C. E. Van Orstrand, c.e. '96, of the United States Geological Survey at Washington is engaged in a rather unusual profession, that of a geophysicist. A geophysicist is one who studies the physical features of the earth.

Van Orstrand has specialized in geothermics, the branch of this earth study which deals with determining how hot the earth is at great depths and with the investigation of deep wells. He has designed various instruments and machines. He says that the increase in temperature with depth varies from one degree in twenty feet in some of the oil fields of Wyoming to one degree in two hundred feet in the gold mines of Johannesburg, South Africa.

One result of the investigations is the belief that earth temperatures have relation to oil deposits, and that future prospecting for oil will proceed accordingly.

In the *Journal* of the Washington Academy of Science Van Orstrand describes his machine for measuring deep wells. A gas well which he measured at Ligonier, Pennsylvania, was 7,656 feet, or almost a mile and a half deep, and, at the time, was the deepest well in the world. However, since then, an oil well has been dug near Brea, California, to a depth of 8,046 feet.

Prof. Rexford Newcomb, arch. '11, has resumed his work in the department of architecture, after investigating architectural polychromy and ceramics in China, Japan, and the near east. He also studied in the Hawaiian Islands and the Philippines, bringing back hundreds of photographs and color notes.

Charles E. De Leuw, c.e. '12, is a member of the firm of Kelker, De Leuw, and Company, consulting engineers, Chicago.

John V. Schaefer, m.e. '88, is president and treasurer, and John V. Schaefer, jr., m.e. '23, is assistant to the president of the Cement-Gun Construction company of Chicago, Pittsburgh, and New York.

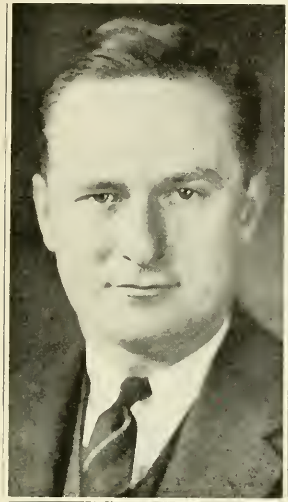
Twenty-nine Illini hold positions with the Illinois Steel company, including Orrin H. Baker, m.e. '07, vice president.

Norman Brunkow, arch. '14, has been engaged in architectural engineering work, including structural design for the State Bank, Foreman Bank, and the Builders Building in Chicago, the Gimbel Store in Philadelphia, and other bank and office buildings in Denver, Detroit, and Minneapolis.

Theo Plack, c.e. '14, is district engineer at Peoria for the Illinois Highway department.

At the age of 31, W. C. Evans '21, is a radio veteran of 16 years experience. He began as a radio operator at the age of 15 on a Great Lakes vessel. After two seasons on the lakes, he became an operator on a United Fruit company ship in Central American waters. Later he alternated between radio operator and securing an education at the University of Illinois.

During the World War Evans was an instructor in the naval radio school at



W. C. Evans

Harvard. When he returned to civilian life, it was to the United Fruit company again. It was during this period that he met with some of his most interesting experiences.

It was there he handled the first radio telephone equipment to be installed on an American merchant ship. He also received the first known SOS from an airplane to a ship. A Navy seaplane had ripped a pontoon in taking off and was being forced down by a missing motor. The distress message was relayed to an American destroyer which discovered the plane safe on the water of Almirante bay, Panama.

Evans entered the broadcasting field in 1921 when he became an operator at station KYW. Before leaving the station in 1928 he had become its manager. It was during this period that KYW became famous for broadcasting the first grand opera.

Leaving Chicago in the fall of 1928, he went to New York where he superintended relations between Westinghouse and RCA Photophone, Inc. Then he was transferred to East Pittsburgh and was given charge of all Westinghouse radio operations.

Evans' experience at sea has left its impression on him, for he is a sail-boat enthusiast and apparently a good sailor. He sailed on the winning boat in the Chicago to Mackinac race of 1925 on the schooner Privateer.

Eugene W. Kraft, m.e. '09, is manager of the Chicago office of the Keuffer and Esser company.

Prof. W. H. Rayner, c.e. '09, of the college of engineering, is one of the authors of "Surveying" which was published recently by the McGraw-Hill Book company.

J. N. Chester, c.e. '91, is president of the J. N. Chester Engineers of Pittsburgh, consulting hydraulic, sanitary, and valuation engineers.

C. B. Burdick, c.e. '95, is a member of Alvord, Burdick, and Howson, of Chicago, which specializes in water works, flood relief, sewage disposal and drainage.

One of the assistants of Ralph Modjeski, nationally famous as a consulting engineer on bridges, is M. B. Case, c.e. '06. Modjeski was granted the honorary degree of doctor of engineering by the University in 1911. Case, engineer of construction for the Port of New York authority on the Hudson river bridge, has assumed similar duties in connection with the new Staten Island bridges.

Ranjit S. Jain, e.e. '15, is professor of electrical engineering at the Benares Hindu university.

Charles Morgan, a.e. '14, has a studio on the thirty-third floor at 333 North Michigan avenue, Chicago.

A. J. Schafmayer, c.e. '07, is division engineer of the Board of Local Improvements, 207 City Hall, Chicago.

William Wraith, m.e. '94, vice president of the Andes Copper Mining company, New York, is the author of an article in the August 24 issue of the *Engineering and Mining Journal* entitled "Leaching, Flotation, Smelting Included in Andes' Operations at Potrerillos, Chile."

W. R. Morrison, a.e. '95, of Quincy, supervised the construction of an ice plant for the Western Illinois Ice company last summer in addition to his regular work. The construction was completed in twenty-six days.

Edwin Grimmer, c.e. '12, has left Fort Benning, Georgia, for the Engineers school at Fort Humphreys, Virginia. He is a captain in the United States army.

W. W. Graham, m.e. '14, of the Holabird and Root company, architects, Chicago, carries on mechanical engineering work there.

John W. Thompson, c.e. '10, is vice president of the Stupp Brothers Bridge and Iron company at St. Louis.

James V. Richards, arch. 10, superintends the Insull Super Power company at Peoria.

George E. Warren, c.e. '12, of La Grange, Illinois, was elected to the executive committee of the American Society for Testing Materials at the thirty-second annual meeting of the society which was held at Chalfonte-Haddon Hall, Atlantic City, New Jersey, during the week of June 24.

Fred L. McCune, m.e. '01, is foreman of the experimental laboratory of the International Harvester company at Chicago.

Albert M. Johnson, m.e. '03, is superintendent of the J. Barnes Drill company, machine tool manufacturers, at Rockford, Illinois.

Earl C. Brown, c.e. '07, is vice president of the Mississippi Valley Structural Steel company at St. Louis.

L. A. Gutting, e.e. '11, manager of the Interstate Public Service company, at Shelbyville, Flat Rock, and Greenfield, Indiana, has been appointed district manager over eight counties. His district provides water, gas, and electricity to forty communities. Following his graduation, Gutting spent five years in electrical engineering, working in the Panama Canal Zone as supervisor of electrical installation in the shops and dry docks of the Isthmian Canal commission. He has been located in Shelbyville for the last ten years.

Frank Ward, arch. '11, architect at Albany, N. Y., also serves as engineer of buildings for the upstate area of the New York Telephone company, a division of the Bell Telephone company.

Charles Gorden, ry.e.e. '12, newly elected managing director of the American Electric railway association, has become widely known as editor of the *Electric Railway Journal*, and has been especially active in advocating co-ordinated railway and bus service under single management. Last year under his edi-

Charles Gordon

torship the *Journal* was awarded the first Associated Business Paper medal for outstanding service. Since graduating from Illinois, he has been in the community transportation industry, except during the war.

Abe L. Glick, mun.e. '14, has been appointed Chicago district manager of the Triangle Conduit company, incorporated. He is a director of the Athletic Officials Association of America.

(Continued on Page 88)

The human brain is a wonderful organ. It starts working when we get up and never stops till we get to class.

—*Nebraska Blue Print.*

Football Player — "Yes, it's my ambition to be a judge some day."

She—"You are fortunate. Your experience on the bench will be very useful then."

—*California Engineer.*

"What do you think is the hardest thing to deal with?"

"An old deck of cards."

—*Exchange.*

"I think she's as pretty as she can be."

"Most girls are."

"I hear they've gone bone dry in the village where your brother lives."

"Dry, man, they're parched. I've just had a letter from Bill, and the postage stamp was stuck on with a pin."

"We have mines so deep, boasted the Welshman, "that it takes half an hour to go down and come up."

"That's nothing," said the American, "we have mines so deep it takes half a day to go down and same to come up."

"Ridiculous!" exclaimed the Welshman. "When is the work done?"

"Work?" was the reply. "Oh, the night shift does that."

—*California Engineer.*

An absent-minded professor was walking down the street one day with one foot in the gutter and the other on the pavement. A friend, meeting him, said:

"Good afternoon, professor, and how are you?"

"I was very well, I thought, but now for the last ten minutes, I've been limping."

—*Ohio State Engineer.*

"Now I'm getting into the game," said the tadpole, as the wild duck swallowed him.

—*P.O.N.*

A man was sitting beside the bed of his business partner, who was dying. Said the latter:

"I've got a confession to make. Ten years ago I robbed the firm of $50,000—I sold the blue prints of your invention to the rival firm—I stole the letters that were used against you in your divorce case."

"Don't worry," said his partner. "Don't worry. I poisoned you."

—*Kansas State Engineer.*

"Doing any good?" asked a curious individual looking over the rail of the bridge.

"Any good?" answered the fisherman below. "Why I caught forty bass out of here yesterday."

"Say, do you know who I am?" asked the man on the bridge. "I'm the game warden."

The fisherman, after a moment's thought, said, "Do you know who I am?"

"No."

"Well, I'm the biggest liar in this country."

—*Kreolite News.*

Forty per cent of the women of this country are working women. The other sixty per cent are working men.

—*Iowa Engineer.*

A man dashed into the station with only a minute to catch his train:

"Quick! Give me a round trip ticket!"

"Where to?"

"Back here, you nut."

The man who drives with both hands keeps the modern girl worried. She wonders what he would do if he had to blow his nose.

—*Goat.*

Jack—"I feel like a better man every time I kiss you."

Mary—"Well, you needn't try to get to Heaven tonight."

—*Rose Technic.*

Down in Arkansas a man was tried for assault and battery with intent to kill. The state produced as evidence the weapons used—a rail, a gun, saw and rifle. The defendant's counsel exhibited as the other man's weapons a scythe, blade pitchfork, pistol, dog, razor and hoe. After being out several hours, the jury gave their verdict:

"We, the jury, would have given a dollar to see the fight."

—*Co-operative Engineer.*

"Not many fellows can do this," said the magician as he turned his Ford into a lamp post.

—*Owl.*

Young Bride—"I didn't accept Harry the first time he proposed."

Her Rival—"No, dear, you were not there."

"Could you pass the bread?"

"I think I can. I moved pianos all summer."

Customer — "Do you carry B-eliminators?"

Clerk—"No, but we have roach powder and fly swatters."

—*Ohio State Engineer.*

"Just been lunching with your husband, darling."

"So good of you, angel, but I do hope it won't come to his secretary's ears; she's so jealous."

—*Missouri Outlaw.*

Tourist—"Those cows run around as though they were drunk."

Cowboy — "Yes'm — them's what we make corned beef out of."

—*California Engineer.*

London Curio Dealer—"Yes, this is the very handkerchief used by the father of William Penn."

Tourist — "Hmm, the original pen wiper."

The minister called at the Jones' home one Sunday afternoon, and little Will answered the bell.

"Pa ain't home," he announced, "he went over to the golf club."

The minister's brow darkened, and Will hastened to explain: "Oh, he ain't gonna play any golf. Not on Sunday. He just went over for a few highballs and a little stud poker."

—*Kreolite News.*

He — "I've been in every night this week, with two exceptions."

She—"Who were they?"

—*Iowa Engineer.*

Engineer—"What engines shall we use?"

Skipper—"Oh, Diesel do."

—*Anapolis Log.*

Doctor (examining unconscious engineer)—"Did that automobile hit his engine?"

Fireman—"No, the driver slowed up to let the train go by and the engineer fainted."

—*Bison.*

"Buy this car, lady, and you'll never go wrong."

"Thanks a lot, but I'd rather see some of the others."

—*Rose Technic.*

If you are caught in hot water, be nonchalant, take a bath.

—*Log.*

Inspection Trip Report

By E. A. LUSCOMBE

Although a number of plants were visited on the Mechanical Engineers' Inspection Trip, there are two outstanding plants, which, to my mind, were very impressive. These two plants were those of the Allis Chalmers company, and of the State Line Generating company.

The Allis Chalmers company of West Allis, Wisconsin, gave me the best impression of all of the industrial manufacturing plants that were visited. Although this plant is, for the most part, a job order plant, they do have production work in their tractor plant. The combination of a job order shop and production shop was one of the reasons that I was so impressed with this plant.

The largest portion of the Allis Chalmers plant is devoted to the filling of job orders. Most of this portion is housed in several parallel buildings that open on one end into a very large assembly room. In each of these several buildings some type of machine work is done. The finished products of these shops are all brought to the large assembly room to complete the machine.

Perhaps one of the most outstanding features of the assembly room was the gigantic boring mill which, for some time, was the largest in the world, but is now the second largest. This boring mill has a table over forty feet in diameter and will turn a piece of metal over forty feet wide and forty feet high. In the assembly room were seen the parts of a 65,000 kilowatt steam turbine unit that was being built for the Waukegan Generating Station of The Public Service Company of Northern Illinois.

In the turbine blading department it was learned that Allis Chalmers does not hold their turbine blades in position on the rotor by means of grooves and tongues as do many other manufacturers, but that they hold them in position by holding the blades and the rotor in a die and pouring molten metal around the base of the blade. Thus the blade is made integral with the rotor.

In any job order plant it is quite necessary to have a number of very large lathes. It is advantageous to have a lathe that will be adapted to numerous jobs. Allis Chalmers Company has an extremely long lathe. The head stock of the lathe is movable so that the lathe can be used for a variety of work.

The foundry was a very interesting place to view. At the time we were there they were pouring a casting that weighed over seventy tons. This pouring was done by means of three thirty-five ton ladles. Castings of this type sometimes remain in the mold for a period of two weeks before they are removed. The location and the types of cranes used in the foundry are such that there is a minimum of interference. There are a number of very heavy duty traveling gantry cranes, below which, a series of smaller traveling jib cranes operate. Thus the operation of any one or of all of the gantry cranes does not interfere with the operation of the lighter and faster jib cranes.

The forge department of Allis Chalmers Company has a number of large drop hammers. The biggest hammer that they have is really a hydraulic press. This machine does not hammer as does an ordinary steam hammer, but it drops rather slowly on the piece and then presses it, by means of hydraulic pressure, to the desired shape. This is a very interesting piece of mechanism, and operates quite differently than the ordinary drop hammer.

The tractor plant of Allis Chalmers is a new plant, arranged on a production basis. Because this plant was recently completed it was not operating heavily when we inspected it. The machines in this plant are all supplied with unit drives. In fact, this new plant presents the latest trend in machine shop practice. The raw material enters one end of the plant and the finished tractor is driven out of the other end under its own power. Overhead rails are used to convey the work from one machine to the next. The tractors are all tested and broken in on electic generators. The power developed is sent into the plant to help run the machinery.

Allis Chalmers Company impressed me because it combined the shops of a job order plant with those of a highly specialized production plant and is one that will not be readily forgotten. Likewise the flexibility of the job order shops with their large and numerous machines combined with the large foundry present a spectacle that is found only in the largest of manufacturing plants.

The State Line Generating Station is located on the Indiana State side of the Indiana-Illinois state line. This plant presents the latest trend in the generation of electricity. The station is planned for a future capacity of 1,000,000 kilowatts with five units. There is, at present, only one of the five units in operation. This unit has a capacity of 208,000 kilowatts or 278,820 horse power. It is the largest turbo-generator group in the world today.

The present group of generators consists of one high-pressure, and two low-pressure turbines. The high-pressure turbine operates on a steam pressure of 650 pounds and exhausts this steam at 110 pounds pressure to two low-pressure turbines. Although the reheater was not in the system at the time of the visit to this plant, it has been planned that the steam will pass through a surface type of reheater on its way from the high-pressure turbine to the low-pressure turbines. This will raise the temperature of the steam from 400 degrees to 500 degrees Fahrenheit at a constant pressure. The high-pressure turbine is of the single flow type and will exhaust directly into the proposed reheaters, while the low-pressure turbines are double flow and exhaust directly into the surface condensers. These condensers have a total capacity of 176,000 square feet and are designed to condense 1,600,000 pounds of steam per hour when supplied with 380,000 gallons of circulating water per minute. This circulating water is taken directly from Lake Michigan.

The capacity of the main generators, at 85 per cent power factor, is 200,000 kilowatts. The high-pressure generator has a rating of 76,000 kilowatts, and the low-pressure generators have a capacity of 62,000 kilowatts each. The two house alternators have a capacity of 4,000 kilowatts each. The electrical energy generated by the main generators is at a potential of 22,000 volts.

Each of the three turbines operate at 1800 revolutions per minute. Steam is bled from these turbines to heat the feed-water. There are five stages of heating ranging from 380 pounds absolute to 9.4 pounds absolute.

The steam for this unit is supplied by six boilers that operate at slightly over 650 pounds pressure. Each of these boilers has a possible output of 450,000 pounds of steam at 730 degrees Fahrenheit. These boilers are supplied with superheaters, economizers, air preheaters, and water walls. The feed-water enters the boilers at 400 degrees and the air enters the furnace at 425 degrees Fahrenheit. Both forced and induced draft are used on these boilers. The concrete lined steel stacks extending 250 feet above the boiler room floor having diameters of 18 feet at the top and over 22 feet at the bottom carry the gas from the boilers.

The fuel for this plant is powdered coal. This coal is supplied to the boilers in a powdered blast after being dumped from the cars by a car dumper and being crushed, and passed over a 42 inch belt conveyor to the pulverizing mill. The coal dust from the pulverizing mill is picked up by an air blast and is carried to the boilers.

The feed-water system consists of a series of filters and evaporators, which are followed by a number of heaters as described above. An auxiliary Zeolite softening system is at hand in case of the necessity to close down all or a part of the evaporators.

The latest precautions for the safety of the workmen are carried out in the electrical system of switching by means of an enclosed wiring system in which each of the three phases are carried in a separate grounded pipe. Thus it is quite impossible for anyone to come in contact with the live lines when properly operating the switches. Energy is transmitted over these switches at 33, 66, and 132 kilovolts.

The heart of the station, or operating gallery, is supplied with numerous controls and meters for controlling excitation, throttles, loads, speeds and frequency of the generators together with the numerous switches in the station. The men in the gallery have considerable responsibility in their work as they are the ones who control the complete functioning of the plant.

Considerable storage battery capacity is found in this plant. The purpose of these storage batteries is to supply direct current in case of the failure of any of the excitors or motor-generators which are so important in the operation of the generating station.

The ashes from the furnaces fall down the back of the furnace wall and are sluiced into a receiving pit where they are loaded into cars by means of a grab bucket crane.

One of the unique features of the State Line Generating Company is that it is not a public service company, but that it is a manufacturing company and sells its product to the public service companies of Indiana and Illinois. In this manner the State Line Generating Station is not controlled by the Commerce Commission as are the public service companies.

The reason I was impressed with the State Line Generating Station is because it is the latest type of generating station, and exhibits the highest developments in the power plant field. The large 200,000 kilowatt unit, the five stage feed-water heating, the double flow turbines, surface type of reheaters, high vacuum condensers, powdered fuel, and the moderately high-pressure, all tend to indicate that this station is a good example of the highest developments in power plant work.

Inspection Trip Report

By V. L. Westberg

The following places were visited and will be reported separately and in order:

Western Electric Co., Chicago
Bell Telephone Co., Chicago
Westinghouse Lamp Co., Milwaukee
Allis-Chalmers Mfg. Co., Milwaukee
North Shore Line Automatic Substation
Hydro-Electric Plant, Lockport, Ill.
Public Service Substation, Volmer Road
State Line Generating Plant, Ill.-Ind.
Illinois Steel Co., Gary, Ind.

As far as possible, each plant visited will be described with the following points in view: general product, plant layout, factory processes, working conditions, handling of materials, and any new features and developments. Most of the explanations will necessarily be brief, due to the large amount of work covered in the many plants visited.

The group was quite jovial as it was lined up on the first morning of the trip at the Hawthorne Works of *Western Electric Co.* We were taken through several buildings where intricate copper cables were being made. The copper wires are made at this plant by putting the red hot ingots through a series of specially constructed rolls so that its size is reduced to about 5-16". These ingots weigh about 200 pounds and are melted from pure copper with a considerable portion of reclaimed material from cable ends and rejects.

The wire then goes through a seemingly endless number of drawing dies where its diameter can be reduced to about No. 40 B.S.ga., the smaller sizes being drawn through diamond dies. The wire to be insulated can be covered by a thin coat of enamel or by a number of cotton or paper covering machines. An interesting process can be seen in the cable room where a series of large spools on a single axis wind upwards to 200 paper-insulated wires on one core which is later covered with a thin lead sheath in a unique hydraulic extruding furnace and press. Modern efficient telephony depends to a large extent upon this compact cable.

From the cable room we were taken to the rubber moulding plant where the extensive and varied uses of rubber has made necessary many rolling machines and complicated moulding dies. The path of the rubber from its crude state direct from the plantation to the finished product can be readily seen here. A new type of hand phone to supersede the common desk phone now in use is being developed using a one piece hard rubber combined transmitter and receiver unit.

Telephone switchboards with their myriads of connecting wires were seen here in all stages of construction. Units were started on one end of the floor and traveled progressively to the finished unit on the opposite end, men putting on relays, reactances, etc., at each stage. Many coil winding machines and relay assemblers are needed to keep these units progressing along to completion. It was at this place where the greatest development of efficient processes and material handling was seen. Also due to very expensive floor space, the machines and operators were placed very closely together, causing over-crowding and resulting poor working conditions. The site of the plant is strategic for material shipment advantages and a plentiful supply of labor at all times.

The effects of being suddenly taken from school desks to a hiking tour were in evidence as the group made their way to *The Bell Telephone Co.*, Randolph Franklin office, Chicago. Practically all of the equipment used by the Telephone Co. is made by Western Electric company which our rather weary group had just left.

On the first floor are located the power plant, wire chief's office, repair service and test desks, and the main distributing frame which is almost a block in length. The power for this large station is generated at low D. C. voltage by motor-generator sets from 230V. transformed from 12,000V, furnished by Commonwealth Edison Co. This D.C. charges four sets of batteries whose output is 48 or 24V. with max. current of 7,000 Amps.

The very latest in switching mounting can be seen at this office. Some of these newest types are the all-metal frame type, the units being absolutely fire-proof. The continual drone of calls being switched is noticeable and the automatic operation of the switching contacts can be studied here. Many indicating lamps are mounted on the panelboard thus making trouble shooting a greatly simplified task. And task it is as is seen by the complicated network of wires, threading up and down the rows of relay contractors.

There were several other interesting phases of the operations of the Telephone Co. besides the actual switchboard controlling of which most of us generally consider the scope of their field. A telegraph service room has a most important work in tying in the many telegraph lines connecting brokers and business firms having stock ticker service. A few tickers were in operation giving us an idea of what they really were.

The broadcast control room where all the chain programs for the Middle West are sent, has three or four operators seated before a control panel where the incoming and relayed programs are modulated or strengthened. The most interesting recent development of all is the machine for the transmission and reception of pictures by wire. During the inspection, a picture was sent to New York over the apparatus. A film print of the picture to be sent is made and curled to form an open cylinder into which a photo-electric cell is placed. A micrometer screw moving in synchronous speed with the receiving apparatus moves the film as it rotates across the narrow slit in the cell. This intermittant light causes a varying current to flow in the circuit connecting the two stations and this in turn charges the intensity of the light beam which acts on the unexposed film of the receiving apparatus. This film is then developed, giving the desired duplicate of the transmitted picture. The entire operation of transmitting takes only about six minutes, but when time of developing is included, the total time required is about two hours. According to the operator, the instrument is not used as much as it could be profitably.

From here the group disbanded to meet at the Edison building for a dinner given by Illinois Public Utilities association and a few peppy talks which will not be soon forgotten. A special North Shore Electric train took us to Milwaukee that evening.

The next morning special trolley cars took us to the *Westinghouse Lamp Works* in Milwaukee. We saw large turret plates with the glass stock bulbs direct from the glass factory, being inside frosted by an acid spray with automatic precision. Some special lamps are tinted different colors on other hand operated machines. A new method of lamp construction and evacuation has been put into operation at this plant; the stem holding the filament is now made of a piece of tubing so that it can be used as a final seal of the lamp. During the assembly of the filament supports, a small hole is blown in this tube by a jet of air on a portion heated to over normal.

A battery of automatic machines makes the small neck fittings from glass tubing and another set of machines assembles all the inside fittings automatically.

Finally, a sealing and evacuating machine takes the globe and internal assembly on a large circular drum and rotates them through a series of pumps and seals which completes the lighting element. The bases are then cemented firmly in place and the terminal wires soldered in place on another machine. The entire factory output seems to be based on automatic production, and, considering the output, this is largely true. Conveyor systems are used wherever practical and material carried from one machine to another is placed in special loading jigs which are common to both machines. Working conditions are good, but it is difficult to get good help, for the few operators needed must be very skillful and adept in their work.

Our next objective was *Allis-Chalmers Co.*, in West Allis. Here we saw an entirely different factory layout; large machine parts in process of construction in widely separated places; no conveyor systems in evidence, in fact, no real systematic order of any sort was found. This can be easily explained if we consider that none of the parts made are put on a production basis, but practically each job is a new special design and product. With this type of product a very flexible method of engineering must be used and is used in this large factory quite successfully. Some of the more interesting things seen were the turbine blade built-up construction, the large transformer and alternator winding jigs, the immense radial planing machine, and the large 65,000 K.V.A. high speed alternator which is being built for the town of Kenosha, Wis. Some very large single and three phase transformers were in process of construction on the floor, their cases towering up eight and ten feet above the floor to the case top. A huge winding vacuum furnace is found on the main floor of one of the buildings which is used to bake the finished transformer and alternator windings at or near a vacuum. This treatment will remove the moisture and air which is present in the windings after which a covering compound is sprayed into the furnace which immediately penetrates into all the open air spaces of the windings. It has been found necessary to remove the very last traces of air in any high voltage windings because of the ionization and consequent chemical action in these minute spaces causing breakdown of the insulation.

The patterns in the pattern shop range in size to some that are large enough to house an automobile comfortably. Then the very largest of them are made by building up an outer casing of brick and shaping the inner surface by hand. These castings are poured by the use of several large ladles which are moved over the mould by overhead cranes and are allowed to cool for about a week before being opened. The crane then picks them up and carries them over a specially prepared ground space where they are dropped, thus cleaning the bulk of the moulding sand off.

The special trolleys then took us back to Milwaukee after a prolonged experiment on the part of motorman in determining which end of the car operated the better. We were quite tired and wet from the continual rain and decided to retire early. After buying a bag of fruit, we were confronted by "Buck" Knight who intimated a probable party when he saw the package. Milwaukee isn't the same.

On the return trip to Chicago the party stopped at an automatic substation of the North Shore Electric where several guides explained its operation. The purpose of this station is to convert high A.C. voltage to 600 D.C. voltage for operating their trains efficiently, there being similar units installed every 5 or 10 miles for feeding under heavy loads. The 33,000 volt 3 phase transmission wires were brought to the steel tower just back of the station and were run through lightning arresters and switches with leads through choke coils and circuit breakers. From here the leads go to a polyphase power transformer which steps the voltage down to 450 and 225 for starting the converter.

The most interesting part of the station is to be found in its automatic operation of starting and stopping when the line voltage falls below 575 or the current falls below 150 amps. When the voltage stays low more than 7 sec., a relay cuts in and starts the converter at 225V holding it there until full speed is reached when it throws in the normal 450V and lowers the brushes into position and the converter is ready for loads as may be applied. To be entirely automatic as this station is, the station apparatus must be protected carefully from the following dangers; armature and bearing overheating, A.C. and D.C. overloading, overspeed, flashover, open shunt field, reversed polarity, and low or single phase AC. power. Overheating is guarded against by placing thermo-couples operating relays and a motor operates the brush lifting device. Under ordinary conditions with a two-car train speeding by, the drop of voltage is not enough to start the converter, but with more cars or when stopped in its range, the station will boost the voltage to normal when it is automatically set in operation.

The next day three comfortable motor coaches took us to the *Hydro-Electric Station* of the Sanitary District at Lockport. At this point the drainage canal is diverted so that its level remains high enough to give up its potential power to the turbine wheels. It is surprising to note that a head of over 30 feet is to be found here in this flat prairie. The wheels are of the old horizontal axis type and are directly connected to 6600V Crocker-Wheeler alternators. Their speed is 160 R.P.M. and current rating is 350 amps. These alternaters, there being six of them, are about 18' diameter. The discharge water flows out underneath the power house into a pond. The single pair of locks are reputed to be the largest in the world even surpassing Suez and Panama locks in size. There are 13 transformers located at the discharge side wall of 1533K.V.A. step-up 6600-44,000V., all water cooled. Most of the equipment at this station is of older types and designs, but some modern switching apparatus is being installed at the present time. A 50 foot spillway for excess storage water is located between the locks and the power house.

The tour then took us to the *Volmer Road Substation,* The Public Service Co. of Northern Illinois. The station was designed with pleasing Spanish architecture because of its location in a growing residential district.

Both A.C. and D.C. power is distributed at this station for a variety of purposes, principally railroad work at the present time. Three 33,000V. 3 phase lines feed the station which are stepped down to 1500V. and 2300/4000V. for town distribution. At this substation two methods of obtaining 1500V. D.C. are used, namely: rotary converters and mercury arc rectifiers. Two 750V. rotary converters are connected in series to give the necessary 1500V. service.

Two 750 K.W. 6 phase and one 1500 K.W. 12 phase mercury arc rectifiers are in operation on the 1500V. lines. They are shaped like a large kettle, the 1500 K.V.A. being about 5 feet dia. and total height of about 6 feet. It has 12 anodes projecting down through the tank top with one auxilliary anode used for starting the arc. The vacuum is controlled and maintained by a single stage rough pump and a Langmuir pump. The efficiency of the mercury arc rectifier is much higher than the rotary converter, it being 90 per cent as compared with about 75 per cent of the converter.

It was noticed that in this station the meters were all small and had colored indicating lamps. This station can be controlled from the Chicago office.

The next place visited was really a treat to us in that the generating plant had just been opened a month or two and gave us an insight into the very latest methods and developments in the turbo-electric generating plants. This plant which is incidently the largest plant of its kind in the world, is the *State Line Generating Plant,* located on the shores of Lake Michigan at the Ill.-Ind. state line. Its ultimate output will be 208,000 K.W. when all its units are operating.

Starting at the fuel source we see the coal cars being run up the incline of the unloading dump where the entire car is turned upside down and the coal drops to a conveyor after passing through the magnetic separater. It then goes to the crusher, through a drying kiln and to the furnace hoppers. Powdered coal is used entirely in this plant, the pulverizers are about the only objectionable parts in the plant, the noise being very annoying. The ash is removed by water wash to a series of settling pits.

Compared to the old types of boiler rooms, these are far superior in many ways. Everything about them is exceptionally clean and there is very little heat radiated through the boiler insulation, in fact, every one in the group kept their topcoats on throughout the plant. The boilers are immense, but are well constructed so that the whole unit is compact.

The turbine room is well laid out, the high pressure stage of the three stage unit is placed in the center of the floor with the two low pressure units being placed on either side. The exhaust steam from the high pressure turbine passes through reheaters and then to the low pressure units. The generators were designed for 22,000V. which is about twice the max. heretofore generated. The K.W. rating of the units are, 76,000 for the high pressure operating on 650 pounds of steam, and 63,000 K.W. for the low pressure.

Two new innovations were tried out in this plant, namely: no switchboard is to be found as all the switching is done on the high voltage side on the outside of the building. One reason for doing this was to be able to cut the enormous cost of the large copper conductors. On the outside switching steel work, the busbar connectors are all enclosed in tubing filled with oil. Thus a man can work all around the high voltage cables without fear of shock. The voltages are stepped up from 22,000 to 33,000V. by several batteries of 20,000 K.V.A. transformers.

Considering efficiency of plant methods and processes and general working conditions, this plant is by far superior to the other plants visited. Some of the processes being used are quite new and can bear watching.

Our final invasion of plant acreages was started with renewed vigor due to clearing skies and visions of afternoon's game: BEAT NORTHWESTERN! We all bought our skull caps and proceeded to do the *Illinois Steel Mills* in Gary, Indiana.

A good example of conservative engineering was noted in the power house where all the power to run the electric motors of the entire mill is derived from the waste gases from the furnaces. About three dozen huge single stroke gas engines drive the 600 K.W. alternators at about 200 R.P.M.

We passed by some large furnaces of 200 tons capacity where the coke and pig iron are placed together. When these large furnaces are tapped, the huge ladle is swung over a row of ingot casings mounted on cars and emptied into them. These ingots are then heat treated and sent to the rolls where they can be rolled into most any form. The hot ingot is reduced in size at each roll setting and is finally cut to proper lengths when the correct shape is reached. Some of the larger rolls must be quickly reversed to take care of direction of the return path of ingot. This is done by quickly reversing the field of the motor.

Another interesting operation is the production of car wheels from round hot slugs of steel. The centers are punched out and the disk is put through a hydraulic press where the general shape is swedged into it. Then the disks are turned in a beading roll where the shape is made true with the center hole. The wheels are finally turned true on their axles in a lathe. All of the handling of the hot disks in the many steps is done with machines of almost human flexibilness.

Due to the few necessary operations of the product and large scale production, this plant can be run upon a very efficient basis. Good material handling devices with few laborers is a sign of good shop practice.

The one thing that impressed me the most on a survey of the trip was the fact that practically all the essential details would have been missed had there been no preparatory study of these machines, etc. The plants covered represented a wide range of manufacturing and power products; from the large quantity of specialized product of Western Electric Co. to the individually designed product of Allis Chalmers Co.; and from the large power production of the State Line Generating Plant to the redistribution of power at the North Shore Automatic Substation.

1929 Sets Record in Electrical Business

As a result of the increased activities in industry, transportation and communication which characterized the year 1929, the volume and the dollar value of electrical equipment produced were greatly in excess of the maximum record of any former year.

The pragmatic worth of research was graphically indicated by the fact that more than twenty per cent of the total income received was for electrical apparatus which as recently as a decade ago was either unknown or of negligible importance commercially.

Two record size turbine-generators were completed and placed in service; a 208,000-kilowatt cross-compound unit and a 160,000 kilowatt tandem-compound unit, each the largest of its type so far constructed. Of exceptional interest, because of its potential influence on the future of central station practice and possible economics, was the growth in the use of turbines operating at steam pressures of 1200 pounds; the aggregate capacity of such machines completed or under construction being greater than the combined capacities of the preceding six years.

A third large passenger ship, with electric propulsion, the "Pennsylvania," was completed for the Panama-Pacific route, and work on similar propelling equipment for coastwise and trans-oceanic liners was in progress at the close of the year. Ingenious applications of turbine-generator sets were made to increase the power available for propulsion on ships equipped with reciprocating engines.

The electrification of railways proceeded at an unprecedented rate, and new records were achieved in the number of electric and oil-electric locomotives built. The gasoline-electric type of railway car was provided with increased power, while the tendencies in street railway operation were generally along the lines of lighter construction and the use of improved forms of electro-pneumatic and magnetic braking in order to maintain adequate schedules despite the growing density of urban traffic.

With more than 10,000 miles of airways and about 260 intermediate landing fields provided with guide beacons and ground lighting, the United States Department of Commerce was enabled to decide on practical standards for airway and airport lighting systems. It is expected that more than 2000 miles of additional airways will utilize this standardized equipment.

Further developmental work was done on the radio altimeter designed to minimize the hazards of blind flying while the new magneto compass, with special alloys in the magnetic circuit, and the electrical fuel supply and engine temperature indicators were produced on a commercial basis.

Investigations in the field on full-sized transmission lines with a portable lightning generator and the cathode-ray oscillograph revealed the fact that the choke coil, used for years in lightning protective systems, was of little actual value in this service and its use was discontinued. The photoelectric tube was developed commercially for the control of electric circuits through variations in the intensity of light, and the thyratron was practically applied in the control of lighting systems.

There was a notable extension of the use ,of the mercury-arc power rectifier, especially in railway substations, and the voltage and the unit and aggregate capacities of this type of equipment were carried beyond previous maxima.

Two outstanding accomplishments in lighting were the production of the sunlamp which serves as a safe source of ultraviolet rays, and the water-cooled lamp which makes feasible a high intensity of illumination combined with low temperatures. The trend toward the concentration of greater wattages in single street lighting standards and higher intensities of illumination for business streets was exemplified by a recent installation in Detroit which utilizes 2000-watt Mazda lamps and gives an illumination of about 1900 lumens per linear foot of street.

In presenting a review of these and many other developments which occurred during the year, all the apparatus referred to are products of the General Electric company. These cover such a wide range that the references will serve as an indication of the tendencies in design and construction as well as the general progress in the electrical manufacturing industry as a whole.

Arc Welding During 1929

The application of electric arc welding to structural work continued, during 1929, to be the activity arousing greatest interest, both popular and technical. The possibility of erecting buildings by this method, thus quieting the clamor in large cities, was principally responsible for the public interest, while the other economic advantages, succh as savings in weight, were further demonstrated and proved for the benefit of architects, builders and engineers.

The number of buildings and structures erected by the use of electric arc welding materially increased during this period. The first statistics of this nature were prepared by Frank P. McKibben in July, 1928, when he listed 100 structures consisting of bridges and buildings. In July, 1929, the total had increased to 138. The number of welded buildings alone jumped from 43 to 65, a 50 per cent increase.

Further demonstration of the reliability of welding as a method of fabrication was found in the results of a two-years' series of tests on welded joints conducted at the Rensselaer Polytechnic Institute. Conclusions based on these tests indicated that the application of electric arc welding to the construction of buildings was no longer in the experimental stage, and that such construction can now be made with complete safety and with entirely successful results.

A general activity in municipal and state bodies was noted throughout the year towards the adoption of ordinances and laws allowing the use of welding in building construction. Early in the year the 38 municipalities in the western and southern parts of the country had sections in their building codes covering this point, and many followed suit later. It was not long before the legislature of the state of Pennsylvania had passed a law allowing this type of construction to be used in first-class cities. Municipalities below that grade being already free to adopt their own codes.

Model ordinances were framed by the American Welding Society, and these were submitted to municipalities for consideration. Pittsfield, Massachusetts, was the first city in the country to formally adopt this new building code. In addition, Pittsfield was the first truly eastern city to incorporate welding in its code in any form.

Many interesting applications of welding to this type of construction were made during 1929, of which a few outstanding examples may be chosen as illustrations. Early in the year an extension to the power house of the Haddon Hall and Chalfonte hotels of Atlantic City was completed, quickly and quietly without disturbing the guests of either hotel or the residents of the cottages in the neighborhood. This power house has a height of 134 feet and is one of the tallest welded-steel building frames in the world. Some of the steel columns supporting the building and its heavy contents are of the heaviest type of steel shapes used in building construction. The hotels are owned by Leeds & Lippincott company, the architects were Rankin & Kellogg of Philadelphia, the engineers were Carson & Carson of Philadelphia and steel contractor was the Bethlehem Steel company. Frank P. McKibben was retained as consulting engineer in connection with the design of the points. Three arc welding sets were used.

Another interesting application to structural work was in the erection of a foot bridge 846 feet long for the convenience of employes of the General Electric company's plant at Schenectady. This bridge, containing 105 tons of steel, extends over the Delaware & Hudson Railroad tracks to a nearby hillside. The shop welding was done in the plant of the Williams Bridge company, Syracuse, N. Y., and the field welding was done by the General Electric company.

A highly important contribution to the building art was announced by the American Institute of Steel construction at its seventh annual convention at Biloxi, Mississippi, November 14. This was the development of a new type of arc welded steel floor which materially reduced the weight of the structure. This floor construction, known as the "battledeck" type, was demonstrated by the erection of a sample structure during the convention in the presence of the institute members. Electric welding plays an important part in the development, a special automatic arc welding machine being used to "stitch" the plates and beams together which form the flooring. The resulting structure met all specifications and tests satisfactorily.

The new flooring utilizes steel plates and structural steel beams. It is, according to the Institute, better than any floor that has been used before, and will stand every service to which the floor may be subjected. It is a floor in which it is possible to determine in advance the stresses in all parts, and a floor which will recover instantly 100 per cent from deflection caused by live loads, when those loads are removed. It may be expected that one of the first objections made to this type of floor will be that it has not been used before and is, therefore, without precedent. This objection is not sustained, however, since steel plate floors have been used for the charging floors of open hearth furnaces and for the decks of battleships where they are subjected to the most severe service known.

The automatic arc welding machine designed for this application consists of a three-wheeled, self-propelled vehicle driven by an adjustable-speed motor. On the framework are mounted a wire feeding device, a reel of welding wire, the travel motor and the control devices —all occupying a space of less than five square feet and having a height of two feet. A motor-generator set at a remote point supplies, through a trailing cable, the current for welding and for operating the travel motor. The speed of travel and the speed of the welding wire feed can be easily varied by adjusting small rheostats. In the demonstration at Biloxi a completely satisfactory weld was accomplished at a speed of 9-12 inches per minute.

In operation the machine is placed on the beginning of a seam where it is lined up and started running. If by any chance it should tend to deviate from the seam during the course of travel, its direction can be readily altered by means of a small steering wheel on the mechanism. At the end of the seam it is merely necessary to turn the machine around and place it on the beginning of the next seam, proceeding from this point as before until all seams are welded.

The new floor is described by the Institute as being a solid steel deck which acts as a girder to prevent any torsional distortion of the building when subjected to wind or earthquake action. It enables the engineer to select that part of the structure which is to carry the wind stresses to the foundations, and to be assured that the deck flooring will deliver the stresses to the most rigid part of the vertical frame. The floor construction can be carried out into the walls to provide standard construction to support the outside walls. It will provide a working floor for other trades during building construction and in many places eliminates the necessity of temporary planked floors.

The total cost of a floor constructed of 3-inch I-beams and 3-16-inch plates, covered on the top with cork tile and fireproofed on the under side, is estimated by the institute as being a little over $1.00 per square foot. It is pointed out, however, in this connection, that the cork tile floor eliminates the necessity of any other floor covering, which is always a part of a tenant's expense when using an ordinary masonry floor. The cost of a good chenille carpet alone is from $1.25 to $1.50 per square foot, and the welded "battledeck" floor complete will cost less than the carpet and eliminate its necessity.

The new steel floor, says the Institute, is equally applicable to residences, multiple-story buildings, and bridges, and for building construction it will save from 20 to 60 pounds per square foot of floor in dead weight. In connection with a 75-story building with floor panels 21 1-2 feet by 22 1-2 feet, the saving in dead load on the foundations for each column is nearly two million pounds, and indicates that its use will permit an increase of 25 per cent or more in the height of the building or in the number of floors without increasing the loads on the foundations.

Other Applications

A marked tendency was noticed during the year to construct long pipe lines by the arc welding method. An example is a 205-mile pipe line built during the year and running from Jal, New Mexico, to El Paso, Texas. This line is 16 inches in diameter and carries gas for the El Paso Utilities company. It was built by Smith Brothers, Inc., general contractors. The electric arc welding of the entire line was done under the direction of Messrs. Fred Clark and F. G. Hoffman. A total of 27 gas-engine driven welding equipments were used, some mounted on Fordson tractors and driven by the tractor engines, and others mounted on trucks and trailers.

The pipe, in 30-foot sections, was strung along the cleared right-of-way. Seven of the 30-foot lengths were then lined up making a section approximately 200 feet long. One welding crew fixed the sections temporarily in position by tack welding and another completed the welds. The tack welding machines were self-propelled equipments, as the first welding crew was often some distance ahead of the men who completed the welding operation. The pipe was turned, as the welding progressed, by one man using long-handled tongs. Every seventh joint was an expansion joint. This consisted of a short piece of pipe with upset corrugations. This joint added flexibility to the pipe as well as allowing for expansion and contraction when in use.

After the 200-foot sections were completed, another crew lined them up with the completed pipe line, using a caterpillar tractor and boom. As the pipe could not then be turned, the welds were made by the "bell-hole" method, in which the operator moves his own position to weld all sides of the pipe, making the weld on the lower side from an excavation dug beneath the joint for that purpose.

By the use of 3-16-inch diameter welding electrode and a current of approximately 175 to 190 amperes, the greatest welding speed consistent with the highest quality weld was obtained. Each operator was able to make approximately 13 welded joints in ten hours.

After the final welding operation was completed, the joints were tested and then treated with a corrosion-resisting compound. The pipe was then lowered into the ditch.

An interesting application in which welding played an important part was the construction of the new vehicular tunnel running under the Detroit river between Detroit and Windsor, Canada. This tunnel was built on dry land in section which were afterwards launched, floated into position and sunk to their places on the bottom of the river. The work was carried on by the Canadian Bridge company at Ojibway, Canada, six miles down the river from the tunnel site. Arc welding was utilized for caulking purposes around the full circumference of the shell in 42 places and for 100 feet of butt-joint welding.

Editorials

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that the long monotonous description of apparatus and method of procedure be set aside, and in its place, a set of conclusions or a set of "likes and dislikes" be substituted. And with this, there should come a more stringent grading of the reports with regard to grammar and neatness. Tabulated data gives no practice, nor does sheet after sheet of curves, unless the results may be understood this way, only. But writing—writing in an interesting way, as one will have to after graduation—is of great value.

A. C. E. Turns to Romance

I stood on the bridge at midnight,
A simple Pratt-truss span,
And my fingers were held fixed-ended
In the clasp of my love—dear Ann.

And I sighed as I there surveyed her,
My love so passing fair,
While a sportive wind-load sudden
Caused tensile stresses in her hair.

"Ann, wilt thou walk beside me
'Long life's hard-surfaced road?
On my ribs' spiral reinforcement
My heart sets up an impact load."

"Oh, Ann, beam thou upon my life,
I pray thee do not dim it."
And my joy when she softly answered yes
Exceeded the elastic limit.

—*Rose Technic*

THE LITMUS TEST

"Now, Mary, when you bathe the baby, be sure and use the thermometer to test the water."

Returning an hour later, the mistress asked:

"Did you use the thermometer?"

"No, ma'am. I can tell without that. If it's too hot the baby turns red, and if it's too cold, he'll turn blue."

—*The Great Northern Goat.*

Steam, Air and Gas Power

William H. Severns, M. S.

Howard E. Degler, M. E., M. S.

The heat engineering problems of modern steam, air, and gas power apparatus, are of daily interest to all power engineers. There exists an enormous amount of material on this broad subject, both in books and in magazines and there are some rather voluminous books covering it. But the busy engineer of today demands brevity and conciseness in his frequently consulted books. There is definite need for a rigorous elimination of that part of the available information which is non-essential. The demand is for a clear statement of principles, for brief definitions, for a selection of practical formulas, for examples of calculation, and for illustrations of typical apparatus. The treatment accomplished in this book is also suited to the classroom as well as to the busy engineer. The book has been adopted in the following schools: Baltimore Board of Education, Baltimore, Md., California Institute of Technology, Pittsburgh, Pa., Colorado School of Mines, Golden, Colo., Dartmouth College, Hanover, N. H., Kansas State Agricultural College, Manhattan, Kan., Lehigh University, Bethlehem, Pa., New Mexico College of A. and M., Messila Park, N. M., North Carolina College, Raleigh, N. C., Ohio State University, Columbus, O., Purdue University, Lafayette, Ind., Rutgers University, New Brunswick, N. J., University of Alabama, University, Ala., University of Illinois, Urbana, Ill., University of Kansas, Lawrence, Kan., University of Louisville, Louisville, Ky., University of Minnesota, Minneapolis, Minn., University of Nebraska, Lincoln, Neb., University of New Hampshire, Durham, N. H., University of Pittsburgh, Pittsburgh, Pa., University of Toronto, Ontario, Canada, irginia Poly. Institute, Blackburgh, Va., Yale University, New Haven, Conn.

The book has 425 pages, 262 illustrations, and is published by John Wiley and Sons, Inc. Prof. H. E. Degler is also author of a 150 page textbook entitled "Internal Combustion Engineer," to be published by the American Technical Society, Chicago, Ill.

Charles A. Coffin Fellowships

The Charles A. Coffin Foundation, established some years ago by the General Electric Company, has announced that applications are now being made for the Charles A. Coffin Fellowships for 1930-31.

The terms of the Charles A. Coffin Foundation made provision for the award of five thousand dollars annually for fellowships to graduates of the universities, colleges, and technical schools throughout the United States, who have shown, by the character of their work, that they could, with advantage, undertake or continue research work in educational institutions either in this country or abroad.

The fields in which these fellowships are to be awarded are *Electricity, Physics* and *Physical Chemistry.*

The committee, composed of Mr. Gano Dunn, representing the National Academy of Sciences, Mr. R. I. Rees, representing the Society for Promotion of Engineering Education, and Mr. Harold B. Smith, representing the American Institute of Electrical Engineers, desires to make the awards to men who, without financial assistance, would be unable to devote themselves to research work. The fellowships will carry a minimum allowance of five hundred dollars. This allowance may be increased to meet the special needs of applicants to whom the Committee decides to award the Fellowships.

Candidates for the Charles A. Coffin Fellowships should file applications on forms provided for that purpose, and obtainable from the Secretary. Applications will be welcomed from seniors desiring to do research work as a part of the requirements for an advanced degree as well as graduates of universities, colleges, and technical schools, but any award to a senior will be conditioned upon his graduation.

The Committee requests that all applications first be sent to the dean of the educational institution at which the applicant is, or has been, in attendance within the year. The Committee desires that the dean or other college executive in turn file all the applications received by him at the same time, together with a statement naming the *two* men applying who in his opinion or the opinion of the faculty are best qualified to receive the award.

Applications must be filed with the Committee by March 1, 1930, and should be addressed to Secretary, Charles A. Coffin Foundation, Schenectady, N. Y.

Alumni Notes

(Continued from Page 73)

Frank T. Sheets, mun.e. '14, state supervisor of highways for the last few years, is one of the eight American delegates to the second Pan-American congress of highways to be held in Riox de Janeiro, August 16 to 31.

Charles R. Sutton, arch. '21, is now in Rome attending the American academy. He received a three-year, $8,000 fellowship for his sketch, "An Island Estate." He also received a degree in landscape architecture in 1926. Last year he was in the office of Ferruccio Vitale, landscape specialist of New York. Hodge Hansen, arch.'28, took third place in the competition.

Prof. Emeritus A. N. Talbot, c.e. '81, is in Tokyo, Japan, attending the World Engineering congress as a delegate of the American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering association, and American Water Works association. He is also the delegate of several engineering colleges. He will present a paper on materials testing by Prof. H. F. Moore and one on indeterminate stresses by Prof. W. M. Wilson.

Leroy Tucker, r.e. '23, who is taking Prof. H. M. Westergaard's place this year, received an A.B. from Washburn college in 1912 and a professional degree in civil engineering in 1928. He has had fourteen years professional experience in railroad work and was responsible for the location of the railroad bridge across the Mississippi river at Fort Nadison, Iowa. More recently he had been head of the department of mechanics at Clemson college, South Carolina.

Richard B. Ketchum, c.e. '96, dean of the school of mines at the University of Utah, at Salt Lake City, is the author of an article in regard to the university in the September issue of the *Mining Congress Journal*.

Lion Gardiner, m.e. '09, is vice president and general sales manager of the Lakewood Engineering company of Cleveland.

The Link Belt company, makers of shovels, cranes and draglines, with main offices at Chicago, claims the services of three Illini engineers: W. W. Sayers, m.e. '97, chief engineer; A. J. Sayers, m.e. '95; and B. A. Gayman, m.e. '97.

Merle J. Trees, c.e. '07, is vice president and general manager of the Chicago Bridge and Iron works, makers of Horton tanks. Horace B. Horton, c.e. '07, is treasurer, and Charles S. Pillsbury, m.e. '08, is manager of operations and director.

Homer R. Linn, m.e. '96, is connected with the Chicago division of the American Radiator company.

K. H. Talbot, c.e. '09, works for the Koehring company of Milwaukee which manufactures concrete machinery, gasoline shovels and cranes.

Ralph L. Hermann, c.e. '15, is southwestern transportation manager for the Westinghouse Electric and Manufacturing company. He is located at St. Louis.

George Geib, c.e. '16, is branch manager of the Haynes corporation, industrial engineers, located at Minneapolis.

W. J. Brown, a.e. '00, and Harry Hunter, a.e. '01, recently completed a $1,000,000 memorial building and city hall on the municipal island in the Cedar Rapids, Iowa.

Frank L. Hanson, e.e. '08, is vice president of the Ideal Electric and Manufacturing company at Mansfield, Ohio. He is in charge of sales.

C. M. Fuller, mun.e. '13, superintends construction for the Gund-Graham company, paving contractors at Freeport, Ill.

Edgar Stanton Belden ex'92, and prominent Chicago builder, died August 27 at his summer home, Holland, Michigan, after a brief illness. He was born July 29, 1870, at Pawtucket, Rhode Island. He was educated in the public schools of Evanston. Later he attended the Rhode Island School of Design and entered the University with the class of '92, attending for two years. In 1889 he was captain of the baseball team.

E. S. Belden

On leaving the University he became a draftsman with Burnham, Root in 1892. His first work was on drawings for the Chicago world's fair. Since 1903 he had been with the George A. Fuller company as vice president in charge of western business. Among the buildings erected under his direction are the Stevens, LaSalle, and Blackstone hotels, Chicago and Northwestern terminal, University club, and the Kansas City Union station. He was one of the founders of the Commercial Trust and Savings bank in Evanston and a member of numerous business men's organizations. He was a leading spirit in the "Low '90's Golf Club" made up of Illini classmates.

John G. Beadle, who received a certificate in architecture in '88, died August 7, in Schenectady, N. Y. He had practiced architecture in Galesburg, Illinois, since his graduation from the University.

Rowland W. Evans, arch.'89, died July 11, at Bloomington, Illinois, where he has been in the building business since graduation.

F. C. Beem, arch. '98, is local manager of the Illinois Bell Telephone company, at Ottawa, Illinois.

Wensel Morava, m.e. '78, has returned from Paris. He has been traveling since January, his trip including India, Persia, and Czecho-Slovakia. He maintains an office as consulting engineer at 205 West Wacker drive.

C. E. Fleager, e.e. '89, is the new vice president of the Pacific Telephone and Telegraph company in charge of system matters. He is located at San Francisco. He has been in telephone work since graduation, beginning as a clerk in the long lines department of the American company in Minnesota and Illinois. Three years later he joined the Pacific company staff at Seattle, going later to San Francisco. Fleager then became plant engineer, then chief engineer of the central area, and finally assistant vice president in connection with rate case matters which position he held previous to his new appointment.

George E. Tebbetts, c.e. '99, is engineer of structures with the Chicago Rapid Transit company.

Maurice M. Wilcox, c.e. '99, is assistant engineer for the Pere Marquette railroad at Detroit.

Ralph Gage, c.e. '03, is secretary and engineer of the Gage Structural Steel company at Chicago.

C. W. Fiske, m.e. '03, is associated with the William White company at Moline, Illinois.

C. E. Winn, c.e. '08, is division plant engineer of the Western Union Telegraph company at Omaha, Nebraska.

Arthur W. Baumgarten, e.e. '14, is chief engineer for the Joliet and Chicago Electric Railroad company, Joliet.

S. S. Ball, c.e. '09, is now supervisor of sanitary sewer design in the San Fernando valley, California.

J. C. Butler, e.e. '14, commercial engineer of the Illinois Maintenance company, Chicago, was elected president of the National District Heating association at the convention held in Detroit this summer. After graduating from the University, he entered the Chicago Central Station institute, then conducted by the Insull company, and also the engineering department of the Illinois Maintenance company. He became commercial engineer of the latter in 1918.

Thomas Fullenwider, c.e. '02, is assistant construction engineer of the Illinois division of highways, Springfield, Illinois.

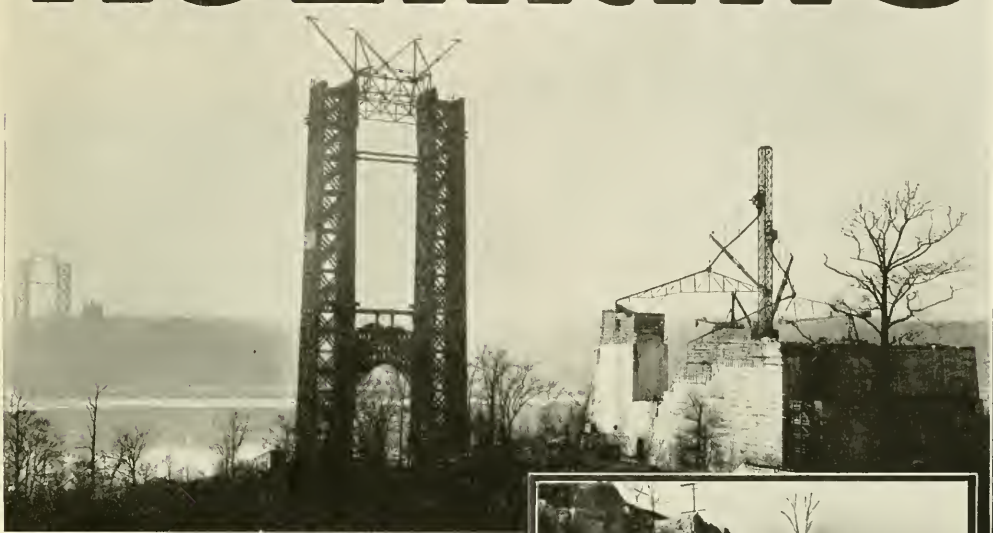
H. K. Humphrey, e.e. '11, has been promoted from assistant professor to professor of electrical engineering at Rice institute, Houston, Texas.

Chih Hsu, c.e. '12, died in September, 1927, at East City, Peking, China. He was in the commercial department of the Chinese Eastern railway, Harbin, Manchuria.

Harold S. Bradley, arch. '15, is developing a subdivision at Rockford, Illinois, known as Bradley Heights.

Harry McCarthy, m.e. '02, is chief engineer with the Walworth company at Kewanee, Illinois.

KOEHRING



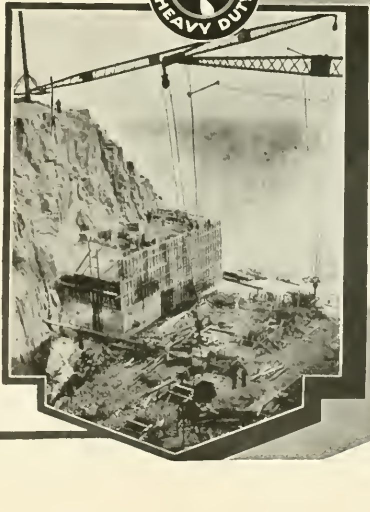
Anchorage for the Longest Suspension Span

A bridge with a main suspension span of 3500 feet, the longest in the world, will soon cross the Hudson river at New York. Suspension will be maintained by four 36 inch cables supported on steel towers 635 feet above the water level.

Abutments on the Fort Lee approach are shown in preparation in the views at the right. Two Koehring Heavy Duty products, a power shovel for the rock excavation and a paving mixer for turning out the Dominant Strength Concrete, were used in this work.

The massive New York anchorage above, 200 feet by 300 feet ground dimension and 125 feet in height, contains 110,000 cubic yards of quality controlled concrete mixed by two Koehring Heavy Duty Mixers.

Another identification of the Koehring re-mixing action with a structure built to endure!



The revised edition of "Concrete — Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, is now ready for distribution. To engineering students, faculty members and others interested we shall gladly send a copy on request.

KOEHRING COMPANY

MILWAUKEE, WISCONSIN

Manufacturers of

Pavers, Mixers—Gasoline Shovels, Cranes and Draglines

Division of National Equipment Corporation

European Airports

(Continued from Page 58)

illuminated so that they make an outline at night that is easy for the aviator to pick out from the other lights of Berlin.

Some of the Mediterranean ports are equipped to handle both sea-planes and land-planes. Milan, Italy, which is an inland city, but which is midway across the Italian peninsula, is building an artificial lake to accommodate such sea-planes as may cross the country from

Croydon Airport, England

the Mediterranean to the Adriatic. Milan has at present, a large landing field, with concrete runways. The airport at Nice was disappointing. This port is used only in winter when the tourists are congregated there. The port at Marseilles is about 15 miles outside the city and along the sea shore. The road is not good leading to it, and the time necessary to allow from the central part of the city to the port is about one and a half hours. This port, like many of the others in Europe, is really for the military and naval planes, while the civilian planes are allowed to use the port. Marseilles is going to construct a new port in 1930 closer to the city. There is a daily service from Switzerland through France to Marseilles and on to Barcelona, Spain.

Fares seem not to be based upon actual distance traveled, but rather upon the competing railroad first class fares. Thus, from Marseilles to Barcelona by railroad costs about $20 and the running time is about twelve hours, with a stop over at the frontier where the customs and immigration officers look you over. By plane the fare is $24 and the time is two hours. A glance at the map will show how the plane cuts across the sea and runs in a direct line to Barcelona while the railroad must follow the long shore line skirting the northwest corner of the Mediterranean. But, although the running time of the plane is only two hours on the time table, that does not tell the whole story, for it will be recalled that the time from Marseilles to the airport is about one and a half hours more, and at the Barcelona airport there is a like expenditure of time running into town over the worst road in Spain. Thus a trip which seems to be but two hours long stretches out into one of five hours.

Some of the services in Spain have been abandoned because of lack of patronage. This seems strange as the railroad service in that country is the worst in the world, and it would be logical to think that people would go by plane rather than suffer the torments of a railroad journey.

If Spain has been abandoning services the opposite is the case with the northern countries of Europe. Germany, Holland, Denmark, Norway, Sweden, and Finland have all increased their lines, have built or are building better airports, and are making preparations for night flying.

On returning to the United States it was startling to see how much airport work is in progress. Visits to some of the leading ports which are building revealed the interesting fact that instead of being behind the procession we are now leading it. Our new ports are being as well laid out, as well built and as well run as those of Europe.

Variable Wings

(Continued from Page 65)

The wing covering consists of 3-ply veneer doped over with airplane fabric. This covering is attached all along the leading edge with dural piano hinge making possible from that point a free movement of the wing covering along with the understructure of alternate variable webs. The piano hinge is itself secured to a half round nose piece of spruce 2¾ inches wide, running along the leading edge of the wing.

The designer plans eventually to manufacture a plane in which the wing covering will be taken up and let out at the gap as required by sliding in and out under a tightly overlapping dural strip. It is estimated that the rubber now used to complete the wing covering at the gap need be replaced only two times per year.

In most previous experiments to vary camber the designers have been unable to overcome the basic difficulty of insuring sufficient rigidity. Wings have crumpled or not maintained the shape intended because of lack of structural strength.

Queries have been made as to whether the wing when expanded will be able to stand the pressure of suddenly increased lift. Although only alternate webs support the expanded wing, the webs are placed closely enough and are designed to bear the load evenly distributed. Movable joints in the variable web structure have been so located after many tests that every point in the web has approximately an equally high load factor.

With an addition of only 30 pounds to the weight of each wing (or 60 pounds to the weight of the plane) Rocheville has constructed a variable wing which successfully withstands the Navy high incidence loading, whereby the wings are given 20,000 pounds to support, or five tons for each wing.

Each web of the wing receives 407 pounds of the high incidence wing loading, since each web is placed 12 inches apart. In tests, a load of the full 407 pounds was given to the top curve of the web, although approximately one-third of this load would in flight be carried by the under surface.

Practical demands, however, on each web rarely exceed 75 pounds, leaving a loading of 50 pounds above and 25 pounds below for each web, less what weight is taken off by the considerable lift afforded by the trailing edge when deflected.

Friction in the operation of the wing has been reduced to a minimum so that the pilot may change the wing sections with a turn of his hand. Natural forces arising from the design of the wing tend to overcome some of the inertia that would seem at first apparent in the mechanical operation of the wing. The vacuum at the top of the airfoil which tends to pull out and hold the wing section into the thick type, is counterbalanced by the opposite pressure from the variable trailing edge. In addition, the tension from the stretched rubber will oppose the upward pulling effect of the vacuum at the top of the airfoil.

The ailerons attached to the variable trailing edge operate in a normal fashion from the stick, whereas the variability of the wing is controlled by a separate lever. Ailerons are of the widely used Frise type.

Length overall of the Rocheville experimental monoplane is 30 ft. 6 in.; height, 9 ft.; wing span, 46 ft.; chord, 7 ft., and wing area, 322 sq. ft. The wing has a total of 144 sq. ft. of expanding surface and 120 sq. ft. of variable trailing edge. The wing is set with three degrees dihedral angle and has no sweepback. A Whirlwind J-5 furnishes the power.

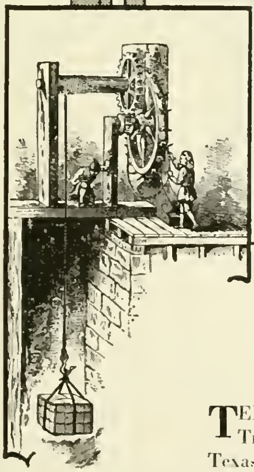
The variable mechanism naturally adds to the complexity and cost of construction; it causes the pilot to watch an additional control, and it adds a slight additional weight to each wing. However, the advantages are distinctly apparent particularly in slower and safer landings. If a pilot makes a forced landing at 25 m.p.h., the dangers are negligible, even though the terrain be rough. On the takeoff, within ten seconds from a standing start on a run of 75 feet or less, the plane vaults into the air. Further, there are the advantages of high cruising speed . . . . the speed range has been widened. Formerly, it has not appeared advisable to operate at cruising speeds of more than 1.8 times the minimum flight speed.

With less speed required for landing, the flyer student should master the art more easily.

In case of motor failure on the take-off or a spin resulting from stalling, the variable wing mechanism makes for safety. The form of the wing can be changed instantly for a long gliding range. It is generally known that high lift wings are comparatively dangerous in case of motor failure. The head resistance is so great that the plane has a tendency to descend steeply or fall off on one wing. With the control of the lift within easy reach, the pilot may flatten and thin the wing so as to glide further with a better chance of making a safe landing.

After the loaded ship is in the air and the high lift wing is no longer needed, the thin wing is used to increase speed and conserve fuel and increase speed by adjusting the wings to suit different loads and diminishing fuel supply. In airplane dusting or in wartime bombing ships, the lifting capacity of the wing may be lessened to suit the changing load. In the case of army bombers as the cargo is dropped and the plane becomes lighter, the pilots may gradually shift the wings toward the thin straight section giving increased speed. When the load is entirely gone the bomber may then speed back to its home port practically as fast as pursuit ships.

SMITH-YOUNG-TOWER BUILDING, SAN ANTONIO, TEXAS
Atlee B. Ayres — Robert M. Ayres, Architects



One of the early phases of Vertical Transportation

State Bond Issue

(Continued from Page 60)

and 11, the mixture is rather dry. I tried to keep the slump between 1″ and 1½″, since this gave the strongest concrete as indicated by beam tests taken every half-mile, and was still sufficiently workable to be handled easily by the puddlers.

The contractor had a scraper made up of blades shaped to the proper subgrade outline which rolled along on the forms behind the mixer, and was pulled by it. Behind this they had a scratcher, (see print 10), with points set to the correct depth by the engineer which gave a final check to the subgrade. If this scratcher

View showing mixer and trucks at work

touched at any point, men with mattocks and shovels scraped the spot till no marks showed. When the mixer moved forward, and the scratcher had been pulled up, several operations went on simultaneously; the longitudinal bars were lifted and set in place by templates, (see sketch No. 4), and were painted with heavy motor oil; the 18 gauge, 10 ft. center steel strips were staked down with 10 in. v-shaped spikes; and the ½″ transverse 4 ft. rods were slipped through holes 5 ft. apart in the center steel and fixed in place by small tin spikes. For a cross-section of the pavement which was constructed, see sketch No. 3.

As soon as the concrete was dumped, the puddlers spread it over the subgrade, and tramped it down, while a man on each side spaded between the fresh concrete and the oiled face of the forms so as to obtain a smooth water-proof surface. The results of this last were excellent, sometimes as much as a mile of pavement being laid without a patch of honeycomb larger than 2 or 3 in., and those very few in number.

Once placed, the "finishing" operations commenced. The Lakewood finishing machine which was used, combined two operations into one. It leveled and tamped the surface with a forward and sidewise motion of the squee, and also gave the surface its initial belting with a 10″ canvas belt fastened on behind. When moving backward, the belt could be raised to prevent its gouging into the soft surface enough times to remove all places of honeycomb, the head finisher, "Chuck" by name, would bring up his 10 ft. straight-edge on its long handle, and float and pull of the water and mortar which had risen to the surface, at the same time checking the same for waves which might be present due to a settlement of a form under the finishing machine. Another man with a small board on a long pole, called a "fly-swatter," spotted the small stone holes caused by pulling of the mortar. As soon as this was done the two would pull up the second canvas belt, giving it much the same sidewise motion that the finishing machine did to the first. After a wait, the length of which depended on the temperature of the air, Chuck again would take his straight-edge, and this time scrape off the laitance which had by that time risen to the surface. Then the last belt was pulled forward, leaving the surface in its final state.

As soon as the concrete was set enough to hold its weight without marking the surface, wide canvas sheets, about 10′ x 24′, were placed on it from a "bridge" that rolled along on the forms. This canvas was kept wet continually by sprinkling, so as to prevent excessive evaporation from the fresh concrete, and thereby reduce the possibilities of checking. In all the pavement laid while I was with them, I do not recollect having seen any hair-checks, nor a bit of scaling.

The day following the pouring, these canvas sheets were taken off the concrete, and calcium chloride applied at the rate of 2½ lb. per sq. yd. This was done by a three-wheeled sprinkler cart which distributed the chloride very evenly.

Just before the chloride was applied, the mixer inspector went over the entire previous days' run with another ten-foot straightedge with a vertical handle to check the surface for bumps and waves. If any over ¼″ were found, the contractor had to grind them off with an emery block. During my time as mixer inspector, I found only one bump, and no waves at all. This was due largely, I think, to the efforts of Mr. Naden, the man in charge of construction, as well as Messrs. Anderson and Empie, who were untiring in their efforts to obtain the best results possible.

A total of 46,135 ft. of pavement was laid in the 48 working days while I was on the job. Construction started on the 27th of June, 1928, and I left on September 1st, rain being the cause of so much lost time. This gave an average of 961 ft. a day, with over 1300 ft. on 10 days, and over 1500 ft. on two days. The longest run was 1527 ft., laid in 12¼ hours actual running time. Another day, 1525 ft. was laid in 12 hours, an average of 127.1 ft. an hour. Data for this day is given in sketch No. 6, which represents a typical page in the mixer inspector's paving notebook.

The joints mentioned in this sketch, or copy, are those described in sketch No. 5, which were specified by the Peoria office in a special order late in July. They were to be included about every 1000 ft., especially at the tops of hills, and the bottoms of depressions. They lost about a half hour of working time, however, on account of the difficulty of shaping the subgrade quickly behind the mixer.

The cross-sections shown on the right hand page of the inspector's note-book, were those which he took from pegs driven alongside the forms about every 250 ft., to determine the thickness of the pavement and thus check up on the scratcher. He first measured from a string down to the subgrade immediately before the concrete was dumped, and then the next day measured down to the surface of the pavement. The Resident Engineer occasionally took "yield tests" by taking sets of readings in the same manner with his transit, only reading every foot across the roadway, and every five ft. longitudinally for 50 ft.; taking down at the same time, the number of batches of concrete which were used, so as to determine the cement factor, and no. of bbls. of cement used per 100 ft. of pavement.

Altogether, I think that this nine mile stretch of concrete pavement will prove to be one of the most acceptable in this district, both from the standpoint of its excellent riding qualities, and because of its durability.

Television Takes to the Air

(Continued from Page 62)

size, but must be a duplicate in all other respects. It is mounted on a synchronous motor of the same speed as that at the transmitter or supplied with some other means for maintaining synchronous speed. Behind a portion of the disc where the pin holes are located is mounted a glow-lamp, usually a neon lamp which has the property of being able to fluctuate in intensity very rapidly when subjected to a varying potential. The glow-lamp

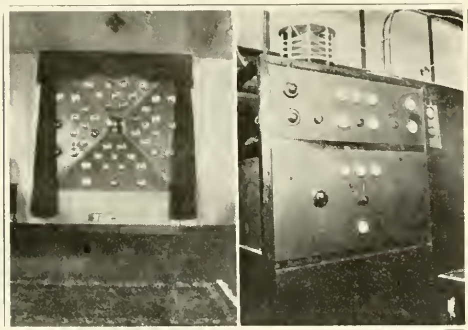


Fig. 5 and 6—Photo cell box and transmitter W9XAO

shines through the pin holes in the disc, and when the disc is revolving, a field of light is formed. In the so-called "peep hole" receiver the person viewing the received picture looks into a small aperture shown in figure 7 on the right hand unit. However, the projection of the image on the screen is far more desirable, and rather easily accomplished by using a glow-lamp with a point source and a condensing lens in back of the disc and a focusing lens in front of the disc. In this way an image twelve by fourteen inches is easily obtained, enabling a dozen or more people to view the image. The receiver in figure 8 is one of this type.

Briefly the image transmission is summarized as follows:

The arc light sends a beam of light through the revolving disc, and at any given instant a certain amount of light is reflected from the subject being transmitted into the photo-cells. The photo-sensitive surface emits a number of electrons proportional to the light intensity, and this gives rise to a current, the strength of which is also proportional to the reflected light intensity. This current intensity is amplified and finally impressed upon the grid of the modulator tubes which in turn modulate the oscilator output in proportion to the amount of reflected light. Therefore, the oscillator puts out a radio signal, the strength of which is proportional to the light reflected from the particular portion of the subject upon which the light beam falls at a given instant. As the beam travels across the subject due to the revolving of the disc, varying amounts of light are reflected and consequently the output of the transmitter varies in amplitude with the intensity of the reflected light.

The receiver picks up the radio signal, rectifies and amplifies it, the fluctuation or instantaneous intensities still being in proportion to the reflected light. The receiver output varies the intensity of the neon glow-lamp in proportion to this reflected light. By revolving the receiving disc at synchronous speed with that at the transmitter and at the same time maintaining both discs at the same position relative to the framing devices, the reflected light intensities at the transmitter are reproduced at the corresponding disc positions at the receiver. With the discs rotating at a speed of 900 r.p.m. the entire field of light caused by the discs will be scanned 900 times per minute or fifteen times per second producing fifteen complete pictures per second. Due to the retentivity of the human eye, the image will appear continuously as in motion picture projection.

Thus the actual television set-up consists of special radio equipment with a few additional pieces of apparatus which are comparatively simple in construction, although somewhat more complicated in theory.

Picture transmission up to this time has been limited to studio work, including close up views of artists and speakers, and larger views of orchestras, boxing matches, piano solos, etc. There is naturally a sacrifice of some definition for the larger images, and at present experiments with scanning methods are being conducted to improve upon this condition.

Considerable work has been done with the single cell pickup which consists of a large photo-cell with one stage of shield-grid amplification contained in a box and arranged so as to be portable. This may be moved to any desired position in the studio, and several are often used simultaneously for particular effects desired.

A few words may be said regarding the development of the three important essentials of television, the photo-electric cell, the glow-lamp, and the scanning disc.

Since the invention of the photo-electric cell by Professor Kunz of the Physics Department several years ago, vast improvements have been made. Much of this

Fig. 8—Special receiver for screen projection

has taken place at the University of Illinois. Prof. Kunz and Prof. Knipp of the Physics Department, Prof. Tykociner of the Department of Electrical Engineering, and L. P. Garner, a research assistant for several years in both Physics and Electrical Engineering Departments and now engineer for the Western Television Corporation, have been to a large extent responsible for these developments. Mr. Garner has constructed what are believed to be the largest photo-electric cells ever made.

These were used at the 1928 Electrical Show. Since leaving Illinois, Mr. Garner has devoted further time to cell development and has also developed a point source neon glow-lamp for projecting purposes.

The disc development has been accomplished by U. A. Canabria, inventor and veteran television experimen-

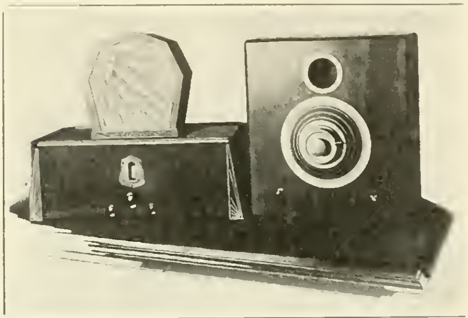


Fig. 7—Commercial receiver adapted for television

ter, who has been working for several years improving scanning methods. Recently he has developed a triple-spiral lens scanner for use in projection upon large screens.

The new *Daily News* installation is being designed in part by W. N. Parker '28, who was the instigator of the television demonstration of the 1928 Electrical Show which met with considerable enthusiasm among students and residents of Champaign and Urbana.

* * * *

From all indications television is approaching a concrete and practical form which will gradually succumb to developments until the dreams of some of the early experimenters and enthusiasts are at least, partially realized. With the installation of the first permanent television broadcast station, television receivers and equipment will be placed on the market, and it is to be hoped that the public will receive this new development sympathetically and with some consideration of the difficult problems which have been encountered in its development. Television development will need the service of the amateur just as radio has needed him; may he come to its aid as willingly as he responded to the romance of radio.

Machine Design

(Continued from Page 64)

viously performed on the piece are often nullified because of distortion.

Welding, which has had important applications recently in structural design and numerous other fields, does not yet seem to have any application of note in the design of machine tool frames.

The two industrial expositions mentioned in the foregoing discussion, one bringing attention to the new group of alloys made available by modern engineering research, the other illustrating many outstanding developments in the design of machine tools, were remarkable demonstrations of progress in machine design which has been made in answer to the demands of industry for high-production equipment.

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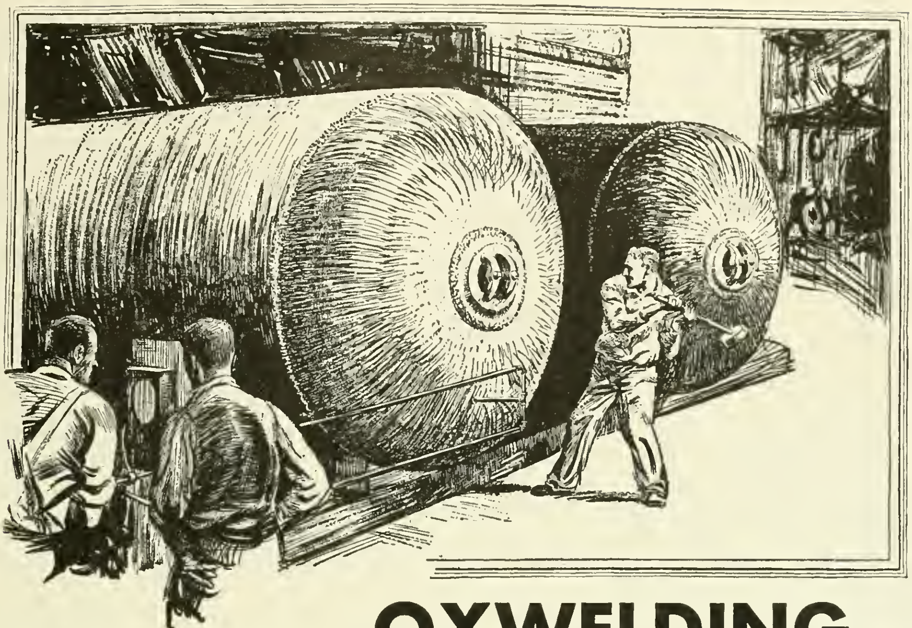


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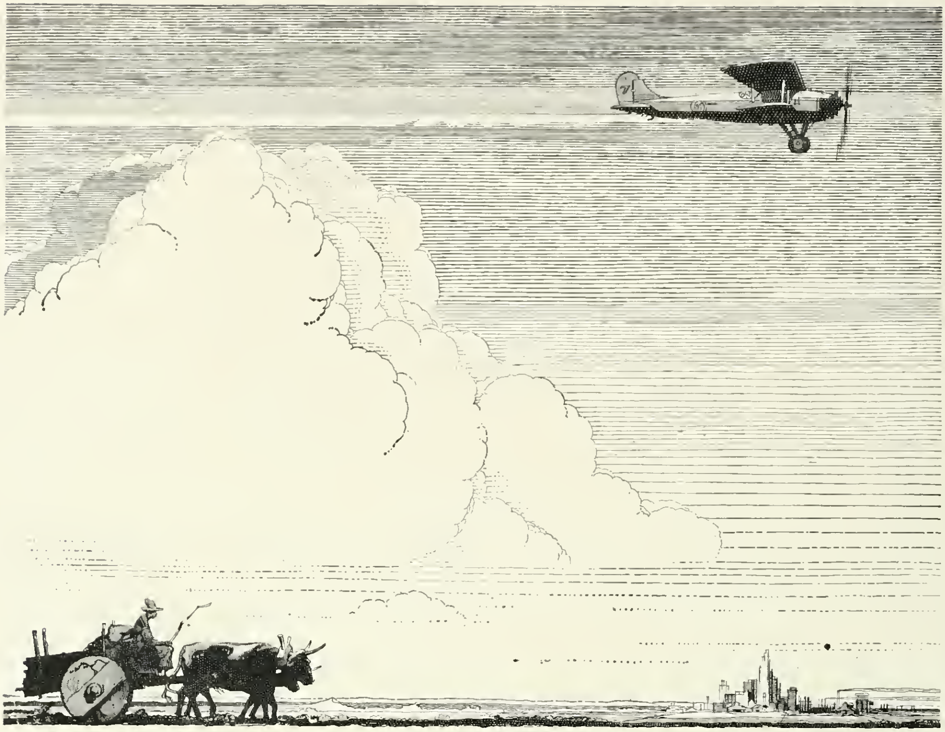

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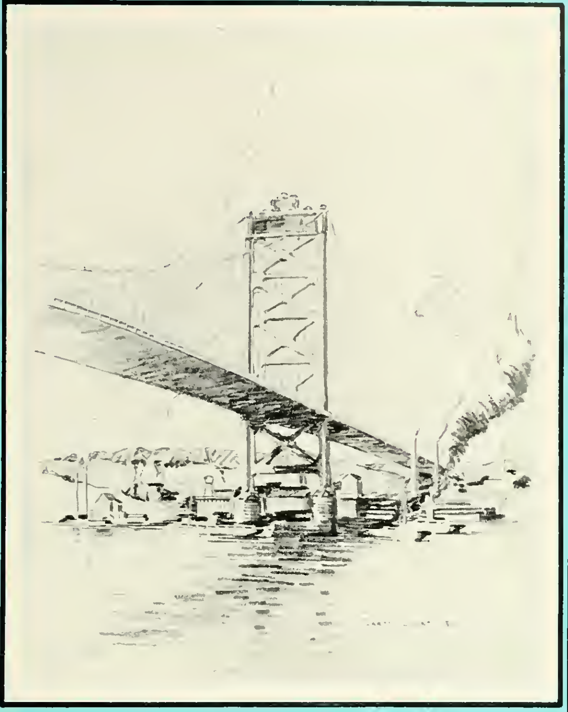

the

TECHNOGRAPH

for march 1930

ember of the engineering college magazines associated

The TECHNOGRAPH

UNIVERSITY OF ILLINOIS

Member of the Engineering College Magazines Associated

VOLUME XLIV | MARCH, 1930 | NUMBER 3

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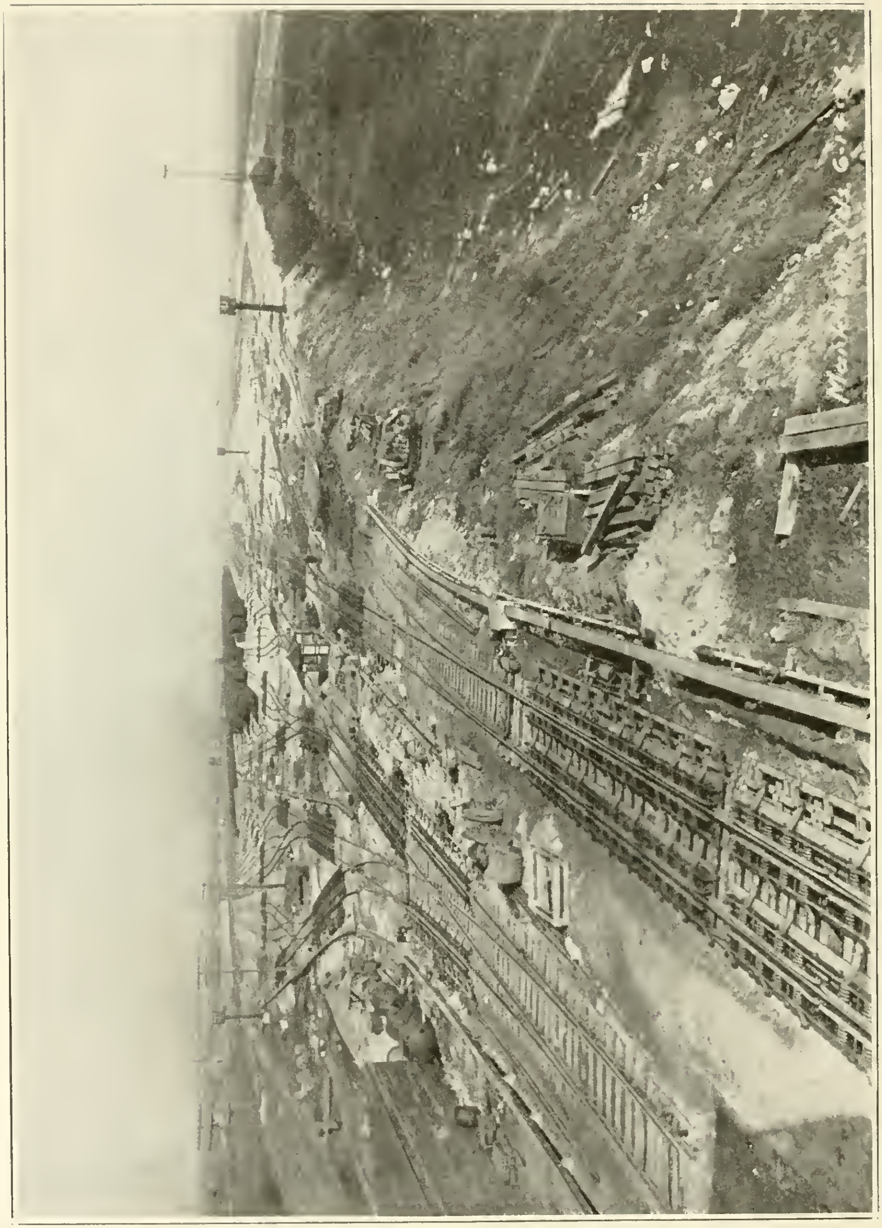

Markham Yard

THE TECHNOGRAPH

Published Quarterly by the Students of the College of Engineering—University of Illinois

Volume XLIV Urbana, March, 1930 Number 3

Markham Yard

P. Joseph Brumley, c.e. '31

THE development of Markham yard has involved many years planning. The yard was built in accordance with the fact that the handling of business in a terminal as large as that of the Illinois Central at Chicago requires not only excellent supervision but also a yard large enough and with supplementary yards convenient enough to avoid congestion or delay.

Up to 1907 no indication of congestion in yard facilities on the terminal had arisen. The yards existing at Burnside, Lower Wildwood, Fordham, and South Water Street would soon reach their limits, however, due to lack of room for expansion.

In August 1907, tentative plans were developed for a yard to be constructed at the present site of Markham yard, but after a thorough analysis of the cost, the matter was laid aside temporarily.

The volume of business, however, increased very rapidly, the climax being reached during the early part of the World War. This made a new yard necessary and authority and appropriation was made for what is now Markham yard.

Electric Car Retarder

An appointed committee studied the general layout of similar yards, volume and class of business handled, requirements in the way of receiving, classification, and departure yards, the mechanical facilities and transfer facilities as well as the facilities provided for repairing cars.

One of the most important features in a hump yard is, of course, the various grades on which the tracks, particularly the hump, are built. It required considerable calculation to develop suitable grades for weighing and classifying cars.

The very latest methods of handling cinders and coal

Switch Orator Tower

were investigated and a study made of the methods and machinery used in repairing locomotives.

The site selected, comprising about 400 acres lying east of the right-of-way and extending for three miles between Harvey and Homewood, offered almost all of the desired features. This land was practically vacant, with few streets, and with the exception of a few acres within village limits was purchased as acreage property. The tract was far enough south to offer a satisfactory terminal for the change from steam power from the south to electric into the city. The natural rise is 50 feet from one end to the other, thus reducing the grading requirements of the north-bound section of the yard. Since most south-bound trains from the yard have less tonnage than the entering north-bound trains, the

Box Car Over South-bound Hump

gradients of the south-bound unit could be increased over those of the north-bound. Another good feature is that it lies south of the interchange points with other railroads entering Chicago.

The total fill for grading amounted to approximately 4,000,000 cubic yards. The fill at the north end was increased by grade separation. The maximum height of fill was at the humps—a 27-foot bank in the north-bound and a 30-foot bank in the south-bound section. Sand was first taken from a borrow pit a mile east of the yard, but later was secured from the dunes near Miller, Indiana. Considerable material was obtained from industrial plants in and around Chicago as refuse. The maximum gradient in the north-bound section, aside from the hump is 0.35 per cent. caused by the elevated main tracks at Harvey. The maximum gradient in the south-bound section is 0.55 per cent. approaching the main tracks at Homewood.

Markham yard consists of receiving, classifying, and departure units for north and south-bound movements. In addition, a 60-stall engine terminal with supplemental machine shops has been constructed. Also half of a 1,000-car repair yard, the layout being so designed that it permits of the location of modern icing facilities, a less-than-carload transfer yard with a 700-foot transfer platform. The north-bound receiving unit consists of 20 tracks, 14 of which are in. These vary in capacity from 90 to 110 cars. The ultimate capacity will be 1,660 cars. These tracks are divided into groups of ten spaced 13.5 feet center to center with a 19-foot space between groups. Immediately adjoining this yard on the west is a grid of five tracks called the re-humper yard, for cars which have come from the south-bound classification unit, but which must be reclassified in the north-bound yard for northern connections. Each of the tracks in this yard has a capacity of 40 cars.

From this yard and the north-bound receiving yard cars are sent over the hump into the north-bound classification yard where there are 60 main classification tracks, each holding from 20 to 40 cars. Twenty of these tracks are assigned for cars for connecting lines; thirteen tracks for the various industrial districts located on the Illinois Central in the Chicago terminal district; six tracks for commercial coal; five tracks for company coal and other company material; one track for bad-order loads for transfer and adjustment; and one track for through cars west on the Illinois Central. The remaining 15 tracks are being used for classifying cars for the downtown terminals.

In addition, there is a grid of thirteen short tracks for reclassifying commercial coal, two grain inspection tracks, two light repair tracks, and a lead into the car repair "hold" yard. The main classification tracks are divided into groups of ten, with a ladder for each group at the hump end and a separate ladder for each five tracks at the lower end. This layout was made necessary because of property limitations which necessitated also the use of ten-degree curves in connecting up the ladder tracks with the lead. The total capacity of the north-bound classification yard is 2,572 cars.

The north-bound departure yard, lying immediately north of the classification yard, consists at present of ten 80-car tracks, one-half of the total planned trackage. Caboose tracks have been located so that cabooses dropped from south-bound trains can be readily picked up and connected to those moving northward. A complete air-testing plant has been installed to test and charge train air-lines before trains are forwarded.

The south-bound units of Markham yard are similar to those of the north-bound, the difference being the number and length of tracks provided. The receiving yard at present consists of twelve tracks with space for 1,023 cars with an ultimate capacity of 1,694 cars on 20 tracks. There are 42 classifications in the classification yard to 60 in the north-bound classification yard. These tracks have capacities ranging from 20 to 60 cars and a total capacity of 1,623 cars. The south-bound departure yard consists of 10 tracks, each with a capacity of 110 to 120 cars, although plans for the ultimate con-

North Yard Office

struction of additional tracks will make the capacity 1,718 cars.

Thoroughfare tracks have been provided throughout the yard for the movement of locomotives to and from the terminal where the round house is located, known as the engine terminal.

At the time this yard was decided upon the most

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Popocatepetl as seen from our camp at Tlamacas

Ixtaccihuatl viewed from the slopes of Popo

The Trail Up Popocatepetl

Don Johnstone, c.e. '31

THE adventure I longed most to have in Mexico was that of climbing Popocatepetl volcano, and when they told me it was doubly difficult in August on account of the snow, I was more anxious than ever for the trip. With Calvo, a Mexican friend, I set out one Friday evening from Mexico City for Amecameca, which is the starting point for trips to the volcanoes. We spent the night there and on Saturday morning were ready for the climb.

Calvo and I had made arrangements previously for guides, and about 7 o'clock they met us with horses and a mule for our equipment. We made the round of the market, buying chocolate, sugar, lemons, and other food, and within an hour were on our way.

The trail led sharply upward almost from the start. Part of the time it was only the bed of a narrow, deep gully; at other times it was a ribbon hanging on the edge of the mountains. In some places we were forced to dismount and lead our horses, so steep did it become. Within two hours we had passed above the vegetation of the temperate zone, and were surrounded with pines and evergreens.

The morning had been cloudless, but as happens every day during the summer, clouds soon began to gather, and from time to time they enveloped us, leaving the trees dripping and chilling us to the bone. The sun, however, was so warm that we were forced to alternately bundle up and take off our coats the rest of the trip.

We had lunch after about four hours, by the side of a snow-fed stream, filled our canteens, and by 2 o'clock had reached Tlamacas. While the guides made camp, Calvo and I went out hunting. We followed the edge of a ravine for an hour or more, hoping to find deer, but we had no success, although we knew they were plentiful. There are mountain cats at Tlamacas, too, but it requires a day or more to hunt them.

A couple of shots, fired for luck, brought shouts. A few moments later we came upon Bealer, an American friend of mine, who had followed us out and was going to make the climb with us. It was fortunate he arrived, for without him I would never have been able to reach the top.

The tent was up and a good fire going when we got back. We told the guides we had killed some rabbits, and tried to get them to go down the ravine for them, but they had met Americans before. So they stayed in camp.

We were advised to eat heavily that day, so that we would be prepared to go without food during the final climb. We had brought along a chicken, which we roasted over the fire, and proceeded to follow the advice by making way with it, a half dozen loaves of pulque-leavened bread, and a quantity of eggs and fruit.

After dinner it started to rain. The guides, with wonderful foresight, had built the fire just in the proper position for the smoke to fill the tent, so inside it was quite pleasant. Pretty soon they followed us in, bringing an earthen jar full of a tea they had made by steeping the leaves of a bush growing nearby in water. They had it highly flavored with sugar and a little whiskey, and it tasted not unlike catnip.

There were six of us to sleep in the tent. We spread the raincoats down, covered them with blankets, and disposed ourselves as best we could.

The four Mexicans snored beautifully. I stayed awake and listened. With the combination of lack of pillows, rain coming in, extreme cold, and the cramped position in which we were forced to lie, sleep was almost out of the question.

About 3 we were up, hoping to get an early start, but it was after 5 when we were finally ready.

I was wearing hiking pants, wool socks and three khaki shirts. I put on a raincoat, and over this threw a wool blanket, fastening it around my neck. A half yard of flannel wrapped about each hand and tucked up my sleeve served in place of gloves. I wanted my fingers free for using a camera.

It was still dark, and for a half an hour we picked our way up a steep slope, stumbling over stumps and logs. Presently we came to a gully, cut through the lava by snow water from the volcano, and there we had to wait for daylight. We picked our way down its side slowly, digging our pikes into the ground to keep from slipping. There was another gully a little further on, and then for an hour we crossed a field of lava, curiously traced with water courses.

The sun was fully up by the time we reached the snow line. Above us, the remaining mile of Popo's white height glistened; to the north its twin volcano, Ixtaccihuatl, stood wrapped in clouds; 100 miles south we could see the snow cap of Orizaba, and to the west Popo fell away to the clouds below, that seemed like the sea at the edge of the world.

The rarity of the air already was beginning to affect us. We made frequent halts to regain our breath. There was another peculiar effect; although none of us had eaten breakfast we felt no hunger after two hours strenuous walking, and a few limes and prunes served us for the rest of the day. During one halt we put on our spikes, and soon the climb through the snow began.

Thawing snow forms many streams like this in the lava each afternoon

Popo's summit is 18,000 feet above sea level. The last two-thirds mile of its height is snow covered, with the exception of about 100 yards near the crater, where the warmth is too great. During this snow covered stretch, the slope is between 35 and 45 degrees—that is, a rise of almost a foot for every horizontal foot.

It was impossible to go more than thirty or forty steps without a rest. And each succeeding time the rest came after a shorter interval. Bealer was the first to give out. He went down in the snow before we had reached the half way mark, and we feared for a while he would be unable to continue. However, he seemed to gain second wind, and for the next half hour led the party.

I was next to give out. I had never felt such fatigue before. My heart was going like a triphammer, and when I would sit down to rest I found myself wanting to go to sleep. My legs seemed scarcely a part of my body, so difficult was it to make them move. Bealer was tired again, too, and we sent Calvo ahead with one of the guides. He was accustomed to high altitudes and did not

Interior court of ancient Maya ruins in southern Mexico Approximate date 500 A. D.

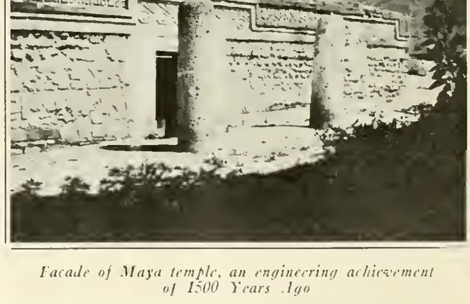
suffer so much fatigue, and it seemed a pity for us to hold him back.

We had given up hope of reaching the top. There remained a two hours' climb, and occasion gusts of sulphur fumes warned us of what we would have to combat as we neared the crater. Our plan was to rest considerably, and then go ahead as far as we could before returning.

It was here that the food we carried came into play. Each of us squeezed the juice of a lime on a large lump of sugar and sucked it slowly. We had tried to eat chocolate, but it made us sick, and the lime seemed to have no such effect. The rest and food combined soon enabled us to start on again, and we went for an hour—five, six steps, then rest.

Calvo and his guide had long been out of sight, but now we heard them shout, and soon could see them through the smoke at the top. They had reached the crater and were returning. We met in a few moments (the down trip is very rapid), and the fact that they had made it cheered us on. An hour remained for us—the hardest of the journey.

It was 12 o'clock when we finally flung ourselves



Facade of Maya temple, an engineering achievement of 1500 Years Ago

forward on the hot, damp lava and worked our way cautiously to the edge of the crater. We were wrapped in clouds, and in front of us thick smoke rose from un-

(Continued on Page 144)

Persian Star-shaped Tiles (13th and 14th Centuries)

Persian Tilework of the Saracenic Period

Otis Winn, arch. '29
Winner Ricker Prize Competition

WHEN one thinks of beautiful tile work, that mysterious and interesting country of Persia is brought to mind, and when one thinks of Persia, the thought is usually colored by the beauty and brilliance of this tilework. The two are inseparable. It is Persia's big bid for fame and it is enough.

Long before the Persians existed, highly developed ceramic industries were being carried on in other parts of the world, especially in Egypt along the Nile and in the Tigris-Euphrates Basin. It was the Persians, however, who having borrowed the art from their neighbors, Assyrians and Babylonians, developed it and preserved it when the older nations fell into decay. It was the ancient Persians, however, who passed the secrets down to the Saracens when that horde of religious swordsmen swept the country and spread over the greater part of the known world. Among other things which the Saracens spread by their great influence was the love for and art of producing ceramic products.

Persian history divides itself naturally into three separate and distinct periods; the Achaemenian, the Sassanid and the Saracenic.

As the successful armies of the Persian kings conquered new lands, added wealth poured into the country, and as a natural consequence living passed into a more luxurious state. The arts were encouraged, and many fine buildings were erected. These buildings, to a great extent, were the marvelous palaces of the monarchs. In a manner similar to the Assyrian palaces, the Persian palaces of this period were built upon great platforms and approached by grand flights of steps.

"The elements of which the palace group was composed, consisted of the propylaeum, or formal entrance gate; the regal apartments (dwelling place of the king and his minister); the open hypostyle audience hall; the harem and the fire-altar." Great palaces of this type were built at Persepolis and at Susa by Darius and Xerxes. The ruins at these cities and especially the wonderful tile fragments known as the Lions Frieze and the Archers Frieze, excavated by Dieulafoy and now in the Louvre, Paris, testify to the quality of work that was being done by these Persians. Since the Persians were so closely associated with the Assyrians and Babylonians, it is not surprising that these fragments should bear strong resemblance to their ceramics products. The figures are in low relief and are rythmatically spotted upon the enameled brick facing of the wall. The color scheme is, in general, the same as the Assyrians employed.

Persian Tiles (13th and 14th Centuries)

In the case of the Lions Frieze, the colors used upon the figures are tan or buff for the dominant note, set with more brilliant spots of yellow, red, blue, brown, and green, indicating the muscles and maine.

In the Archers Frieze, the garments of some of the figures are white relieved with blue or yellow spots, others are blue-gray with white rosettes, still others are yellow with blue rosettes. The skin is brown and the shoes are yellow. The dominating color, however, is blue-green, which is the color of the enameled brick ground.

Both of these examples indicate a highly developed state of civilization. These are truly marvelous examples of Ceramic work, and the industry which created them must have produced many others of a high degree of excellence.

After the fall of the old empire at the hands of the Macedonians, the Ceramic industry along with the other industries of the country suffered a great decline. It is true that some clay work was done, but it was of a cruder

Persian Relief Lustre Tile

sort. Their wealth was gone and with it went the products of the arts. Crude brick work and ordinary pottery remained, but the industry that produced the marvelous tiles was lost and was not regained through all the years in which Persia was being ruled by foreigners until the coming of the Saracens.

From 333 B. C. to 644 A. D. is a long time, and the country of the Persians was under many different rules during it. The Alexandrian, Parthian and Sassanian periods followed in order. Each had its measure of success and prosperity or lack of it, but none compared with the glory of old Persia. The Sassanians were, in a way, more productive than the others in that they did build a great deal. But their work was of a very inferior nature as compared with the wonderful colored and enameled brick work of the Achaemenian period. They employed the principles of the arcuated forms and relied more upon the excellence of their mortar than upon their masonry skill to hold their great walls, arches and domes in place.

This is in brief, a story of Persian ceramics before the coming of the Saracens in 644 A. D. By it I wish to indicate that the industry of ceramics is native to Persia, and that the marvelous cermaic products of the Saracens were developed naturally here and not imposed upon the country by a foreign race. The wonderful clay deposits, abundant wood for heating and fuseing, and the brilliant sun under which they dried many of their bricks are all native to Persia. From the time of their creation under Cyrus, the Persians have always used clay in a greater or lesser degree in some way or another. It has always been in the life and blood of the country, and while the Saracens did develop the art far beyond that of any of the nations before them or since, it was the Persians who first taught them the fundamental principles.

The Saracens were most responsive students. It is the general impression that they were a wild and barbarous race and did not contribute anything of value to civilization except possibly their ceramic products. Such is not the case, however.

Besides this contribution in Ceramics, the Arabians made great strides in mathematics, astronomy and chemistry. "In mathematics, the Arabs building upon Greek foundations, became famous; the Arabic numerals, the use of decimal notation and algebra are prominent among their contributions. Although they did not add much to Euclid, they further developed spherical trigonometry inventing the sine, tangent and cotangent. In physics, they invented the pendulum and studied its laws and did distinguished work in optics; they advanced astronomy and made substantial progress in the development of astronomical instruments. In medicine they made great advances over the work of the Greeks; studied physiology and hygiene; understood the use of anaesthetics and developed a "materia medica" very similar to our own. While western Europe was still resorting to magic and trusting in miracles, the Saracens had a real science of medicine."

"Like-wise in chemistry, which of course, came out of alchemy, they made a wonderful start, discovering many new substances, like alcohol, potash, nitrate of silver, nitric and sulphuric acid. In manufacturers they excelled the world of their day working in gold, silver, copper, bronze, iron, and steel. Damascus and Toledo (Spain) are to this day famous for their fine blades; Cordova for her fine leathers. Their textiles have not been excelled. They made a good grade of paper by means of which the book-copying industries of Alexandria, Damascus, Cairo, and Bagdad made possible the dissemination of knowledge before the invention of printing. They knew the secrets of dyeing and how to make sugar from cane. Farming they practiced in a scientific way, developing good systems of irrigation and the use of fertilizers. They understood the principles of grafting and plant-breeding; produced new varieties of fruits and flowers and wrote scientific treatsies in Agriculture."

It is true that their sword was a mighty aid in the spreading of their religion but wherever they settled, prosperity followed. They were nothing if not religious, and their architecture is as perfect a mirror of the Mohammedan religion as the French-Gothic is of the Catholic religion.

The fatalistic element in their religion permiated their philosophy of life and caused them to live and build for the present without fear or anticipation for any

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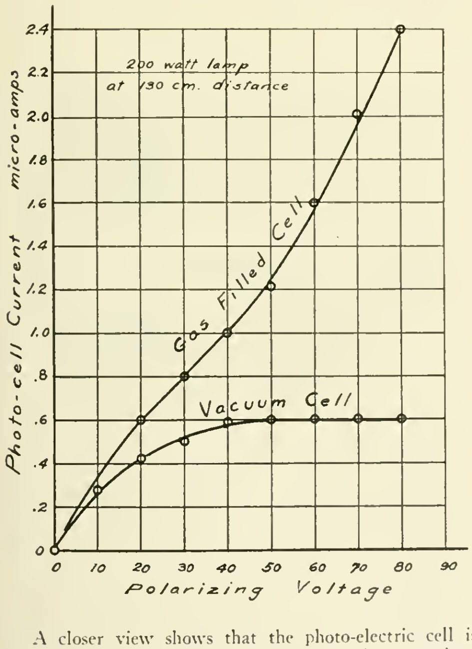
The Talking Beam

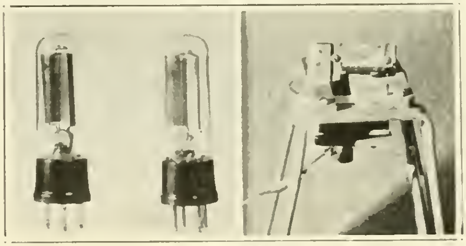
H. A. Wenzell, c.e. '30

HAVE you ever heard the light from a match, or the ripple in a direct current generator, or a beam of light? An apparatus capable of converting variations of light intensity into sound was developed and demonstrated several years ago by Mr. Taylor of the General Electric Company. The author, in conjunction with S. Weissman and D. H. Smith, has constructed a similar apparatus in the electrical research course, E. E. 71. This device may be seen in the third illustration. When in use, the beam of light from the transmitter is directed through the section of pipe seen on the right end, the pipe acting as a screen for stray light. The secret of reproduction is the light sensitive photo-electric cell, which is located in the upper right hand corner of the copper shield, just at the end of the pipe. A rectangular opening in the shield, to the right of the cell, allows the light beam to fall upon it.



A closer view shows that the photo-electric cell is made by mounting two special electrodes in a standard UX 199 type bulb. The darker of the two cells, on the left in the illustration, is the gas-filled type which produces a larger current than the other, or vacuum type. Their internal construction is the same; a half cylinder coated with a light sensitive substance being the cathode, and a straight bare wire, the anode. The standard base faciliates mounting and makes replacement simple.

Refering now to the current-voltage curves for the photo-electric cells, the difference between them is at once apparent. The current of the gas-filled cell increases more rapidly than that of the vacuum type, and continues to increase with the polarizing voltage, while the latter reaches its saturation point at about fifty volts; a further increase of applied voltage is therefore unnecessary with the vacuum cell. On the other hand, if the gas-filled cell is operated at excessively high voltages, to gain increased sensitivity, there is danger of a glow discharge



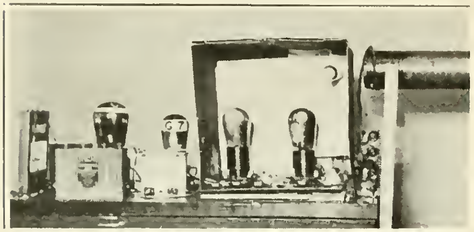
Left—Photo-electric cell
Right—Modulating unit of transmitter

which is injurious to the life and efficiency of the cell. Such a disturbance cannot occur with the vacuum cell since there is no gas to become ionized. It is readily seen that the first mentioned cell can produce about three times as much current as the latter, and consequently, is three times as sensitive. This conclusion was substantiated by actual test, the gas-filled cell giving much better results. These curves were taken with the polarizing battery directly across the cell, that is, actual difference of potential between anode and cathode. Hence slightly higher voltages may be used when there is resistance in the circuit.

The second set of curves is probably more important than the first, because, as used, it is the light intensity which varies, and not the polarizing potential. These curves of current-light intensity for various voltages were taken with a two hundred watt, clear Mazda bulb, by varying its distance to the cell. The abscissa, then, is $1/D^2$, where D is the distance between cell and lamp. It will be noticed that all the curves are straight lines, which means that the photo-electric current is proportional to light, for any intensity. Were it not for this relationship, distortion would result when energized by a modulated light beam. Fortunately again, another distortion factor is eliminated by the zero time lag of the photo-electric current; in other words, current flows as soon as light strikes the cell, and changes the instant the light intensity changes. It was found that all points on the cathode were equally sensitive, and that the current remained the same when the light was brought to a point rather than distributed over the entire surface of the cathode; proving that a photo-electric current is dependent only upon quantity of light.

All of the light intensity curves were plotted to the same co-ordinates, the better to compare the characteristics of the cells. The first fact noted is that the gas-filled cell is more sensitive at twenty-five volts than is the vacuum cell at sixty-two and one-half volts. Also, a change of the polarizing voltage has a much greater effect on the former. Thus the vacuum cell would be chosen if consistant results were necessary from a fluctuating polarizing supply, but if greater current is required and a dry B battery is available, the gas-filled cell operating at high voltage would be chosen. If there is only a small quantity of light on the gas-filled cell, its current may be kept up to an appreciable amount by using higher voltage; the vacuum type has no such advantage.

Photo-electric cells have been made, with a barium coated cathode, which give a current of three hundred micro-amperes in direct sunlight, as compared to the ten



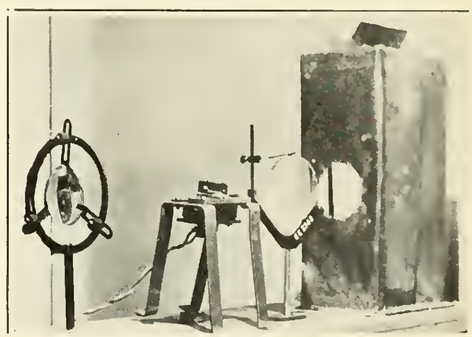
Receiving photo-electric cell and amplifiers

micro-amperes which the cells described above produce. These heavy current cells are able to operate relays without the use of an amplifier, but the life of such cells is relatively short.

Since the photo-electric current, under actual operating conditions, is of the order of one-half of one micro-ampere, and its audio frequency component is still less, it may be seen that the amplification of such minute currents was something of a problem. Foreign effects, such as surface leakage and stray magnetic fields, had to be reduced to a minimum. That is the reason for the shield on the first two stages of resistance-coupled amplification and the grounding of one point in the circuit (see circuit diagram). The photo-electric cell itself had to be placed within the shield, without which the electro-static pickup from the amplifer used on the transmitting end was sufficient to operate the loud speaker, without any light whatever. Resistance coupling was found to be the best method of amplifying the weak cell currents, two stages being required to bring it up to telephone audibility. The B power for the two stages of transformer-coupled amplification was drawn from a power pack, but B batteries were necessary for the first two stages and the polarization of the photo-electric cell. This amplifier was extremely microphonic until the first two tubes were supported on felt, in spring sockets, and capped with anti-howlers (not shown). Even then the speaker could not be placed near the cabinet.

The so-called transmitting end of this experiment, which produces the talking beam, is shown below. It is simply a powerful lamp, enclosed, whose light is focused on the modulating unit, and re-directed by the second lens, in a parallel beam. The center of attention at this end is the light valve of modulating unit, which is pictured in a larger illustration. A fixed knife edge is mounted on the frame of a cone speaker unit in such a manner as to leave a narrow slit between its lower edge and another knife edge soldered to the cone armature. Thus the moving edge (showing black in the photograph) interrupts the light thrown through the slit in direct proportion to the audio frequency currents which actuate the unit. Hence the light leaving the slit is modulated, and when focused on the receiving end, will cause the afore-mentioned photo-electric cell to operate. A phonograph pickup and amplifier was used to energize the light valve, but the output from a good radio set would work as well.

The moving part of the valve was made as light as possible, since one having a great mass would not respond to high frequency pulsations, such as notes on the upper register on a violin. It was necessary, further, to damp the armature, there being no cone or diaphragm, in order to reduce distortion caused by mechanical resonance in the vibration system. Fortunately, the motion necessary to modulate the light is very small indeed, being just sufficient to be felt by the finger when in operation. The percentage of modulation was immaterial, because the image of the moving edge itself was focused on the cell.



Apparatus for sending light beams

The only source of light that could be used was a direct current incandescent lamp. An arc light was discarded because of the sputter, and alternation current could not be used because the fluctuation of light in-

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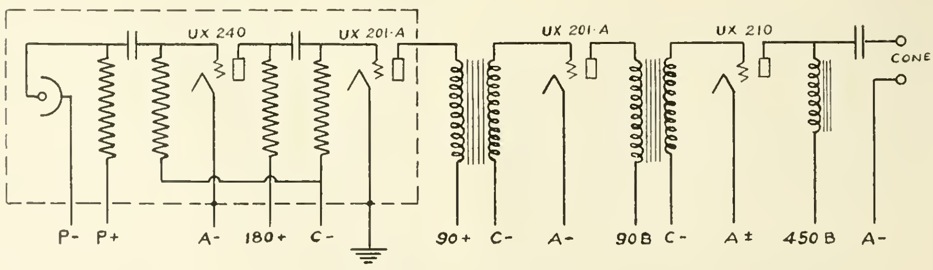


Circuit diagram of receiver

Loading a car with a machine loader

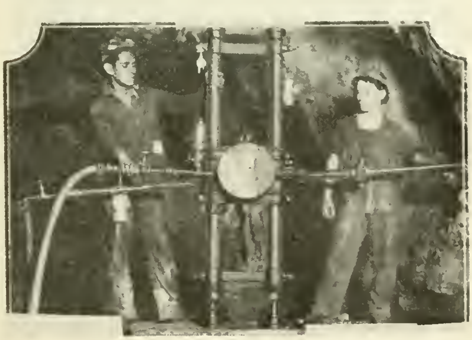
Inspection of a cutter bar on a drilling machine

The Problem of Mine Illumination

Gilbert H. Fett, e.e. '31

THE proper illumination of underground mines constitutes a problem which must be solved by modern engineers. The question is too often neglected by the mine operator or owner. The miner himself is so accustomed to poor lighting that he does not complain. In the past there have been published reports by national miners' commissions, which showed that miners' nystagmus, a disease of the eye produced by eyestrain due to inadequate light while at work, was increasing; and following each report some agitation was created to help the situation, but nothing was done. Combined with poor lighting is the danger to which the miner is subjected, that of ignition of gases in the mine by the flame of certain types of miners' lamps.

It might be interesting to trace the history of mine illumination, just to see what progress has been made.



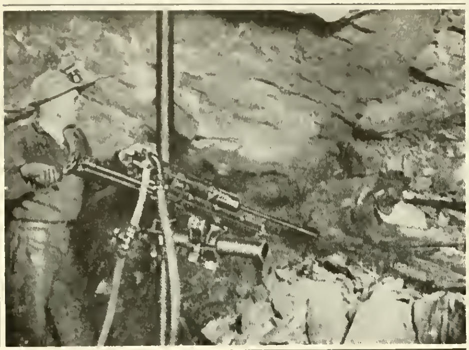
Drilling Operation In Copper Mine

When the Romans came to England, some two thousand years ago, they found mines there. The light for the workmen in the caves, for they were little more than caves, probably was furnished by a candle which the miner carried with him, and placed on a stand or on the ground by his work. The light from the candle must have been very little indeed, when one considers that there is no reflection of light on the black walls of the mine, and one tiny candle furnishes the illumination for an area of perhaps a ten foot square, in which the miner worked.

Some time later, at the beginning of the industrial revolution, came the day of the open flame oil lamp. In its early design it was simply a pot of oil with a wick fastened so that one end projected into the oil and the other end extended an inch or two above the surface. This produced a large, smoky, yellow flame, not much of an improvement over the old candle. However, this lamp was soon revised, and two types were developed. The first was the Davy safety lamp, with which all are familiar. Humphrey Davy was not the first to build a flame enclosed lamp, to prevent the ignition of gases in the mine, nor is the Davy lamp the lamp used today, but his lamp was the first to receive recognition from the miners. Heretofore the miner had been the victim of numerous explosions of gases in the mine, and of many fires. This lamp, with the flame enclosed with the screen, gave the miner a better chance to fulfill the normal expectancy of life, but the light from the lamp was much less than that of the other lamp, because of the screen which shut off a great deal of the light.

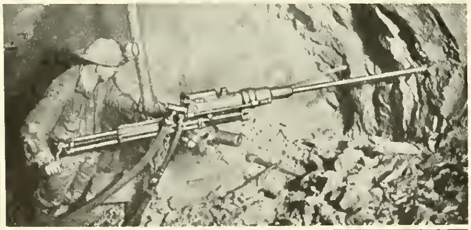
The second type of improved oil lamp was the cap lamp, which was so ably exploited by the oil interests in the period after 1880. It consisted of a little can of oil, a spout through which a wick came, and a hook arrangement, so that the miner could clip the lamp onto his cap. This was a distinct innovation, in as much as the previous lamps were on the floor in back of the miner, to cast a shadow, or in front of him and in his way. With this lamp, where ever the miner looked he had a light; not much light, only about .9 candlepower, but much more than before.

Along about the turn of the century, the acetylene cap lamp was developed. Most of the readers will be familiar with the old type bicycle lamp which burned acetylene gas, formed by water dripping on calcium carbide. The miner's lamp works on the same principle, the gas formed by the reaction being forced by its own pressure through a small hole, after which it combines with air and burns, if ignited. Usually the flame produced is a long, slender pencil of brilliant, white light, although other flame shapes are sometimes used. The acetylene lamp is equipped with a polished metal reflector of brass, placed behind the flame to intensify it. In tests made by the writer on lamps of this type, it was found that with a flame about one and one-half inches long, the



Drifting in a copper mine

lamp gave a light of six candlepower when viewed directly ahead, and a light of two candlepower when viewed at right angles to the axis of the flame. The introduction of this lamp practically eliminated the oil lamp from the mines in the United States where the manufacture of calcium carbide was comparatively cheap, and the state laws were lenient in the specification of safety lamps. In other countries, notably England and Germany, its use was limited by legislation against the dangerous open flame, and in these countries insistance upon the safety oil lamp was made. It is significant to note in comparing the results in mines, that there is a great deal more of miners' nystagmus in the mines which use the safety lamp, than in the mines which use the open flame lamp. This was the conclusion of an English professor, James Cooper, after an extended survey. But there are also fewer explosions in the mines using the safety lamps, as might be expected. Experiments were made by the writer in an attempt to make a safety acetylene lamp, by placing a safety screen around the flame. The variation in size of the flame of the acetylene lamp when moved about, from one to six inches, the heat produced by the burning of the gas, and the immense size of a screen to



Drifting in a copper mine

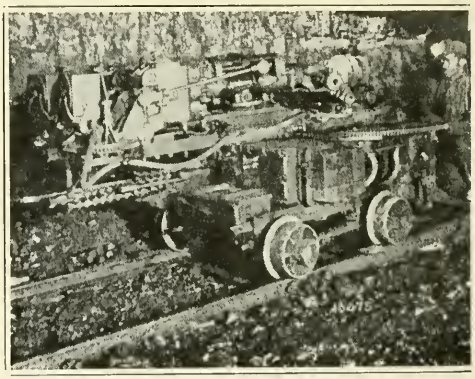
protect the flame, were drawbacks in making a lamp for the cap. In hand lamps the safety screen could be used, for these lamps are placed on a ledge or hung from a timber; but the light is very much reduced. A few lamps of this type have been constructed for use in mine rescue work, but their use is limited.

The next type of lamp developed was the electric cap lamp. After a number of years of research, Thomas Edison developed the alkaline type of storage battery; and this source of electric current was adapted to the use of the miner. This lamp had a head-piece consisting of a bulb and a reflector enclosed with a glass door, a wire running from the headlamp to the waist of the wearer, a belt with a battery which was worn on the hip and to which the wire was connected. The battery embodies the Edison features, in which the alkaline solution is used in place of the usual sulfuric acid of the ordinary battery.

The head lamp of the electric cap lamp has a small Mazda type B bulb, arranged for four volt service. The type C, gas filled bulb, cannot be used, because, if the bulb breaks, there is a chance for the ignition of gases by the incandescent wire before it burns up, while in the vacuum type B bulb, the moment of fracture of the bulb is also the moment at which the wire burns up. The light given by the lamp is about seven candlepower, and the light is thrown out through a plane angle of 130 degrees by means of a reflector.

The battery of the Edison lamp weighs in the neighborhood of five pounds; with the headlamp and cord it weighs approximately five and a half pounds. When the lead-acid storage battery of other makes of miners' lamps is used the total weight is about eight pounds.

At present, in Europe, there is being used an electric



Drilling machine

hand lamp. This lamp is similar to the old oil lamp, in that it is placed on the floor of the mine, or hung on a timber. The lamp is more powerful than the cap lamp, but the light is farther from the worker. In a series of tests conducted by the Commission on Mine Safety in Canada, the report indicated that the light furnished by the cap lamp was about ten times greater than that of the hand lamp at the place of work, although the light of the hand lamp was greater around the remainder of the area. The commission recommended the adoption of the electric cap lamp in the mines of Canada.

A comparatively recent development in mine illumination, and one that will be used more extensively in the future, when the present methods of mining are antiquated, is that method called "blanket," or centralized lighting. Some of the mine owners of the metal mines of the northwest, and of some of the coal mines of Illinois and Pennsylvania, are lighting their drifts, tunnels, and crosscuts with electric lights operated from the 110

(Continued on Page 134)

Railroad Signalling

Joe Tiffany, c.e. '31

THE development of signalling in the United States has been entirely different from that in England. What had been done in this country prior to 1874 need hardly be considered, while in England at this time the signal system had reached a high degree of perfection. It is because of this fact that the signal system in this country is to a large extent automatically controlled, while in England signals are still for the most part mechanically operated. Automatic signals were being developed at about this time, and American railway engineers, recognizing their advantages, adopted them immediately. The English railways, since they were already efficiently signalled, were much slower to adopt the automatic system, as the reinstallation was expensive. Today the larger part of the English roads still cling to the old manual signal system.

The first railroads were regarded as an alternative method of travel to coaches, and since everyone knew the schedule of the few trains in operation, signals were of course unnecessary. Verbal instructions were ample to secure safety while slow speeds were general, but with the increase of speed, and the development of passenger traffic, it became evident that something more definite would have to be employed. As a first attempt, hand

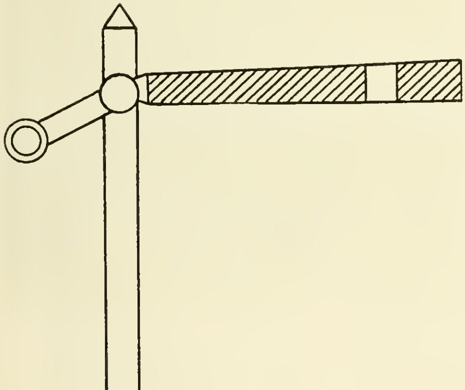


FIG. 1

Home Signal at "Stop"

signalmen were placed at important junctions to work the points and control the train running. The next advance was the use of a board, painted red, fixed to a post. When a train was required to stop, the broad side of the board faced the driver, but when there was no necessity for stopping, the board was turned so that the edge of it faced the driver. This proved to be objectionable as the indication for a clear line was the absence of the red board; hence should the board have been destroyed by accident a clear signal was given. This was followed by the adoption of a distinctive signal for "clear" as well as for "danger."

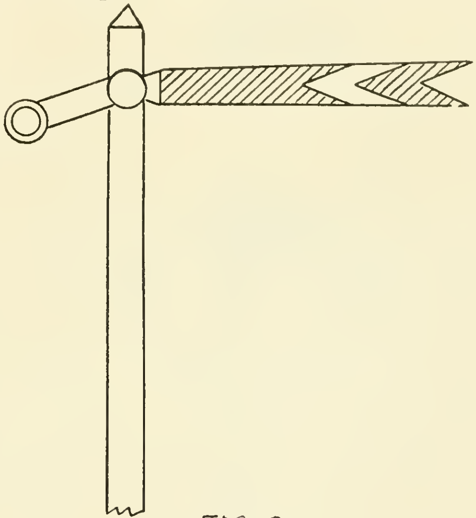


FIG. 2

Distant Signal at "Caution"

Before about 1840, in England, where almost all the signal development was taking place, the arrangement for forwarding one train after another on the same rails was to allow a certain interval of time to elapse before the second one was forwarded. This method was known as the time interval system. About 1840, when the electric telegraph was invented, it became possible to ascertain that a train had actually reached the station ahead before another train was allowed to follow. This arrangement was known as the space interval system.

One objection to adoption of the space interval system was the great distance between some of the stations, and as no train could follow until the preceding one had reached the station ahead, it was obvious that the carrying capacity of the line would be decreased unless the distances between stations were shortened. The line then had to be cut up into comparatively short sections, termed block sections, by means of small signal stations which were generally termed block boxes or block posts.

The usual equipment of a simple block box was a telegraph instrument for sending the requisite messages from one block box to the next, and out-door signals for each set of rails, one signal being fixed near the box, termed the home signal, which trains were not allowed to pass when at "danger," and a signal fixed further out, termed a distant signal, which the driver could pass at "danger" provided he so got his train under control that he could stop at any obstruction before or at the home signal.

Even under these arrangements accidents were not uncommon, and this turned the minds of inventors to the problem of making it mechanically impossible for the signalman to have conflicting signals pulled to the clear position at the same time. From about 1850 to 1875, several inventions were patented, interlocking the signal levers with each other and with the switch points in such a way that conflicting signals and points were impossible.

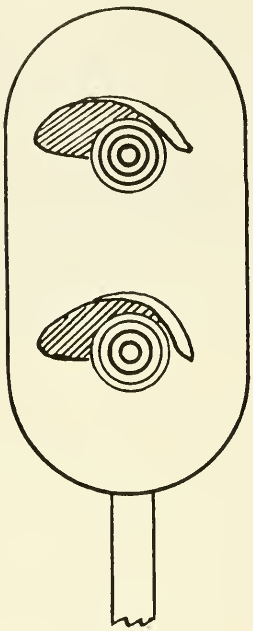


FIG. 3

Two-Position Color Light

The next step in the development was automatic signals, making each train protect itself by causing its passage over a section to raise the danger signals behind it. This step was preceded by the invention of the track circuit, on which the principle of automatic signalling is based, which makes it possible for a train to give continuous indication of its location on a track.

The remainder of this paper will be devoted to a somewhat more full description of these steps in signal perfection:

1. Types of signals.
2. The block system.
3. The track circuit.
4. Principles of interlocking.
5. Automatic signals.

1. Types of Signals

The types of signals used have gone through as long and slow a development as the methods of signalling. Tradition has it that the first signal was a candle in the window of the station master's office at Hartlepool, England, to inform approaching trains that all was clear for them. One of the earliest forms of signals was a bucket suspended from a policy attached to the end of a jib on a post. The height of the bucket determined the signal. The bucket was perforated, and at night was filled with glowing coals.

The semaphore signal is the most common day signal in use in the United States and England, and its use is compulsory on English main lines. The semaphore is mounted on a mast which is, when possible, on the right-hand side of the track it controls. When it is not possible to so place the mast, because of the topography of the ground, it is placed on a bridge, or mounted on a branched or bracketed post. The semaphore is about five feet long and about twelve inches broad. It is usually fitted with a spindle on one end, on which it swings, although some signals swing on a center spindle.

The reason that the semaphore signal was first introduced was that it could readily be seen at great distances. This is true regardless of the color it is painted, and in fact at a distance the color of a signal of this form is not distinguishable. If seen in shadow it appears dark gray or nearly black against the sky, and if seen in bright sunlight it appears a lighter gray.

The semaphore displayed horizontally means "stop"; displayed at an acute angle with the post, in either the upper or lower quadrant it means "all clear" or "proceed." Some roads make this same semaphore give an intermediate indication which means "proceed with caution."

The home signal is painted red, with a white stripe, and has a square end. The distant signal, to distinguish it from the home signal, has a fish-tail end, with a white stripe which may be either straight or may follow the V of the fish tail. (See Fig. 1 and Fig. 2.)

The usual night signals employed in Great Britain and the United States are a red light for "danger" or "stop," and a green light for "proceed." For a long time there was no distinction between distant and home signals at night. In recent years two arrangements have been adopted in order to provide a distinction. The first consists of a special lantern having a reflecting extension arranged to illuminate a white fish-tail next to the ordinary colored light. Unless the lantern were kept very clean, however, the fish-tail was not visible for great distances. The second arrangement consists in substituting a yellow light for the red in the distant signal. Yellow lights are extensively used now in this country.

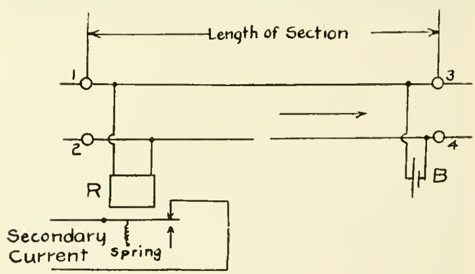


FIG. 5

Direct Current Track Circuit

Light signals have recently been introduced in the United States, and have met with much favor. They are of two general types. The first (Fig. 3) gives a red light for "stop" and a green for "proceed," and is much the same as the night signals except that the lenses have to be specially designed so that the signals are visible in bright sunlight. The second (Fig. 4) consists of a backboard on which are mounted several rows of lights, one horizontal, one vertical, and another at an acute angle. The signal for "proceed" is given by lighting all the lights in the vertical row, just as the semaphore "proceed" signal is the vertical or acute-angle position. This type of light signal is in use on the Pennsylvania railroad.

It has been found that the range of visibility of the light signals is from 3,000 to 3,500 feet.

Light signals are being installed in considerable numbers on American railways. The simplifications obtained with light signals, the ease and low cost of maintenance, and the small first cost more than make up for the increased cost of energy required to operate them. Further an installation of light signals will eliminate all failures due to moving parts of signals and mechanisms, all chances of freezing or sticking, and should reduce all dangerous signal failures by 40 per cent, according to A. M. Rudd, who installed the Pennsylvania system.

2. The Block System

The block system is an arrangement for spacing trains, in order to prevent collisions. The system consisted originally in simply telegraphing the arrival and departure of trains from station to station by means of the ordinary telegraph instruments, and this is still done in some countries. The telephone is also used in the same manner, especially in the United States, but in England neither of these systems is permitted. Independent instruments called block instruments are required.

A brief description of the block system as used in England will be given. The method in the United States is much the same, where automatic signals are not in use, except that telephone or telegraph takes the place of the block instruments.

The whole of the railway is divided into what are known as block sections. The lengths of these sections are, in most cases, arbitrarily fixed by the existence of a station, siding, or junction. At all these situations there have to be signal boxes in order to work the essential switches, signals, etc., and block instruments are required in these boxes in order to protect the various train movements. The length of the sections reflects on the time occupied by trains passing through the section, and consequently the carrying capacity of the line.

Take for example a block section between two boxes B and C. Box B has a block instrument electrically connected by means of line wires to a corresponding in-

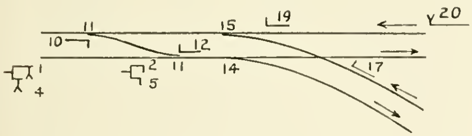


FIG 6
Interlocking Requirements

strument in box C. The box B also has an instrument for communication with A, and C has one for communication with D.

There is a separate instrument for the up line and for the down. There is a dial which has upon it three indications; in the center, "line blocked"; on the right, "line clear"; and on the left, "train on line." It is the principle of the block system that the sections normally are closed, even though there be no train in them, and are only open when permission has been given for a train to enter. The galvanometer needle for the upper dial is actuated by current from C, in accordance with the turning of a commutator on C's instrument. The needle on the dial on the lower part of the instrument at B is actuated by the battery at B by the turning of the man's own commutator, and tells what indication he has given.

The mode of procedure is for B, when he has a train to send to C, to ask, by a set of signal bells, "Is line clear?" at the same time intimating for what kind of train he is inquiring. If the man at C is in position to

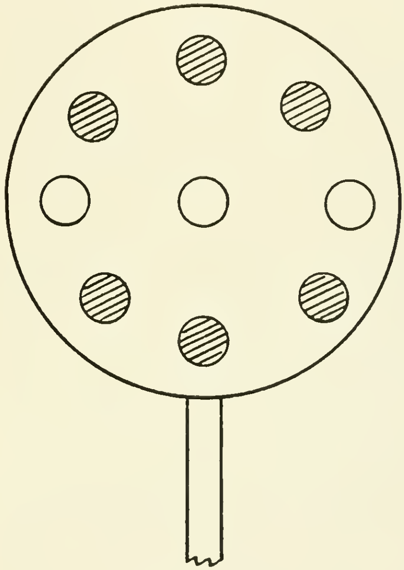


FIG. 4
Position Light at "Stop"

receive the train, he accepts it by repeating the bell signals and turning his commutator so that his needle and the corresponding one at B are deflected to "line clear." If he cannot accept the train, he does not answer, and B offers it again later. When B has received acceptance he lowers his signals, and as the train passes his box, he again gets C's attention, and bells "train entering section." The man at C repeats this signal and turns his commutator so that his needle and the corresponding one at B are deflected to "train on line."

The man at C will now ask the next box, D, for permission to send this train, and C and D will go through the same movements.

The indications on the block instruments thus tell a signalman the condition of the lines in the section up to the next box.

Over many sections of line there are run trains going to different destinations, and these trains have to be routed at certain points. This is done by the driver sounding a prescribed whistle at a given signal box some distance in the rear of the junction, and this information is sent to the junction by telephone.

Emphasis should be placed on the principle that the normal condition of the section is "line blocked," and that signals are normally at "danger." If the normal condition of the line were "clear," and if a signal happened to be out of order, the entrance of a train on a section might not show a danger signal, and a collision might result.

3. The Track Circuit

The principle of the track circuit consists in making the actual presence of the train or vehicle on a given section give a continuous indication of the fact, and lock or otherwise control the signals, block instruments, etc., applying to the section, so that it is impossible to admit a second train to it until it is clear throughout its entire length. The control is thus effective the whole time the section is occupied at any part, even by a single pair of wheels.

The track circuit may use either direct or alternating current. It has been found that direct current will operate the system efficiently provided the track ballast is of such material as to properly insulate the two rails. If the ballast has a high conductivity, and allows the passage of current from one rail to the other, it has been found that the use of alternating current makes it possible to operate the circuit. The controls which are used are the same in the two cases. This paper will illustrate the general principles of the direct current circuit only, as the only difference is in the power-feed arrangements and the type of relay employed.

The closed track circuit is generally used. (See Fig. 5.) The ordinary fishplates are replaced at points 1, 2, 3, and 4 by special insulating fishplates or joints. A relay R is connected to the rails, at the entering end of the circuit as a rule, and a battery B is similarly connected at the opposite end. The intervening rail joints are bonded to insure good electrical connection. The battery B normally energizes the relay R, which by means of a local circuit may operate an indicator, lock and lever, etc. When a vehicle comes on the insulated section, the relay is shunted, as the mass of the wheels and axles offers practically no electrical resistance, and the magnet, becoming de-energized, releases its armature, opening the secondary circuit, which affects the controls. The relay thus reflects the condition of the section, "clear" or "occupied."

In order that the circuit work properly, it is of course necessary that the section be insulated from other sections. The simplest method of insulation is to separate the various parts with plates and collets of hard fiber or other insulating material. As it is equally important that the circuit have no breaks within itself, the rails are bonded with heavy wire. To avoid risk of failure two wires are fixed at each joint. Also, in order that the wheels of the train properly short the circuit, they should be bonded to provide a connection between the tires and the axle.

As the circuit normally is closed, the relay is normally magnetized, and this keeps the secondary circuit, which directly controls the signals or switches, normally closed. When a train enters the track section the wheels and axles connecting the opposite rails short circuit the current from the relay, which promptly releases its armature, thus opening the secondary circuit. As soon as the last pair of wheels passes out of the track section, the current will again flow through the magnet coils of the relay, causing the secondary circuit to be closed.

It is seen that the object of the track circuit is to indicate the presence of trains on certain portions of the line to the signalman in the signal box, and to protect those trains by locking the signals in the rear if required. There are four main purposes for which track circuit is used. (1) To protect trains standing at a starting signal. In this case it is usual to provide an electric lock on the lever working the home signal, thus locking that signal when a train is standing on the track circuit. (2) To indicate to the signalman the arrival of a train at his outer home signal. (3) To indicate in the signal box the arrival or presence of trains on sections where they have to stand out of view of the signalman, such as in cuts or stations where bridges, buildings, or track curvature may restrict the view of the signalman. (4) The most important use to which the track circuit has been put is the controlling of the operation of automatic signals, the train protecting itself by its presence on the track holding the signals behind it at "danger." The line is divided into sections insulated from each other, and each section operates its own signals.

4. Principles of Interlocking

Use of the block system and of the track circuit for indicating the presence of trains did much to reduce the possibilities for accidents, but safety still depended on the proper interpretation by signalmen of the indications given, and on their care in properly adjusting the signals and switches for different conditions. It was possible for a careless signalman to give the "clear" signal to two trains, even though all the mechanical apparatus were working properly. So railway engineers set to work to devise a scheme for working the switch and signal levers in such a way that it would be mechanically impossible for the signalman to give conflicting signals, or to signal a train one way and set the switches for another direction. To accomplish this end several schemes of interlocking the levers were invented.

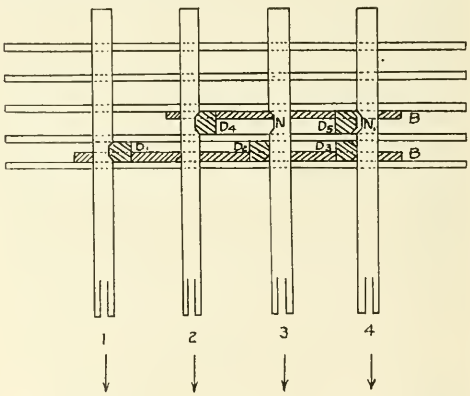


FIG. 7
Interlocking Principle

For the requirements of interlocking at a representative junction, see (Fig 6.) Interlocking requires No. 14 switch points be set before No. 5 home signal and No. 4 distant can be lowered, permitting a train to go on to the branch; it also compels No. 14 and No. 11 points to be opened before No. 10 signal can be obtained, permitting a cross-over. It insures that before No. 2 is lowered, permitting through passage on main line, that No. 14 is normal, and that when No. 2 is lowered No. 14 is locked. No. 2 and 5 signals cannot, therefore, be lowered together. It also prevents a train from leaving the branch when a train is travelling along the main line. And if a

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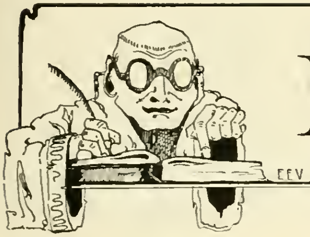


EDITORIAL

History

Next year will mark another new era for the Technograph, for next year the magazine will appear as a monthly publication. With this change should come new interest and new enthusiasm.

The Technograph is far from new—it is a tradition of the University. Established in 1885 as the annual publication of the Engineering School, it soon become a standard reference. In it were published numbers of authoritative technical papers, written entirely by faculty members or by research students. Two text books and several other books of an engineering nature first appeared in its pages, so that, even yet, one finds occasional reference to this or that statement of the Technograph.

As time went on, however, the students became more impatient, or perhaps the single volume, with its six by nine pages and its gray or brown cover, became too bulky. So, in 1911, it was changed to a quarterly, still keeping its smaller size, and still holding to its strictly technical nature. Just how the next change came about cannot be seen at a glance. Perhaps the first hint that the character was to change was in the year 1918, when, to make the pages come out even, one or two jokes were added. Or perhaps the articles, a few of which were now written by students, lacked the technical nature of the earlier days. At any rate, its attitude gradually changed from that of a reference to that of an interesting, though perhaps less important "news-magazine." It still published articles of engineering value, but along with these, it began to publish news of alumni, and notes of interest of the different departments. Editorials were introduced, and advertising began to appear. Perhaps one of the biggest changes along with all this was the change of size from the smaller seventy-five to a hundred page issue, to one larger in dimensions by with fewer pages. So, in 1920 was established the present size. The cover design was changed from the rather ornate heary paper to a glazed manilla cover that is so familiar to those who have followed its progress.

Thus the magazine remained for ten years—the basic cover design unchanged except for, once or twice, a different colored paper, and, six times, color in the picture. Inside, headings for departments were established which are used today, and even the type was kept the same in size.

This year the first indication of another change was given in a new cover design and a variation in the type used, making it more condensed in its appearance. And next year will come the more issues.

In this way a magazine progresses from an annual to a monthly, as its nature changes to fit the ever-changing likes and dislikes of a student body. May you take the new and support it as you have the old!

Biggest Show on Earth

Attention is called at this time to perhaps the biggest event in the engineering school—the biennial Electrical Show. Appearing as it does, every two years, it never becomes monotonous, and never fails to arouse the interest of all those who attend.

This year the show should be larger than ever before, because of the larger space available. As before, the commercial exhibits and the bigger exhibitions of general interest will be held in the Gym Annex, while many of the student demonstrations will be housed in the old and new parts of the Electrical Engineering aboratory.

Most of the exhibits are now in the state of preparation, so the management has been able to give a partial list of demonstrations. Among the most interesting ones are the "talking beam," described by H. A. Wenzel in this issue, television, and a miniature train, "Casey Jones," which may be made to go in either direction or to stop by command of voice. Then there will be the ever-flowing wine bottle, dancing matches, miniature lightning, and other exhibits familiar to those who have attended past shows, but interesting just the same.

And so, all ye Illini who are interested in the unusual, and all ye engineers who desire to see the new as well as to delve into the mysteries of the unreal and fake, gather together your crowd and rally to Manager O'Donnell's "biggest show on earth" — the Thursday, Friday, and Saturday after Easter vacation.

ALUMNI NOTES

William Tennent Butler, c.e. '92, died suddenly on November 1, 1929, at his home in Seattle, Washington. He was secretary of the class of '92, and had been a prominent engineer and contractor in that city. He was born in 1868 at Franklin, Ohio. He attended the University academy and then the college of engineering of the University between the years 1887 and 1892, studying civil engineering and building construction. From 1892 to 1895 he was with Purdy and Henderson of Chicago, detailing and diagraming structural steel forms. The next year he went to C. L. Struble in Chicago.

Beginning in 1896 he was in detailing and design work for the Haugh Noelke Richards Iron works of Indianapolis for seven years. For three more years he was chief engineer of this firm. Three more years were spent as chief engineer for the Westlake Construction company and from 1910 to 1914 he was chief engineer and manager of the Butler Construction company at Seattle.

Among the various steel structures he designed and detailed were the north half of the Monadnock building, Old Colony, and Marquette building in Chicago; the D. S. Morgan buildings in Buffalo, Liverpool, and London; the Globe building in New Orleans, the State Life building in Indianapolis, the Jefferson hotel and Grand Leader building in St. Louis.

As chief engineer of the Westlake Construction company he had charge of the construction of the engineering and chemistry buildings and the auditorium at the University of Washington, a $435,000 contract. As head of the Butler organization he built the Fourth avenue viaduct, a concrete 100 feet by 1800 with concrete pile foundation, 20,000 cubic yards.

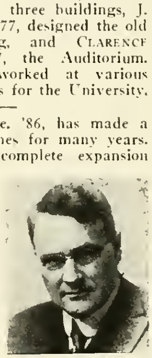
Butler was chairman of the state of Washington in the Stadium campaign. He was president of the West Seattle Athletic club, whose baseball team played the University team during the summer of 1928. He leaves a widow and four sons, three of them graduates of the University of Washington, Mayo P. '22, Robert S. '23, and W. T., Jr. '25. Butler's first wife, Margaret Philbrick, a former member of the class of '92, died in 1915. Later he married a Seattle woman.

Philip Steele, m.e. '89, is chief engineer of the Springfield avenue pumping station of the city of Chicago, one of the largest of the city waterworks system. In addition to this, he is supreme president of the Chicago Fraternal Life association, an insurance organization of which he has been a member for thirty-three years.

In the development of the campus and the growth of new buildings, the work of Illini architects has been of great importance. Professor J. M. White, arch. '90, has been supervising architect of the University for twenty-two years. He and C. A. Platt of New York have designed all campus structures but three in the last nine years. White, either alone or working with others, has designed and seen through to completion twenty-four major campus buildings.

Professor N. C. Ricker, arch '72, designed most of the early campus buildings, being responsible for five buildings. G. W. Bullard, arch '78, designed Engineering hall, C. A. A. Gunn, arch. '92, the Observatory. N. S. Spencer, arch. e. '82, was architect for three buildings, J. C. Llewellyn, arch. '77, designed the old Agricultural building, and Clarence Blackhall, arch '77, the Auditorium. Blackhall has also worked at various times on campus plans for the University.

C. E. Sargent, m.e. '86, has made a specialty of gas engines for many years. He built the first complete expansion tamden double acting engine, the first of these built being presented to the University by him eighteen years ago. He has taken out more than twenty-five patents on internal combustion engines, meters, draft gauges, calorimeters, dynamometers, and turbines. He is now on the staff of consulting engineers of Westinghouse at Wilkinsburg.


C. E. Sargent

He has recently turned his attention to automobile engines, his latest patent being on a "constant compression complete expansion gas engine, which at one-third load shows seventy per cent higher efficiency than any of the 27 million throttling engines now in use."

The new engine has no carburetor, no cam shaft, valves, or tappets. "It is the quietest engine ever built, and the most efficient. It will drive a car sixty to seventy per cent further per unit of fuel than the standard throttling engine with the same piston displacement."

The general theory used by Sargent here is the same as that governing his complete expansion stationary engine—to expand the gases gradually during the working stroke to practically atmospheric pressure, and control the quantity of the explosive mixture by cutting off the admission at different points of the induction stroke instead of throttling it. Such an engine, according to Sargent, will save millions of barrels of gasoline a year. He also points out its advantages in airplane work, saying that it will drive a plane twenty-five per cent further with the same initial weight of engine and fuel at cruising speed, which is about three-fourths of the maximum. Such an engine, he maintains, would not need a supercharger, as a later cutoff would give the same results, and with the low exhaust temperatures the manifold would not get hot to ignite gasoline accidentally sprayed upon it—a considerable fire hazard in present type airplane engines. He has designed an airplane engine, 52 h. p. weighing 250 pounds and giving a propellor thrust of 300 pounds.

Patent rights for the new engine have been sold in England, Italy, France, and Germany. Sargent also has to his credit a vertical cross compound condensing high speed steam engine; a single valve tamden steam engine with but two stuffing boxes; several steam meters, and other devices of the same sort.

S. F. Holtzman, arch. '95, and Otto Goldschmidt, e.e. '94, were among the experts whose co-operation was enlisted in investigations made in a study of the economic height of skyscrapers for the American Institute of Steel construction. As a result of this work, it was found that tall buildings in congested areas were advisable. Goldschmidt has also given some time during the past year in assisting in the revision of the New York city building code which was done under the direction of the Merchants' association.

H. F. Doerr, arch. '13, and W. P. Doerr, arch. '09, constitute the firm of Doerr and Doerr. They have been employed for all grade school and junior high school work for the city of Blue Island since 1924.

C. H. Wescott, c.e. '14, is the author of an article, "A Covered Stadium at Chicago With Long-Span Roof Trusses," in *Engineering News Record* for October 17. It describes the new Chicago stadium, the arena of which is 245x125 feet, with a clear height of 88 feet. 25,000 people can be seated for wrestling and boxing matches. The building can also be used for hockey. The Wescott Engineering company, of which he is vice-president, designed the structural steel framing, the reinforced concrete work, and the foundations.

Ralph Green, c.e. '14, contracting engineer with the Chicago Bridge and Iron works, is vice-commodore of the Lake Michigan Yachting association.

W. C. Hueckel, c.e. '08, is no longer engaged in civil engineering work, but has taken over the management of his father's store at Caseyville, Illinois.

Fermor S. Cannon, arch. '11, has withdrawn from active practice and is a vice-president of the Railroadmen's Building and Savings association at Indianapolis.

John W. Page, c.e. '92, is the head of the Page Engineering company of Chicago, manufacturers of draglines, scrapers, and buckets.

Sydney C. Rathfor, arch. e. '12, died April 4, 1929, at Des Plaines, Illinois.

CLIFFORD H. WURTZ e.e. '29 and DAVID V. JOHNSON, m.e. '29, are members of the junior executives' training class of the Frigidaire corporation at Dayton, Ohio.

J. L. WIEGREFFE, e.e. '29, is enrolled in the graduate student course of the Westinghouse Electric and Manufacturing company, East Pittsburgh, Pennsylvania. Upon completion of this course Wiegreffe is planning to enter the radio engineering department. He is also attending the University of Pittsburgh where he is studying for a master's degree.

E. E. BOONE, e.e. '10, has been appointed gearing apparatus manager of the Nuttall Works of Westinghouse Electric and Manufacturing company. He has charge of the company's sales of industrial and transportation gearing, speed reducers, reduction gears, pantagraphs, and trolleys. Boone has been associated with the Westinghouse company since 1911, in its sales activity with the coal and oil industries.

RUSSELL G. CONE, c.e. '22, is resident engineer for Modjeski and Chase on the Ambassador bridge, being built over the Detroit river between Detroit and Windson, Ontario. Before graduation he was an inspector on caisson foundations for the Metropolis bridge, Ralph Modjeski, D. Eng. '11, being the chief engineer. He also worked for Modjeski on the Delaware river bridge between Philadelphia and Camden, New Jersey. MONTGOMERY B. CASE, c.e. '06, was engineer of construction on this bridge. He is now engineer of construction on the 3,400-foot bridge over the North river, between New York and New Jersey. Other Illini associated with this firm are E. P. DAVENPORT, c.e. '27, JOHN BLONDIN, c.e. '28, and CHESLEY J. POSEY, M.S. '27.

Nine Illini engineers are engaged in highway construction for the state of Illinois. FRANK T. SHEETS, Mun. e. '14, is chief engineer; G. F. BURCH, c.e. '09, is bridge engineer; H. E. SURMAN, c.e. '10, is engineer of design; V. L. GLOVER, c.e. '20, is engineer of materials; T. I. FULLENWIDER, c.e. '02, is an assistant construction engineer; and C. M. SLAYMAKER, c.e. '08, THEODORE PLACK, c.e. '14, C. H. APPLE, c.e. '14, and P F. JERVIS, c.e. '10, are district engineers.

J. J. WOLTMAN, c.e. '14, of Taylor Waltman, was engineer for the sewage treatment plant recently completed in Bloomington, Illinois.

H. C. BOARDMAN, c.e. '10, is engineer of research for the Chicago Bridge and Iron Works.

H. B. BUSHNELL, c.e. '07, is general manager of the Western Wheel Scraper company, Aurora, Illinois.

PROFESSOR REXFORD NEWCOMB, arch '11, is the new editor in chief of the *Western* Architect, now called Current Architecture, which is the second oldest publication of its kind. He had been the architectural editor of the magazine for the last seven years. Newcomb is widely recognized as an authority of architectural history and has written many books, magazine articles, monographs, and bulletins. His books on Spanish houses, on old mission churches, and on California houses, as well as a book on Abraham Lincoln are of special importance. Last year was spent in studying architectural polychromy and ceramics in China, Japan, and the near east.

Current Architecture is a monthly publication with offices in New York, Chicago, and Minneapolis. The work of various Illini architects are often pictured in it. A. T. NORTH, arch. '85, is associate editor, and LORENZ SCHMIDT, arch e, '13, WILLIAM L. STEELE, arch . '96, and ARTHUR PEABODY, arch. '92, are advisory editors.

CHARLES A. CLARK, e.e. '97, lieutenant-colonel in the United States army, is stationed at Fort William McKinley, Rizal, Philippine Islands.

WENSEL MORAVA, m.e. '78, is the author of "The Hermit's Story," an illustrated account of his trip through the Mediterranean countries, Palestine, Syria, Iraq, India, and Java. He maintains an office as consulting engineer at 205 West Wacker drive.

H. E. BARTLETT, c.e. '93, is chief engineer for James Walker, consulting engineer of Chicago.

J. J. LLEWELLYN, arch. '77, is represented in a new book, "College Architecture in America," with a picture and plans of the Barbara Pfeiffer Chapel-Music building at North Central college, which he designed.

TRYGVE D. YENSON, e.e. '07, is research engineer in charge of the magnetic section of the research department of the Westinghouse Electric and Manufacturing company, East Pittsburgh, Pennsylvania. He received the degree of bachelor of science in electrical engineering in 1911 and the professional degree of electrical engineer in 1912. The California Institute of Technology conferred upon him the degree of doctor of philosophy in physics in 1927. While at the University, he was elected to Tau Beta Pi, Eta Kappa Nu, and Sigma Xi, honorary fraternities.

T. D. YENSON

Yensen has done much work in removing traces of impurities from iron in order to determine the magnetic properties of pure iron. He was the first man to develop magnetic materials having permeabilities higher than 15,000 (1914), and has since prepared unalloyed iron, iron-silicon and iron-nickel alloys having permeabilities between 50,000 and 100,000.

Dr. Yensen is a member of the American Institute of Electrical Engineers, the American Institute of Mechanical Engineers, the American Physical Society, the physical Society of Pittsburgh, and the American Association for the Advancement of Science. His home address is Hillcrest road, Forest Hills, Wilkinsburg, Pennsylvania.

A. J. CLARKSON, ry.e. '16, is superintendent of electrical equipment at the Grand Central terminal, New York city, representing the New York Central rail road.

CLARENCE SPERRY, ry.e. '24, is a railway mechanical engineer with the Detroit Lubricator company, Philadelphia.

MILO C. TAYLOR, c.e. '15, is the other Illini partner in the firm of Taylor and Woltman, Bloomington, Illinois.

F. G. GORDON, mun. e. '12, and F. H. BULOT, mun.e. '14, make up the firm of Gordon and Bulot, consulting engineers, of Chicago.

E. K. HILES, m.e. '94, is superintendent for a new oil plant which the Gulf Refining company is building on Staten Island, including immense tankage for oil storage, large docks, and other buildings incidental to such a plant.

GUY R. RADLEY, e.e. '00, is serving on a committee to revise the city of Milwaukee's ordinance regulating electric signs.

H. E. WESSMAN, m.e. '24, is professor of engineering at the Nanyang university, Shanghai, China.

L. K. WHITCOMB, c.e. '22, was resident engineer with H. M. Byllesby and company of Chicago on the construction of the new office building of the Northern States Power company in Minneapolis. He formerly was making special studies of the development of hydroelectric power on the Ohio river at Louisville.

The officers for the central Illinois section of the American Society of Civil Engineers were elected December 3, 1929, at a meeting in the Inman hotel, Champaign. G. W. PICKELS, c.e. '11, associate professor of drainage engineering of the University, is the newly elected president; J. J. WOLTMAN, c.e. '14, of the firm of Taylor and Woltman, Bloomington, vice-president; N. D. MORGAN, M.S. '28, associate professor of architectural engineering, secretary-treasurer. PROFESSOR REXFORD NEWCOMB, arch. '11, the speaker of the evening, talked on "Structural Forms and Their Relation to Architecture."

CARROLL G. LAWRENCE, arch. '99, died November 26 at his home in Cincinnati. He was born November 12, 1875 at Carbondale, Illinois, where he attended the local schools. He attended the State Normal school there before entering the University. After graduation he worked as a draftsman in St. Louis and as an architectural appraiser in Chicago. Since 1903 he had been associated with the

(Continued on Page 126)

THE HONOR SYSTEM

Professor: "Why did you put quotation marks at the beginning and end of your exam paper?"

Student: "I was quoting from the man in front of me."

* * *

Guide: (breathless) "I just saw a man-eating tiger."

Guided: (pre-occupied) "Some men will eat anything."

—*Cornell Civil Engineer.*

* * *

Judge O'Flaherty: "Haven't you been here before me before?"

Casey: "No, y'r honor. Oi niver saw but wan face loike yours an' that was a photograph of an Irish king."

Judge: "Discharged. Call the nixt case."

—*Oregon State Technical Record.*

* * *

"She's a very nicely reared girl, don't you think?"

"Yeah. She don't look so bad from the front, either."

—*Rose Technic.*

* * *

It's the little things in life that hurt. You can sit on a mountain, but not on a tack. —*Armour Engineer.*

* * *

There is nothing strange in the fact that the modern girl is a live wire. She carries practically no insulation."

—*Rose Technic.*

* * *

"Remember when we first met in the revolving door at the post office?"

"That wasn't the first time we met."

"Well, that's when we began going around together."

—*Armour Engineer.*

* * *

A backwoodsman mountaineer one day found a mirror which a tourist had lost.

"Well, if it ain't my old dad!" he said, as he looked in the mirror. "I never knowed he had his pitcher took."

He took the mirror home and stole into the attic to hide it. But his actions didn't escape his suspicious wife. That night while he slept she slipped up to the attic and found the mirror.

"Hm-m-m," she said, looking into it, "so that's the old hag he's been chasin.' "

—*Yellow Strand.*

* * *

Senior: "Waiter, I'll have pork chops with French fried, and I'll have the chops lean."

* * *

Waiter: "Yes, sir, which way shall they lean sir?" —*Purdue Engineer.*

"Did Hannibal believe in the open game?"

"Sure."

"How do you know?"

"It says he crossed the Alps by means of passes." —*Exchange.*

* * *

There are three classes of women—the intellectual, the beautiful, and the majority. —*Exchange.*

* * *

An Englishman was visiting this country for the first time, and as he was driving along the highway saw a sign, "Drive Slow. This Means YOU!"

The Englishman stopped in surprise and exclaimed, "My word! how did they know I was here?"

—*Co-operative Engineer.*

* * *

"Was Mary in a bright red dress at the dance?"

"Some of her, big boy, just some of her." —*Exchange.*

* * *

Her hat was on the one side, her clothes rumpled and her shoes torn.

"Were you knocked down by a motorist?" asked a sympathetic bystander.

"No, picked up," she snapped.

—*Co-operative Engineer.*

* * *

"What did the boss do when you told him it was triplets?"

"He promoted me to the head of my department."

"What department are you in?"

"Production."

—*Sibley Journal of Engineering.*

* * *

Wedding guest: "This is your third daughter to get married, isn't it?"

MacTight: "Aye, and our confetti's gettin' awful gritty."

* * *

Pledge: "Must I eat this egg"
Brother: "Yer damn right."
Silence—
Pledge: "The beak, too?"

—*Kitty-Kat.*

* * *

"You are the most beautiful girl I've ever seen! I long to hold you in my arms, to caress you, to kiss your eyes, your hair, your lips—to whisper in your ear, 'I love you!' "

"Well, I guess it can be arranged."

—*Tawney Kat.*

* * *

Salesman: "This is, sir, an epoch-making concrete mixer."

Customer: "Let's see it make an epoch."

—*Iowa Engineer.*

"What is your name and occupation?" asked the magistrate.

"My name is Sparks, sir," replied the offender, who now repented bitterly of his misbehavior, "and I am an electrician."

"And what is the prisoner charged with?" queried the magistrate of a sergeant.

"Battery, sir."

"Hum!" murmured the other. "Six months in a dry cell. Next."

—*Kansas State Engineer.*

* * *

"Better keep your eyes open around here."

"Why?"

"You'd look funny with them shut all the time." —*Rose Technic.*

* * *

"Gimmie a shoe horn!"

"You don't need a shoe horn, anyone can hear your shoes coming."

—*Kansas State Engineer.*

* * *

"How do bees dispose of their honey?"

"They cell it." —*Exchange.*

* * *

He: "Put a nice, moral play in one of the theaters and the thing is a flop; put in something risque, and you can't get a seat."

She: "Well, there's no harm in trying." —*Pennsylvania Triangle.*

* * *

I'm getting tired
Of Loretta Shields
She's satisfied more Guys
Than Chesterfields. —*R. T.*

* * *

Reckless chemical stude (after running over dog): Sorry, sir. I will replace the animal.

Indignant owner: Sir, you flatter yourself.

* * *

Prof.: Do you believe the five dollar gold piece will dossolve in this solution?

Rat: No, sir. You wouldn't put it in there if it would."

* * *

"Rastus, I understand that you have become the father of twins."

"Yassuh. I done called the fust one Adagio Allegro and Ah'm gwine to call the othah one Encore."

"Musical names, all right. Might know you play in the band. But why do you call the second one Encore?"

"Well, suh, you see, he wasn't on de program at all." —*Auburn Engineer.*

* * *

Love is a balloon that takes you to heaven; marriage is a parachute that brings you to earth again.

CONTEMPORARY ENGINEERING NEWS

Air Transport Progressing Rapidly

An editorial survey taken from the Engineering News-Record of February 1930, shows of the rapid increase of air transport. There are now 458 municipal, 491 commercial airports and 282 intermediate landing fields in operation. During 1929 about $50,000,000 was spent on airport construction and some 110 new commercial or municipal airports were added. About 100 hangars and 30 to 35 administration buildings were constructed. Scheduled operation mileage totaled 24,874, against 19,254 in 1928. Scheduled miles flown was 16,000,000 in 1929 against 10,673,000 in 1928. It is estimated that daily schedule of flying was 79,570 miles. Passengers carried totaled 85,000 against 49,000 in 1928, and the 8,000,000 pounds of mail carried was just double the 1928 figure. Established airway mileage is now 35,000 against 16,000 in 1928. Plane production in 1929 reached 7,000 planes.

Outstanding developments of the year included: inauguration of air-rail passenger service and ship-to-shore mail service; large increase in paved runways; the Lehigh Airports competition; and unusual number of tragic accidents, although the mileage flown per fatality was about 25 per cent greater than in 1928; inauguration of South and Central American air routes by American companies; completion of the airship hangar at Akron and the start of construction on the "ZRS-4," the largest rigid airship yet undertaken; around-the-world flight of the "graf Zeppelin" in 21 days, 7 hours and 34 minutes; successful completion and test flights of the first metal-clad dirigible; heavier planes, capable of carrying up to 32 passengers; attempts by the aeronautics branch, Department of Commerce, to secure the support of the states in controlling and licensing intrastate air traffic; regional conference subsequently in Bridgeport, Boston, Los Angeles and Atlanta, sponsored by the airports section, Aeronautical Chamber of Commerce; airport conference in Washington, sponsored by the city officials division, American Road Builder's Association; large increase in use of radio and of U. S. Weather Bureau facilities.

In spite of these developments, the aviation industry by the close of the year reached a state of severe depression. Plane-building plants shut down or curtailed operations, passenger lines cut rates in many cases to nearly those of railway line, an indication that the traveling public is still air-shy. Two or three unusually distressing passenger-plane crashes had a discouraging effect. The aviation industry and government supervisory authorities probably increase the public shyness by their policy of secretiveness in matters of plane accidents. Flying safely is one of the big subjects for advance in 1930.

Welded Steel Floors for Higher Skyscrapers

The February issue of the Popular Science brings us news of welded steel floors for higher skyscrapers. In their efforts to design higher skyscrapers architects are limited by an enormous dead load of flooring. To lessen this unnecessary burden on the building's supporting structure, a new type of floor panel construction has been invented by steel engineers. This revolutionary flooring, demonstrated recently before the American Institute of Steel Construction, is designed to act as a solid steel girder embracing the whole girth of a building, preventing tortional quirks and reducing the danger of high wind or earthquake action. So much lighter is the new flooring than the old, that for a seventy-five-story building it is calculated to save 2,000,000 pounds of dead load on the foundations for each column. This, it is said, would permit an increase of twenty-five per cent in the height of the building. Thus may the dreams of 100-story buildings become a reality.

The new so-called "battledect" flooring consists of plates "stitched" by a new automatic arc welding machine comprising a self-propelled vehicle carrying a wire feeding device, a reel of welding wire, and arc welding apparatus.

Controlling the Colorado

Raymond F. Walter, chief engineer, U. S. Bureau of Reclamation, writes concerning the Boulder Canyon project act which was approved by the President on December 21, 1928. This act has finally come to have a permanent foundation after an eight year legislative fight, it authorizes subject to future appropriations, the construction of a reservoir of not less than 20,000,000 acre-feet capacity on the Colorado river, the dam to be located at either the Black Canyon or Boulder Canyon. The purposes of the act in order of importance are (1) controlling floods, improving navigation and regulating the flow of the Colorado river; (2) storing and delivering stored water for reclamation of public lands and other beneficial uses within the United States; and (3) generating electrical energy as a means of making the project self-supporting.

The U. S. Reclamation Service began its investigation of the Colorado river basin in 1904. After a prolonged study of the upper part of the main valley and principal tributaries, which study indicated a lack of necessary storage at reasonable cost, an investigation of storage sites in the lower river was begun. A preliminary examination of the problem and a reconnaissance of the river below the mouth of the Virgin was made, and as a result thereof work has concentrated on the better dam sites in Boulder and Black canyons. Approximately half a million dollars was spent from 1918 to 1924 in foundation exploration at these canyons, in geological examinations and engineering studies of feasibility and cost of the Boulder Canyon project, and in studies of alternative projects for the fulfillment of the same functions. Activities preparatory to the development of final plans have been renewed during the past year in anticipation of the availability of construction funds in the near future.

Congress by joint resolution directed the Secretary of Interior to appoint a board of five engineers and geologists to review the plans and estimates and report on the safety, economic and engineering feasibility, and adequacy of the plan presented. This board, called the Colorado River Board, consisting of Major-Gen. William L. Sibert, chairman, D. W. Mead and Robert Tidgway, consulting engineers, and W. J. Mead and Charles P. Berkey, consulting geologists, made a report on November 24, 1928, published as House of Representative Document No. 446. This report was favorably accepted. A quarter-million square miles send their waters down the Colorado, sometimes in great floods, sometimes in a dry summer trickle. To control these varying waters and save them not only for the dry seasons but for dry years, a storage dam nearly twice as high as the greatest ever attempted is to be built.

Boulder dam will be more than 700 feet high and will contain approximately three and one-half million cubic yards of crete, of which about half a million yards will be below low-water surface, the lowest point of the base being approximately 125 feet below low-water. After the river is diverted and the foundation and abuttment excavation is completed, the construction problem will be simply a huge mass-concrete manufacturing job, probably the largest ever undertaken, considering the vertical height and limited horizontal area involved. The time required to complete the mass concrete work is estimated at about two years and eight months.

For the discharge and regulation of irrigation water it is proposed to install in both canyon walls needle valves connected by tunnels to the reservoir above the dam. Under the present plan of flood regulation a spillway of only nominal size would be required, but because of the location of the power plant, the great height of the dam and the damage which might result should an abnormally large flood overtop the dam, spillways of ample size will be provided. Tentative plans for the proposed power plant contemplate an installation of approximately 1,000,000 horse power. The power plant will be located immediately below the dam, one-half on the Nevada side and one-half on the Arizona side, forming a U-shaped structure with a base of the U resting on the down-stream toe of the dam. Access to the site and supply

of materials and equipment constitute the most important preliminary problem of construction, now that river and rock conditions have been fully explored. Access will be from the north or rigfht bank.

Before work can be started at the damsite it will be necessary to build a construction railroad, to provide housing facilities and to secure electric power for construction purposes. The estimated cost of the Boulder Canyon project according to the Colorado River Board assuming a construction period of seven years will total $165,000,000.

Alumni Notes

(Continued from Page 121)

American Appraisal company of Milwaukee, traveling a great deal of the time, but later settling at Cincinnati.

The Tokyo Illini entertained PROFESSOR A. N. TALBOT, c.e. '81, PROFESSOR H. E. BABBITT, mun. e. '17, JOHN CHESTER, c.e. '09, m.e. '11, and others when they were in that city attending the World Engineering congress. A dinner was given by MIKISHI ABE, c.e. '11, Ph. D. '14, prominent structural engineer and architect, at his home. Abe has recently written a treatise on reinforced concrete construction.

Other former Japanese students were presebt. SHIGETSURA SHIGA, arch. e. '93, has retired from teaching architecture in the Tokyo Higher Technical school, but continues to practice. TOKIJIRO YOSHIDO, c.e. '16, and KOZABURJ MISE, c.e. '16 are professors of civil engineering in the Kyushu Imperial university at Fukuoka. SENTARO SEKINE NEMOTO, m.e. '13, is connected with the bureau of mechanical engineering of the department of railways of Japan. GUNDAYER MIZOGUCHI, e.e. '14, is managing director of the Shokawa-Hydro-Power Electric company.

EMILIO A. TEIXEIRA, min. e. '17, has returned to his home in Passos, Minas, Brazil, South America, after a trip to Rio de Janeiro and Sao Paulo. In Rio he met M. F. COSTA, c.e. '16, now with the Electric Bond and Share company, and RUY PINHEIRO, c.e. '19, who has been with the Standard Oil company for several years. Illini engineers met in Sao Paulo included J. CUBE DE SOUZA, c.e. '17, consulting engineer, and HUMBERTO MONTIERO BARROS, m.e. '17, who is with the Ford Motor company. Teixeira has been connected with a sugar company for two years in the erection of a sugar mill plant in Passos. He plans to move to either Bello Horizonte, the capital of the state of Minas, or to Rio de Janeiro where he will continue work. He is the author of an article published recently in the Bulletin of the Sao Paulo Engineering club on "The Definition of Engineering," and is now working on article about Rio de Janeiro which will be published in the United States.

P. J. SWEENY, e.e. '15, has recently become assistant general manager of manufacturing of the Pan-American Petroleum and Transport company, at 122 East 42nd street, New York city.

C. B. MCCLURE, c.e. '93, is at Ishpeming, Michigan, where he is chief engineer for the Cleveland Cliffs Iron company and general manager of the Cliffs Power and Light company.

FRANK ENO, c.e. '91, is now research professor of highway engineering of the Ohio State university. He is also chairman of the executive committee of the highway research bureau of the National Research council, going to Washington four times a year in this capacity.

W. L. FERGUS, m.e. '98, is head of the W. L. Fergus and company, 343 South Dearborn street, Chicago, construction engineers.

GRANT W. SPEARS, m.e. '87, is with the Dearborn Chemical company, New York city.

C. C. WILLIAMS, c.e. '07, dean of the college of engineering of the University of Iowa, is the new chairman of Iowa's athletic board.

CYRUS E. PALMER, arch. e. '12, professor of architectural engineering at the University, was recently elected to the American Society of Civil Engineers.

WALTER C. VOSS, arch. e. '12, is associate professor of building construction at Massachusetts Institute of Technology.

BRUCE R. UPHAUS, m.e. '15, died October 10, 1929, at the Iroquois hospital, Chicago, from injuries received in an automobile accident.

V. A. MATTESON, arch. '95, claims that there is no reason why a waterworks plant cannot be as handsome as a union building of a fine arts hall and has proved it in his design for the new water plant at Saginaw, Michigan. It has been planned so well that it might be taken for a library or a university building. The building houses the pumping station and the water purification works, which has just been put into service and is considered the last word in waterworks construction.

The interior of the building is in keeping with the design of the exterior, and is finished with stone, marble, terracotta, terrazzo, and tile. Matteson believes that a waterworks should be designed with the care and thought that its importance as compared with other public buildings warrants. "The waterworks is of more importance to a community than even the library, jail, courthouse, or city hall," says Matteson.

Matteson was the architect for this building; Professor W. C. Hoad of the University of Michigan designed the water purification equipment; F. G. GORDON, c.e. '12, designed the pumping equipment; J. C. JORDAN, e.e. '06, was electrical engineer.

Matteson has spent a great part of his time in the design and construction of public utility structures, specializing in waterworks buildings. Examples of his work may be found in various parts of the country, especially in Florida, Texas, Kentucky, Tennessee, Indiana, Michigan, Wisconsin, Iowa, and Minnesota.

M. L. CARR, e.e. '05, made the speech of acceptance on behalf of the founders of Eta Kappa Nu at the presentation and dedication of a bronze tablet bearing the names of the ten Illini who started the organization during the celebration of its founding which was held on the University campus on November 7, 8, and 9. The tablet is at the entrance to the newly rebuilt electrical engineering laboratory. MAYNE S. MASON, e.e. '11, national vice-president of the society, and EVERETT S. LEE, e.e. '13, member of the committee for the memorial, were also present. E. J. MEHREN, e.e. '06, was the principal speaker at the anniversary banquet.

H. T. ROGERS, arch. e. '16, is connected with the Great Lakes Dredge and Dock company.

E. S. HIGHT, e.e. '10, is an assistant vice-president of the North American Light and Power company.

H. E. DRALLE '15, is a general engineer for Westinghouse E. & M. Company at East Pittsburgh. A. J. SCHOCH '17, is also a general engineer in this company.

J. D. VALLIER '22, is in the St. Louis office of the General Electric at 112 North Fourth street.

FRANK L. HANSON '08, is vice-president in charge of sales for the Ideal Electric and Manufacturing Company, Mansfield, Ohio.

New Aircraft Compass

Announcements have been made of a direct-reading card compass for aircraft for use where the remote indicating type is not essential. This card compass is marketed as an addition to the line of highly accurate magneto compasses made by that company, and is a relatively inexpensive instrument.

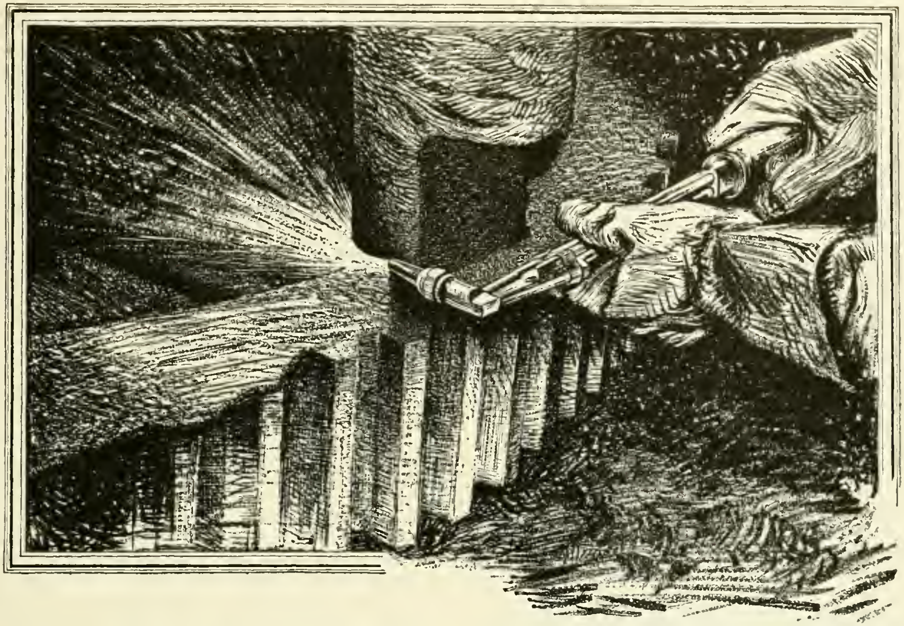
The new card compass is well adapted for use with small aircraft because of its light weight and low price. Its design embodies a spherical aluminum bowl filled with a liquid and containing a graduated dial card mounted on a jewel pivot. The compensating scheme used to correct for local magnetic disturbances consists of an adjustable magnetic mechanism which eliminates the old arrangement of needles in a drawer. It is positive in adjustment, convenient to handle and well suited to general requirements.

A ground glass lens is provided in front for reading the position of the card with respect to a fixed "lubber line," and two expansion chambers at the top allow for changes in volume of the liquid in the bowl, caused by temperature and altitude variations. An electric light is placed between these two chambers to illuminate the front edge of the card. The intensity of this light can be varid by th pilot, and the socket, is so located that he can conveniently change lamps in flight should the necessity arise. This illumination feature is standard but can be omitted if desired. Its part are readily detachable in the field. The source of electric supply can be a storage battery, dry cell or a generator.

A correction card is included with each compass so that the pilot can note whatever variations exist after compensation is made. The entire instrument is mounted on a three-point suspension which is well damped and shock-obsorbing. It can be suspended from above, mounted flush with an instrument board, attached to the top of a flat base or mounted in front of a spar.

The principal advantages of the new compass, as listed by the manufacturer, are as follows:

1. Ground glass lens.
2. Multi-mounting feature.
3. Light weight—1.88 pounds complete.
4. Electric illumination.
5. Luminous paint on card dial and lubber line.
6. Adjustable type compensation.
7. Elimination of sylphon.
8. Use of spherical bowl.
9. Relatively low price.



Persian Tilework of the Saracenic Period

(Continued from Page 110)

future life. With such a religion, in a country whose life was so closely connected with ceramics, it appears only logical that the Saracens, with their almost barbaric love for the brilliant color which helped to minimize the effect of the fierce sun, should take naturally to that material which challenged their keen minds and which could so completely satisfy all of their demands.

Not only did the religion of the Saracens tend to promote the erection of buildings not permanent in themselves, yet decorated with pleasing forms and colors, but it also placed prohibitions upon the use of certain decorative motifs such as the use in color and sculpture of all natural objects including human and animal forms. This lead to the development of that intricate form of geometrical surface decoration known as Arabeques. However, like all prohibitions, which are contrary to human proclivities, this prohibition of natural forms was not always observed and various kinds of floral and animal forms (including the human) were used as motifs as the system developed.

Although the Persians of the medieval times produced practically all varieties of ceramic products, it is their architectural ceramics that we have chosen to investigate at this time. Most of the best of this work was

Archer's Frieze for Palace of Darius I, Susa

executed between the eleventh and seventeenth centuries. Like the ancient Persians, the medieval Persians encased their walls with an envelope of colored enameled fireclay. Since the core of the walls of the medieval Persians was of burned brick, it could be quite a bit thinner than that of the ancient Persians which was of sun-dried brick.

Although the medieval Persians did not find the enameled brick so satisfactory because of the limitation its rather standardized size and shape imposed, they did use it some and true to their nature produced some very excellent examples of that type of brick work.

It was in the development and use of thinner and more varied shaped units that the medieval Persians excelled. Nowhere in all the world at any time have they been equalled.

"Star-shaped" tile was one of the popular types used. These usually had eight points resulting from the placing of one square upon another, one of which had been revolved concentrically through an angle of forty-five degrees.

"These tile were produced either by white clay, mixed with sand, or fashioned by some inferior clay surfaced by a fine coating of siliceous slip or with a mixture of soda-glass, clay and oxide of tin. The aim in either case was a white ware, which could be decorated in delicate and minute patterns, geometrical, floral or animal, that could be painted on in cobalt-blues, maganese-purples, copper-greens or turquoise, with mixtures of these for intermediate hues. The designs were generally bordered by delicate lines of brownish black produced by a mixture of the oxides of iron and maganese to which perhaps a trace of cobalt was added. Over the whole of the painted surface a limpid alkaline glaze, often quite thick, was spread and fired just to fashion, with the result that a tile of crisp brilliant color upon a slightly toned white ground was produced."

The Persians also used the "star-shaped" tiles in combination with a cross-shaped tile. Upon these was used the lustre mixture that had been produced originally for their pottery and tableware.

While the general form of this tile was geometrical, the motifs used in its decoration were usually animal and floral. As in the case of the "stellar" tile, the spotted hare and deer were common motifs. The designs were sometimes covered with the lustre and set in a blue-grey ground. Sometimes the process was reversed and the ground was the lustred part. In either case small scrolls, curves, and dots were scratched upon the ground. The whole face of the tile was sometimes covered with ivory-white tin-enamel, especially in the earlier examples. The ground is a dark blue alakline glaze. The letters are in low relief. Scrolls and arabeques in white enamel or gold leaf add brilliance to the field between the dominating letters. While this variety of tile was not as common as some of the others, it is not surpassed in beauty and delicacy both of form or color by any of them.

The elements of the process used in producing the lustred tile were used first upon vases and pots with most excellent results. The secrets of its production seem to have been known almost by the Persians alone. Others tried to produce it, but their product was much inferior to that of the Persians. It did much for the beauty of Persian architecture from the thirteenth to seventeenth centuries.

"Faience Mosaic" was another type of ceramic product highly developed by the Persians in the fourteenth and fifteenth centuries. In this type of work the design is produced by cutting the tiles to fit the patterns, "opus sectile" fashion.

"Faience Mosaic" is thought to have originated at Khorassan. The Persians adopted, developed, and used it very extensively upon numerous monuments of the fourteenth and fifteenth centuries. As was characteristic of the work of the Persians, the intricate patterns were

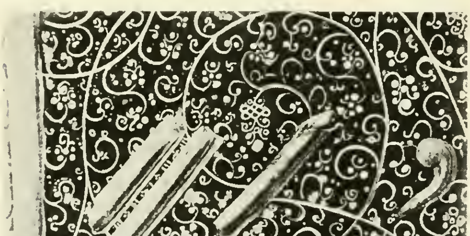
Persian-shaped Tiles (13th and 14th Centuries)

carefully worked out. The effect was very brilliant as the contrast in colors was usually great.

This method of decoration was spread into other countries where it was carried on with some degree of excellence, but nowhere did it equal the work done in Persia. Either the borrowers had not the ability, or else they would not pay the price of time and patience the work demanded.

Another type of tile developed by the Persians was the glazed relief tile. They were produced largely during the fifteenth century. Some of the best remaining examples of these tile are at Samarkand and Buchara.

The decorative motifs are floral forms enframed by geometrical patterns all in relatively high and rather sharp relief. The dominant color is usually cobalt blue.



Painted Persian Tiles from Palace of Shah Abbas

Brown-black and white are often used on borders, bands, and inscriptions.

While a comparatively large surface of this type of decoration was undoubtedly very effective, it does not appeal to me as being the highest form of Persian tile work.

Early in the sixteenth century another new and brilliant tile was produced by the Persians. It is known as Damascene ware and like the lustre tile which dated from the thirteenth century, it owes its origin to the efforts of the potter in the production of vases and other table ware.

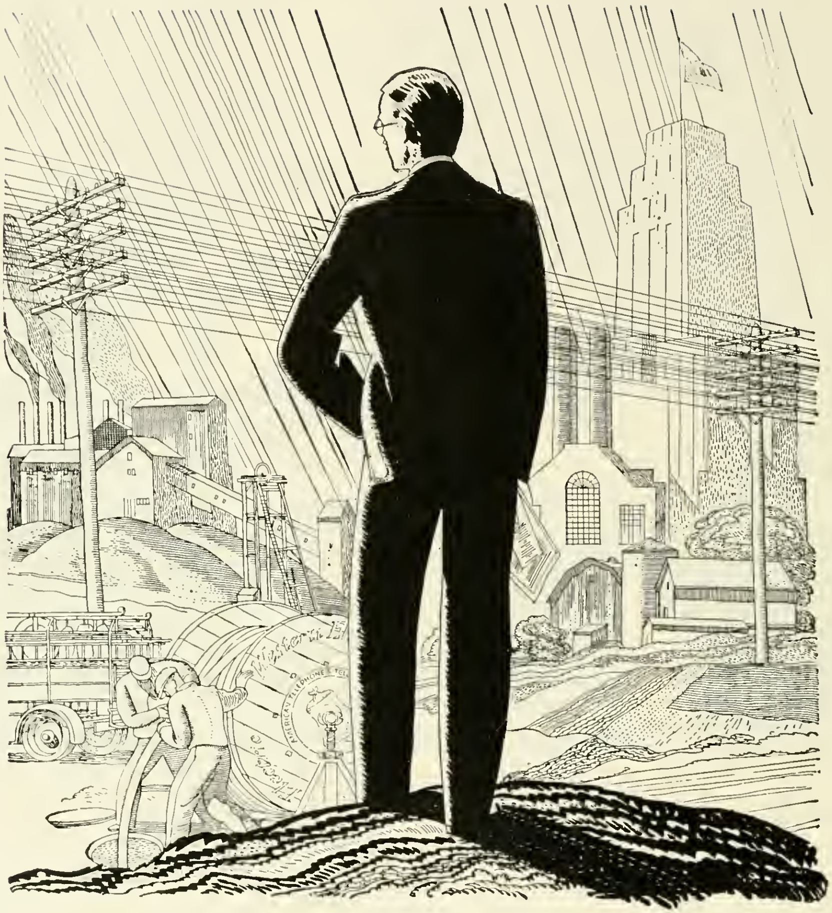
The tiles were rectangular in shape and were usually of a fine grade of white clay. The decorations were in very brilliant colors and were painted upon the tile after it had been covered with a thin white "slip." Floral forms usually slightly conventionalized made up most of the decorative motifs. As with other types of tile they were some times produced in repeating patterns, but some marvelous examples of this work can be seen at Ispahan upon the palace of Shah Abbas I and tomb of Abbas II in which the tiles are not repeated at all. Persia must have been exceedingly rich at this period because this tile which was so brilliant and beautiful but which was exceedingly costly in production was very popular. It was used extensively upon all kinds of buildings which they wished to make beautiful such as palaces, schools, and tombs.

Like all of their work it was imitated by others of their day and since, but as is so often the case, the imitation did in no way equal the work of the Persians. Even among the Persians, the work lost in perfection and toward the middle of the seventeenth century the art had fallen far from the pinnacle which it had reached in the late sixteenth century.

Still another type of work which the Persians of this period produced and in which as usual they excelled was the pictorial title. The motifs painted upon these tile were generally of human and floral forms with which idealistic scenes were pictured. Unlike the earlier work the colors used in these tile were not limited to two or three but included a great variety. Pictorial tile was developed at Ispahan presumably under the reign of Shah Abbas I.

In my opinion it is a long way from the beautiful earlier Persian products of glazed and lustred tile, the faience decoration and the Damascene ware to this late work in which their association with other nations is evident. They are beautiful in a way, but the unity and directness is gone; the colors are not pure. The motifs used are inferior to those of the earlier work. In fact no other scheme of decoration could quite equal in its fitness to tile, the intricate geometrical forms developed while they were observing the dictates of their religion.

One other ceramic product used in architecture by the Persians might be mentioned. It is commonly known as "Tile-stucco Mosaic" and consists of ceramic units laid in intricate interlacing patterns, the spaces between which are filled with stucco. The tiles were often blue, green, buff and salmon-colored while the stucco was



A CHALLENGE TO THE IMAGINATION

usually gray. Not only were intricate geometrical patterns worked out, but quite often inscription from the Koran were used.

While this work cannot be called exactly tile work, I like the effects that were produced by its use much more than those of the later and more pictorial tendencies.

But what ever the Persians of this period did in the way of ceramics they were far superior in it to the other nations. It is true that, being a country so completely saturated with contacts from other countries, their work often shows this influence, but it is always handled in a Persian manner. They not only developed their own intricate geometrical motifs, but adapted many floral and animal forms from the Assyrians, Babylonians, Chinese, and Indians to produce the most beautiful tile work the world has ever seen.

As their religion spread, their arts went with it and affected the life and work of such countries as Syria, Turkey, Egypt, North Africa, and Spain. From these countries effects of it shifted through to all parts of the world. Through our association with things Spanish, we are privileged to enjoy the art of that ingenious race.

Not only may we enjoy it but we may study it and perhaps learn some of the principles of its production and use. The possibilities for the use of colored tile in the United States today are great. We have an abundance of all the materials necessary for its production. We have a natural need for it—not as the Persians, to soften the effects of their brilliant sun which they so effectively did by the use of cool blues and greens as their dominating note, but to *add* a little color to our lives which are influenced for about three-fourths of the time by the greyness of our climate. Even in the summer their brilliance would only be in key with the brillance of nature.

We have, rapidly developing in our own country today, a building material which without doubt is destined to greatly effect all our buildings. Concrete with the aid of steel is solving the modern demands which will eventually free us from that bondage that has dominated our work so far. Concrete is very sympathetic to the use of tile inserts, and I anticipate a great future for that material which is more durable and brilliant than its rival, paint upon crete. Upon the interior, also, great strides have been made, but the surface has only been scratched.

While it is natural that since the citizens of this country, only shortly removed from older countries, should build in the manner of their past homes, I believe that we are in the midst of a formative period from which an expression of our life and philosophy will be evolved. I do not believe that we shall divest ourselves completely of all influences from the past. It is my opinion that that is not even desirable. The lessons and principles to be learned from them are far too valuable. Our heritage is too great. It remains for us to become the masters and not the slaves of this heritage.

The Problem of Mine Illumination

(Continued from Page 114)

volt circuit, supplied by the mine power plant. This is especially true in mines which use electric lamps to keep them dry, and electric railways to transport the ore or coal from the miner to the shaft. In most mines of today the shaft, turnouts, and the switching points are lighted with large electric lamps. The advantage of this type of illumination is the reduction of accidents in the mine, which occur far to often. In one mine in Montana, a copper mine, electric lights are used by the miner in his regular work also. The miner lights his charge, flees from the spot, dragging his portable light with its trailing cord with him. Then he returns to the spot, hangs his lamp from a timber, and begins his work with the light illuminating the entire area in which he works. The light has a reflector on it to prevent glare on the eyes of the miner, and gives about 10 candlepower. On the drifts there are also electric lights at frequent intervals. This mine is one of the best equipped in the country. While mainly an experiment, the improved lighting must be giving results, or the mine owners would not continue to use it. Reduction of accidents, and increase of efficiency pay dividends.

With existing methods of mine lighting there are many troubles and difficulties. The Bureau of Mines issued a bulletin in 1924, relative to the use of open flame lamps in mines. "An open flame lamp and the presence of gas in a mine constitute a vicious hazard." These words make up the greater part of the report. It goes on to say that even though the mine may not have a trace of gas, the possibility of gas accumulating or appearing when a vein is tapped is so great that the open flame lamp should never be used. Some mines have the gas pockets located and fenced off, but this is very dangerous, says the bulletin, since the careless miner will eventually stray into the dangerous district, or the gas may move to an unprotected location. From 1907 to 1924, 102 explosions occurred, 2,341 men were killed in mine disasters, all due directly to open-flame lamps. If the explosions which were believed to have been caused by open flame lamps are added to this total, the men killed total about 3,000. Since 1924 there have been more explosions, which would add to these figures.

The case, in so far as safety is concerned, seems clearly against the acetylene lamp, and in favor of the electric lamp. However, the former has some advantages over the electric, which should be considered when a new type of lamp is developed. The acetylene lamp is very much lighter than the electric. The average weight of this lamp is about eleven ounces at the most, when fully loaded with water and carbide, and will burn about two hours with one charge of materials. Additional carbide can be carried by the miner in tin cans, and the cans placed near his work. There is always enough water in the mine to more than fill the lamp. The electric cap lamp weighs from five to eight pounds. This weight must be carried around by the miner continuously, and the heavy battery on his side make his movements unnatural. When the miner must work 6,000 to 8,000 feet below the surface the heat causes him to almost strip, and the chafing action of the battery on his side combined with any splattering of alkali or acid makes the miner rather uncomfortable. In Illinois in September, 1928, a group of miners went to the state legislature to demand that that body pass a law forbidding the use of the electric lamp in mines, citing the above reasons. The law was not passed, but the miners evidently had a real grievance. The electric lamp must also be recharged after each shift, since the battery has a capacity of eight hours only. This work must be taken care of by the mine owners, and this also means that the upkeep of the lamp is at the expense of the mine owners. The acetylene lamp requires little care to keep in operation, and this is attended to by the miner.

Centralized illumination is without question the best means for lighting permanent passageways in the mine, but in the regions where the miner works alone, the long trailing electric wire from the source of electricity to the miner is so great a disadvantage that this method of lighting is seldom used. When new mining equipment is developed so that there will be machines to do the

work, with men used only to guide the machines, this type of illumination will be used.

The problem for engineers interested in mine illumination is a great one, and it will pay the men who solve it. What must be done now to aid the miner is to develop a cap type lamp which will combine the good points of all of the lamps. It should be light in weight, since a heavy one is obviously uncomfortable and inefficient. It should be self contained,—that is, there should be no heavy battery to be carried about by the miner, and no long wires with which his hand or arm may become entangled. However, the lamp should be operated by electricity, since the open flame lamp is too dangerous to be used.

This brings up another point which must be considered. The trained miner can tell by the appearance of the flame of his acetylene lamp the amount of oxygen in the air, and can thus foretell the appearance of "black damp," carbon dioxide. When the oxygen content gets below thirteen per cent, the acetylene lamp will go out, and this is about the lowest amount of oxygen that a man can breathe and still move. The electric lamp of course keeps on burning whether there is any oxygen in the air or not, and can therefore give no such warning. Some kind of detection apparatus must be devised whereby the miner will be warned of the presence of the gas. One such device has been experimented with, but as yet nothing much has been done with it. A palladium strip with a current of electricity passing through it was found to display certain characteristics when in the presence of the "black damp." However, the effect is not striking enough to be of practical value to the miner. More work along this line must be done before anything worthwhile is found. Other devices have been suggested, from

the canary of the ancient miner, special safety oil lamp adjusted to go out when the oxygen content goes below a certain minimum, to continuous chemical analysis of the atmosphere, but the only one which is used at all is the oil lamp, and this but seldom, because two lamps are required.

The ideal miners' cap lamp that is being discussed, should be made so that it is easily recharged and made ready for operation without going through a long charging process. For acetylene lamps there are located at various points in the mine, cans of calcium carbide, so that in case of a disaster which entraps a group of miners, these men can have light if they locate one of the cans. As for the electric lamp of today the lamp burns eight or ten hours and then goes out; it must go through the charging process at the mine power plant, before it is ready for use again.

The battery of the lamp should have no acid or alkali, or if these are present, the container should be of such nature as to be non-spillable. This means that no fumes or gases are to be given off by the battery during discharge. In addition to all of these requirements, the electric lamp should be so simple in operation that the intelligence of the average miner will be comprehensive enough to master the details of operation and recharging.

This gives an inkling as to what must still be done, and what fields still remain open to the engineer in the problem of mine illumination. It is something which has been inherited from previous generations of underground operations, and it remains to be seen whether or not modern engineers can work it out satisfactorily. The miner should have, and is entitled to good light and safety.

Railroad Signalling

(Continued from Page 118)

train is leaving the branch, it is protected from main line traffic.

In (Fig. 7) the two primary movements of interlocking, that of one lever locking others, and that of one lever being released by one or more more others, are illustrated.

2 locks 4
3, 4 release 1

Before the signalman can move the lever at all he must raise the catch handle and withdraw the catch rod, to which it is attached, out of the notch in the quadrant plate. On the catch rod of No. 2 being raised, a movement is imparted to the tappet in the direction of the arrow which drives dog D_4 out of the notch, and as both dogs, D_4, D_5 are riveted to bar B_1, D_5 is driven into the notch in No. 4 tappet, locking lever No. 4. Thus, before any actual movement of the lever itself takes place a conflicting lever is locked.

To consider the other movement, it is seen that lever No. 1 cannot be moved, as D_1 riveted to bar B is entered in the notch in the tappet and cannot be driven out as D_2 and D_3, also riveted to bar B, have no notches offered to them to enter. On the catch handle of No. 3 being raised, the tappet is moved so that notch N is lowered so that N is offered to D_2. No. 4 lever is similarly operated, and a notch is offered to D_3. No. 1 lever can now be pulled over.

5. Automatic Block Signalling

The next step in the elimination of the human element in signalling and train control was to make the entire system automatic, that is, to make the train itself control the signals before and behind it, making it impossible for accidents to happen because of the negligence of a signalman. Even in the early days of railroads the idea of operating the block system by purely automatic means was proposed, and patents were taken out on several plans, most of which had little of practical value. Track circuiting was unknown, and before it was developed the only method of controlling automatic signals was by means of treadle contacts of some kind actuated by passing trains at intervals along the line. There are still a few examples of this method, notably on the Paris Metropolitan Railway. The fundamental defect of this system is that the control of the signals is not continuous, but is set and released at intervals.

After the invention of the track circuit, a means was provided for a continuous control of the signals. Automatic signals have been so nearly perfected that the percentage of failures is negligible. In addition to their reliability, they are more economical than the manual system, and provide an easy method for automatic train control.

There are four systems of automatic signalling in use in the world today. The most common is the all-electric signal. In addition, there are a few installations of electro-pneumatic signals, low-pressure pneumatic signals, and electro-pneumatic signals. All of them make use of the track circuit for their control.

The all-electric system, as stated above, is most used, especially in the United States. A brief explanation of the working of this system follows:

The secondary circuit, which is opened and closed by the relay of the track circuit, furnishes the current for an electric motor which operates the signal. When the track circuit is in its normal condition, that is, when the current is flowing through the relay, the relay is energized, and the magnet keeps the secondary circuit closed. This secondary current operates a motor which raises the signal to a "clear" position. When the "clear" position is reached, a mechanical device shuts off the current, stopping the motor, and at the same time operating a brake which holds the signal in position. The brake is held by a magnet energized by the current. When the track circuit is shorted, the track relay is demagnetized, the secondary circuit is opened, and the magnet holding the signal brake is de-energized. This releases the brake, and the signal arm drops by its own weight to a horizontal position, indicating "danger."

This system has been modified so that the signal is normally at "danger," and an approaching train clears the signals ahead of it provided the track sections ahead are not occupied.

The method described is limited to two-way signals, that is, "clear" and "danger." Three position signals, allowing for a caution or speed signal operate on the same principles, but are not so simple in their operation.

The electro-pneumatic system has been used in England to a large extent. In this type, the power is furnished by compressed air, at a working pressure of about 60 pounds per square inch, which is fed into the air main at different sub-stations on the system. Smaller pipes are taken from this main to the signal and train-stop electro-pneumatic motors. These motors are composed of an electric-magnet, and a piston and cylinder. When the track relay is energized, current flows into the magnet, which attracts an armature. The movement of the armature opens a pin valve which allows air to pass into the cylinder, pressing down the piston. A rod connected to the piston is coupled to the signal or train-stop mechanism and when the piston moves, the mechanism moves. When the track circuit is occupied, the current is cut off in the magnet, the armature is released, the air is cut off, and the weight of the rods forces the piston back and the signal goes to "danger."

The electro-gas system operates on much the same principle as the electro-pneumatic type, except that the power is furnished by carbonic acid gas. The gas is stored in steel cylinders at the foot of the signal mast, and must be replenished from time to time.

The fourth type of control is the low-pressure pneumatic system. This is similar to the electro-pneumatic system, except that the pressure of the air is about 25 pounds per square inch in the mains, and about 5 pounds per square inch in the branch pipes to the motors.

Markham Yard

(Continued from Page 106)

modern practice for classification yards was power operated switches, controlled from one tower for the whole yard. This equipment consisted of electro-pneumatically operated switches and the usual push-button machines, air lines and other incidental equipment.

The grades are such that under most free running conditions the car will not accelerate after leaving the last retarder. One 675 cubic foot air compressor will take care of the entire retarder system which includes the retarders, switches, and skates. One machine controls the whole system within the limits of its particular tower. The retarder controls have six positions—off, exhaust, 25 pounds, 50 pounds, 75 pounds, and full pressure.

The car retarder itself is, in effect, a car brake, and performs the same functions. It is an arrangement of brake shoes placed alongside and parallel to the track rails. As the car moves over the retarder the shoes are forced against the inside and outside faces of the wheels by compressed air acting on a piston which, through levers, transmits the force to the brake shoes. The effect on the car is the same as if either the hand brake or air brake had been applied. The retarder system in the north-bound yard at Markham consists of 121 car retarder units containing 7,872 feet of retarders, 69 power operated switches, and 65 power operated skates. This is the largest car retarder system in the world.

On every classification track about 50 feet beyond the last retarder a skate placing mechanism is installed. A skate, or skid, is merely a device for stopping a car in an emergency. It is a casting or forging which is placed on the rail in front of a car. The car runs onto the skate and the skate then slides along the rail, but sliding friction being so much greater than rolling friction, the car soon comes to rest.

The hump in the north-bound unit has been designed to be used as a mechanical hump at the apex and with a 60 foot-150 ton automatic recording scale located beyond it. The distance from the center of the hump to the center of the scales is 101.5 feet with 35 feet of 3.25 per cent. gradient between. This affords a maximum weighing speed of seven miles per hour. It is approximately 3,000 feet from the scales to the lower end of the classification yard and the gradients have been fixed to give a velocity of 11.7 miles per hour at the entrance to the classification yard. The scale is laid on a one per cent. descending gradient, beyond this a three per cent. grade for 95 feet, next there is a two per cent. grade for 158 feet which connects with a one per cent. grade through approach to the yard.

Markham yard is designed to operate 24 hours a day; hence adequate and efficient lighting is essential. Powerful batteries of electric projectors atop steel towers 90 to 120 feet high. Forty-five projectors are used in illuminating an area of approximately 12,000,000 square feet. These lights are so powerful that comparatively small type can be read at a distance of 2,000 feet. The

illumination is sufficient for efficient operation of the yard at night even in foggy or stormy weather.

The yard is equipped with a pneumatic tube system, whereby messengers are eliminated and bills, switching lists, reports, and messages are dispatched between various points in the least possible time. A previous installation of steel pipe covered with tar was destroyed by the corrosive action of the cinder ballast and soil. The new installation was placed above ground as far as possible and properly insulated wherever it was necessary to put it underground. The hump yard offices are also connected with a loud-speaker system. A telephone system connects control points in the yard.

A modern mechanical terminal at the south end of the yard includes an engine house of 48 stalls, a double track 300-foot deepwater cinder pit, a 1,200 ton coaling station, machine shops, storehouses and other buildings. This terminal is capable of handling 150 locomotives daily. A duplicate installation of engine house and cinder pit is contemplated for the future.

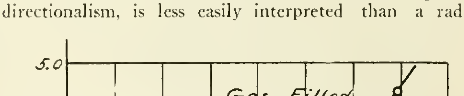
The total cost of Markham yard is $12,285,889.48.

The Talking Beam

(Continued from Page 112)

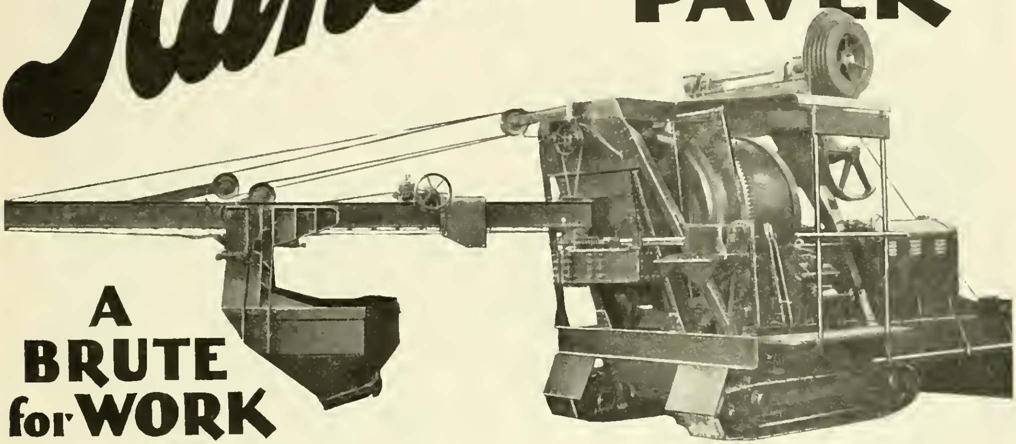
tensity due to the sixty cycle current, although invisible, was picked up by the photo-electric cell. Even the ripple in generated direct current was noticeable when the lamp was only a short distance from the cell. Using a one thousand watt lamp, this set-up has successfully transmitted sound over a distance of one hundred and twenty feet, and indications point toward a still greater range.

A development of this kind, might some day, replace radio communication for a time. It is the height of directionalism, is less easily interpreted than a radio



signal, and might be made invisible by the use of dark light. However, the disadvantages are very great; the talking beam in its present state is useful for relatively short distances only, requires a large variety of equipment and power, is easily screened, and would probably

The New MASTER Ransome 27-E PAVER



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The traction reverse bevel gears and the jaw clutch are now included in the main gear unit.

Reduction gears and traction reverse gears with their clutches are now mounted in main gear box.

Another enclosed gear box takes care of the power discharge and boom bucket gearings.

A third enclosed gear box is used for the power boom swing.

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be distorted beyond recognition by rain or snow, when used out of doors.

The operation of the talking beam is a close parallel to that of the recording and reproducing apparatus used in making the "talkies." Realizing that the light valve is inferior to that used by the motion picture companies, the principle of operation is, nevertheless, quite similar. As a matter of fact the transmitting end could be used to record sound on a film, and the receiving end could be made to reproduce it at will.

Although the talking beam apparatus has but little practical value, yet it demonstrates in a spectacular manner many of the scarcely known principles involved in such widely discussed developments as the talking movies and television.

Steinmetz Camp Given to Ford

The little shack-like camp which the late Dr. Charles Proteus Steinmetz built for himself on a little stream flowing into the Mohawk River during his early years in Schenectady is to become a part of Henry Ford's great Museum Americana at Greenfield, Mich. The camp was offered to Mr. Ford by Joseph L. R. Hayden, Dr. Steinmetz's foster son, and was immediately accepted by Mr. Ford, who wrote that he will place it in the historic American village, orient it just as it was on its original site, and locate it on the banks of the River Rouge in a setting, duplicating as nearly as possible that which surrounded it on the Mohawk.

The Trail Up Popocatepetl

(Continued from Page 108)

seen depths. We could hear rumblings and boiling, and the warmth of the lava on which we lay told us something of the fire below.

Little to see, and a sickening place to be, but it was a chimney of the world, and its grandeur thrilled us. Twenty years ago there was a crystal blue lake in the crater; now there is a boiling cauldron.

There isn't much you can do with a mountain after you climb it—except go back down. After a few minutes we commenced the descent. It was run and slide, always holding our speed down as much as we could, and catching ourselves from time to time with our pikes. On the way we saw a large eagle in the snow, and later Calvo told us that further down they had seen a coyote chasing a deer. I was so tired that twice, turning my foot slightly on a rock, I fell headlong down hill, unable to catch myself with the pike.

We reached camp at 2:30 o'clock with four hours of riding ahead of us, and anxious to reach Ameca in time for the 6 o'clock train to Mexico City.

There were certain reasons, connected with our ride of the day before, that made Bealer and me hate even the sight of a horse trotting, but trot we did for an hour. The pack mule knew he was headed home, and set a good pace, but we soon saw we would not reach Ameca by 6 o'clock at that rate, so we took the lead and went at a gallop wherever the condition of the trail permitted it. The result was that the mule sped up too, not wanting to be left behind, and we made the trip in three hours and a quarter, lopping three-quarters of an hour off the time of Calvo, who had gone ahead.

The final touch to the day was made by the guides. They followed us to the train and in true Mexican fashion asked us for tips. It seemed disgusting to talk of such trivial things just then. We had just climbed Popo—in August.

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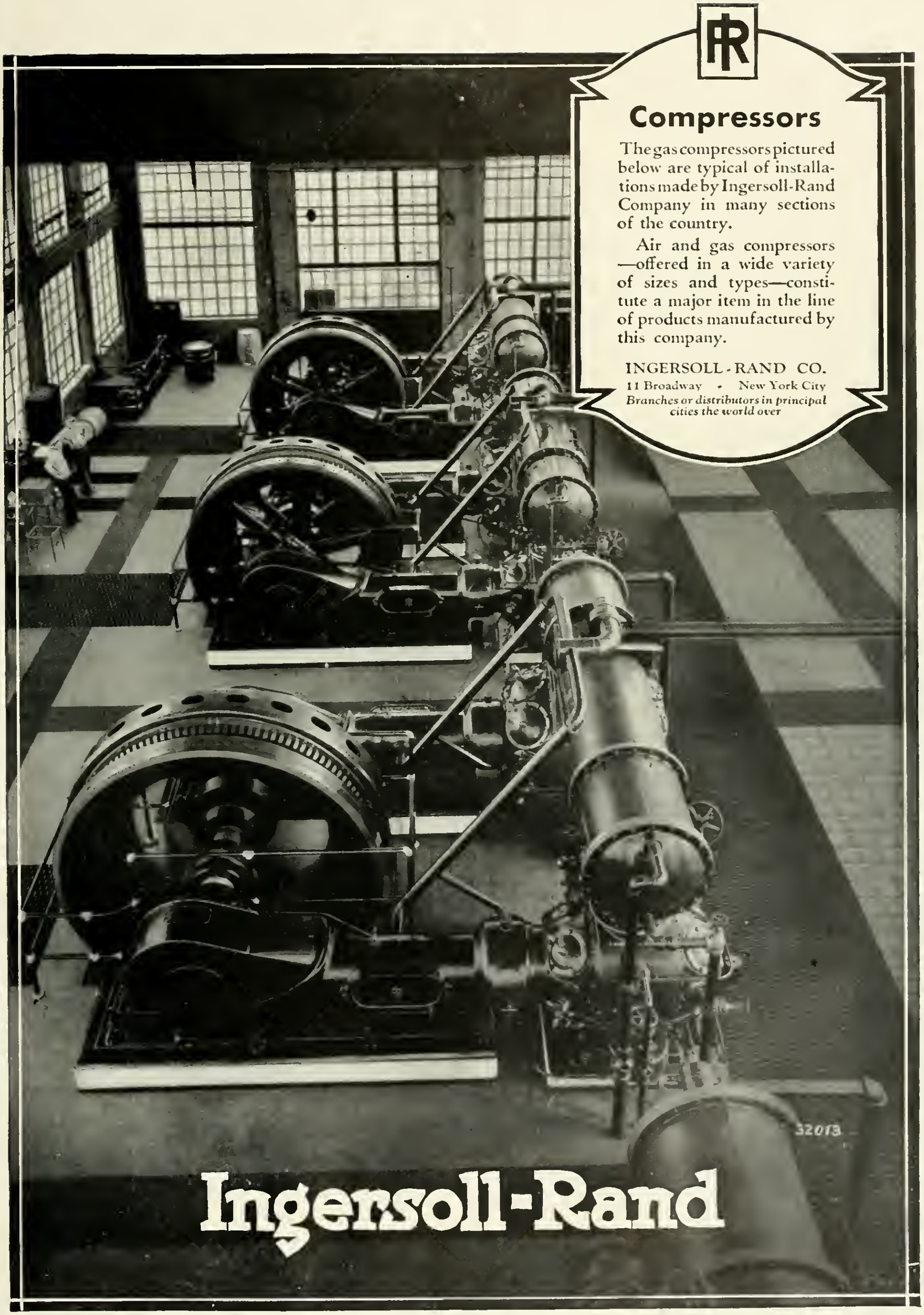
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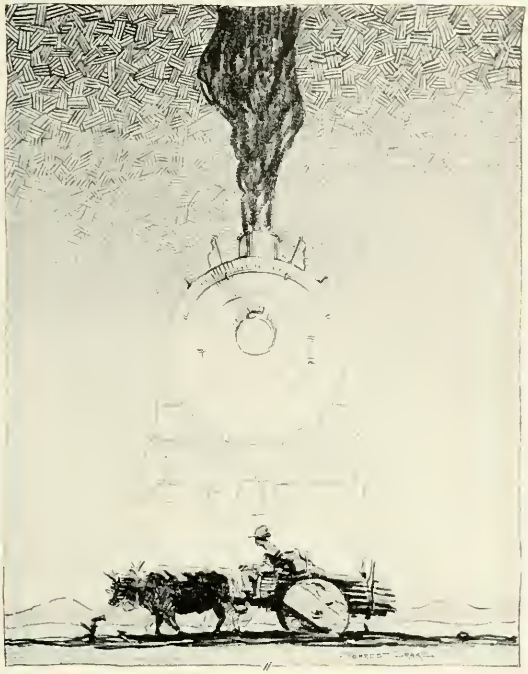

the

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for may 1930

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The TECHNOGRAPH

UNIVERSITY OF ILLINOIS

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VOLUME XLIV • MAY, 1930 NUMBER 4

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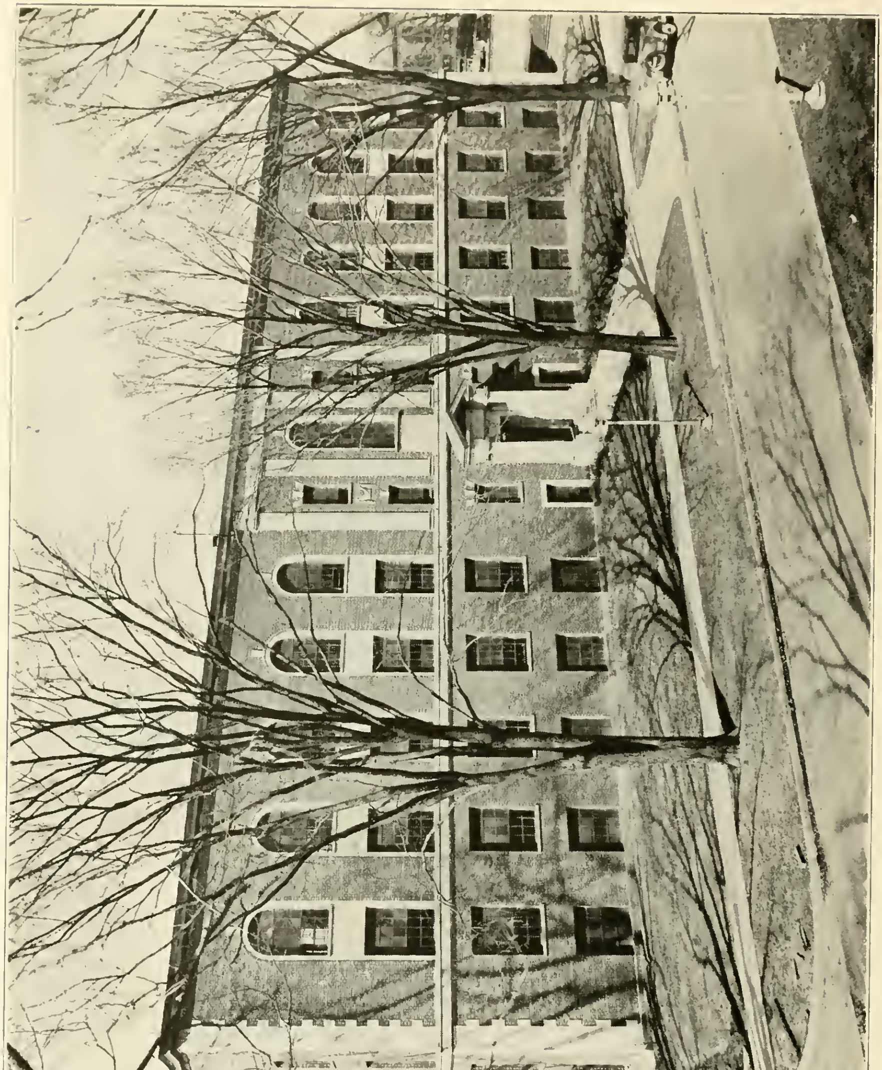


The Theoretical and Applied Mechanics Building

THE TECHNOGRAPH

Published Quarterly by the Students of the College of Engineering—University of Illinois

Volume XLIV Urbana, May, 1930 Number 4

The 3,000,000 Pound Testing Machine of the Materials Testing Laboratory

Wilbur M. Wilson
Research Professor of Structural Engineering

THE new Materials Testing Laboratory of the University of Illinois that houses the experimental work of the Departments of Theoretical and Applied Mechanics and of Civil Engineering, has just been completed at a cost of $500,000 for the building and equipment.

The most conspicuous feature of the new laboratory is the new large testing machine. This machine has a capacity in either tension or compression of 3,000 000 pounds, the clear distance between screws is 7 feet 6 inches, and the maximum clear height from the bottom of the compression head to the top of the bed of the machine is 38 feet 6 inches. The machine is located on the basement floor in the large crane bay of the Materials Testing Laboratory and occupies the full height of the building, extending 49 feet 6 inches above and 15 feet below the basement floor.

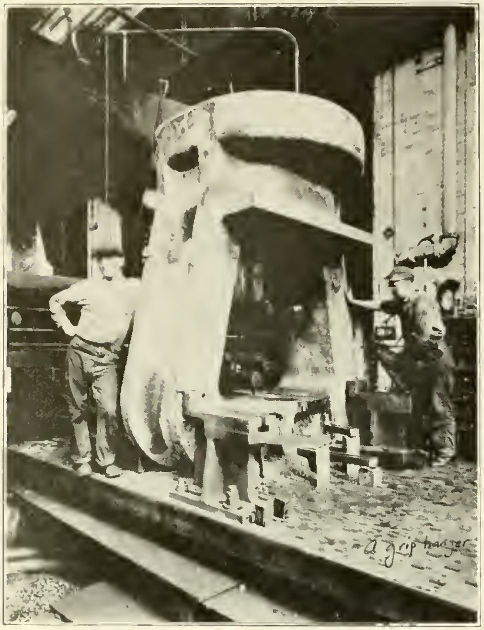
The operation of the machine is partly mechanical and partly hydraulic. The upper, or holding, head is connected by means of four steel keys to cast iron columns resting upon the bed of the machine. Keyways are provided at five elevations so that the head can be set at a corresponding number of positions to accommodate the machine to various lengths of specimens. This head is used for tension tests only. The intermediate or pulling head (the lower head for a tension and the upper one for a compression test) contains nuts at its extremities that engage the two main screws of the machine. This pulling head is raised or lowered to its proper position for a test by rotating the screws, there being no load upon the specimen when the head is shifted. The head having been adjusted and the specimens attached, the load is applied by means of a hydraulic plunger and cylinder, the load being transmitted to the pulling head through the main screws. The screws do not rotate during the loading process but serve only as tension members, the pressure being produced by a movement of the hydraulic cylinder to which the screws are attached.

The action of the hydraulic cylinder and plunger differs from the usual practice in that the plunger is stationary and the cylinder moves. The cast iron plunger, which is 46 inches in diameter, is bolted to the under side of the steel bed-plate whose top side is flush with the laboratory floor. The cast steel cylinder extends below the plunger and is attached to the lower ends of the main screws. The hydraulic medium is a heavy grade of machine oil. When oil is pumped into the cylinder the pressure tends to force the cylinder downward, carrying the screws and the intermediate or pulling head with it. If a specimen is fastened to the intermediate and upper heads, the downward movement of the cylinder will produce a tension in the specimen; if a specimen is placed between the intermediate or pulling head and the bed of the machine, the downward movement of the cylinder will produce a compression in the specimen. That is, the working stroke of the cylinder

View of Main Laboratory Containing Large Testing Machine

is downward for both tension and compression tests. By using the screws to shift the intermediate head and using the hyraulic cylinder to exert the force during a test, the pulling-head can be shifted quickly to any desired position and the screws are not rotated when subjected to a high tension. The cylinder has a stroke of 36 inches, and it is returned to its initial position at the end of a test by means of two pull-back hydraulic rams provided for the purpose.

The main screws, which are steel forgings, have an overall length of 57 feet 8 inches, an outside diameter of 12 inches, and weigh 11 tons each. The screws are



Machining Pulling Head of 3,000,000 Pound Testing Machine

threaded for a length of 38 feet 4 inches with a double square thread having a pitch of 3 inches and a depth of one-half inch. The screws extend 49 feet above the laboratory floor and 8 feet into the pit. They are attached to the hydraulic cylinder and engage bronze nuts inserted in the intermediate or pulling head. Acting as tension members, they resist the full capacity of the machine, 3,000,000 pounds, but are not turned when loaded and therefor are not subjected to combined tension and torque.

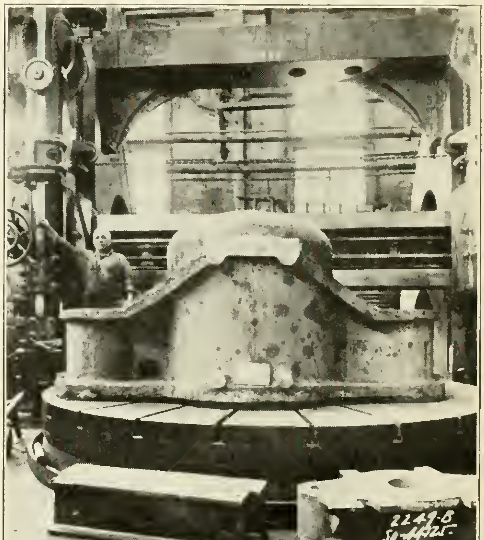
The load delivered to the specimen is measured by means of an Emery Hydraulic Support built into the pulling head of the machine. The Emery Hydraulic Support consists essentially of a reinforced diaphragm whose area subjected to oil pressure is definite and known. The reaction from the specimen produces a pressure in the oil which is measured by means of Emery precision gages. Three gages are provided with the machine, having capacities of 200,000, 1,000,000 and 3,000,000 pounds respectively. The small gages are provided to give a greater sensitiveness at small loads. The graduations on the dial were made to correspond to the position of the dial hand when the gage was subjected to known pressures, the calibration being done personally by Mr. Emery and Mr. Tate of the A. H. Emery Company. The pressure cell is attached to the loading head in such a manner that the diaphragm is deflected in the same direction for both tension and compression tests. By having the hydraulic support in the loading head the specimen to be tested need not be supported on the bed of the machine but may be supported in any manner subject, however, to the limitation that if the specimen, such as a long truss or girder, is supported on the laboratory floor, the maximum load to be exerted cannot exceed the dead weight of the machine, about 280,000 pounds. The clear space around the machine is such that light trusses or girders 100 feet long can be tested and the load indicated on the gages of the machine.

In addition to the indicating gages, an electric autographic machine records the pressure during a test. The pressure-indicating mechanism consists of a telemeter connected to the hydraulic system in such a manner that the telemeter actuates the pen of the autograph in the direction representing force, the resulting chart being a time-load curve.

The pressure of the oil in the cylinder when the machine is working its full capacity is approximately 1800 pounds per square inch. The pressure is developed with a Hele-Shaw pump direct-connected to a 15 h. p. motor having a speed of 1500 r. p. m. The pulling speed can be varied from zero to three inches per minute and the maximum speed can be developed at full load. Also, by means of an automatic regulator the load can be maintained constant for a period of several hours.

The screws, operated by means of a 50 h. p. motor move the pulling head at a speed of 2 feet per minute.

The machine is operated and controlled by means of instruments contained in a steel cabinet located just off



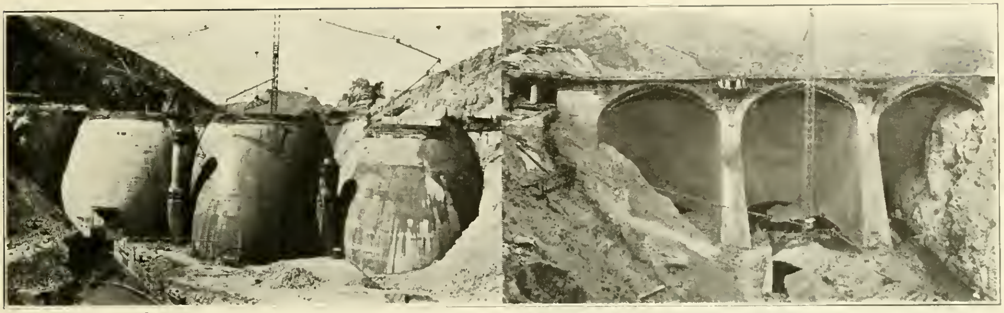
Machining the Cylinder for the Testing Machine

of the bed of the machine. This cabinet contains the pressure gages, autographic recorder, hydraulic control, and electric switches.

The oil tank, which has a capacity of 500 gallons, is supported on a steel frame located in the pit adjacent to the hydraulic cylinder. The pump and motor are on top of the tank. The motor driving the screws is set on a ledge at one side of the pit and just below the floor of the laboratory.

The testing machine is to be used jointly by the de-

(Continued on Page 188)



Upstream and Downstream Views of Coolidge Dam as it Approaches Completion

Building The Coolidge Dam

Bruce Johnston '30

ARIZONA is a land of great contrast. In her southern and western areas are flat deserts, dry and bare except for their growth of brush and thorned cactus. But in the eastern and central portions are table lands and mountains that rise step upon step from the deserts below. Here in these highlands are clear streams which cut their way through deep canyons and forests of pine; streams which are doomed to disappear in the hot sand and dry air of the lowlands unless they are caught and held in reservoir.

When the desert is touched with water it offers a striking contrast within its own boundaries. Let one day of rain fall in the springtime and the bare sands will bloom over-night with a hundred kind of flowers; and when water is available for regular irrigation the desert yields a variety and abundance of crops that is unequaled elsewhere in our country.

The rivers of the desert are generally not rivers at all, but dry sandy beds with only a small trickling stream at best. In the late summer months, however, there are sudden torrential downpours of rain which fill these dry stream-beds to over-flowing with muddy, swollen, flood-water. In the late winter and early spring the rivers are again moderately flooded by the melting snow of the mountains, but it is during May and June, when the water is needed most, that the rivers are almost always dry.

The irrigation of the desert is accomplished by creating storage reservoirs which are large enough to catch and store the flood-waters and to issue the water again as it is needed by the ranchers below. The Coolidge Dam stores up the waters of the Gila Rover at a point where it formerly cut its way through a box-canyon nine miles west of the old town of San Carlos, Arizona. The reservoir forms a lake thirty miles in length when full, and can impound a maximum of 1,795,000 acre-feet of water, whereas the average flow of the river itself is only 400,000 acre-feet per year. These figures show that a period of three year utter drought can be taken care of by a full reservoir, provided that only sufficient rain falls to equalize the evaporation from the lake.

Situated in the San Carlos Indian Reservation, the site chosen for the Coolidge Dam was remote from transportation and power facilities. A great deal of preliminary work remained to be accomplished before actual construction could start. Congress had authorized on June 7, 1924, the appropriation of $5,500,000.00 for the building of the dam. The structure was to be built under the supervision of engineers of the United States Indian Service. One of their first acts was to construct a thirty mile electrical transmission line from Hayden, Arizona, to the dam site, to furnish power for construction, with the purpose in view of using this same line to carry electrical energy away from the dam when it is completed. With its long spans and high steel towers, the building of this transmission line across rugged mountainous terrain was no easy task, for there

Map of the Territory Surrounding the Dam

were no roads and all material had to be packed across the cactus covered hills on burros. Another preliminary job was that of building a nine mile highway for use in trucking material and equipment from the railroad warehouse at San Carlos to the dam site. The Indian Service also made an exact reservoir survey to locate any property within its bounds which would have to be condemned by the government. In this connection it became necessary to re-locate about twenty miles of Southern

Pacific Railway track at a cost rivaling that of the dam itself.

The design of Coolidge Dam required the investigation of many diverse problems. Studies of stream flow data and rain fall records of the previous thirty years were made and these were factors which determined the size of the reservoir and fixed the corresponding height of the dam. Test-borings were made at the dam-site to

Gravel Plant and Tramway

determine foundation conditions. Various types of dams adaptable to the location were designed and cost estimates prepared for each. Special attention, however, was given to a unique design which has been called the "multiple-dome" dam by its originator, Major C. R. Oldberg, and it was this type which was finally decided on.

The multiple-dome dam consists of a series of egg-schaped domes which rest against massive buttresses and is especially adapted to high structures in relatively wide canyons where good rock formations are available. In the Coolidge Dam the domes are three in number and rise to a height of nearly 250 feet above bedrock. The two central buttresses are 180 feet apart on centers and vary in thickness from twenty feet at the base to four feet at the crown and are reinforced with two mats of steel bars placed six inches from inner and outer surfaces. The design provided for complete reinforcement of the entire dam against temperature and shrinkage cracks.

The contract for the construction of the dam was let on January 1, 1927, to the Atkinson, Kier Bros., and Spicer Co., of Los Angeles, California. The original cost estimate was $2,268,000.00 and payment was to be made on a unit price basis for the various classes of work. This cost was for erection only and did not include cement, steel, electrical equipment, or electrical power; all of which was furnished by the government.

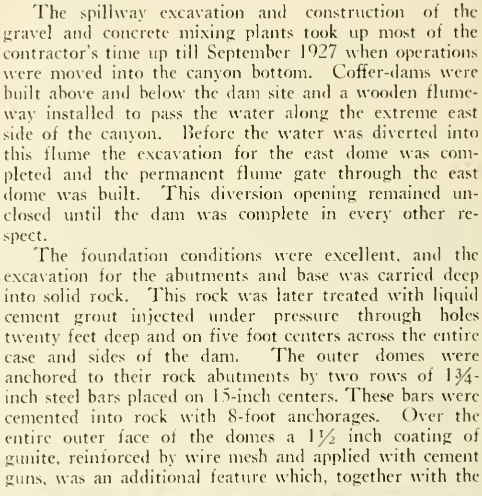
Building the Coolidge Dam involved a great deal of interesting survey work. Before any excavation was started a cross-section of the entire canyon at the dam site was made thereby to obtain an original basis for estimating quantities. This survey consisted of a set of profiles across the entire canyon at twenty feet intervals, during which the survey crew encountered many difficulties. In fixing the location of the dam, control points were established on the center lines of the domes and buttresses. The points were marked by special targets placed over 500 feet from the dam on both the up-stream and down-stream sides. With actual work in progress, the setting of elevations and the locating of construction points for excavation and form-work kept the two field parties busy at all times.

In January 1927 the contractor began the construction of a modern camp which would be capable of housing and feeding 500 workmen. Machine shops, bunk houses, offices, and mess-halls quickly took form on the slopes of the canyon a quarter of a mile above the dam site. Running water, electric lights, telephones, and a sewage disposal plant were features which gave strength to the contractors' boast that their camp was the most up-to-date and convenient that had ever been built.

Spillway excavation was underway by February 1, 1927, and this item required the removal of about 200 000 cubic yards of solid rock. The spillways were 166 feet wide at the crest and were cut to an elevation 35 feet below that of the roadway across the dam. A great number of Indians were hired for the work of drilling holes and placing powder for blasting, and their only fault was that they had a habit of disappearing for several days at a time to journey the hills on a hunting trip or ceremonial dance. Two of these Apache Indians worked for the government as rodmen and their uncanny memory and perfect steadiness of eye and hand made them very valuable at this type of work.

The spillway excavation and construction of the gravel and concrete mixing plants took up most of the contractor's time up till September 1927 when operations were moved into the canyon bottom. Coffer-dams were built above and below the dam site and a wooden flume-way installed to pass the water along the extreme east side of the canyon. Before the water was diverted into this flume the excavation for the east dome was completed and the permanent flume gate through the east dome was built. This diversion opening remained unclosed until the dam was complete in every other respect.

The foundation conditions were excellent, and the excavation for the abutments and base was carried deep into solid rock. This rock was later treated with liquid cement grout injected under pressure through holes twenty feet deep and on five foot centers across the entire case and sides of the dam. The outer domes were anchored to their rock abutments by two rows of 1¾-inch steel bars placed on 15-inch centers. These bars were cemented into rock with 8-foot anchorages. Over the entire outer face of the domes a 1½ inch coating of gunite, reinforced by wire mesh and applied with cement guns, was an additional feature which, together with the



Construction Progress on February 1, 1928

treatment of the bedrock, made the entire structure as impervious as possible.

Two steel cables were suspended across the canyon above the dam site and these formed the first unit of the contrractor's construction plant. Each of these cables had a clear span of about 1,200 feet and was capable of handling from 15 to 20 tons. The cables were used to carry machinery, materials, and passengers into and across the dam site at a later date but these were used solely for the suspension of chutes and rigging.

(Continued on Page 184)

Modern Tendencies In Architecture and Their Influence Upon Landscape Architecture*

Prof. Rexford Newcomb, A. I. A.
Editor of Western Architect

ARCHITECTURE and Landscape Architecture have, down through the ages, gone hand in hand. How close this association has been has not been generally well understood in America or, if understood, not well remembered. But the careful student of the history of architecture is cognizant of this age-old association of two important phases of the human shelter problem, and can point with assurance to the splendid co-operation between architecture and landscape development in such lands as ancient Egypt, Japan, China, and India. To come closer to our own time, thought, and feeling, he can recall the landscape development of the *atria* of the Greek, Roman, or Pompeiian house and the splendid planning of both the Roman metropolitan and provincial *fora* in relation to the public buildings which surrounded them. He can remember the lovely courtyards of Saracenic Persia and the colorful patios and terraced gardens of Spain or North Africa, the magnificent landscape setting of the villas and palaces of Renaissance Italy, and the woodland entourage of the chateaux of France and of the manor houses of old England.

In the old days, apparently, it was not too much to expect the architect to be also the landscape architect, and for ages these two arts were practiced by the same artist, as indeed were often also the arts of painting and sculpture. With our era of high specialization and the consequent segregation of related arts into what often proves to be almost water-tight compartments, a sad lack of sympathy and understanding has often arisen between the practitioners of these arts and this, in turn, has all too often wrought a serious divergence between the arts themselves.

In America, it appears to me, this hiatus is more pronounced than elsewhere. This is due, no doubt, to our peculiar educative and economic system which provides more and more for specialized preparation and segregated practice as time goes on, or it may come about from the peculiar American habit of doing just as we blame please, regardless of others.

Several years ago I was much pleased and agreeably surprised, when visiting the architectural schools of England, to find that in the training of architects in that country, a far greater regard is paid to landscape considerations than is true in our own schools. In fact, the fifth year of the architectural curriculum in England is practically totally devoted to city planning and a consideration of the relationship between architecture and its setting.

One fine attempt to make up for the American deficiency in this respect is seen in the summer school for Architecture and Landscape Architecture at Lake Forest, Illinois, and in the collaborative design problems that are given in some of our schools. The school is the place to begin this co-operation between the arts because it early breaks down a barrier that often grows as one proceeds into practice.

While in some quarters there is a fine growing collaborative spirit between the architect and the landscape architect, it is all too seldom that anything that may be called a real collaboration takes place. Here is usually what happens. The client calls in the architect and commissions him to design the structure. This the architect does, to the best of his ability, often succeeding in admirable fashion. When the structure is complete, the landscape architect is called in "to plant the grounds," as the client says, and as anyone may guess, often has a difficult task at harmonizing and making less obvious and objectionable mistakes that the architect, due to his lack of knowledge of landscape procedures, makes in developing a site.

Modern German Dwelling

I hope we shall soon come to the time when the landscape architect will be called in at the same time that the architect is called, and that the problems of how best to develop the property, both architecturally and from a landscape standpoint, will be studied concurrently. Certainly the architect, as well as the landscape architect, would profit by such a collaboration, and best of all, the client would come nearer getting what he is paying for.

Often a tract is capable of several architectural treatments, but susceptible to but one best landscape solution. Could the architect know this solution, both through his own eyes and through those of his landscape collaborator, how much more adequate and beautiful his own (architectural) solution might be.

On the other hand, I have found all too often a tendency upon the part of the landscape architect to feel that his mission was to obliterate as completely as possible the work of the architect, and the true function of a landscape setting lost sight of. We see upon all hands really fine architectural essays marred by indiscriminant planting of unsuitable material that can do little but discredit both the architect and the gardner. Co-operation should

*An address before the Second Garden Club Week, University of Illinois, March 19, 1930.

be the keynote in all such matters, and co-operation early enough in the undertaking that it will actually accomplish the one best solution.

In speaking of the adequate development of a property, I do not need to discuss in this company the various considerations that attach to the selection of a site, but

Modern German Interior Stairway

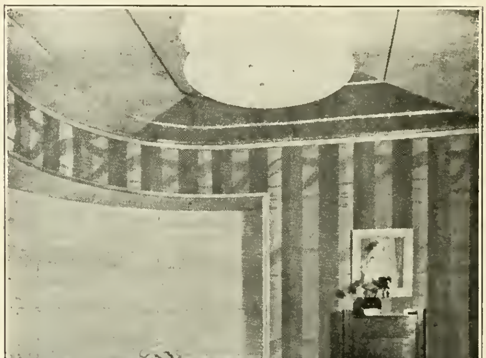
perhaps a reference to them may not be out of place. These, of course, vary with the purpose of the site, but aside from the more general considerations of location with respect to transportation, arterial streets, parks and recreation grounds, zoning and restrictive regulations, there are the more intimate problems of exposure, outlook, topography, drainage, and natural objects upon the property. These all enter into the correct artistic solution of the home site.

The exposure to the sun, to prevailing winds, and winter storms are important considerations, both in the selection of a site and afterwards in the utilization of it. While tastes vary with respect to the matter of orientation, it is perhaps a good rule to remember that one should avoid an arrangement that permits storm to beat at the exits, front or rear. In summer one wants cooling breezes, but in winter he hopes to avoid them. Often view or outlook *is* the making of a site otherwise quite uninteresting, and outlook has operated always to enhance the value of property.

Topography, the "lay of the land," largely determine the beauty of a site and holds its possibilities for development by means of landscaping effect. Moreover the more extreme types of topography actually dictate the type of house, its lines and form. Historically this consideration, like that of climate, has had a marked effect upon the development of architectural form. The architectures of two lands as far different in spirit as are those of Egypt and Switzerland may be cited to prove this contention.

Since a structure must always "belong," to the site, a study of the lines of the house, in relation to these aspects of the site, is important. One can do in a hilly situation that which a plain will not gracefully permit and *vice versa.* Sloping contours beget similar architectural contours; broad, horizontal terrains foretoken horizontal lines. Roof lines, by their direction, may tie a house to its site, while planting affords a natural and graceful transition between the vertical house walls and the more or less horizontal plane of the ground.

Natural objects, like outcropping stones, fine old trees, a genial knoll or a winding stream we may add to a picture that is already rich with suggestion. But any site, no matter how fine, can, and often is, ruined by injudicious development, the wrong placing of the house, the selection of a house type that does not emphasize or fulfill the splendid suggestion offered by the setting. In a sense, the site is to the house as the mounting is to the diamond, except that in the case of the house we have the mounting first. The task, then, is to select the gem (architectural) that will best enhance the site. Then the site must be sufficiently modified by the landscape architect to bring harmony out of the combination of natural and man-made forms. These are essentially the central problems involved in developing any site.



Modern French Interior

Once the type of plan adapted to the site is determined, and the landscape development is predicted, one may proceed to the actual house plan, always keeping in mind the purely architectural considerations which so materially influence the success of the house.

1. Economy of space, beauty and efficiency of planning.
2. Economy of apparatus.
3. Ease of circulation.

(Continued on Page 176)

View of the Wooded Stream *The Garden of the Goofs*

Highway Location In Mountainous Country

Milo S. Ketchum, c. e., '31

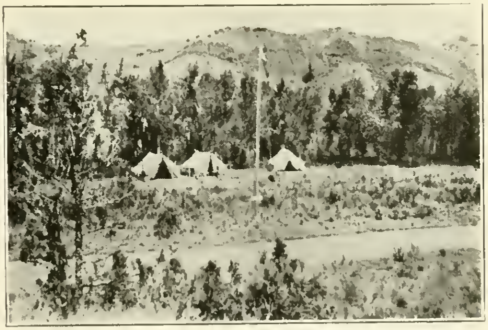
During the summer of 1929 the author was a member of a location party for the U. S. Bureau of Public Roads in the Shoshone Range of Northwestern Wyoming. The project was the relocation of the highway from the east entrance of Yellowstone Park at Sylvan Pass Ranger Station to the Trail Shop, a distance of approximately twenty-seven miles. This survey completed the design of a modern highway from the railroad center of Cody to the Yellowstone to be constructed by the U. S. Forest Service.

This highway follows the valley of the north fork of the Shoshone River which for scenery compares favorably with the best in the park. From the almost desert county at Cody, the road winds up the gorge of the Shoshone River past a great reservoir, through large ranches to the entrance of Shoshone National Forest. A modern highway has now been built for twenty miles along this route except one mile in the gorge through which there is now a sixteen per cent grade for half a mile. The estimated cost for the new road at this point is $400,000 for the one mile. At the Trail Shop, which is near the entrance to Shoshone National Forest, the valley suddenly becomes narrow and along its sides are many curious shapes wrought by wind and weather. At one point walls of rock two hundred feet high called the Palisades rise straight up from the floor of the valley. As one goes on the vegetation increases so that at the upper end the timber is very tall and much wild game abounds.

A camp was established at Eagle Creek seven miles from the east entrance. This permitted half the work to be done from this base. At the end of one month we moved fifteen miles down the valley, and the latter half was surveyed from that point.

The automotive equipment of the party consisted of two war time White trucks which were supposed to have seen service overseas. The reason for not having more modern equipment was because the two gave such excellent team work. One was geared up to run at higher speeds to use for carrying men back and forth from work. If this truck broke down, a part could be taken from the other and work would not be interrupted. When the freight was on a steep grade, the passenger truck would push from behind, and thus get over grades which an ordinary truck was unable to negotiate.

The party was well supplied with four large 18 by 21 feet tents. Two were used as sleeping tents, the third as a cooking tent, and the fourth as an office tent. These tents were well erected and the cook and office tents were floored over so that there was an air of permanancy about the camp. One problem we did not worry about was water, because there was always a large clear river of uncontaminated water near.



Elk Fork Camp

The organization of the survey consisted of the Chief of Party as the locating engineer; the transit party consisting of a transitman, the rear flag, the rear chainman, an axeman and a stake carrier, the Chief of Party acting as head chainman; the level party composed of a rodman and a levelman; and the third division composed of a topographer and two assistants whose duty was to take cross-sections at stakes set every fifty feet by the transit party. Because the taking of topography was slower than the work of the transit and level parties, the transit line was run only four out of five and one-half days of the week. On the other days the Chief of Party took topography.

The method used by the Bureau of Public Roads in highway location differs from the orthodox method of railway location in which random lines are run over a projected route, maps drawn up and a paper location is made. Such a method is necessary where grade problems must be studied minutely as where the ruling grade is one per cent. In highway locations, however, the maximum grade is more than six per cent, and these problems are much simpler. Under the system used by the Bureau of Roads the first transit line was made with the intention that it be the final location of the road. All grade problems are solved by means of a transit. A further advantage of this system is that the balancing of cuts and fills can be done in the office in the winter time, thus decreasing the work of the engineer on construction. The total cost of a survey by the method outlined is much lower than by other methods. The total appropriation for the twenty-seven miles of highway surveyed was only five thousand dollars.

Fig. 4. Weather Stained Cliff

There are many conditions which are peculiar only to highway locations in mountainous country. Because most of the mountain highways now being built are through government land, the location engineer does not need to bother about right of way or property lines. At the same time the problem of grade becomes more important. Problems cannot be solved as they are in flat country by having excessive grades of short duration. In mountainous country the grade must be continuously at a maximum for many miles.

Since most mountain roads are built for tourists, the greatest problem of the locator is to develop all the scenic possibilities of the route. This fact is often lost sight of by otherwise good engineers. What may look best from an engineering standpoint may not be best from a scenic point of view. The best locator finds the route where scenery will be at its best and the cost will be at a minimum. One condition favorable to mountain roads is that they are used only in the summer time and consequently they are often built in spring when the problem of maintaining traffic is much less acute.

The problem of reconnaissance may vary from a major problem in heavily timbered low hills between points at a great distance from each other to a minor problem as in going up a deep valley. The survey in question was of this latter type and very little reconnaissance was necessary. A visual survey was in most cases all that was taken.

Because the alignment contains so many curves, the usual method of laying out a tangent by setting up the instrument on the Point of Intersection of Tangents, measuring the deflection angle, and computing the curve is not used by the Bureau of Roads. Instead all curves are measured and run in from the Point of Curvature, a system which is much faster and equally as accurate as many for the purpose intended, and which has many advantages that the orthodox method does not possess.

An explanation of this method is illustrated by the sketch. (Figure 5). The transit is set on a trial PC, and it is desired to pass a curve around the side of the hill approximately to the tangent shown. A flag pole is set up at a point near the desired curve, and its stadia distance and azimuth is taken. From these data the degree of curvature, D, is computed mentally. If the angle 38° 15′ and the distance 500 feet, D would be 38 5=15° (Aprox.). This curve would then be run around until it came parallel with the tangent desired. If the error is too great, the proper PC and degree of curve can be computed mentally and the curve be re-run in much less time than it takes to measure a curve from the PI. The greatest advantage of this system is the ability to come down along the side of a mountain constantly at maximum grade. If in the preceding illustration by means of a vertical circle we lay off the maximum grade and place the flag pole on this line, the curve will fit around the hill and will be at maximum grade.

Work was started on the first of July at Sylvan Pass Lodge. The first major problem was not one strictly of engineering, but was a problem that the location engineer must face more often than one of pure engineering. This was the task of preserving a very beautiful weather stained cliff. The alignment of the old road was too narrow for the proposed new road. The easiest and least expensive solution would have been to run the new road over the old road, cutting out the base of the cliff and filling in the river for a few feet. To do this, however, would have been disastrous to the appearance of the rock. If you look at Figure 4 you can see a rock slide about one-fourth on the distance from the left edge. Some one had tried to cut along the foot of the cliff. The alignment was put out in the stream at an increased cost, but preserved the beauty of the piece of rock.

The second major problem was one that could not be satisfactorily solved in the field. The old bridge was narrow and would require widening. Also the ailgnment was poor on the right side of the stream. Since this was a matter of cost, and could not be solved without calculations; the engineer in charge laid out alternate lines to be studied in the office.

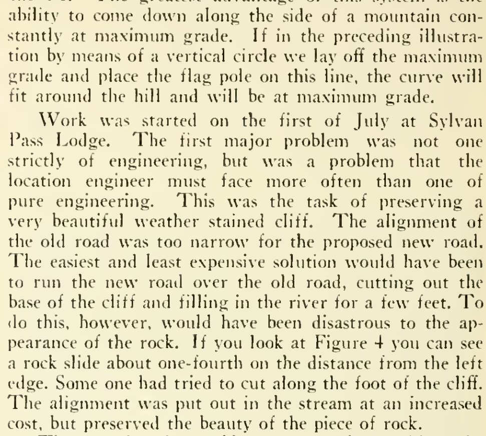


Fig. 5. Sketch Showing Method of Running Curves

(Continued on Page 184)

Fig. 2. Dikes Used to Throw the Channel Back

Fig. 4. A Standard Pile Clump Dike

Missouri River Improvement

Don Johnstone

Schaefer Competition Essay, 1930

Note: This essay treats of the project of preparing the lower Missouri River for navigation. It describes the principles of river action, and the various improvement methods employed. It is not intended to cover the organization of personnel, and touches only briefly on the financial side.

GOVERNMENT engineers have set themselves the task of preparing the lower Missouri River for navigation by 1931. For years they have controlled the stream in spots, but it is only recently that they have expanded from an organization using a million dollars a year to one whose demands exceed eight millions, and whose purpose is to provide a nine-foot channel all the way from St. Joseph to the mouth.

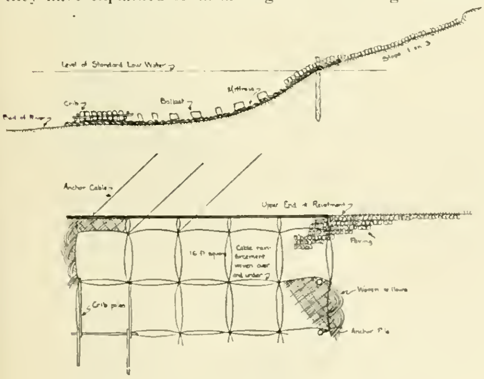


Fig. 3. Revetment for Bank Protection

General Characteristics of the Missouri River

The stream they are attempting to tame is the Amazon of North America, a rampaging river challenging them at every turn. Now tearing through narrow reaches, whipping around sharp U-curves, now spreading out into a lazy, shallow, lake-like stream a mile wide, the Missouri makes its way in its lower eight hundred miles from Sioux City to its confluence with the Mississippi above St. Louis. In a hundred different places a year it completely shifts its bed, carrying away thousands of acres of land and hundreds of valuable buildings. A rough average loss of arable land is 43 acres per mile per year.

The rapidity of change of river topography is astonishing. A map prepared in 1926 is worthless today, and the one which followed it in 1928 is already thousands of feet in error in many places. Farms cut in on one bank, and on the opposite side bars build up. Next year the bars are covered with dense willow growth. Successive high waters raise their levels inches at a time with rich deposits of alluvium, and in the fertile soil willows grow rapidly, thin out to a stand, and in the course of a few years are replaced by cottonwood timber. Soon this is cleared and the land is tilled. In twenty years it may be gone again.

So there is not only the question of cheap transportation which will be solved by river improvement, but the increase in value of the bottoms. For improvement of the river means stabilization of its location, and when farmers can once be assured their land will not be washed away they will put into its cultivation the improvements which that rich soil is capable of paying for.

The Cause of Cutting

This destructive play of the Missouri is due to the carom action of the current. Very like a billiard ball rebounding from cushion to cushion, the channel reflects from one resistant point to another in the bottoms. These points may be tough gumbo soil, or bluff contact, or heavily wooded banks—in all these cases we have the relation between angles of incidence and reflection which applies on the cushioned table.

Now if something happens to disturb the equilibrium at some point (if the angle of incidence of current on bank is altered) the whole condition of things below that point begins to change. Cutting begins, which itself

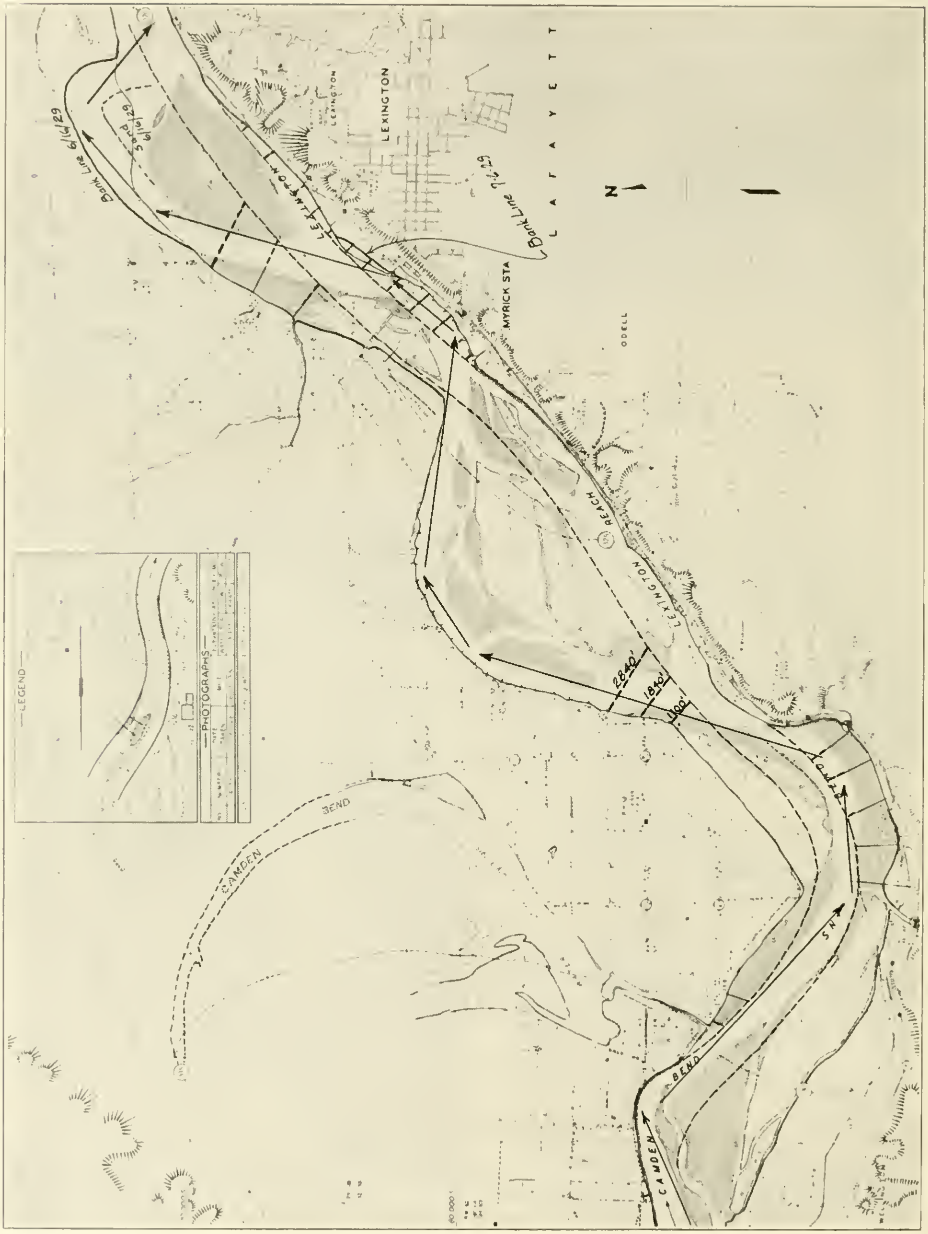


Fig. 1. Map of the Territory

causes further changes, and so the problem goes working itself out down many miles of river.

Perhaps the finest example we have of this is near Lexington, Mo. (Figure 1). The irregular dash line entering from the left about a third of the way from the top is the 1890 channel-line. "Camden Bend" was then at mile 335 (as indicated by the figures in the circle). This sharp bend gradually smoothed itself out into the more regular curve in which the name appears dotted, which was its location in 1915. All this while the river swung sharply northeast from bluff contact just upstream from the present location of Sni Bend, and as shown on the map continued tangent or near the bluffs, with only gentle curves, throughout the whole area covered by the sheet.

But further upstream, cutting action was turning Camden Bend into a horseshoe curve, and the narrowest portion of the peninsula it formed was at about the location of the present Camden Bend. When high water came in June of 1915 this unprotected neck, covered by water, scoured out and on July 3 of that year the river left its old channel and took the short cut it now follows. (The whole horseshoe does not show in this sheet.)

The whole equilibrium had been disturbed. The channel was now given an almost right angle change of direction in Camden Bend, and cutting commenced on

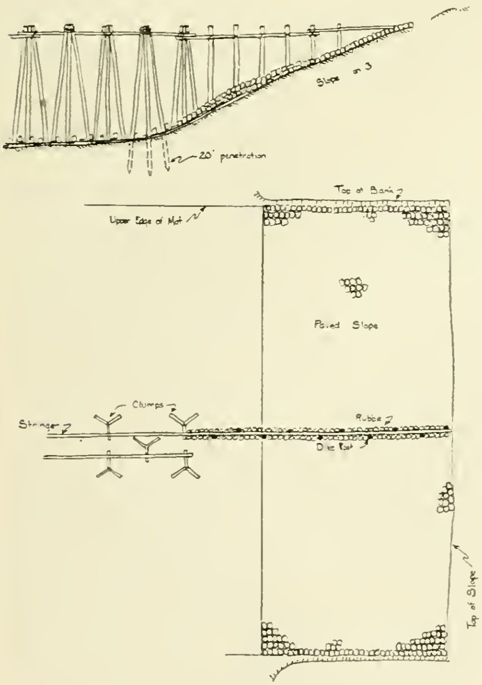


Fig. 5. Revetment for Bank Protection

the soft right bank of Sni Bend, which was then farther north than the present sand-bar. Cutting continued until the railroad countered with the revetment indicated. This made the angle of incidence in Sni Bend such that the channel was diverted northeast and the river cut away several sections of land on the left bank north of mile 325. Here a series of 20 short retards was constructed as a protection measure. They are shown numbered on the map.

Swinging east again, the river attacked the bottoms in the vicinity of Myrick Station, necessitating retards on the right bank below that point. It was still bearing hard on the right bank at the bridge, and finally moved so far south as to almost miss the navigation spans. Reflecting from the bluff, it again went on a rampage to the north at mile 321. The map was made in the fall

Fig. 4. Revetment for Bank Protection

of 1928. It was in the spring of '29 that active cutting began again, and the sketched bankline shows how far it had progressed by June 16. This time the angle of incidence on the right bluff at mile 320 is small, so the carom action is reduced, and below this point the channel again follows roughly the 1890 scheme. The black arrows show how it was playing caroms in the summer of 1929.

The System of River Improvement

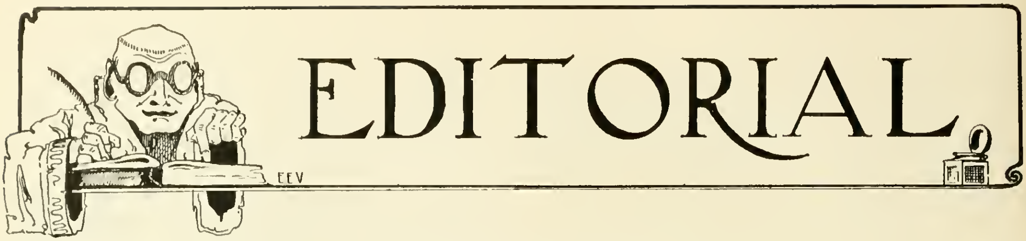
Dredging would never maintain a sufficient channel in the Missouri. Its silt suspension, aggregating 270,000,000 cubic yards per year, would build up bars faster than any conceivable installation of pumps could eat them away. So the engineers turn to that very characteristic for their solution. If bars can be artificially created which will keep the river narrow, then the increased velocity in that narrow channel will keep it scoured deep and clean.

River structures are of two general types: those intended to protect existing bankline and those designed to shift the channel. In the first class are revetment, retards, and jetties. In the second class we find dikes and long retards. Their action is to form artificial bars on their downstream side, since the water drops its solid material when its velocity is retarded by the obstruction. The bars so built up force the river to change location, and if this new location is properly protected it can be maintained.

The rate of deposit below dikes is very rapid. Dikes driven in 20 feet of water will commonly have visible bar formation within a year, and willow growth should start on the bars the second season.

In location of improvement work the important factors are (1) creation of gentle, smooth bends, (2) the following of the existing channel as far as practicable (on account of least cost), and (3) the maintaining of the present river mileage. It would not be practical to straighten the river, as some have suggested, since the shortened distance would so increase the unit fall that the

(Continued on Page 182)



Ending

And thus for many of us, closes our college education. We have been here in the University of Illinois for four years, we have been subjected to and passed all the required courses. We have carefully chosen our few hours of electives, and received credit in them. We have ordered our cap and gown, joined or failed to join the Alumni Association, checked the spelling of our name on the sheepskin—we have only to wait a few days now until the stamp is on us and we leave here as, if not cultured, certainly educated young men. In four years we have been transformed from the state of ignorance to that of learning—a truly miraculous process.

Some of us leave here with a feeling of great regret —for we have enjoyed our few years here and the contacts they have brought to us—we have enjoyed these four years of freedom. Some of us leave here with a feeling of great joy,—we too have enjoyed our four years, but we are looking forward, now, to the time when we won't have to remember from day to day, the lessons and problems, that are due on the morrow. And we, who have looked forward all through our senior year to the time when we may look back to school days, are eager to get out and learn the ways of the world.

But as a last word of parting, may we suggest, again, that a change ought to be made. The laboratory courses in the school take far more time than that for which they are given credit. It is hardly fair for the student to spend three and four hours a week in the lab., and then spend from four to six hours at home working up the results and submitting them in an elaborate report —all for two hours credit. It is hardly just that, since he is asked to be neat and brief, that he be graded only upon the rightness or wrongness of this statement. That is not the type of work he will do after school—for there he will be judged not only on what he says, but as much or more on the way he says it.

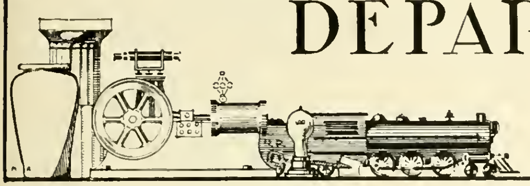
May we suggest, then, that reports be written as part of the laboratory, and that they be merely a summary of the results of the experiment, an adequate explanation of the results, to be turned in at the close of the period—or that the reports be required as they are now, that they be graded much more upon grammar, spelling, and neatness, and that, being so required, they be given enough credit that it will be worth the effort of striving for high grades. If this credit must be gotten at the sacrifice of the purely theoretical courses, all well and good—one would then, as he does now, learn much more from the laboratory work and the practice in stating facts is a clear-cut methodical way. At all events give the student credit for his time.

Extra-Curricula Education and Required Education

The argument most often used and most convincing propounded by the large educational institution enthusiast is the fact that many advantages are offered by the large institution, such as the visits of famous artists, lecturers and scientists, which are not otherwise available to the small institution. This argument is sound because many famous educators place these extra-curricular educational sources on a par with the required education necessary to complete ones course and obtain a degree. And yet these advantages are neglected by the majority of the students, which leaves the impression that the students are not aware or do not care to take advantage of their opportunities.

We believe that the average student does wish to take advantage of the opportunities which are offered. Then why the seeming neglect? The answer lies in the fact that on the evening of the extra curricular event the professors have probably assigned long and tedious lessons which will take the whole evening to complete. Added to that the student can usually look forward to a ten minute quiz during some period of the next day. The student is in a dilemma. Shall he go to the lecture and take a flunk the next day, or shall he stay at home and study to keep his grades up to a high standard? It is obvious that the best procedure is to stay at hame, for "I went so and so" is no excuse for a flunk in the average professor's mind. The other type of student, who cares nothing concerning his scholastic average and is attempting to go through on the least amount of work that will keep him in school, has no interest in these outside advantages which invariably add to ones cultural education.

In this way the large institution, striving to offer greater cultural advantages than the smaller school, breaks down what it is attempting to achieve. J. E. C.



DEPARTMENTAL NOTES

Architecture

Illinois again came to the fore by taking the three prizes offered by The American Institute of Steel Construction for the design of a "Steel Arch Bridge." The first prize, $500, the second prize, $250, and the third prize, $100, were won by G. D. Recher, R. O. Dieter, and D. P. Ayers, respectively. In the open competition which was held, six out of the ten men that placed were from Illinois. The problem was a bridge of 650 feet, including the main span, which was 325 feet, and the approaches, the piers were to be of masonry, and the approaches and span were to be entirely of steel.

The final drawing consisted of an elevation and plan of one-sixteenth inch scale, a section through the center span at one-sixteenth scale, and one-half of the main span at a scale of one-eighth. The problem was to be rendered in ink with a light background and on unmounted paper. The final judgment took place in New York on April 1.

Mr. Harmon and Mr. Laidig each took a second medal on the problem of "A Suburban Co-operative Apartment House." Eleven mentions and fifteen half-mentions were also given. Honors were also reaped on the problems of "A Chereau Stair Tower" and "A New One Hundred Dollar Bill."

Out of the many exhibits that have been in the Exhibition Hall of the Architecture Building this year, the Oriental Rug collection obtained through the courtesy of the Nahigian Bros. Co. and the exhibition of paintings from the Grand Central Galleries have been the most outstanding.

The University of Illinois Department of Architecture was presented with the gold medal by the *Societi Des Architectes Diplomes Par Le Gouvernment Francois* for the best record of accuracy in teaching architecture along the line followed by the school in Paris.

The department has arranged plans for the sixth Annual Fire College on Fire Prevention, Control, and Extinguishment. Some of the most important subjects to be dealt with are: Hazards of Dust Explosions; Handling and Storage of Gasoline; Fire Hazards and Their Corrections; Storage of Photographic, X-ray, and Motion Films; Electrical Hazards; Salvage Work and Ventilation; and Insurance Classification of Towns.

Civil Engineering

Mr. Robert Ridgeway of New York gave an interesting illustrated talk before a meeting of the A. S. C. E. on Monday, April 21. He brought out in his talk some of the difficulties encountered in building subways of New York. He also cited the fact that the subways were expected to transport a large percentage of their daily traffic in a period of only one hour and that these commuters boarded the train in a concentrated area of only a few blocks. They are planning a $5,000,000.00 project at the present time and are contemplating an additional $5,000,000.00 project. Mr. Ridgeway also spoke at the A. S. C. E. banquet held the evening of April 21. The banquet brought an attendance of about 100.

Dr. J. A. L. Waddell, bridge engineer from New York City gave three talks at the University. He spoke on "Engineering Opportunities in Foreign Lands," "The South Manchurian Railway" and "Some Experiences in China." The firm of Waddell and Hardesty, with which he is connected has branch offices in nearly all of the larger countries in the world.

Mr. W. D. Jones, Illinois Registered Land Surveyor, spoke on May 1 on the subject, "When and How—Boundary Lines." Mr. Ralph Modjeski, New York and Chicago Consulting Engineer, spoke May 13. Mr. Modjeski is noted for the Delaware River Bridge, the Detroit, Windsor Bridge, and many others.

M. E. Picnic

The annual M. E. picnic was held the afternoon of Saturday, May 10th. All loyal Mechanical Engineers met at the Transportation Building and were transported to beautiful Crystal Lake Park north of Urbana. The picnic lunch was the center of interest, but a number of sports events were promoted in an attempt to rouse the spirits of the group. A speedy boat race on Crystal Lake stirred the onlookers and strained the racers. Each boat was filled with judges and officials so that no unfair methods could be employed to gain the victory. In the baseball game the Faculty nine suffered an overwhelming defeat. Even the umpire agreed that the student team excelled. Several carefully selected eggs were carried in an egg race. The event was so precisely timed that the last man to finish carried in a small chick which had discarded its shell enroute. All prizes in the horseshoe pitching tournament were won by the gentlemen from the Shop Laboratories. The committee members were unanimous in their agreement that the lunch was ample and delicious. Underclassmen insist on perpetuating the occasion and plans are already underway for next year's celebration.

Railway Department

Since the March issue, the Railway Club has had two meetings, each of which was well attended. In the first of these meetings, which was held April 15th, Mr. E. B. Stover, '20, spoke on the subject of "What Lies Behind the Ticket." Mr. Stover has been connected with the Chicago, South Shore and South Bend Railroad since his graduation, and it was largely this road which was featured in his talk. After the talk quite a lengthy discussion was held concerning speed, safety, and other factors of interest in electrical railway work.

On April 29, Mr. J. M. Trissal, of the Illinois Central, Terminal Improvement Department, spoke on the Illinois Central electrification and its operation since electrifying. In his talk he particularly showed how accurate the estimate and calculations on the project were, and how nearly the railroad company estimated the whole improvement.

The last meeting of the year, to be held sometime in May, will be solely for the election of officers, in order that the next year may get off to a good start. For the club the year has been successful, both for the members and for the treasury and it is to be hoped that it will start off as well next year.

Sigma Epsilon, honorary railway fraternity, held its annual banquet at the Southern Tea Room on April 15. The banquet was unusual in that no one was bored by the speeches or talks, primarily because there were none. Mr. E. B. Stover, of the Chicago, South Shore and South Bend Railway was the guest of honor. Every member was present, and thoroughly enjoyed the banquet, as well as the railway meeting afterwards.

Quite a little interest in the engine ring school has been shown in the tests now being conducted by the railway department relative to feedwaters on locomotives. The test, which will take from three to four months, is being made on an Illinois Central Mikado locomotive, taken from regular freight service. It is proposed to include in these tests a complete efficiency test with and without the feedwater heater in order to determine the saving effected by such a heater.

Tau Beta Pi

Tau Beta Pi held its semi-annual initiation banquet April 30 at the Inman Hotel, following the initiation at Wesley Foundation. Some fifty or sixty student and faculty members of the society were present at the banquet and took part in the welcoming of the new members into the society. The welcome itself was delivered by the president, R. C. Oeler and the response was given by C. H. Rapp. Following this, a talk on "Backgrounds" was given by Professor Hardy Cross and a recitation on "New Ideas," by D. L. Levine. J. W. DeWolf was toastmaster for the occasion.

In its spring initiation the fraternity took into membership nineteen new men, each one of whom came up to the high standards set by the organization. These men were: G. E. Flodin, R. J. West, R. V. Strong, J. H. Armstrong, D. E.

(Continued on Page 174)

ALUMNI NOTES

This is the age of specialization and ALFRED FELLHEIMER, arch. e. '95, has followed the idea of specialization. Just as V. A. MATTESON, arch. '95, designs only waterworks plants, Fullheimer plans and constructs railroad stations. In fact he is such an authority on this type of work that he was the author of the article on terminal passenger stations in the 1929 edition of the "Encyclopedia Britannica."

Although he has designed the small two or three-room type of station, his work now centers around the cathedral-like structures which are prominent in large cities. Such a terminal is the Grand Central terminal in New York city, of which he was associate architect.

His most recent work is the union passenger station at Cincinnati. He has just completed the plans for one at Buffalo and is now studying developments and improvements for others in Montreal and Chicago, involving the Illinois Central, Chicago and Western Indiana, and New York Central railroads. The Baltimore and Ohio station at Philadelphia, and other stations at Boston, Erie, Pennsylvania, Elyria, Ohio, Springfield, Massachusetts, and Youngstown, Ohio, were designed by him.

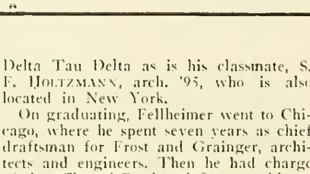
Earlier he was architect for the New York Central stations at Utica and Troy, New York, for the Central of Georgia at Macon, Georgia, for the Southern at Atlanta, Georgia. He served as architect or associate architect for eleven stations of the New York Central and for seven of the Northern Pacific.

While architect for the New York, Westchester and Boston road he had charge of the design and construction of twenty-three passenger stations and terminal buildings, grade crossing elimination projects and track structures. He also was associate architect on the Michigan Central terminal at Detroit. Besides this, he has worked out many grade crossing elimination projects, both in the United States and Canada.

Fellheimer has kept abreast of the times and has studied airport design. He was architect for the Secaucus, New Jersey, airport terminal building of the New York Air Terminals, Inc., and consulting engineer for the East St. Louis airport terminal building of the Curtiss Airports, Inc. He has also done some work on resident and commercial buildings, such as the Corn Exchange and Chase National Bank buildings in New York and a hotel and exhibition building in St. Paul, Minnesota. During the war, he was placed by the war department in charge of the development of the port of embarkation and railroad facilities for the Hoboken Shore railroad.

At the age of fifteen he entered the University Academy, where he spent a year before enrolling in the University proper as a student in architectural engineering. Sketches and cartoons by him appeared in the *Illio* and he was assistant editor of the *Illini*. He is a member of Delta Tau Delta as is his classmate, S. F. HOLTZMANN, arch. '95, who is also located in New York.

On graduating, Fellheimer went to Chicago, where he spent seven years as chief draftsman for Frost and Grainger, architects and engineers. Then he had charge of the office of Reed and Stem, architects



ALFRED FELLHEIMER

and engineers, of St. Paul and New York. In 1904 he became a member of the firm. He is now the senior partner of the firm of Alfred Fellheimer, Stewart Wagner, architects and engineers, located at 155 East 42nd street, New York.

Illini engineers working for the Westinghouse company include R. W. OWENS, e.e. '14, manager of the industrial motor engineering department; A. J. SCHOCK, ry.e. '17, an associate of Owens; SCOTT HANCOCK, e.e. '17, designer of direct-current motors; M. E. REAGAN, e.e. '17, switch-board engineer; I. R. CUMMINGS, e.e. '21, application engineering; C. M. WILLIAMS, e.e. '21, switch-board engineer; W. H. RODGERS, e.e. '22, joint author of a paper presented at the last meeting of the American Institute of Electrical Engineers; H. L. HILDENBRAND, e.e. '25, circulation manager, *Electric Journal;* and J. E. BAUDINO, e.e. '27, radio engineer.

At the tenth biennial short course in ceramic engineering held in January, J. E. HANSEN, cer. e. '20, of the Ferro Enameling company, Cleveland, Ohio, and R. R. DANIELSON, cer. e. '14, Elizabeth, New Jersey, delivered talks.

ALEXANDER M. ALLAN, arch. e. '84, prominent banker and fish packer of Monterey, California, died February 25, at his Point Lobos home in Monterey, from heart trouble. He was widely known as an architect and engineer of race tracks, having built the Emeryville, Ascot Park, and the old and new Tanforan courses in the west and the Harlem and Hawthorne tracks in the east. He also constructed much of the California state fair grounds at Sacramento.

He had organized the Monterey Canning company, one of the leading sardine packing concerns in California, and two years ago he was named president of the Monterey bank when it was founded.

He was born in Pittston, Pennsylvania, and began work in the coal fields at the age of twelve. When he was about twenty he entered the University to study architecture and engineering. He was interested in athletics and was one of the former athletes to receive an "I" sweater at the dedication of the Stadium.

While a student he was awarded the contract for completing the tower of the First Presbyterian church in Champaign, and he continued this line of work, becoming a computor and superintendent for a large contracting firm in Chicago.

PETER JUNKERSFELD, e.e. '95, nationally known construction engineer of Scarfield, New York, was buried in St. Mary's cemetery after funeral services conducted at St. John's Catholic church, Champaign, on March 24.

He died suddenly at his home in New York after a heart attack. He formerly was a resident of Sadorus, New York. While in attendance here at the University he was prominent in student affairs. After graduation he entered the employ of the Commonwealth Edison company, Chicago, and became chief operating engineer. Later he became vice-president of the Stone and Weber concern. During the World War he saw active service and was awarded the Distinguished Service Cross.

Honorary pallbearers at the funeral included President David Kinley, Dean Thomas Arkle Clark, Dean Milo S. Ketchum, c.e. '95, of the College of Engineering, Professor A. N. Talbot, c.e. '81, of the department of civil engineering, Professor J. M. White, arch. '90, supervising architect, Major W. S. C. Lemen, c.e. '95, of the engineering corps, and W. L. Abbott, m.e. '84, chief operating engineer of the Commonwealth Edison company.

Walter N. Vance, e.e. '95, Charles B. Burdick, mun. e. '95, A. J. Sayers, m.e. '95, and Professor E. J. Lake, arch. '95, were among the active pallbearers.

PROFESSOR O. A. LEUTWILER, m.e. '99, has been made national president of Pi Tau Sigma, honorary mechanical engineering society, for a three-year term.

The Kawneer Manufacturing company of Niles, Michigan, was awarded the contract for the aluminum alloy sash in the new Chemistry Annex building of the University. F. J. PLYM, arch. '97, is connected with this concern.

MELVIN HEWINS, m.e. '15, has been with the Studebaker corporation for three years, first as a factory salesman, and now branch manager at Los Angeles, from which point he directs sales in southern California, Arizona, and New Mexico. He was formerly with various corporations such as the Johns-Manville, Standard Oil, and Goodyear Tire. He served two years in the World war.


MELVIN HEWINS

W. D. GERBER, mun. e. '99, engineer of the Illinois State Water Survey, with headquarters at the University, was elected secretary of the Illinois Society of Engineers at the annual meeting held in January.

ARCHIE H. WITT, min. e. '09, is a consulting mining engineer with offices at 1219 American Traders Bank building, Birmingham, Illinois.

Among the recent bulletins issued by the Engineering Experiment station were "Results of Tests on Sewage Treatment," by PROFESSOR HAROLD E. BABBITT, M. S. '17, and HARRY E. SCHLENZ, mun. e. '27, and "The Measurements of Air Quantities and Energy Losses in Mine Entries" by CLOYDE SMITH, min. e. '20.

Two engineers are among the nominees presented by the nominating committee of the Alumni association of the University in the election of new officers which is held in May. JAMES T. HANLEY, c.e. '10 has been nominated for the first vice-presidency and RODNEY L. BELL, c.e. '09, for a directorship from the general membership.

L. V. JAMES, e.e. '06, is director of the lighting service department in the Chicago office (Midland lamp division) of the National Lamp works.

JULIUS M. WRIGHT, m.e. '08, is assistant engineer in the tool design department of the Deering works in Chicago.

H. BARRETT ROGERS, c.e. '15, is an industrial engineer, connected with the Trundle Engineering company, with offices in the Card building, 118 St. Clair avenue, East Cleveland, Ohio.

ORLIE RUE, m.e. "15, is superintendent of transmission and distribution for the Central Illinois Public Service company, Springfield.

W. LESTER NICHOLS, ry.e. '15, is in the engineering department of the New York Central railroad at Cleveland, Ohio.

H. S. GREENE, e.e. '05, is now assistant to the president of the Chain Belt company of Milwaukee, manufacturers of Rex chain, concrete mixers, sprockets, traveling water screens, elevators, and conveyors.

CHARLES P. POTTER, e.e. '09, is in charge of the transformer and large motor design for the Wagner Electric company of St. Louis. He is member of the St. Louis Engineers club, the American Institute of Electrical Engineers, and past president of the St. Louis Illini club.

JAMES M. BATEMAN, e.e. '08, is one of the directors of the National Federation of Radio Associations, Incorporated. He is also the executive president of the James M. Bateman company of Cleveland.

EDSON A. WILDER, m.e. '07, is with the Kansas City Gas company.


H. G. D. NUTTING

H. GEORGE D. NUTTING, m.e. '06, wrote the James H. McGraw prize paper, "The Electric Water Heater," which was recently published. It won the prize of the three best papers on any engineering or technical subject relating to the electric light and power industry.

In his paper he says that there are 20,000 electric water heaters in the United States, and that the average family uses 6,000 to 10,000 gallons of 50-degree hot water a year. Nutting for four years has been power sales engineer for the Detroit Edison company, and in private practice has acted as consulting engineer in rate cases and appraisals.

T. E. BUCK, m.e. '06, now with Armour and company of Chicago, was for twelve years builder and designer of steel mills in various parts of the country.

JOSEPH D. BOYER, arch. '07, of the office of the supervising architect, field force of the United States Treasury department, is construction engineer in charge of building a new postoffice at Anderson, Indiana.

O. E. STREHLOW, c.e. '96, is president of Walsh and Masterson, Incorporated, of Chicago, engineers and contractors.

Appointment to the sixth Plym foreign scholarship in architectural engineering has been given to E. M. SEARCY, arch. e. '28, of Dwight, Illinois, alternate, due to the resignation of E. L. DECOSTED, arch. e. '28, who had been originally honored.

F. B. POWERS, ry.e. '26, is in the railway motor engineering department of Westinghouse Electric and Manufacturing company. He has been identified with the locomotive developments on the Pennsylvania railroad electrification and assisted in the design of the type 422-A single phase locomotive motor. While at the University he was elected to Eta Kappa Nu and Sigma Tau. He played on the varsity water polo team in '24 and '25, and was captain in '26.

C. C. BRAUN and R. B. MITCHELL, both arch. '28, now of the division of landscape architecture, have been selected for the final competition in the Paris and Rome prizes of architecture.

This is the twenty-third annual Paris prize awarded by the Society of Beaux-Arts Architects and is the highest honor obtainable by the younger architects of the United States. A purse of $3,500 is also given to aid the winner in further study in famous foreign art centers for a period of two and one-half years.

On May 26, Braun must be in New York to execute the final rendition at the Beaux-Arts Institute of Design, final sketches being due June 18. His sketch, "A National School of Fine Arts," has been developed with the help and aid of Professor L. C. Dillenbach of the department of architecture.

The prize of Rome in architecture is awarded annually by the School of Fine Arts of the American Academy of Rome. $4,500 in cash is awarded to the winner to be spent in three years of study at Rome. B. KENNETH JOHNSON, arch. '28, was awarded the prize last year and is in Rome at the present time.

R. J. ROARK, c.e. '11, associate professor of mechanics at the University of Wisconsin, is the author of University of Wisconsin Bulletin 69, "A Study of Circumferential Bending of Pipes and Cylindrical Containers."

H. C. KRANNERT, m.e. '12, is president of the new Inland Container corporation at Indianapolis, which is a consolidation of the Inland Box corporation with the Gardner Harvey Container company of Middletown, Ohio. Krannert had been the president of the former organization. The new company, which makes corrugated fiber board shipping containers of all types, turns out about fifty carloads of boxes daily. A printing plant is also maintained, and the volume of business necessitates both day and night shifts.

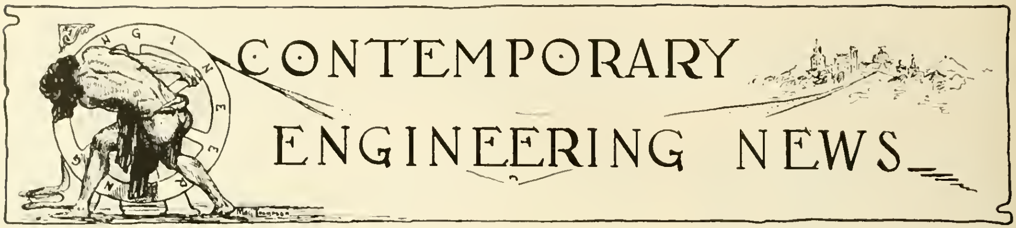

A. C. KRANNERT

Krannert has been in the paper business ever since graduation and has originated various improvements in machines and methods. The Inland Box corporation was started about four years ago.

H. CARL WOLF, e.e. '13, is now assistant to the operating vice-president in charge of gas operations of the Central Public Service company of Chicago.

L. P. ATWOOD, c.e. '94, has been appointed principal assistant engineer of the Railroad commission at Madison, Wisconsin.

(Continued on Page 174)



CONTEMPORARY ENGINEERING NEWS

An American Factory in Russia

A group of American engineers began automobile factory and model industrial recently the construction of a $50,000,000 city at Nizhni Novogorod, 270 miles east of Moscow. More than 100 engineers and draftsmen have worked here during the fall and winter preparing plans for this great project.

The preliminary work was completed before the arrival of the American party —the channel of the Oka River was dredged so that supplies could be landed, railroad tracks were laid to the site, and quarters erected for the engineers and the 8,000 Russian workers.

The Soviet Detroit will be completed some time in the near future and may aid in the reconstruction of Russia.

A New Trend in Foundry Industry

While no figures are available on the tonnage of gray iron castings produced in 1929, an increase over the total output of 1928 is indicated in the statistics on pig iron production recently released by the American Iron and Steel Institute. During 1928 a total of 3,808,988 tons of foundry pig iron was produced for sale, while in 1929 the amount was 4,112,649 tons. This is an increase of 303,661 tons or 7.97 per cent. Production of malleable pig iron for sale showed a remarkable increase over the same period. The figures as given are 1,700,178 tons for 1928 and 2,060,662 tons for 1929. The increase is 360,484 tons or 21.2 per cent. This increase cannot be wholly attributed to an increase in malleable castings production as a reliable estimate places the production in 1929 at 5 per cent over the output of 1928. However, it is known that many gray iron foundries are using more and more malleable pig iron to improve their mixtures. Therefore a large part of the gain in malleable pig iron output may be attributed to the gray iron foundy demand for that material.

Lithium Lightest Solid Purifies Metals

Lithium, the metal, is the lightest known solid. It is only little more than half as heavy as water; light enough to float on ether or the lighest gasoline.

The pure metal is very unstable in air and causes water to decompose at ordinary temperatures. When heated to just above its melting point, 365 degrees F., lithium burns with a dazzling flame. Its salts, however have a brilliant red flame.

The metal has a most remarkable chemical activity of a type to make it useful as a "scavenger" in purifying metals. It is said to be able to remove carbon, sulfur, phosphorous, oxygen, nitrogen and other impurities from alloys and pure metals. A few hundredths of a per cent of lithium added to aluminum and its alloys produces a hardness not otherwise obtainable. Such an alloy is "Skleron." A fraction of a per cent of lithium added to lead makes a suitable bearing metal. "Bhnmetall," such an alloy is used extensively in German railways.

Skyscrapers Outlawed

Buildings over twelve stories in height have been prohibited in Germany by the order of the German government. In some provinces the maximum height of buildings is limited to ten stories, and dwellings in no part of the country can exceed five stories. These limits were established after a canvass in German municipalities.

Changing City Building Codes

Early in 1929 Merchants Association of New York began the preparing of a draft revision of the building which was last amended in 1915. Several subcommittees made up of leading engineers and architects of the city did the actual work and submitted their report in December, 1929. Some of these changes, including minimum loads on structural steel and iron, were incorporated in a bill which was signed by the mayor and went into effect on March 25. This amendment shows advanced thinking in the field of structural design.

A Long Gas Pipe

Preliminary negotiations have been completed for the construction of a 950-mile pipeline to deliver natural gas from the Texas Panhandle to the Chicago area. The pipeline will probably be 22 inches in diameter, and intermediate pumping stations will maintain the flow.

Aeroplane Aids Geodetic Survey

The aeroplane is proving a valuable aid to engineers of the Geodetic Survey of Canada. During 1929 officers made air journeys totaling 22,000 miles in the performance of their duties. The results obtained, it is stated, point to even greater usefulness of the aeroplane in seasons to come.

Winter flying in connection with geodetic surveying was tried for the first time in Canada during February and March of 1929, and the results were adjudged highly successful. Geodetic operations which could not otherwise be conducted during winter are thus made possible. Many aeroplanes which are used for other purposes during the spring, summer and fall are available for surveying work in the winter months, and it is an advantage to keep them employed at this time.

The aeroplane is especially valuable in reconnaissance work. In establishing triangulation, suitable routes may be chosen in a fraction of the time required to carry out this work on the ground. Further, flying is a means of covering otherwise inaccessible territory.

A Modern Fishing Ship

A 5,300 ton ship, the "Seapro," was recently put in commission in England for fishing along the African coast. It is to be the mother ship of a fleet of motor boats which will do the actual fishing. The vessel is unique in that it can take a daily catch of 60 to 100 tons of fish and reduce it on the spot into the most useful commercial commodities.

Since 70 to 75 per cent of the weight of the fish is water it is obvious that a great deal of handling expense can be saved. The ship is virtually a floating factory. The coarser kinds of fish are shredded in hacking machines and after passing through dryers are ground into meal. The finer grades are cleaned, cooked and canned. These cans are made in a complete can making plant aboard. In another part of the ship oil is extracted from fish livers. When the ship docks after a trip it has a stock ready for the consumer.

A. S. M. E. Student Branch

The American Society of Mechanical Engineers is a universal organization of men engaged in engineering, chiefly in mechanical engineering, having a total membership of approximately 20,000 members in all parts of the world.

It is a mutual benefit organization its chief purpose being the promotion of the profession of mechanical engineering and to conduct investigations and set standards governing that profession.

The U. of I. student branch is one of 99 similar organizations, located in other leading technical schools in America and affiliated with the national organization.

The various student branches through this affiliation are granted many of the privileges of the organization's regular members, such as purchasing any of the society's publications at special membership prices, use of the society's employment bureau, and the right to receive technical bulletins and papers of the organization free of charge.

The purpose of the student branches so to bring together the students taking M. E. to a closer contact with their instructors and members of the national organization. To carry out this purpose these meetings the business of the organization is first discussed and is followed meetings are held twice each month. At by a short talk by a man from some en-

(Continued on Page 174)

PAGE EINSTEIN

A certain chap had an old hack that kept him poor buying gasoline. Recently he bought a new set of tires that were guaranteed to save 15 per cent of his gas; a new carburetor that saved him 25 per cent; a new transmission that saved him 15 per cent; a new oil that saved him 15 per cent; a new water pump that saved him 20 per cent; a new set of valves that saved him 20 per cent; and a new rear axle that saved him 18 per cent; now he has to stop every 100 miles and bail out his tank.

—*Wisconsin Engineer.*

* * *

The old doctors watched each move of the student doctor as he amputated the man's leg. Upon finishing, the student said:

"Well, was it done correctly?"

"Yes it was done correctly, but you've made one slight mistake. You amputated the wrong leg." —*Purdue Engineer.*

* * *

"I'm twenty-one today, but I can't vote."

"Why?"

"There's no election."

—*Purdue Engineer.*

* * *

"Just think, man has learned to fly like a bird!"

"Yeh, but he can't sit on a barb wire fence." —*Exchange.*

* * *

A young lady who wanted to keep up with the latest styles went into a dry goods store and called for a pair of rolled hose. The clerk was equal to the occasion—with a little to spare.

"Have a seat, miss," he said with alacrity; "we roll them free of charge."

—*Kansas State Engineer.*

* * *

"Jakie, do you know what dense is?"

"Dense is vot mine sister does mit every muscle in her body ven she's in the ballroom." —*Purdue Engineer.*

* * *

He-sez: "You didn't know who I was at the game yesterday, did you?"

She-sez: "No, who were you?"

—*Kansas State Engineer.*

* * *

Lady: "Do you do anything in the nude, Mr. Von Dobber?"

Artist. "Just my morning shower, madame." —*Exchange.*

* * *

First Papa: "Do you think your son will soon forget all he learned in college?"

Second Papa: "I hope so—he can't make a living necking."

—*Columbia Jester.*

A careful girl is Mary Dunn,
She never stands against the sun.

—*Yellow Jacket.*

* * *

"A pretty snappy suit," said the baby as he was put into his rubber panties.

—*Wisconsin Engineer.*

* * *

If you get caught in hot water be nonchalant. Take a bath.

—*Annapolis Log.*

* * *

Heard the one about the Scotchman who always drank a pint of whiskey before going to bed so he can sleep tight?

—*Ohio State Engineer.*

* * *

Hubby: "Gee, but I miss that old spittoon!"

Wifey: "That's precisely why I took it away." —*Wisconsin Engineer.*

* * *

Bond house clerk (dictating to steno): "Do you retire a loan?"

Steno: "No, I sleep with grandma."

—*Wisconsin Engineer.*

* * *

Jack: "C'mon, slip us a kiss."

Jill: "Naw, I got scruples."

Jack: "That's all right. I've had 'em twice." —*Rose Technic.*

* * *

When a diplomat says "Yes," he means "Maybe," and when he says "Maybe" he means "No," and if he says "No" he's no diplomat;

while

when a lady says "No" she means "Maybe," and when she says "Maybe" she means "Yes," and if she says "Yes" she's no lady. —*Exchange.*

* * *

Three fraternity men died about the same time and went to heaven together. St. Peter was examining them at the gate and assigning them to their places. He turned to the first and said:

"Well, what were you down on earth?"

"I was a Sig Ep."

"Well, you can sit down over there at God's left."

St. Peter then turned to the second and asked him the same question.

"I was a Sigma Chi on earth."

"Well, I guess you can sit down at God's right."

The third fellow then advanced to be recognized, stuck out his chest, and proudly announced:

"I was a Beta."

St. Peter looked puzzled, scratched his head, and finally said:

"Guess you'll have to get up, God."

* * *

Old maids wear cotton gloves because they have no kids. —*Exchange.*

DEFINITION

Bachelor: One who didn't own a car when he was young.

—*Wisconsin Engineer.*

* * *

"Why this office is a regular oven."

"It ought to be. It's where I earn my daily bread." —*Exchange.*

* * *

"I hear he was a big gun at college."

"That so? What kind?"

"A sort of smooth bore."

—*Purdue Engineer.*

* * *

"Mygawd," cried the tight as he crashed into a gas station. "I've struck oil." —*Purdue Engineer.*

* * *

Judge: "I fine you a dollar and ten cents for beating your wife."

Prisoner: "What's the ten cents for?"

Judge: "Federal tax on amusements."

—*Wisconsin Engineer.*

* * *

Jake: "Who's this guy Timken?"

Ache: "I'm not sure, but I think he's one of these Holy Roller fellows."

—*Purdue Engineer.*

* * *

Pat was tired of war and longed to go back to his friends. He had served in the army of the Potomac for two years and was anxious to be free for a few days at least. So he went to the captain and said: "Captain, I have been in the army two years without a furlough. I would like to go home for a few days to see my dear wife and children. I am sure they would all be very glad to see me. May I have a two weeks' leave of absence?"

"No, Pat," replied the captain, "I have just had a letter from your wife asking me to keep you here as long as possible. While at home you get drunk and beat her; I think you had better serve your term."

Pat turned around and asked the captain: "Captain, will you put me in the guard house if I tell you one thing?"

"No, Pat."

"Captain, two of the biggest liars in the Army of the Potomac are in this tent; I am one of them. I have no wife."

—*Wisconsin Engineer.*

* * *

Voice from above: "Mary!"

Voice from below: "Yes, mother?"

Voice from above: "The clock has struck twelve three times now. Let it practice one for a while."

—*Wisconsin Engineer.*

* * *

The big difference between the stuff that the student of today drinks, and the stuff Rip Van Winkle drank is that Rip woke up. —*Exchange.*

TIME—THAT TOUGH OLD TESTER—FINDS A FOE THAT FIGHTS HIM OFF

Many generations ago, Time—That Tough Old Tester—began his fight with genuine puddled wrought iron. Against that sturdy metal of which Reading 5-point pipe is made, Time first used his most potent weapon, corrosion.

Year after year after year, Time poured his corrosive mixtures over and through 5-point pipe trying to set in action the destruction which men call rust. But no loop-holes could Time find—filaments of silicious slag barred the way. Only pipe made of genuine puddled wrought iron has proved that it can thus fight off the test of Time—the only conclusive pipe test known.

Make your first cost of pipe the last cost, avoiding damaging leaks, by insisting on Reading genuine puddled wrought iron pipe.

READING IRON COMPANY, Reading, Pennsylvania

For Your Protection. This Indented Spiral Forever Marks

All

5 POINT PIPE
READING
GENUINE PUDDLED WROUGHT IRON
RESISTS CORROSION · HOLDS COATINGS · THREADS EASILY · WELDS BETTER · DEFIES VIBRATION

GENUINE PUDDLED WROUGHT IRON
READING PIPE
DIAMETERS RANGING FROM 1/8 TO 20 INCHES

Science and Invention Have Never Found a Satisfactory Substitute for Genuine Puddled Wrought Iron

AMONG US

Each year it is the custom of the Technog
six men, seniors in the engineering sch
years here, who have, as it were, ad
campus. These men are chosen by
seem to us the best engineers, no
other activity honors, but bec
more, within and without, t
the engineering school. S
partially—we have tried
rather than prejudice.
six outstanding eng
'30. May their
continue to be
have their
the Univer

R. C. OELER

W. A. HEINZE

R. A. RODGERS

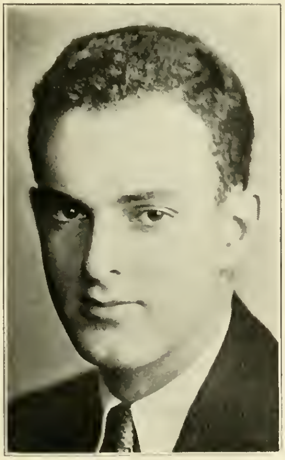
These faces are all well known and a few words will be devoted to their outstanding achievements here on this campus. R. C. Oeler, M. E., won three letters on the gym team and was awarded Big Ten Conference Honor Medal for superiority in athletics and scholarship. He has served as president of Tau Beta Pi one year. W. A. Heinze, M. E., has been prominent in publication work and, for the past two years, has been a member of the Illini Board of Control. R. A. Rodgers, Arch., won three

ENGINEERS

h to bring forward the names of five or , who have been outstanding in their four ' a little more to our glory here on the junior committee, not because they ecause they have won letters or e as a group, they have done epresent on the campus, and men must be chosen im- choose them so, on merit , may we present again, ers from the class of s after graduation successful as ur years at y of Illinois

J. J. Foreth

F. W. Holbrook



J. W. DeWolf

letters in track and was a member of a World's champion shuttle relay team. J. J. Floreth, M. E., gained military honors as Lt. Colonel in the University Brigade; and on the field he was awarded two letters in soccer. F. W. Holbrook, C. E., won three letters in swimming and was Big Ten Champion of the breast stroke. J. W. Dewolf, R. E. E., has been prominent in Engineering activities as a member of Tau Beta Pi, and has been very active in dramatics, serving as senior business manager of the Theater Guild.

Alumni Notes

(Continued from Page 167)

JACOB H. WALLACE, m.e. '03, died Janu-ry 23, at his home in San Diego, Cali-rnia. He was connected with the city ngineering department there. He was orn March 8, 1877, at Altamont, Illi-ois, where he attended grammar and gh school. He was a member of Tau eta Pi and Sigma Xi. Upon graduation went to the University of Missouri to ach for a year. After that he moved the University of Colorado, where he ecame a professor. Since 1909 he has en with various commercial engineering ompanies in Denver and other western ties. He went to San Diego in 1924, ter becoming chief engineer.

FRANCIS O'DONNELL, c.e. '11, is chief ngineer of the gas and electricity de-artment of the city of Chicago.

PHILIP D. GILLHAM, c.e. '04, is a civil ngineer for the Kentucky state highway epartment and lives at Frankfort, Ken-cky.

FRANK A. RANDALL, c.e. '05, has been ected a member of the board of directors the Collegiate Club of Chicago. He is so head of a group in the membership ampaign and a member of the ways and eans committee.

CHARLES HARRIS, arch. '10, of the firm Harris and Spangler, Decatur, has en named supervising architect of a emorial fountain to be erected in De-atur in honor of the late M. L. Harry, vision manager of the Illinois Power nd Light corporation. RODNEY SPANGLER, rch. '21, is his partner. Both were form-ly in the office of the supervising archi-st of the University.

WILLIAM G. HILLER, m.e. '10, of Route Peoria, died December 28. He was an ficiency engineer with the Central Illi-ois Light company. Before this, he had en associated with the Copper Queen onsolidated Mining company at Bisbee rizona.

D. D. WILLIAMS, c.e. '07, is a civil en-neer and southern erection manager for e Chicago Bridge and Iron works.

JOHN W. THOMSEN, c.e. '10, is vice-esident of the Staupp Brothers Bridge nd Iron company of St. Louis.

JOHN V. SCHAEFER, m.e. '98, president the Cement Gun Construction company, author of an article in a recent copy the *Engineering News-Record* dealing ith his line of work.

BURT L. ANDERSON, e.e. '07, is assistant the president of the Union Switch and gnal company of Swissvale, Pennsyl-ania.

FRANK GOODSPEED, arch. e. '09, is as-ciated with the Illinois Engineering ompany of Chicago, doing both sales and ngineering work.

CHARLES S. POPE, c.e. '09, is vice-presi-ent of the Central Valve Manufacturing ompany at 231 East 95th street, Chicago.

LOUIS E. FISCHER, mun. e. '98, president the Illinois Terminal Railroad system, now planning a new route for the lines to St. Louis.

A. E. HORST, m.e. '11, was elected president of the Associated General Contractors of America for the year 1930 at the eleventh annual convention which was held January 20 to 23 in New Orleans.

JOHN KUHL, arch.e. '13, is a general building contractor in Los Angeles with offices at 7360 Beverly boulevard.

GEORGE A. LUERS, e.c. '13, is superintendent of pleasure drives and park districts in Springfield and is a director of the Chamber of Commerce.

Contemporary Engineering

(Continued from Page 168)

gineering company, an instructor in the University, or a film on some subject related to engineering is shown. Outside of the regular meetings, the student branch sponsors an annual smoker, annual banquet, and an annual picnic for mechanical engineering students.

The local student branch of the A. S. M. E. has at present 126 student members, 39 of which are seniors, 45 juniors, 21 sophomores, and 21 freshmen. In addition to these there are several faculty members.

The officers of the organization are:
Advisory president—Prof. O. A. Leutwiler.
President—W. S. Benjamin.
Secretary—V. L. (Vern) Durrestein.
Treasurer—W. R. (Bill) Reinbold.

At the last meeting, May 7, a five reel film entitled "Arteries of Industry" was shown. These meetings are held in the lecture room in the M. E. Lab. and are open to anyone interested whether he is a member or not.

V. L. Durrestein.

Departmental Notes

(Continued from Page 165)

Wiegand, R. L. Manville, L. R. Solomon, C. M. Gardiner, R. P. Honold, V. W. Joslin, C. H. Rapp, K. C. Lyon, W. J. Strain, P. B. Evans, S. P. Langhoff, K. J. Caddy, A. S. Davis, E. C. Franzen, R. K. Cook.

The last meeting of the year was an election and installation of new officers, a short discussion of activities for the coming year, and a report of the financial condition of the organization.

Pi Tau Sigma

Pi Tau Sigma, honorary mechanical engineering fraternity, held its regular spring initiation banquet Sunday, May 4 at Newman Hotel. At that time six juniors were initiated, namely, V. W. Joslin, C. E. Ford, B. E. Boyd, G. O. Christensen, R. H. Newell, and M. K. McAnally. The chapter has now a total active membership of twenty-seven. The officers of the organization are:: C. Y. McCown, president; R. P. Honold, vice-president; K. F. Eklund, corresponding secretary; J. F. Schroeder, recording secretary; and R. Roman, treasurer.

—*K. F. Eklund.*

Scarab

Scarab Professional fraternity announces the following men who were initiated on May 6. *Architecture*:—J. J. Fitzpatrich, W. F. McVaugh, T. Christenson, F. W. Salogga, A. E. Gullinger, B. E. Rine, C. H. Vogtborg, R. J. Schauer, F. A. Plumbo, K. H. Lind, R. W. Graham, B. C. Gerber, F. Reed, and J. E. Ferry. *Arch. Eng.*:— D. E. Thal, V. C. Swanson, W. A. Strandin, J. B. Mochenhaupt, P. B. Byrne, and M. Turley. *Landscape Arch.*: R. H. Griffith, L. F. Rischer, J. G. Roberts, T. B. Forbes, and R. I. Ellifrit. Scarab was one of the fraternities helping to sponsor the Fine Arts Ball. A pledge dance was held April 25.

Gargoyle

Gargoyle Society held their spring initiation at the Urbana-Lincoln Hotel Sunday, May 4. Seven juniors were initiated: *Architectural Engineering*: J. N. Pirok, J. E. Spann, T. Ito, and L. S. Sutherland. *Architecture*: K. Lind, A. Klasing, and F. J. Rose.

Sigma Tau

Sigma Tau initiated nineteen junior engineers at its semi-annual ceremony held at Inman Hotel Sunday evening, April 27. The initiation was followed by an elaborate banquet at which Prof. L. H. Provine of the Department of Architecture ably filled the chair as toastmaster and entertained all with his wit as he introduced the speakers.

President M. F. Carlock welcomed the initiates into the organization, and in response to his talk F. K. Eklund arose and spoke a few words. Prof. LeRoy Tucker, a graduate of Illinois and instructor in the Department of Theoretical and Applied Mechanics, told of his experiences among engineering schools of the South. Prof. Hardy Cross entertained all with wit and wisdom as he sketched the "Big Job You Will Get." The program closed with a speech by Prof. W. C. Huntington on the "Changing Status of the Engineer."

Those who were initiated include: J. N. True, M. T. Ekovich, F. K. Eklund, C. E. Ford, V. W. Joslin, S. P. Langhoff, C. E. Staples, M. M. Culp, K. C. Lyon, Bob Rugh, R. J. West, W. P. Burglund, W. J. Strain, P. B. Evans, Art Klassing, W. T. Cooper, M. E. Dean, and A. Mabon.

Eta Kappa Nu

Three juniors were initiated into Eta Kappa Nu, honorary electrical engineering fraternity, last Sunday evening, May 4, 1930, at a banquet held at the Inman Hotel. The names of the initiates are:: G. E. Flodin, J. H. Armstrong, and G. W. Pickels. Informal initiation was given to the men Thursday evening in the Electrical Engineering Laboratory.

Most of the seniors who are graduating this June have decided which of the numerous branches of their profession they are going to enter after Commencement. Celso Gentilini, C. E. O'Donnell, and W. H. Formhals are going to work for Westinghouse Company. R. C. Webeck will be operating a power plant in Kewanee, Illinois. H. A. Manual is going to build synchronous motors up in Minneapolis. C. A. Huebner and W. T. Cooper are going to be exposed to the Central Station Institute Course offered by the Insull Utilities group in Chicago. S. R. Jordan just can't think of leaving his Alma Mater to go to the dogs, so he is going to come back in the fall and take graduate work with the intention of getting a Master's Degree and then perhaps teaching the juniors and seniors of the future. The rest of the actives are just waiting for that million dollar job to walk up and bite them.

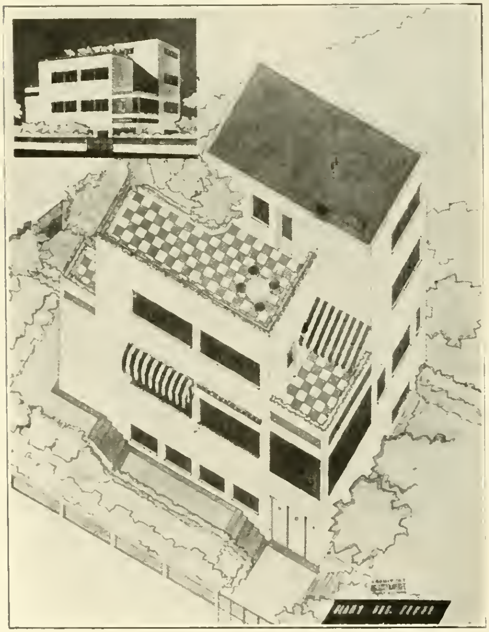
Modern Tendencies in Architecture

(Continued from Page 158)

4. Vista or view from room to room.
5. Outlook and exposure.

Recent tendencies in house construction seem to be in favor of smaller houses. But, while most people seem to prefer a smaller house, the average home-builder insists upon larger rooms, especially those who have lived in apartments or the cheaper commericial houses. The "restfulness of uncluttered space" appeals to American women more insistently than ever before. Where lack of funds or space make it impossible to have two rooms of desirable size, most people prefer one large room (doing the duty of two rooms) to two smaller rooms. Thus the dining room and living room are now often combined, while tiny bedrooms disappear in favor of bed closets.

While there has been, for the past few years, a marked tendency toward the erection of period-style houses, such as Colonial, Spanish, English, French, and



A Modern German House

the like, there now seems to be a movement toward something more expressive of the materials used and more completely reminiscent of our life and thought. This movement, so far as residential types are concerned, has, however, not become so apparent as in our commercial, educational, and religious architecture, and the *close* student of modern material progress is forced to admit that our architecture pretty generally and our houses particularly are quite antiquated, if not almost medieval.

The momentum of old art forms or perhaps a certain artistic inertia with respect to new forms seems to bind us. Thus, although we have had the incandescent electric lamp for fifty years, we have not yet learned its meaning or solved its artistic expression, and still insist upon constructing medieval candelabra with fake white cardboard candles and flame-shaped bulbs. But I must not allow myself to multiply the great number of insincerities we practice, for I would consume my time and fail of my purpose.

Some observations upon what is the matter with the present house-plant physically and artistically may, however, not be out of place. Perhaps one of the most serious objections to the present-day American house is that it is over-heated. This is because the humidity problem has not at all been solved, and with low humidity we have to have high temperatures in order to feel comfortable. The result is that our homes are dry kilns that effectively wreck our furniture, our books, and our musical instruments and seriously affect our health. This condition, destructive to property and detrimental to health, is one crying for scientific investigation and an economical solution.

Correct humidity involves sweating windows in cold weather and most people seem to prefer air that is too dry for both us and our belongings rather than have condensation upon the windows. Correct humidity seems to call for double window sash wihh provision for drainage in case of condensation. Moreover, wood as a material for window sash under ideal conditions of humidity is, because of its expansion and shrinking, not ideal. A more nearly correct material would seem to be a welded steel frame into which the glass is directly set. Even this can be improved by the substitution of some non-corrosive metal or some plating of the steel, or perhaps the use of the much-heralded rustless steel.

Casement windows capable of being closed as tightly as a refrigerator door set double so as to entrap an air space between would seem to come nearer a solution than we have at present. The development of a good, workable, and cheap *steel* or *expanded-metal* double-hung window sash might solve this problem.

The advent of the new "Vita" glass, which admits all the beneficial rays of sunlight may make of our hot houses something that more nearly corresponds to the out-of-doors, if we will but profit by its use. Moreover, an entire revision of the whole plan problem may result, if we take up seriously this problem of orientation in order to capitalize upon sunlight. My own view is that the future house will have far more windows and windows placed far differently than is our present practice. Vacuumized correctly, they need not be a serious source of heat loss in cold weather.

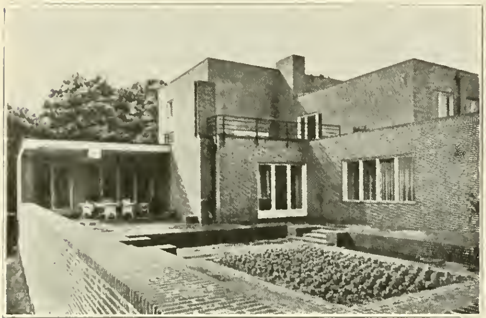
The whole matter of insulation (both against heat and sound) which has recently received some thought, holds untold benefits for future home-building. Made of refuse materials, like the bagasse of sugar-cane or from cornstalks, as Professor Sweeney of Iowa State College proposes, much material may become cheap enough that it can be used not only to keep houses warm in winter but to keep them cool in summer. Moreover, some cheap method of refrigeration which will permit cool air to be blown through our warm air pipes in summer, is a possible solution, if houses are adequately insulated and vacuumized sash are used. Certainly we can look forward to sound proof floors, walls, and doors in the very near future.

A more adequate flooring material is still one of the crying problems, and one that has not by any means been solved. The ideal floor surface should be soft, quiet, warm, cleanly, durable, yet easy to repair. Hardwood is not the solution, and as yet there is not a perfect material. Cork and rubber are probably the best materials now available, but they are still fairly high in price and not completely satisfactory, either physicially or artistically.

The problem of smut and soot in winter and the

consequent soiling of walls, draperies, upholstery, and rugs, to say nothing of the terrific burden of cleaning, is still one of the outstanding problems in home operation. Whether or not it will ever be possible to burn bituminous coal in the private home plant without a consequent accompaniment of filth, I rather doubt. Certainly, the present method of cleaning warm air ducts, even with the so-called vacuum method, is not all that is claimed for it.

A solution especially in Illinois, would seem to be available in the burning of the coal at the mines for the generation of electrical energy that could be used to heat our homes. I am not conversant with the economic aspect of this matter, but if conducted upon large enough scale, it would probably be possible to furnish the electricity at a rate cheap enough for heating purposes. In certain parts of our land, endowed with much sunshine, the storage of solar heat by some mechanical process might be devised. The domestic water supply is now heated by a solar process in many parts of the southwest.



A Modern German Residence in Berlin

While we are learning the splendid values for healthful living to be found in fresh air and sunshine, we are also learning that ground air at night is not the best. Moreover, mosquitos and other insects hover near the ground and upon bushes. I look for a rapid utilization of the roof, not only as a daily recreation ground for sunny winter days, but the regular lounging place for summer evenings. Peoples in Mediterranean lands have long ago learned to utilize the roof; why should we not apply this knowledge?

All these suggestions, sketchy as they are, are only signs of a deeper movement—a movement which, through the application of science, seeks to make a better, cleaner, and happier world. Already the material adjustments have begun to take place, but strongly the aesthetic expression has not as yet caught up. Hence our childish worship of historic forms that ill befit modern living physically, and ill express it spiritually.

In France, Germany, and the Scandinavian countries the artistic solution is being attempted with a splendid and fresh enthusiasm, but so far in America, where freedom from precedent should prompt us to clear thinking, we have been very conservative and most of the attempts at modernity have been childish imitations of what is being done abroad. So long, apparently, have we been concerned with adopting the manner of foreign lands, that now, when the 'makings'" of a new architecture are at hand, we do not know what to do. This thing is clear: *we shall never get anywhere constructively if we accept the "moderne" simply as a new style and attempt to adapt it by an imitative process to American uses.*

Style is *not* the thing. We must begin at the beginning. We must first concern ourselves with utility—with the mechanical expression, as it were, of American life and living. When some of these problems have been solved, the lines, the forms, the spirit, *the style* if you will, will follow.

Take the automobile. It started out as an ugly, ungainly, horseless carriage, but within twenty-five years it has become one of the trimmest, handsomest expressions of American life. It has real style and that style does not consist in becluttering the machine with reminiscences of Roman chariots, French coaches, or even American Colonial stage coaches. It makes no reference to its horselessness by placing an ornamental horse or even a horse-head upon its hood. It stands on its own logic, and lives or perishes by its artistic expression of its function.

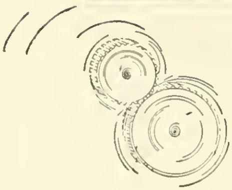
Architecture, on the other hand, is not so. It has up until the present, been backward-looking instead of forward-looking, and has concerned itself with slavishly copying the past when it should have been solving the artistic problems of the present, and anticipating the future.

But in Europe today, and to a small extent in America, the realization that we face new problems and new conditions is bringing forth new forms to meet these conditions. The large scale of modern business—the business of the combines (whether they be banks, manufacturers, or chain groceries) the tremendous scale of transportation, surface and aerial, the delegation of functions originally seated in the home to the various social agencies—in general the rapidly changing character of American living—these facts call for a changed form of house, a changed street system—in short, a new type of city.

What that new type of city will be, I do not feel qualified even to guess. This, it will take all the creative ingenuity of sociologists, economists, engineers, landscape architects, and architects to determine. It is so vast and far-reaching a problem that no single class can solve it.

But while I may not say just what the future city is to be, I may guess at the general type of the future house. Precise predictions, in so fluid an industrial age as is ours, are always dangerous, but I look for a steel-framed, electrically welded house, with tremendous glass areas, flat roofs for living and recreation purposes, interiors insulated against cold in winter and heat in summer, vacuumized windows, correct humidity, the general elimination of wood as frame, floors, and perhaps as trim, the utilization of an increasing number of new synthetic materials, and a general form and membering that will produce a beautiful expression of interior utility and function with no archaeological references to past habitation whatever.

In Germany, concrete houses made of interlocking wall slabs, 1½ inches in thickness, with precast floor slabs made in factories, are being utilized, and what may be called a "mass-production" house, but one designed by architects, and having real artistic merit, is at hand. Whether or not America will take this tack, I do not know. I do expect, however, that the house of the very near future will become a cleanly, trim thing that solves its utilities and art expression as efficiently and beauti-



AMERICA TRAVELS IN HIGH

fully as do the modern automobile, aeroplane, or ocean liner.

Now this progress toward a new architecture will bring a serious re-orientation of garden forms and procedures, and while the general fundamentals of design will doubtless remain unchanged, all of our present notions of what constitute beauty will probably topple. I look for a trim, efficient, cleanly, "handsome is as handsome does"" type of beauty in the American house of the future, and I believe something akin to this will carry over into and be expressed in our landscape forms as well.

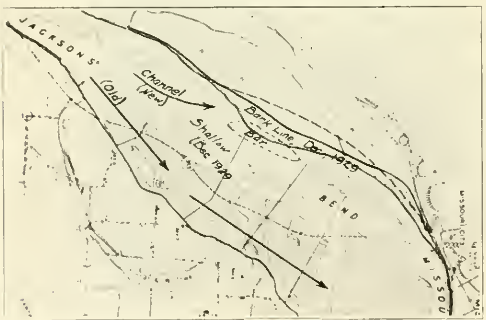
Missouri River Improvement

(Continued from Page 163)

speed of the current would make the stream unnavigable. Revetment will be used to prevent concave banks from further cutting; dikes will be thrown into places where the engineers want the river to seek new channels. No changes can be made in the channel without considering the downstream "carom effect" and making proper provision therefor.

The improvement subproject at Lexington is a good example of application of the first two principles, though for certain reasons it was seen fit to violate the third one in this stretch. In 1927 a series of five dikes was driven in 35 feet of water in Sni Bend (figure 1). Filling action began immediately. Notice that in 1928 there are two patches of willows on the accretion.

It was decided to iron out the double S-curve between that point and mile 321. The dikes driven or projected for that purpose are shown dotted on the map, and the dotted line tangent their ends is the proposed rectified bank line which will some day approximate the true bank of the river. The extensions of the lower Sni dikes were for the purpose of creating a gentler curve. The left bank dikes at mile 326 will eventually cause a



Map of a Portion of the River

complete shift of the channel back to tangency with the right bank bluffs. Nearer the bridge, right bank dikes (figure 2) are tending to throw the channel back under the navigation spans, and further downstream left bank dikes are blocking the final loop and completing the stabilization.

Improvement Structures

Revetment is the commonest form of bank protection. It consists of a smoothly graded, paved bank and a willow or lumber mattress securely anchored and heavily ballasted which lies on the bed of the river in front of the bank and prevents scouring. (Figure 3).

It is customary to grade the bank with a slope of one on three, by hydraulic methods. During the process sharp points of the bank are cut away, or faired out to gentle projections. The graded bank is paved with one-man stone.

The mattress may be either willow or lumber. It is 86 feet wide and extends the length of the revetment. If of willow, it is woven a foot thick of willows having a diameter of from 1 to 2½ inches and a length of 10 to 25 feet, and reinforced with 3/8 inch galvanized strand. If of lumber, 1″x4″ material is used. This mat is quite flexible and adjusts itself to contact with a very irregularly shaped stream-bed. The upstream end of the mat is anchored by cables slanting upstream to piles driven on the bank, and a line of anchor piles extends the length of the mat along the inside edge of it, spaced 16 feet on centers and driven to 15 foot penetration. One cubic yard of stone is used per 100 square feet for ballast on willow mat, and .6 cubic yard for lumber. Cribs on the outer edge of the mat carry additional stone ballast.

A minimum plant for a revetment job might be a towboat of 80 horsepower, one floating pile driver, a standard mattress barge, and four standard Missouri River barges. In addition the contractor would need a

Fig. 6. Mat Laid on River-Bed Revetment for Bank Protection

quarter-boat, barges for storage, and gasoline launches. The average revetment job is figured at $21 per linear foot.

The standard pile clump dike is the most common structure used for changing the channel. (Figures 4 and 5). The piles are of yellow pine, ash, hickory, pecan, sycamore, cypress, oak, or elm. They average 16″ diameter at the large end, and are customarily driven to 20 foot penetration.

The three piles for each clump are driven in a roughly equilateral triangle with a seven foot side, and the clumps are spaced 15 to 24 feet on centers, according to the desired strength. There may be two, three, or four rows of clumps in the standard dike. The piles of each clump are drawn together and fastened near the top by seven turns of 3/8 inch galvanized strand, drawn taut by mechanical power and secured with boat spikes.

After clumping, stringers are put in place, wedged in by the pile driver, and cabled to each other and to one pile of each clump by three turns of the strand (see figure 5). The lap of stringers must be at least six feet.

Ordinarily specifications call for 104 feet of paving at the root of each dike. It is constructed as previously described. A line of piles set in postholes continues the line of the dike up the slope and constitutes the "root."

After construction all piles are cut to the proper elevation by an electric bandsaw. To prevent scouring of the bed at the dike line, and the consequent washing away of the dike, mat similar to revetment mat is laid on the river bed along the dike axis. (Figure 6). Its construction ordinarily precedes the driving of piles.

Dike work is figured to average $30 per linear foot.

Retards are principally for bank protection. They are constructed of trees lashed together with cable and anchored at the outstream end to concrete deadmen. Anchor cables also slant diagonally upstream from the outer end and intermediate points to deadmen on the bank.

There has been some objection to long retards, on the ground that they are liable to sink, but a mat laid below them tends to prevent this, and a 1929 subproject called for over 6,000 feet of retards, with the longest one 2,200 feet in length.

Method of Location

For the study of river conditions aerial maps were made of the lower river on a scale of 2,000 feet to the inch. They show all topography in the river bottoms. Because of the large number of detailed features which it is possible to locate from the photographs, even small changes in the river location can be determined by hunting up objects of topography, observing their relation to the new bankline, and sketching it on.

On these maps tentative layouts of dike and revetment work are made. A detailed map on a scale of 400 feet to the inch is then prepared of the vicinity of proposed work. The rectified bankline and projected structures are laid out on it, and then staked out in the field in such a way that the pile driver can be easily lined in at all times during construction.

Present Status

For actual construction, the government has four plants of its own on the river, and other work is done by contract. River conditions during the season just passed were unfavorable and the work has been retarded. It is not considered possible to have the river in shape for navigation before late in 1931, some months later than originally predicted. 1932, however, will see barges in operation.

Building the Coolidge Dam

(Continued from Page 156)

Sand and gravel for use in concrete making were obtained from a large bar in the Gila River about half a mile below the dam. A washing, screening, and crushing plant was installed here by the contractor and the graded aggregate was carried to storage bins at the concrete mixers by an aerial tramway which had a horizontal length of 2,200 feet and a total lift of 285 feet.

The mixing plant was located on the west side of the canyon above the top of the dam and was equipped with two Smith mixers, each of which had an output of two cubic yards of concrete. These mixers were fed by automatic measuring batchers located directly under the storage bins. The cement, which was carried by truck from the San Carlos warehouse, was unsacked and stored in a cement silo adjacent to the mixing plant. The correct amount of cement for each batch was weighed automatically before being fed to the mixers. The proportions of sand and gravel for each batch of concrete were measured by volume in Blaw-Knox batchers.

The construction work continued night and day with three eight-hour shifts. In the hot summer months no concrete was placed during the day and work on this shift was concentrated on the preparation of forms for night pouring. At night the deep canyon glowed under the illumination of brilliant flood lights which brought out every detail of the structure and the rigging and cast long black shadows into the darkness.

Building the form work for the dam was a major engineering problem in itself. In the first place, a surface which continually changed in shape and curved in every direction presented in the domes a difficulty which was overcome by the use of flexible wood panels which could be warped in any direction. As the domes in height the amount of over-hang increased, but the use of these 4x8-foot wood panels continued until the domes were leaning about 55 degrees with the vertical. This feat was accomplished by cantilevering out from each four-foot lift of concrete after it had set up, and for this purpose bent steel bars in the form of an inverted V were set into the dome concrete during each pour and the new forms tied to the apex of these V-frames. The framework for the final crown of each dome was carried by a system of four three-hinged steel arches which spanned the gap between the tops of the butresses where the clear span was about 140 feet. Wooden auxiliary trusses were suspended at right angles with the steel arches and these supported the remaining framework for the upper part of the domes.

The dam was completed and water storage commenced in December 1928. The program of construction had been carried through from start to finish without any serious delays and an excellent spirit of co-operation had been maintained at all times between the contractor's men and the government engineers. Six months later the power house equipment had been installed and was in operation. The water of the reservoir is now about 100 feet deep at the dam and the lake has already flooded over the historic Indian village of San Carlos, nine miles to the east. The successful development of this project will add about 80 000 acres of irrigated land to the Arizona desert and yet this is only one small step in the great service the government is doing in the reclamation of the west.

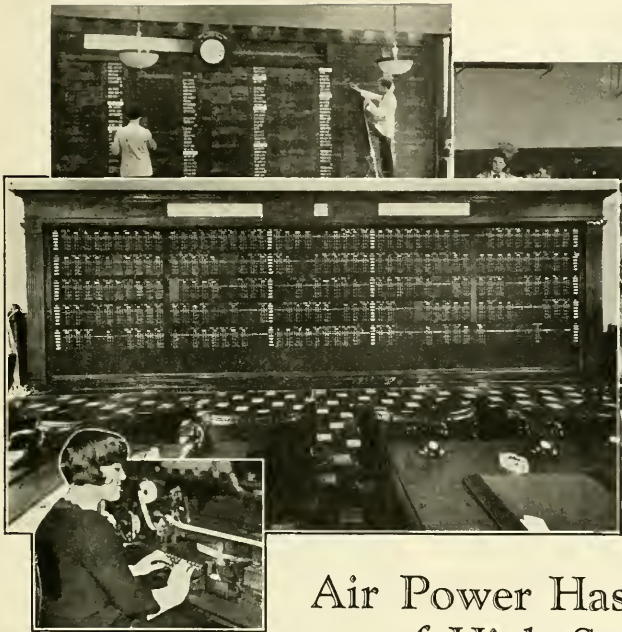
Highway Location in Mountainous Country

(Continued from Page 160)

At Grinell Creek another problem was solved in the same way. The old bridge over this creek was placed in such a situation that any high water was likely to wash it away. That spring an unusually high water had seriously weakened it. Another bridge at the same site would undoubtedly meet the same fate and the stream was also in danger of making a new channel. In order to clear up any uncertainty, at this point a survey was made of the land around the bridge for excavating a new channel. Detailed plans could then be drawn up in the office in the winter.

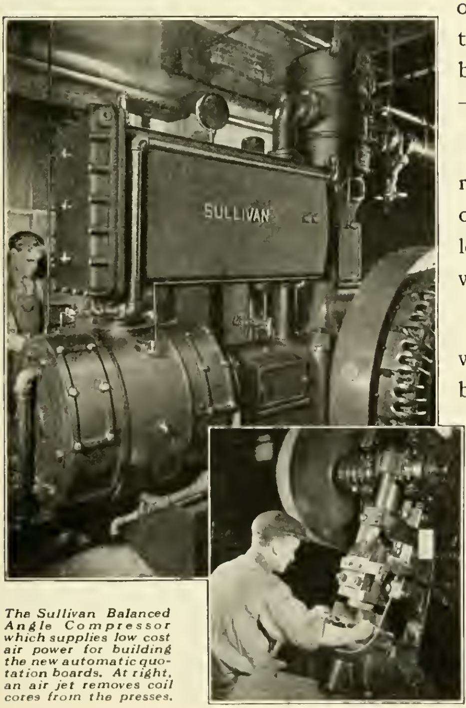
By the end of July one-half of the transit line had been run, and it was necessary to move the camp fifteen miles down the valley. Before this was done, however, it was necessary to run several alternate lines and to "Reference out" that is to mark the transit line at frequent intervals. One method of doing this was to set the instrument over a transit point, pick out a nearby tree which was blazed, a tack was nailed in it, and a hub was set on a line between this tack and the transit.

An interesting example of why the engineer must always check every detail of a problem occurred at this time. Three steel bridges had been built for the old road. It was noted, however, that they vibrated excessively. An examination showed that no room had



ABOVE: *During the recent crash, tickers were an hour behind.*

ABOVE: *She punches a key and the quotation appears simultaneously, in brokers' offices all over the country; securing a tremendous increase in speed, and reducing the chance of error to the work of one person, instead of hundreds of board boys*



The Sullivan Balanced Angle Compressor which supplies low cost air power for building the new automatic quotation boards. At right, an air jet removes coil cores from the presses.

been left between the abutments for expansion, thus causing stresses for which the bridge was not designed.

One of the last problems was again that of developing scenic possibilities. Figure 13 shows some curious rock formations which could not be seen very well from the old road. The new road was led on top of a hill in such a way that a better view of this scenery was obtained.

Highway location requires that a man be both a surveyor and an engineer. A surveyor is a technician, that is he is proficient at a task done a thousand times every day. On the other hand the engineer is subjected to many different kinds of problems every hour.

An engineer must be very versatile: first there are alignment difficulties so the engineer must be a mathematician and be able to compute the proper curves to fit around hills. At every river crossed there must be a culvert, and the engineer must know his hydraulics. He must be a woodsman to know the kinds of trees when running the line through timber. He must be a geologist to note the types of dirt and rock for excavation. He must be an athlete because locating requires great exertion. Lastly he must know how to handle men, because he is dependent on them for the accuracy with which his work is carried out.

The Chief of Party on this location was Mr. S. A. Wallace, Senior Engineer of the U. S. Bureau of Public Roads. The writer held the position of chainman and worked in the topography for the first month. For the second month he held the ranking of rodman and ran the transit for the completion of the work.

On to Colorado

Late in October, the University of Colorado will welcome the delegates of the Engineering College Magazines Associated who will hold their tenth annual convention at Boulder, Colorado.

The year 1930 could not hold a more pleasant prospect than a convention at the foot of the Rocky Mountains combined with a trip such as this one promises to be.

From the campus of the University of Colorado one looks westward upon the first rise of the Rockies, half a mile away. A few hours motoring brings one to such scenes of beauty as Estes Park, Long's Peak, Boulder Canyon, Arapahoe Glacier, Buffalo Bill's Grave, and a thousand well-known, quiet nooks—the old romatic stamping grounds of western cattlemen and miners. The Colorado Engineers are sure that their eastern fellow students will enjoy a rare treat in the fall and they are busy maturing plans for a unique convention. On to Colorado!

Gliding

The sport of gliding has assumed great proportions in America and the world for that matter. From humble beginnings in post war Germany the art of building and handling gliders has developed to some degree of perfection.

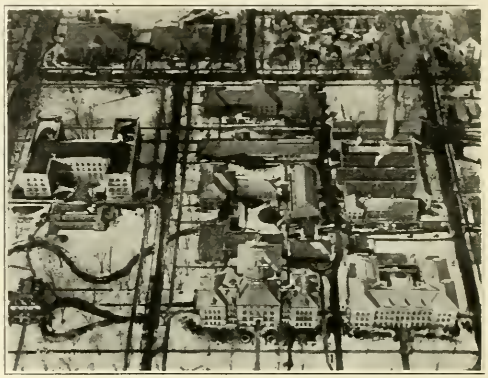
Many well known persons have taken active parts in operating gliders and many clubs are formed for the purpose of training pilots. But what practical use and what future application will these gliders have? Captain Hawks recently showed that long distance towing behind a plane is possible. This suggests aerial trailers for hauling freight; and as aerial life boats they may save many lives in air ship disasters. Greater applications than these should develop however. L. J. H.


Wherever, whatever men build
—giant dams, great reservoirs, towering skyscrapers, city streets, cross-country highways, long bridges and massive viaducts—in fact, wherever construction work is in progress, you will find the products of N. E. C.—National Equipment Corporation.
N. E. C., the greater name in construction equipment, now unites great names which have long stood for quality and integrity—Koehring, Insley, T. L. Smith, Parsons, C. H. & E. and Kwik-Mix—for greater engineering, greater service and greater realization of quality.
KOEHRING
Pavers, Mixers; Power Shovels, Pull Shovels, Cranes, Draglines; Dumptors.
INSLEY
Excavators; Concrete Placing Equipment; Cars, Buckets, Derricks.
T. L. SMITH
Tilting and Non-tilting Mixers, Pavers, Weigh-Mix.
PARSONS
Trench Excavators, Backfillers.
C. H. & E.
Portable Saw Rigs, Pumps, Hoists, Material Elevators.
KWIK-MIX
Mixers — Concrete, Plaster and Mortar.
Pardee Dam, California. Four 56-S Smith Tilters poured the 600,000 cubic yards of concrete shown here.
NEC
National Equipment Corporation
Milwaukee Wisconsin

The 3,000,000 Pound Testing Machine of Materials Testing Laboratory

(Continued from Page 154)

partments of Civil Engineering and of Theoretical and Applied Mechanics, and it will be limited in its use to research work. One project requiring a machine of this capacity has already been financed and is now under way. This is a series of tests on large reinforced concrete



Airplane View of the Engineering Group at University of Illinois

columns. Three other projects have been planned and are now in process of being financed.

The machine was built and erected by the Southwark Foundry and Machine Company, of Philadelphia, Pennsylvania, under license issued from the Emery-Tatnall Company.

Jobs—and Grades

Name, age, college, degree, outside activities—those are all among the first questions asked anyone of the many representatives of large companies who are seeking students from the universities. And then comes the question which makes some hesitate—"And what is your scholastic average?"

If grades did not count, then that question would never have been asked, but, unfortunately perhaps, they do. Grades, in the end, are the measure of the way you perform your real job here in school, and as that, they are an idication as to how you are likely to perform your real work afterwards.

So, the seniors and many of the juniors are beginning to find out why they should "try for marks." To you who are not that far along, may we who are almost through leave this thought—that grades *can't* be made in the last year alone.

He (on golf course): "Just look at that pretty girl dressed as a man. What are her parents thinking of anyway? I think it's disgraceful."

Golf partner: "That, sir, is my daughter."

He: "I beg your pardon. I didn't know you were her father."

Golf partner: "I'm not. I'm her mother."

—*Purdue Engineer.*

Using Gas for Arc Rupture

In these days of long transmission lines and intricate power networks, practically all high-voltage switching is done with oil circuit- breakers by the joining and parting of electrodes immersed in oil. The insulating oil, a petroleum product specially refined for this purpose, serves the double purpose of quenching the arc drawn as the electrodes part, and acting as an insulating medium to prevent flashing across the electrodes after they have parted and the circuit has been disconnected. For the highest transmission voltages, these circuit-breakers are very large and the biggest breakers today require from two to three carloads of oil at a filling.

In addition to their normal switching operations, circuit-breakers are required to operate in the event of a fault to disconnect the faulty section of the circuit before other portions of the system are affected. Modern large power systems are controlled by delicate relays so carefully set and adjusted that they will respond to any unusual conditions in the circuit and actuate the necessary circuit-breakers, causing them to open and isolate the portion of the circuit on which such conditions exist. If the fault or short circuit is allowed to remain, great damage may be done to costly generators or to other apparatus and the supply of power to consumers may be interrupted.

In the case of very serious short circuits, almost unlimited power may be flowing in the circuit at the time the circuit-breaker opens and the interruption of this flow of power in a fraction of a second represents the dissipation of enormous amounts of energy in the oil. To absorb this energy safely and in the shortest possible time is the problem of circuit-breaker designers. The drawing of a heavy-current arc in oil results in the generation of considerable quantities of gas due to volatilization of the oil in contact with the intense heat of the arc. The phenomena accompanying arc extinction in oil has not been thoroughly understood in the past due to the difficulty of observing its action, but this gas generated by the arc has in the main been regarded in the light of a necessary evil to be endured only because no other method of switching was available. In some quarters it has been regarded as a decided detriment since in the event of a prolonged arc, sufficient gas is sometimes generated to produce dangerous pressures in the arc rupturing chamber.

Engineers have lately discovered a way of utilizing this gas to extinguish the arc in a very much shorter time than has been possible hitherto. The amount of gas formed by an arc in oil is dependent on the length of time during which the arc persists, and these engineers have found that by generating gas at an even faster rate for a short interval of time, and by utilizing this gas more efficiently, they can decrease the time of arcing, extinguishing it much more quickly than has been done heretofore, and thus decrease the total amount of gas generated. Tests have been made with the new device in which an arc was extinguished in less than fifteen per cent of the length to which it was formerly necessary to draw an arc in oil.

This marked improvement in performance is accomplished by small arc-quenching devices known as De-ion-Grids located in the oil at the point where the electrodes separate and the arc is drawn. In the De-ion-Grid is a deep and comparatively narrow groove, closed at one end but open at the other. The length of the groove varies with the voltage of the circuit on which the breaker is applied. As the grid is located below the surface of the oil, a small portion of the oil body is entrapped within

the groove. When the electrodes part, an arc is drawn near the open mouth of the groove and is moved toward its closed end through the action of a magnetic field made by the arc itself acting on a suitable iron circuit. This movement of the arc against the entrapped oil in the groove keeps it in constant contact with fresh oil, the arc cutting its way through the entrapped body of oil in much the same way that an acetylene torch cuts a steel plate.

The intense heat of the arc causes the oil to be transformed into gas as the arc moves forward, and this gas in order to escape must pass transversely through the arc stream to the open mouth of the groove. The groove is so narrow in width that the arc occupies practically all of the space between its side walls and all of the gas formed must, accordingly, pass through the arc on its way to the open. It is this continual flow of fresh gas through the arc stream along its entire length that destroys its ability to conduct current and ruptures or extinguishes the arc in the shortest possible length of time. Thus, although the rate of gas generation is higher than that of previous oil circuit-breakers, all of the gas generated is used and used so effectively that the length of time during which formation of gas is taking place is greatly decreased and the total amount of gas formed is very much less than with previous circuit-breakers.

The De-ion-Grid is also much more economical in the use of oil than has been the case with oil circuit-breakers up to the present time. For any one rupturing operation only a very small portion of the entire oil body is used, that portion which entrapped in the groove at the time the arc is drawn. Immediately after the arc is extinguished, other oil rushes in to fill the groove and to be used in turn for the next circuit interruption. In this manner only a small portion of the oil in the chamber is exposed to the deteriorating action of any one arc and a breaker may be subjected to very much longer service before changing the oil than has been possible in the past. Previous instances have been known in which two or three short circuit interruptions have reduced the insulating value of the oil to a point at which the breaker required refilling with fresh oil before further rupturing duty was possible, while with the new device upwards of fifty short circuit tests have been made on a single body of oil without any marked depreciation in its insulating value.

The development of this device sets a new standard for high-voltage oil circuit-breaker performance and offers a solution to the problem present on every power system by providing a safe, positive and expeditious means for clearing faulty conditions on transmission lines and distribution networks.

"You don't mean to tell me that funny little man is your father?"

Kappa: "That is what mother has always told me."

—*Exchange.*

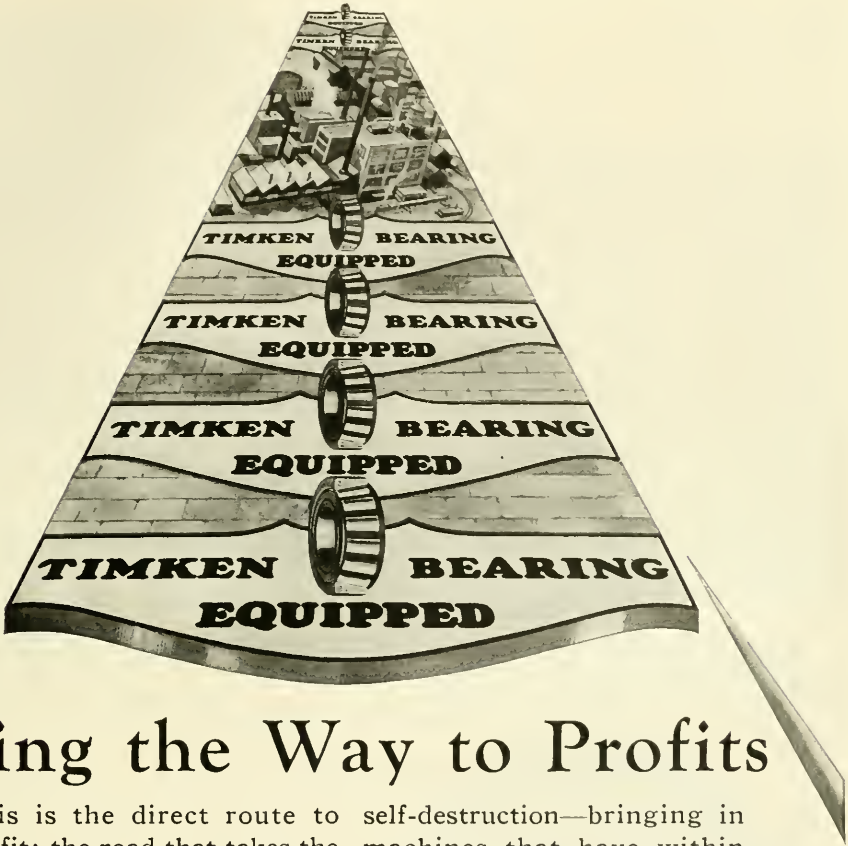
Instructor: "What is a sanitary sewer?"

Stude: You can't fool me. They're all dirty."

Joseph had been sent to bed by his mother for using profane language. When his father came home she sent him upstairs to punish the boy.

"I'll teach that young fellow to swear," he roared and started up the stairs. He tripped on the top step and even his wife held her ears for a few moments.

"You'd better come down now," she called up after the air had cleared somewhat, "He's had enough for his first lesson."



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TIMKEN *Tapered Roller* **BEARINGS**

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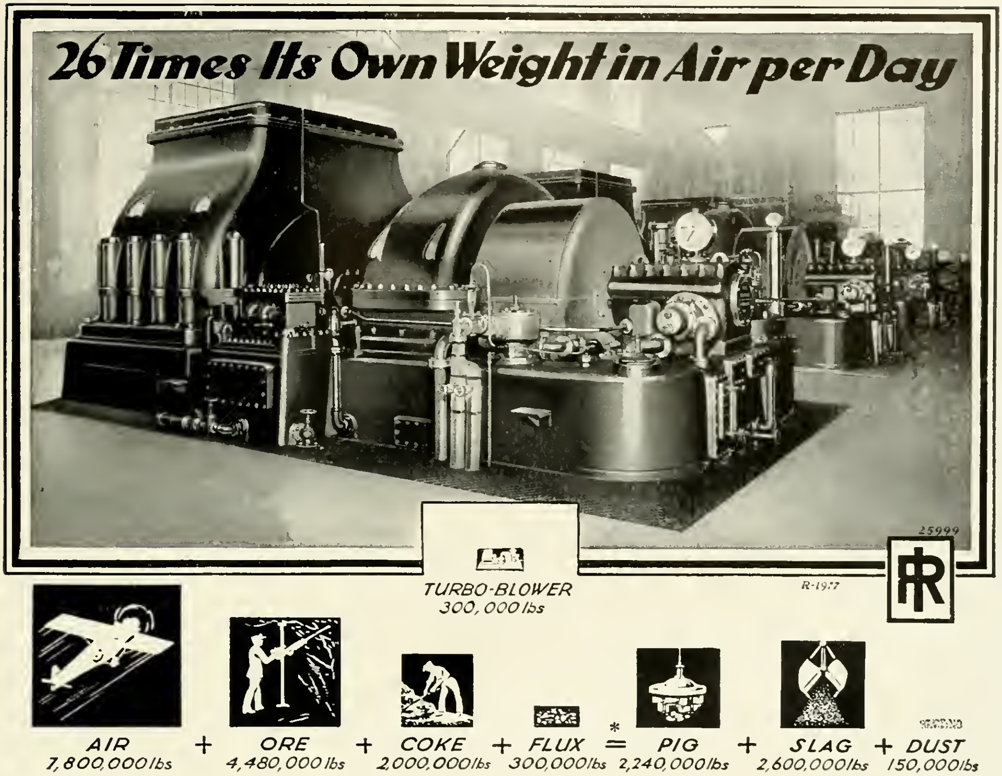

An Ingersoll-Rand turbo blower serving an average 1000-ton blast furnace handles approximately 26 times its own weight in air each 24 hours. More air is used than the combined weight of all other ingredients. This relationship is shown clearly by the above diagram, which picturizes the approximate daily consumption of a 1000-ton furnace.

*Balance of this equation is blast furnace gas

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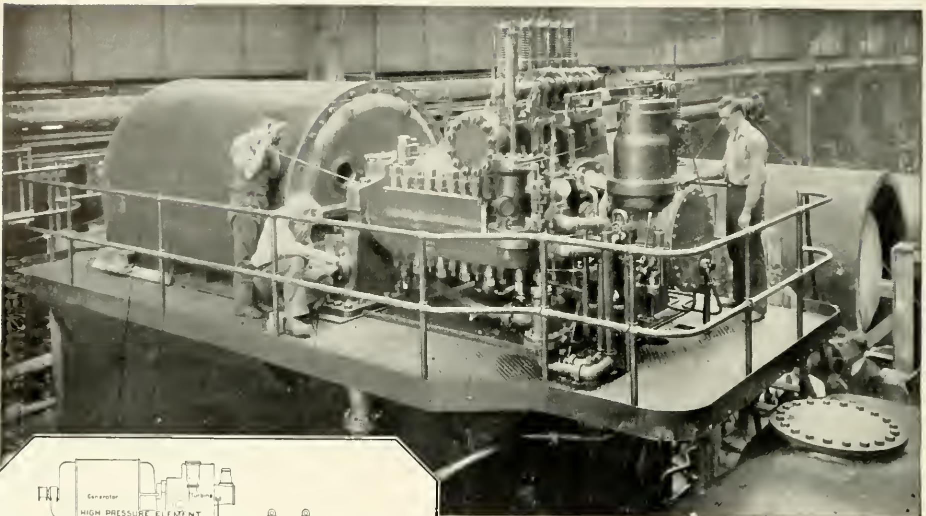

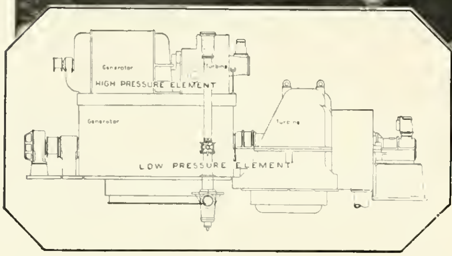

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Test men—veterans, as well as more recent graduates of engineering colleges—take charge of the machine after assembly, test for oil leaks, bring it up to speed and check balance in the initial run, and set the emergency and operating governors. Electrical tests follow after the generators are coupled on. This work is part of the training program for general, industrial, sales, or advanced engineering work with the General Electric Company.

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