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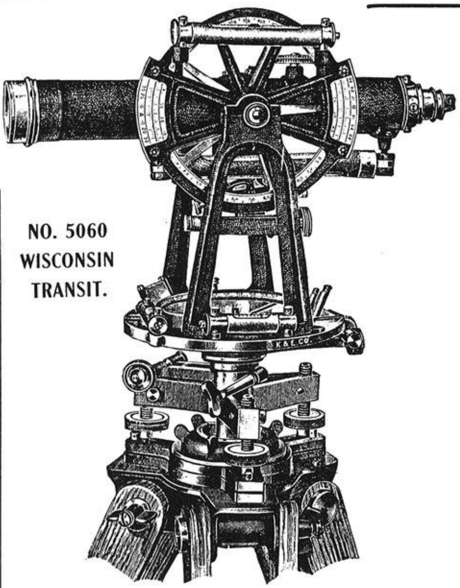

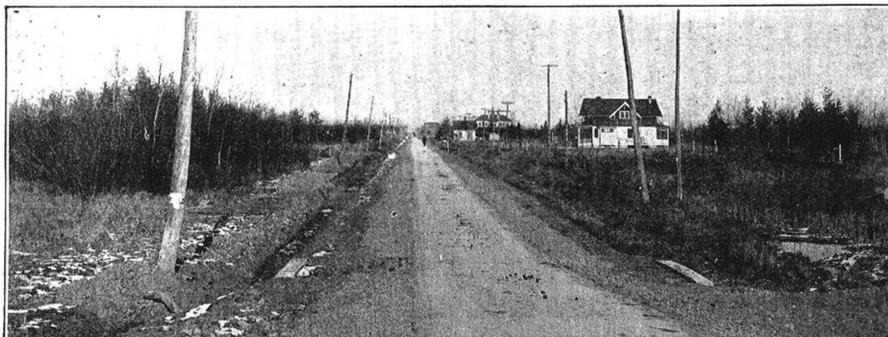

Tower Avenue Road, Superior, Wis. Length 10,560 feet—Width 9 feet. One course 8 inches thick at crown, 6 inches at sides. CHICAGO-AA used.

The Wisconsin Engineer

VOL. XX NOVEMBER, 1915 NO. 2.

SOME ENGINEERING AND ILLUMINATION FEATURES OF THE PANAMA PACIFIC INTERNATIONAL EXPOSITION

GEO. S. JOHNSON, *Assoc. M. A. I. E. E.*

Just within the Golden Gate fronting on the San Francisco Bay for a distance of two miles, the Exposition site offers a beautiful prospective, the three sides comprised of picturesque hills, forming a vast natural amphitheater. No site could have been selected which would offer greater advantages for displaying architectural features.

The exhibit palaces occupy the central portion, grouped about the Grand Court of Honor upon whose central front the great Tower of Jewels rising some 435 feet forms the centerpiece of Exposition architecture. For economic reasons these main buildings are separated not to exceed 150 ft., and so connected that visitors may traverse all without passing from under cover. The Machinery Hall is set to the east, Fine Arts to the west, and Horticultural and Festival Halls to the south of the group, while the "Zone" containing the amusements concessions, is at the east end of the grounds and the state and foreign buildings at the west.

The facilities which were to be provided were for a great city to be constructed in a year or two, serving their purpose for a few brief months. It took hundreds of engineers and ten times as many workmen to design and build the great buildings, roads, sewers, fire-protection, water, gas, electricity, transportation, steam and compressed air service before the great dreams of architects, sculptors and artists could be realized.

It will be the purpose of this paper to describe briefly some of the electrical problems and features involved.

The main problem was to distribute electrical energy economically, avoid unsightly construction, maintain good service and keep the whole in accord with the temporary construction.

It was soon found from an economical point of view that the exposition building arrangement seemed to have been laid out most carefully with consideration to the distribution of electrical energy. The exhibit buildings could be closed at sun-down so that the day load could then be shifted to decorative lighting.

A well designed conduit system permitted flexibility as to sectionalizing, the pulling in and *withdrawal* of cable at will, so that there was little capital tied up on account of cable lying idle, awaiting such time as it might be needed in service. This last reason militated against the use of armored cable although the ease with which it could be laid seemed quite attractive. During the construction period, the ground would literally be torn to pieces and the armor would hardly afford enough protection. Then too the landscape gardeners would require that the cable be in place before completing their beds. A fault would be more difficult to find, splices harder to make and it would have a lower salvage value.

A 1/8″ wall slip sleeve wood fibre duct was laid in sand and the whole contained in a wooden box or trough between manholes. Not only does this conduit system provide facilities for primary power cable but also for all arc cable trunks as well as the private telephone and signal system of the exposition. There are approximately 150 manholes, thirteen of which are of standard concrete construction with cast iron covers, while the remainder are of wood.

The average cost for installing 3-inch wood fibre duct in wood box construction was 10.3 cents per duct foot. The average cost of the timber-constructed manholes ranging in size from 5 by 6 ft. and 5 ft. deep to 7 by 8 ft. and 6 ft. deep was $49.30 each in place.

The feeder system was laid out most economically by installing approximately four small sub-stations in each of the main exhibit buildings. These sub-stations are in reality concrete vaults with their only entrance opening to the outside of the building, thus minimizing the fire hazard for the wood frame buildings.

Power is supplied to the main transformer station east of the

Machinery Hall at 11,000 volts by the Pacific Gas and Electric Company. The primary distribution is 3-phase 4150 volts A. C. with grounded neutral. The secondary distribution is a 115–230 volt, 4-wire 3-phase alternating current system, which with reasonable care can be loaded to give a satisfactory balance. A great portion of the load during the evening hours will rseult from the great projectors which require direct current. Just east of the "Home Electrical," in the General Electric Co.'s fine exhibit in the Manufacturers' Palace will be found one of the great 1,500 K. V. A. Motor Generator sets, while the other is in the northwestern part of the Liberal Arts Palace. These furnish the necessary direct current at 250/125 volts 3-wire, and along with them are the 250 K. V. A. Balancer sets. For the complete control of so much apparatus it will be readily seen to require as many oil switches, starting compensators, transformers, meters, etc., as are found in a modern sub-station.

One cannot help being impressed by the fact that the entire Exposition is electrical, from the illumination of the exterior to the motor-driven appliance or lighting of almost every interior exhibit. The visitor who thinks some of the colorings too harsh by daylight has only to await the indirect flood lighting from a concealed source, to change his opinion as the last rays are superseded by the soft artificial glow. Huge standards thirty to fifty feet in height placed along the walks bearing from five to nine luminous arcs or nitrogen filled lamps, shielded by banners on all sides except that opposite the facades of the palaces, made a beautiful ornamental feature by day as well as a useful reflector by night.

There is no outline lighting of the buildings with its consequent glare; but something of a garish nature has been allowed in the lighting scheme for the concession district where it is the natural accompaniment of the fun and frolic reigning there. Ornamental incandescent standards are used along the Avenue of Palms and in the South Gardens interspersed among the foliage. One of the distinctive features of this Exposition is the numerous courts and the individual method of illuminating each.

The central feature dominating all is the Great Tower of Jewels, rising in eight terraces to a height of 435 ft. decorated with statuary and bespangled with myriads of jewels, whose prismatic colors are intensified by the hundreds of search lights placed at advantageous positions to bring out its overwhelming beauty. This is accomplished by many thousand Novagems hung so as to vibrate with every gentle breeze, so that it presents at night as well as by day one of the most vivid pictures of quivering, sparkling light ever produced. One will see when they start to build up the illumination every evening how this rich mixture of color is produced. The interior of the large ball surmounting the tower and the colonnades about the various terraces, appear in relief in a blood-orange glow as a back ground for the myriad twinkling jewels. Sixteen projectors have been erected over the main entrance, just opposite the Tower to illuminate its front. They are equipped with diverging doors, made of convex lenses, at such angles as to illuminate only the object aimed at, just alleviating any waste light, without revealing their location.

Another spectacular lighting effect is that of the dome of the Palace of Horticulture. In the central interior there is erected a small tower for supporting the illuminating apparatus. This is made up of large and small lenses each capable of projecting rays to all parts of the dome. A circular color screen is placed beneath the lens plate. The scheme uses the three primary colors, red, blue, and yellow. There is a circular sectored disc of the same diameter as the screen, and both are mounted on a vertical rotating shaft made up of a sleeve and a solid shaft, so that the screen and disc may be rotated at varying rates of speed. Twelve 30 in. electric projectors are arranged in a circle about this small central tower and set to throw their light upward through the color screen, having first to pass through the apertures in the disc. It will be readily seen that when the position of the aperture coincides with one of the color plates, a ray of that color will issue, but as the disc in its slightly accelerated rate of speed begins to throw light into the next plate, a color different from the other two will be formed and then fade into the color of the next plate. As the screen rotates we find first the yellow rays, then the green formed by the blending of the yellow and the blue, then the blue, then the purple as the blue encroaches upon the red, then the red, then orange as a combination of the red and yellow, then the cycle of colors is completed. Various combinations have been worked out and all have proven marvelous conceptions.

One of the most beautiful effects is seen in a series of twelve ribbons of light, each a sixth revolution ahead of its neighbor, all turning together. It is purely an astronomical effect and one which baffles powers of adequate description. The united action appears as a rippling wave of light traveling around the dome, a constant color for each ribbon, then a spectral series, in which the whole ribbon assumes various solid colors, then a rainbow effect, each ribbon having one edge of red and the other of blue with various intermediate colors. Added to the ribbon effect are seen rising out of the horizon, planetary rings of light together with spots, appearing in the various color arrangements.

The great Scintillator in the bay furnishes another spectacular element in the great lighting scheme.

Forty-eight searchlights whose beams are colored with all the tints of the rainbow form an aurora borealis of ever changing magnificence.

Mammoth steam and fog effects, the projection of myriads of flag and other combination of colors on the clouds will afford constant variety and interest.

The court of the Universe being of an odd shape required a rather unusual solution to the illumination problem.

At either end of the sunken garden there are two large fountains in which are placed the fluted columns, containing the first installation of the latest development in incandescent lighting. These columns are approximately 38 ft. high and 5 ft. in diameter and each support ninety-six 2,500 candle-power nitrogen filled lamps, which are calculated to give a luminous intensity of 3 foot candles of even light on the space of the peristyle.

There are a number of smaller sources of light, none of them intense, placed so as to accentuate the losenge shape of the sunken garden and serve as a means of adding an appearance of festivity and brilliance as well as to wipe out any objectionable shadows from the main sources.

It is upon the top of the peristyle that the Seraphic figures are mounted with arms supporting a great star hung with Novagems. In the base of each figure is placed a small projector, not visible from below, but casting a beam of light across the court and shining on the star of a figure on the opposite side.

In the court of Four Seasons, each niche or corner contains a group designating the season portrayed, mounted up above the electric fountain.

The Court of Abundance with its beautiful tower symbolizing some grand old cathedral has suggested many unique lighting effects. The basin in the center has a fountain which is in the form of a globe surrounded by figures. The arrangement of light gives the effect of turning as the earth does on its axis. Streams of water will pour over it and about the sides steam will issue in slow rising swirls representing as a whole the planet of the earth turning in space.

At the opposite end of the pool and a part of the artist's conception will be the sun setting at the water's edge. Two great sunbursts of incandescent lamps send a warm light throughout the court. Gas flambeaux are placed at intervals about the pool and tend to break up that steady evenness of the electric lights.

The Palace of Fine Arts lighting effects will be conducive to quiet, peaceful and mysterious as well and an effect of moonlight will be striven for to cover the lake, shrubbery and trees.

The most noteworthy groups of statuary of the Exposition have been erected over the Arch of the Rising Sun and the Arch of the Setting Sun situated at the east and west entrances of the Grand Court of Honor.

In general the statuary is lighted from two directions, one a strong clear light and a weaker colored one from another to make a luminous shadow. This idea gives a definite depth to the object and brings out clearly the modeling and decorations.

The many new and startling effects in shapes and colors are unbelievable until a person has actually seen them, and it is due to the daring originality of W. D. A. Ryan, Chief of Illumination, that the wonderful lighting of this Exposition will shape the trend of illuminative practice in the future.

RESUSCITATION FROM ELECTRIC SHOCK

II.

H. W. Rusch, '15

This is the second of two articles dealing with the effects of electric shock and resuscitation methods. The first article appeared in the October issue.—EDITOR.

Resuscitation from electric shock is a subject, which, with the growth in the use of electrical energy, is becoming more and more important. The increasing application of electricity has added to the dangers of electric shock, so that electricity may be termed a destroyer, as well as a servant, of mankind. It is therefore of the utmost importance that those who are directly connected with the electrical profession and whose work often makes them the guardians of the lives of their fellows who may have suffered from electrical shock should be familiar at least with the simpler methods of resuscitation.

It will be the purpose of this paper to consider briefly the physiological effects of electrical shock, and to take up more in detail the first-aid methods of relief.

In another paper, published in the October issue of the current volume of The Wisconsin Engineer, the author has considered fully the effects of electric currents on the body. They are: (1) muscular tetanus; (2) cardiac fibrillation; (3) paralysis of the central nervous system; each effect capable of causing death.

Muscular tetanus is of most importance when the voltage is low. It is a general stiffening of the muscles traversed by the current, and exists only during the period of current flow. If the victim is removed from contact with the electrified object in time, his life may be saved. Any delay may cause death by asphyxiation due to the failure of the intracostal muscles to maintain respiration.

Cardiac fibrillation is the most dangerous condition and is invariably fatal. In this condition the individual muscle fibers of the heart run amuck, as it were, each functioning for itself without regard to the action of the others. The heart becomes a mere writhing mass of muscle without coherent action. The exact voltage conditions necessary to cause fibrillation in human beings are not definitely known; also, voltages which under some conditions may be harmless, can, under others, produce fibrillation. Therefore it cannot be determined from the electrical conditions whether fibrillation has set in, and as there is nothing in the external appearance of the victim to indicate such a condition, there is no sense in wasting time trying to determine it. Any delay in the application of resusciation methods may be fatal.

Unfortunately, the medical profession has no simple or easily applied means of treating a fibrillating heart. One method, suggested by Dr. Eister after hearing the author's paper on The Physiological Effects of Electrical Shock is as follows: Inject the veins of the victim with a solution of potassium chloride, or better still, pierce the heart wall with a hollow needle and inject the KCl directly into the heart. The chloride has the effect of stopping fibrillation and stimulating vigorous normal heart action.

A second method, suggested by the experimental results of Prevost and Batelli, two French experimenters, is to make use of a higher voltage. Their experiments showed that fibrillation could be eliminated by the application of higher voltages than those causing it. The objections to this method are twofold. First, the higher voltage is seldom immediately available; second, the necessary voltage and the electrical constants of the body are so indeterminate that it is always doubtful whether the fibrillation is being eliminated or aggravated. If the second objection could be obviated, a method might easily be devised for the cure of fibrillation in this way. However, the use of the cause of the accident as a cure is an idea that does not appeal very strongly to the average man.

The third physiological effect is paralysis of the central nervous system, resulting in asphyxiation by cessation of respiration. The respiratory muscles fail to act because the stimuli set up in the medulla oblongata by the presence of the carbon dioxide in the lungs cease. When respiration stops, the supply of oxygen to the lungs, blood, and nerves is cut off, and the body dies. If, however, the necessary oxygen can be supplied by artificial means, the victim's life can be sustained, even to a point where paralysis ceases and the nervous system again functions normally, and respiration is restored.

From the foregoing review of the physiological effects of electric shock, it is evident that there is only one condition for which the non-medical man may offer treatment, namely, nervous paralysis, or what amounts to the same thing, cessation of respiration. Artificial respiration must be applied,—quickly.

Two general methods of producing artificial respiration are commonly advocated; (1) the manual method, (2) the mechanical method.

Under the head of manual methods, which may be used where-ever the air is fit to be breathed, may be mentioned the Marshall-Hall, the Howard, the Sylvester, and the Schäffer methods.

In the Marshall-Hall method the patient is placed on the floor face down and slowly rolled to a lateral position, then back to the prone position. This method has not found very wide application, because better and simpler methods, with less danger of injury to the patient, are in vogue.

The Howard method consists in rhythmically compressing the lower portion of the thorax while the patient is lying flat on his back. This method is better than the preceding one, offering less chance of injury to the patient. It is not as effective as either the Sylvester or the Schäffer methods in producing respiration, and is open to the objection that the tongue and the secretions of the mouth are likely to close up the air passages unless proper precautions are taken to prevent it.

In the Sylvester method the victim is placed upon his back with a roll of cloth beneath his neck in such a position as to throw his head back and the spine forward. The operator kneels at the head of the victim and facing him. Grasping the subject's elbows, the operator draws the arms backward and over the head. They are held in this position for about three seconds, and then returned to the victim's side. The operator then firmly compresses the patient's chest by throwing his weight on it. After two or three seconds the cycle of operations is repeated. The operation is carried on at the rate of about fifteen cycles per minute. It is necessay to draw the patient's tongue forward during the whole operation in order to free the throat. These manipulations stimulate respiration in the following manner: The raising of the arms above the head causes the thorax to expand exactly as in natural respiration, and, provided that the throat is clear, air will rush into the lungs. When the arms are brought down and the chest compressed, the air is forced from the lungs exactly as in natural respiration.

If an assistant is present, the Sylvester method can be materially improved by having the assistant exert traction on the patient's tongue by grasping it with a handkerchief and drawing it forcible out of the mouth at the moment of inspiration, letting it recede into the mouth during expiration. The rhythmical traction of the tongue is in itself an excellent stimulant of respiration, because of the reflex action set up by the forcible contact of the bridle under the tongue with the lower teeth.

The Sylvester method is the one most used at the present time, but the advantages of the Schäfer method are so great that it is but a question of time when it will be the universal method. Because the Sylvester and the Schäfer or prone pressure methods are the two leading methods in use, they will be compared in detail.

The Schäfer, or prone pressure, method is the one which was adopted by the committee on resuscitation from mine gases. Dr. W. R. Cannon, professor of physiology at Harvard University, was chairman of this committee. In this method the patient is placed on his stomach, with his face turned to one side so that the mouth and nose do not touch the ground. The arms are drawn away from the body or extended above the head. A roll of soft material is placed under his abdomen in such a position as to aid in the compression process.

The operator kneels straddling the patient's thighs or at the side of the thighs, facing the patient's head. His hands are placed on the patient's loins, thumbs nearly touching each other, and with the fingers spread over the lower ribs. Care must be exercised not to bring any pressure on the spine let serious injury result.

At the beginning of the operation the operator's thumbs are rotated outward, aiding him in keeping his arms straight. Then, with arms held firm, the operator's weight is gradually brought to bear upon the subject. This operation should consume from two to three seconds. It should not be violent, or it may result in internal injuries. By this application of pressure the lower portion of the thorax and the upper part of the abdomen are compressed, and the air is forced from the lungs. Then the pressure is relieved as the operator swings back to an upright kneeling position, the organs of the abdomen drop back to their normal positions, the ribs spring outward, and air enters the patient's lungs because of the partial vacuum caused by the relief of the pressure. There is no danger of injuring the lung tissues by this method as there is in some of the mechanical methods in which air is supplied to the lungs under pressure.

The rate of operation should be a little slower than that of normal breathing, and may be timed by the operator's own deep breathing at about twelve cycles per minute. Timing of the operation may be done in any other convenient way, as by noting a watch, or by having an assistant aid in keeping time. The lungs should be thoroughly and rhythmically emptied of air by firm vertical pressure; the filling will take care of itself when the pressure is released.

An assistant can aid greatly in restoring normal respiration. He can keep the patient's mouth free from secretions or foreign matter. A little aromatic spirits of ammonia held near the patient's nose will aid in exciting respiration. No liquids should be given by mouth while the patient is unconscious, as they are more likely to go into the lungs than into the stomach.

It is needless to emphasize that a doctor be called as soon as possible, unless there is only one man present. In the latter event it is this man's duty to do his utmost to restore the patient to life before leaving him alone while he calls a doctor.

When the doctor arrives he can administer such restorative measures as call for medical skill and judgment. He can administer cardiac stimulants, and can properly direct the application of external heat. Then, too, it often becomes necessary to stimulate the muscles by inflicting pain, as by pulling the patient's hair, slapping or rubbing him, or by stretching the sphincter ani, or muscle controlling the rectum, or by pulling the tongue. These are all extreme methods and great care must be taken not to inflict serious injuries on the patient while applying them.

Sudden, forcible stretching of the anus is a method very frequently resorted to when all others have failed. It is a measure which should be applied only by a physician or by someone who understands what the results of carelessness in its application may be. This sphincter muscle is probable the last in the body to lose its sensibility; if it is irritated by sudden stretching it will often cause a gasp in a body that is actually dying. The method of application is as follows: The patient is placed upon his side or back and the index finger or thumb is inserted carefully into the rectum. If the sphincter ani is still sensible it will be felt to resist. Care must be taken not to lacerate the muscle or tear the lining of the rectum with the nail as the finger is inserted. The muscle is then drawn suddenly and forcible backward toward the spine. This operation will usually produce a gasp. As soon as one gasp has been produced by this method, artificial respiration should again be practiced until it fails before attempting to repeat the process.

In some cases it becomes necessary to repeat the stretching of the sphincter muscle with each inspiratory movement during artificial respiration. In the Sylvester method it is necessary to draw the patient's knees upward to render the anus accessible. In the Schäfer method there is no difficulty from this source, since the patient is already on his back.

If oxygen is available, it is an excellent aid to artificial respiration. The methods of supplying it to the patient will be discussed later, as it involves mechanical features whose discussion is best postponed for a moment.

It has been shown by accurate spirometer measurements that the average efficiency of the Schäfer method is 520 cc. of air expelled per cycle as compared with 175 cc. by the Sylvester method. This is largely due to the superior mode of applying pressure in the former method, and to the fact that the Schäfer method utilizes the diaphragm. which is the most important muscle of respiration. The Schäfer method possesses many other advantages, which will be briefly mentioned.

(1) It most nearly duplicates the action of natural respiration;

(2) In thin people it affords a fair amount of massaging action on the heart—an excellent restorative measure;

(3) It is not tiresome for the operator;

(4) Because of the patient's position there is no danger from secretions accumulating in the mouth or from the tongue's blocking the air passages to the throat;

(5) It is very simple and easily applied;

(6) There is practically no danger of injuring the patient.

In addition to the foregoing manual methods of resuscitation, there are several mechanical methods which deserve mention, not because of any remarkable success attending their use, but because of their increasing prevalence. There are four machines on the market for producing artificial respiration—the pulmotor, the lungmotor, the Dr. Brat apparatus, and the Salvator.

Of these, the pulmotor is most widely advertised by the popular press and has the widest popularity. It is a machine which supplies oxygen under pressure to the lungs by means of a mask and reversing valve which automatically forces oxygen into the lungs and pumps it out again as soon as the pressure in the lungs and the mask have become equal. The operation, once started is automatic and continues until the apparatus is removed.

Although the pulmotor appeals to the popular imagination, and is widely advertised by the press at large, its use is open to very serious objections. Its chief drawback lies in its automatic operation, dependent only on the equalization of pressure. If for any reason the bronchial tubes or the finer air passages of the lungs offer but slightly more than normal resistance to the flow of the gas into the lungs, the action of the pulmotor reverses and the lungs are pumped out before they are given a chance to fill. Then, too, the fact that the oxygen is sucked from the lungs may cause a complete collapse of the air cells and a sticking together or adhesion of their walls. Then we have the condition before mentioned, in which the pulmotor operates without actually producing respiration. The pulmotor also fails to furnish massage for the heart, one of the strongest points of the prone pressure method.

The best that can be said for the pulmotor is, that if it be used carefully in connection with one of the manual methods, preferably the Schäfer, and operated by hand, it provides an excellent means of insuring a good supply of oxygen. Great care must be exercised in its use if no internal injuries are to result.

The main thing, then, in cases of electrical shock is to apply some method for producing artificial respiration, and to apply it IMMEDIATELY. Every second that is lost may mean the loss of a human life, whereas cool, systematic action can usually save it. Learn at least two methods for producing artificial respiration, so that if one becomes unavailable because of burns on the patient's body or on account of other injuries, the other may be applied without loss of time. Never give up until a physician pronounces the victim absolutely and entirely dead. And always remember that no restorative measure can quite equal the foresight which recognizes and avoids the danger before it is too late.

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THE UNITED STATES NAVAL ENGINEERING EXPERIMENT STATION AT ANNAPOLIS, MARYLAND

ARTHUR D. FULTON, '16

The United States Naval Engineering Experiment Station is situated on the Severn River opposite the sea front of the United States Naval Academy at Annapolis, Md. An endeavor will be made to give in this paper a comprehensive view of the purpose, equipment and accomplishments of the station.

The grounds of the experiment station contain about ten acres and have a water frontage of sixteen hundred feet. There is but one building constituting the experiment station, although there are under one continuous roof three distinct parts, the main building, the boiler house, and the boiler house extension. The main building which is three hundred sixteen feet long and sixty-six feet wide is in three parts. The north half contains offices, laboratories, store room and tool room, with testing machines in the central space; the south half contains the machinery laboratory, machine shop, woodworking shops, etc. A fifteen ton crane of full building width traverses the main building from end to end.

The boiler house contains a marine type 200 H. P. Niclausse boiler designed for pressures up to 300 pounds per square inch, a 300 H. P. Babcock and Wilcox boiler designed for pressures up to 500 pounds per square inch, and a marine type 500 H. P. oil burning Mosher boiler designed for pressures up to 300 pounds per square inch. This latter boiler is installed in an air tight fire room compartment. The oil burning system is of the mechanical type and is capable of burning four thousand pounds of fuel oil per hour, with an induced draft of two and one-half inches of water. The boiler room machinery consists of feed water heaters, feed pumps, air compressors, dynamo and auxiliary condensers, grease extractors, etc. The dynamo room, which is partitioned off from the boiler room proper, contains a 75 K. W. alternating current generator direct-connected to a marine type Diesel engine, a 75 K. W. direct current turbo-generator, and a 15 K. W. direct current 110 volt generator direct-connected to a reciprocating engine.

The boiler house extension contains two airtight fire room compartments in one of which is installed an oil burning Mosher boiler. The south "lean-to" is used as an instrument storage and calibration room, while the north "lean-to" contains the foundry, sheet metal shops, and gasoline motor testing rig.

The testing plant and equipment is extensive and varied in character. The testing machine equipment consists of an Olsen 300,000 pound universal machine, a Riehlé 50,000 pound universal machine, a 60,000 pound torsion machine, a fibre stress endurance machine, impact and vibratory machines, a Brinnell ball hardness machine, and four oil testing machines. Two of these oil testing machines are of the Riehlé design while the other two are of the experiment station design, and are intended for the comparison of engine and turbine oils. A design is also under way for a machine to test steam and gas engine cylinder oils.

The photo-micrographic laboratory is well equipped with polishing machines, a microscope with illuminator and camera, and an electric oven for heat treatment investigation.

The chemical laboratory is fully equipped for the analysis of waters, metals, etc., and for the chemical and physical examination of lubricating oils, etc.

The machinery laboratory is equipped with three Parsons experimental turbines, a duplex horizontal fire pump, two Navy Standard evaporators, a large testing platform in eight sections with a total area of 300 square feet; two turbo-blowers, and auxiliary apparatus such as weighing tanks, scales, venturi meters, prony brakes, water rheostats, water brakes, etc.

An idea of the uses to which power plant apparatus is put for testing purposes may be gained from the following. The Babcock and Wilcox boiler is used for coal, evaporation, and safety valve capacity tests, for endurance tests of boiler hand hole gaskets, boiler tubes, bottom blow valves, feed water level regulators, and other boiler accessories. The Mosher boiler is fitted for oil evaporation and safety valve capacity tests.

The feed pumps and condensers of the power plant are made use of for endurance tests of pump valves and packings. In the boiler house are placed fittings and apparatus for the endurance testing of ordinary valves, reducing valves, gage glasses, condenser tube materials, and other boiler house accessories.

The station is under the control of the bureau of steam engineering of the navy department, by whom all test work is authorized, the costs being charged to the proper appropriation or against a special deposit made by the exhibitor of the apparatus or material to be investigated. The activities of the station may be grouped under the following general heads, namely: (1) testing, (2) research, (3) instruction, (4) increase and improvement of equipment, and (5) repair and maintenance.

Testing is usually undertaken for the following purposes: examination for conformity with specifications; examination for framing of specifications; performance and endurance of machinery, performance and endurance of apparatus, and performance and composition of materials.

Research may be considered as applying where the following conditions obtain: existing data not systematic or sufficient; a new combination of mechancial or physical principles desired or proposed for a special purpose; a new material or compound to be developed for a special purpose.

Instruction is given to midshipmen of the Naval Academy in the form of inspection of tests under way and demonstrations of test apparatus. Student officers of the post graduate department of the Naval Academy also get a three or four months' course during which they are enabled to obtain a working knowledge of all test and research work under way.

Increase and improvement of equipment involves much time and study in the examination of testing instruments and apparatus on the market, and in the improvement of apparatus to meet the special needs of the experiment station, the latter phase being especially important because of the need for apparatus which will as nearly as possible duplicate conditions on board ship.

Repair and maintenance applies not only to the experiment station buildings and equipment but also to the hydroaeroplanes and their accessories belonging to the naval aviation camp situated in the immediate vicinity of the station, and the Annapolis reserve torpedo division which is berthed in the experiment station basin and utilizes the facilities of the station for upkeep.

In order that the work of the experiment station may be better appreciated, a brief mention will be made of the more prominent work in the several classes of tests. Gage glasses have been thoroughly investigated with the result that a type of gage glass employing mica to insulate the glass from the action of the steam has been found which will give service with a minimum of breakdown and attention.

Lubricating oils are undergoing investigation with a view of developing a method of examination before use which will indicate performance in service. These investigations have led to the development and construction of an oil testing machine of experiment station design, for the examination of engine and turbine oils, which is very promising in its results.

Corrosion of boiler metals has received a good deal of attention, both as to the materials themselves and to the treatment of boiler waters, with the result that there has been developed a boiler compound which, when properly used, will prevent corrosion.

Tests have been made as to the relative evaporative efficiencies of coal stored under salt water, under cover, and in the open. Coal from the old U. S. S. Maine has been tested for evaporative efficiency after having been submerged in the Havana harbor for fourteen years.

Turbo-blowers for installation in torpedo boat destroyers have been investigated at the experiment station both for the efficiency of the blower and for the efficiency of the turbine.

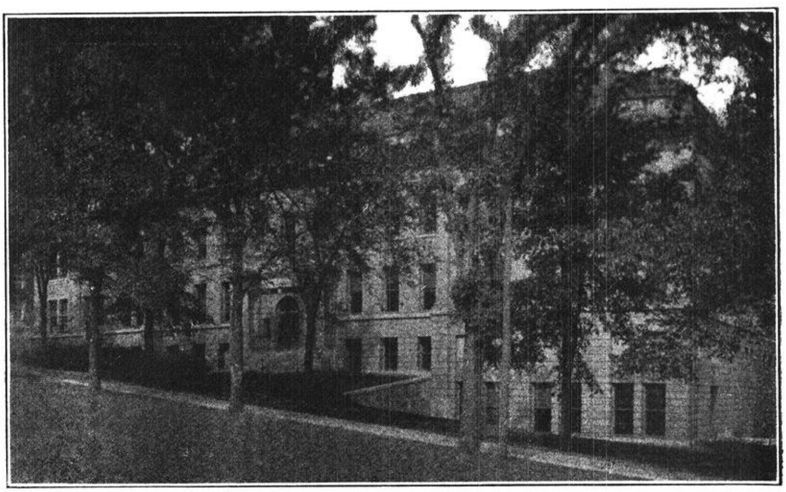
Investigation of several types of fuel oil burners have been made to discover the effect of the pressure and temperature of oil on the quantity discharge.

Safety valves are also being tested. This work has to do with the capacity rating, lift of valve, design of springs, design of valves and valve seats, etc., and has resulted in a modification in several particulars.

All the tests are conducted from a "service" point of view and under conditions as nearly approaching conditions on board ship as the facilities of the station will permit. Special effort is made to conduct endurance tests where practicable.

Reports of tests are submitted in triplicate to the bureau of steam engineering which forwards a copy of the report to the exhibitor if there be one. These reports cannot be used by the exhibitors for advertising purposes though they may make use of the report as they see fit for the alteration and improvement of their product.

Thus it is seen that the United States has kept up with progress in the establishment of this experiment station in 1908, although this establishment was no great innovation, since all large railroad, steamship, and manufacturing companies, both in this country and abroad have considered their testing laboratories an essential part of their apparatus. It is to be hoped that the station will continue to grow in usefulness both to the navy and to the engineering world in general.



ARROWROCK DAM

M. F. Cunningham

Could Benjamin Franklin have seen the effect the little key he tied to a kite had in revolutionizing irrigation project construction, as it has revolutionized almost everything else, he would have witnessed human beings working like ants in a great cavity at night above this city boring into the very bowels of the mountains under the powerful play of searchlight. They were helping to make a great excavation below the Boise river bed so that the highest dam in the world, the Arrowrock, could be anchored to a solid granite base. His discovery of electricity, made it possible to build this dam in record time or in four years at a cost of five millions of dollars. It stands completed today, a masterpiece to the engineering profession and its formal dedication in which Boise and all Idaho participated, took place October 4 with proper ceremony. Its construction means the irrigation of an empire, 240,000 acres of land in western Idaho.

A coal mine not being available in 1912 when work on the dam was started, the Reclamation Service engineers in charge, F. E. Weymouth, supervising engineer, C. H. Paul, constructing engineer and James Munn, superintendent of construction, to whom credit is due for the project and dam building, proceeded to harness the waterpower going to waste in the Boise river sixteen miles below the dam site, to provide power for the great steam shovels which had to be operated, for other power purposes as well as for lighting Coal would have been too expensive for this purpose and the supply uncertain. Water was plentiful and close at hand.

They erected the Boise hydro-electric power plant primarily for construction purposes at what is known as diversion dam, the point where water released from the great dam above is diverted into the main canal leading to the lands of the project thirty and forty miles below. The dam and project finished, the electric plant stands a valuable asset for both. It is built of concrete and steel at a point on the river where a 25-foot fall is secured. It consists of three Allis-Chalmers 725 horsepower hydrolic turbines, each with direct connections to an EVA generator. Its capacity is from 2,500 to 3,000 horsepower. The output is 3-phase, 60 cycle, alternating current at 2,300 volts which is transmitted from the station at 22,000 volts.

Without this power, construction of the dam would have been made doubly difficult. With it the power question, an important one in their construction, was quickly solved. Transmission lines were built both to the dam and to project points. It kept dredges at both places busy for several years. When the problem of building ditches for a drainage district came up, the power from the plant supplied the electric dredges.

A record was made in the dam construction. Credit for the record is largely due to electricity for with it feeding into powerful searchlights it was possible to keep a night shift on the job—and so well was the light distributed that the men worked as well as in the daytime. Two other shifts preceded the night shift which went on at 6 o'clock p. m., having had breakfast at 4:30 p. m. From two to three hours after they had been at work, the search lights were turned on. Their powerful rays carried across the deep canyon lighting up the cableways, struck the hoppers where the concrete buckets dumped and played about and on every avenue of occupation. Arc lights were pulled out over the works on cables stretched overhead. Clusters of incandescents, with an arc here and there, lighted up the railway. There were no dark corners within the limits of activity for the artificial light was apparently as good as Old Sol himself could provide. When it is realized that close to 500 men composed the shift and had almost as many difficult duties to perform while danger to life and limb was always possible, the advantage of electrical energy so used can be appreciated. Without abundance of electrical energy for the searchlights, a third shift would have been impossible and the great dam would not stand completed today. The plant also furnished all the electricity for lighting the town of Arrowrock which sprung up below the dam and had a population of 1,500 people for four years. Today it has practically disappeared.

The Arrowrock dam stands 348.5 feet high, ninety feet of which is below the bed of the river anchored to solid granite, through which a series of holes were bored to a depth of from thirty to forty feet and grouted with concrete under pressure to prevent possible seepage. The river was diverted from its normal channel in which the dam sits into a tunnel put through a cliff. A coffer dam left the river bed dry and in it were placed 70-ton Atlantic shovels, derricks, hoists, etc. With the assistance of men to operate them and work in the pit the excavation was gradually sunk down, the grouting took place and the foundation for the towering dam laid 240 feet wide at the base and 1,100 feet long. Each day thereafter saw the structure 2,000 cubic yards nearer completion. A line of open holes to catch possible seepage bored just below the holes for grouting together with grouting holes was carried up through the dam and connected with galleries built inside of it from which the outlet are operated partly by water pressure and partly by electricity. In these galleries additional grouting can be carried on deep below the base of the dam if necessary. The thickness of the structure was gradually reduced until at the crest it stands but sixteen feet wide, forming a roadway, guarded on either side by a parapet wall four feet high. Mounted at intervals on this are rows of pedestals crowned with arc lights, power for which is furnished by the electric plant.

To the one side of the dam has been cut a gigantic spillway through a cliff of solid granite. It is 400 feet long following the contour of the ground in a direction at right angles with the dam. In flood season water from the reservoir will enter the spillway over the lip mounted on which are specially constructed gates. It will be carried off around the dam and allowed to cascade down the mountain side back into the river. In an extreme flood year, should the spillway be unable to handle the water, the dam is so constructed as to permit it to plunge over its crest dropping over 250 feet to the river below. A total of 40,000 second feet of water can rush through this spillway at its normal capacity and could it be harnessed it would develop a vast amount of electrical energy.

To the opposite side of the dam, a concrete log chute has been built to permit the passage of logs from the reservoir to the river below. The estimated stand of timber tributary to the reservoir is three billion feet valued at thirty-six million dollars. It will take fifty years to pass it over the dam. On the same side, should it be deemed advisable to build an additional hydro-electric plant, a tunnel can be bored through the mountain side to tap the reservoir and provide the water to generate as high as 50,000 horse power.

The reservoir is eighteen miles long with a maximum depth of 200 feet. Its capacity is 244,300 acre-feet which if spread one foot deep would cover 360 square miles, or it would cover the city of New York including Manhattan Island, Bronx, Brooklyn, Queens and Richmond to the same depth; cover Chicago with two feet of water; Boston with eight feet; the District of Columbia with five feet and the state of Rhode Island with four inches.

The dam itself weighs over a million tons. If loaded a ton to each 20-foot wagon, the wagons would reach from San Francisco to New York and double back to Cleveland. The project is located tributary to Boise from forty to sixty miles from the dam. Every acre with the exception of about 1,000 has been filed on by settlers.

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EDITORIALS

In another part of this issue will be found an account of the University of Wisconsin Engineers' Club smoker. Such occasions as this are of more value than appears at first glance. They give the student an opportunity to see what kind of men there are in the faculty; they are not so unapproachable as many think, in fact they are really good companions when you know them. They furnish an opportunity for mixing of the students, especially those of different classes and courses. Also they show the rest of the University that we are not asleep. Let's have another.

The clubs in the Engineering College are getting well started on their activities for the year, and now is the time for every man to get behind his club if he is a member of one. If a man does not belong to a club now is the time to pick out the one he prefers and join. Membership in one of these clubs is an outside activity that is still closely allied with the work of the college. Some of the clubs are devoted to special lines of engineering as is the case of the case of the A. S. M. E., The Chemical Society, The Mining Club, the A. I. E. E., and the Civil Engineers Society. These are all good and desirable organizations and a man does a wise thing in joining his department club. There is another club which is open to men from all courses in the college; this is the U. W. Engineers Club. This club is more of a social organization than the others. Its total membership is limited but a man who is really interested always has a chance. Thus far this year a smoker has been held, plans for an All University Dance to be given in connection with the other clubs, have been made, and the prospects for a banquet like the memorable one of last spring are very good.

Look the clubs over, then join one; you'll never regret it.

* * *

Just a word about The Minstrels! Every live engineer knows permission to stage the show has been obtained, a committee has been elected to take general charge, and they have chosen a business manager and assistants. Before long the tryouts for positions will be held; let's be there with a lot of PEP and ideas.

"Good evening, Mr. Jones. How do you feel this evening?"

* * *

This issue contains the announcement of a new plan to liven up the alumni section of the magazine. We hope that it will meet with the approval and support of the alumni. This little extract from a letter recently received expresses a sentiment which we are trying to make more prevalent.

"Having been away from Madison and the University for several years, I find that one soon loses track of his old friends and classmates. I remember THE ENGINEER as being a good instrument to prevent this and would like to be placed on your mailing list."

The statement that each issue will be devoted to definite classes does not mean that we do not want others to write. We are always more than glad to hear from the alumni.

* * *

THERE ARE NO QUITTERS AT WISCONSIN! Long has this been the boast of our University. Long, also, have we engineers maintained that we are the Varsity's best. Well, then, let's get together and prove it this year as we have in the past. There is one little word which is the keyword to the successful attainment of our ideals. PEP is the word. Pep means strength, it means initiative, it means spirit, it spells success. Pep in theory is good; applied pep is far better.

How to apply it? Well, that's easy. Don't be an innocent bystander when the parade goes marching by. When the call comes, rally to the flag, and support your societies, boost your college, cheer for the Minstrels and make the other fellow hustle if he is to get that coveted job at the end of the line! Don't wait for the other fellow to do it, do it yourself! You admit that you have as much ability as the next man; can you prove it?

What do you get out of it? Not a red cent, but something that money never bought. You get, first of all, the respect and good will of your fellows. You get Experience. And then you get the grandest reward in the world, the feeling of honest work well done for its own sake, the feeling of conviction of your own ability to do things, the feeling that you have won on your own merits against a field of men who are worthy opponents for the best of them.

With this thought in mind, START SOMETHING! And always remember, once you have started, that THERE ARE NO QUITTERS AT WISCONSIN!

E. A. K.

* * *

At this time of year every real Wisconsin man is watching the TEAM. So far it bids fair to repeat the performance of 1912. We of the College of Engineering are especially interested this year with "Cub" as captain and other men on the team. When this magazine comes out Ohio and Chicago will have been met and things may be different than now, BUT no matter what happens let's get out and ROOT.

Successful Wisconsin Engineers.

George H. Burgess graduated from the civil engineering department, University of Wisconsin, in 1895. He worked first in the Edgemoor Bridge Works at Bloomington, Del., from there in 1897 he went with the Pennsylvania Railroad as asistant engineer on the lines west of Pittsburg. He then became assistant engineer for the Erie Railroad, having responsible charge of the large engineering undertaking in running through the Bergen Hills. Five years ago he became chief engineer for the Delaware and Hudson Railroad, with offices at Albany. Since the valuation of the railroads of the country has been undertaken by the Interstate Commerce Commission, Mr. Burgess has had charge of this work for the Delaware and Hudson Railroad, his present title being chairman of the Valuation committee.

IN MEMORIAM

FRED CHRISTIAN HENKE, C. E. '10

Fred Christian Henke, C. E. '10, died at his home at Wautoma, Wis., on the thirteenth of last March.

The deceased was born at Crystal Lake, Wis., January 1, 1881. He received his early education in the public schools of that place, after which he taught for four years. He then entered the State Normal School at Stevens Point, where he remained two years, after which time he taught in various public schools for three years.

In 1905 Henke entered the College of Engineering, and was graduated from the advanced civil engineering course in 1910. On the 4th of July of the same year he was married to Miss Pearl Richardson, also of the class of 1910.

During the summer Henke was appointed instructor in civil engineering at the State College of Washington, at Pullman, Wash., serving also as general secretary of the Y. M. C. A. at that college. Early in February, 1912, their infant child died, as did also Mrs. Henke, a few days later. At the end of that school year he resigned his position and returned home quite broken in health. After a long rest he planned to enter Harvard University, but was prevented from so doing by the sudden death of his father. In September, 1914, Henke became ill as the seeming result of a cold, and after a lingering illness, he died the following March, death being charged to endocarditis.

Perhaps nothing stood out so sharply in Henke's tragic life as service. It was this more than anything else that comes back to those who knew him, coupled with a distinct lack of grumbling, and an unfailing diligence.

IN MEMORIAM

Maurice Brereton Lamont

Maurice Brereton Lamont, class of 1911, met an untimely death the last week in September. While out duck hunting with a companion, he tripped in the boat, accidentally discharging his gun, and killed himself instantly. He was buried on October 2 at Aberdeen, S. D., where he was in business with his father.

In September, 1912, he was married to Miss Margaret Mather, of Groton, S. D., who, with two sons, survives him.

While at the University Lamont was by virtue of his high ideals, rare scholarship, and intense personal magnetism a student leader. He was extremely active in student affairs, being a member of the following organizations: Tau Beta Pi, Eta Kappa Nu, Phi Delta Theta, Monastics, Badger Board, University band, and Student Conference.

His memory will ever be an inspiration to those whose good fortune it has been to know him.

CAMPUS NOTES

THE SMOKER

On a Friday night in October, to be exact, it was on October 15, the engineers disported themselves at one of their annual classics, to wit, The University of Wisconsin Engineers' Club smoker. A fine time was had by all. Any engineer who missed it is certainly to be pitied. The smoke was so thick it made you think of the heating plant. It didn't smell bad, though. Cookies and real frisky cider added to the general air of festivity that pervaded the atmosphere.

Speakers? Surest thing you know! Lots of them, and of the best. The galaxy of talent was so great that those present had to wear glare dimmers in order not to be blinded by the brilliance. Professor Mack, state engineer, father, grandfather, great-grandfather, and great-grandfather emeritus of the club was with us. His words of reminiscence and encouragement, which have so often been the breath of life to the club in less prosperous days, were again welcomed as of old, and as they will be for many a day to come. Dean Turneaure proved that, as he put it, "The faculty does not consist of highbrows," but of real, live, loveable men. A newcomer in our midst, Professor Callan of the Steam and Gas department, was a real find. Called upon to speak impromptu, he acquitted himself in a manner that won the respect and admiration of all who were there. The professor may be a newcomer, but he IS a comer just the same. Of course, Professor Millar received his usual ovation both before and after speaking. Professor Kowalke of the chemical engineering department proved that our well-beloved Charlie Mann is not the only engineer in the white brick building by the sea. Edwin Lee Andrew was three people, and acquitted himself with credit in his protean role. His impersonation of Robert Conrad Disque, whose place he filled, was a thing of beauty and a joy forever. He had even the senior electricals foöled. He spoke as himself for THE WISCONSIN ENGINEER, and in place of our poet, "Whitey" Heuser, he read a brief metrical production entitled, "Ode to the Electrical Engineer," in which it is proved that our noble science dates back to the garden of Eden. Then there was some real music by the Suhm brothers, also *some* singing by the crowd. Altogether, it was an affair long to be remembered. E. A. K.

* * *

ODE TO THE ELECTRICAL ENGINEER

If you want to know who was the first
Electrical Engineer,
You must go back in history
For many and many a year;
Back of the Roman Empire,
Back of the Siege of Troy,
Back of the time when Methuselah
Was a schriveling, half naked boy.

Now first I will tell you of Noah,
And this is my excuse:
He was the earliest victim
Of an overload of juice.
One night Ham stumbled across him;
Noah was stiff and stark;
And that's how we know that long, long ago,
Blow-outs took place on the Arc.

Then next I will mention Moses;
A disagreeable cuss.
For he was the first conductor,
He led the Exodus.
The Egyptians made resistance,
But Pharoah's hosts were fooled,
And one and all, you will recall,
Were thoroughly water-cooled.

Don't forget the old serpent,
Who in the garden lay.
He was the first to wind a coil,
And then there was Hell to pay.
He magnetized Eve and Adam,
And thus it was, in brief,
As everyone knows, they wore their first clothes
A laminated leaf.

Let me tell you the tale of Jonah,
Who liked to do nothing but roam,
One day at the end of his journey,
Was offered passage Ohm
But Jonah was over-excited,
And caused a reactance inside,
And the whale would have broke, except for the choke
That landed Jonah outside.

If you want to know who was the first,
Electrical Engineer,
You must go back in history,
For many and many a year.
Back of the tombs of Egypt,
Back of the temples of Pan,
Back to the time when the pure virgin earth,
Gave birth to the first trouble-man.

* * *

SUMMER SCHOOL OF MINING

The junior and senior mining students left for their regular summer mining trip this year on June 19, reaching Denver on the 21st, where they visited one or two mining machinery houses, and spent the next day at Colorado Springs inspecting the large commercial cyanide plant of the Golden Cycle Company. The following week was spent in the Cripple Creek district, with headquarters at Victor. The most important mines of the district were visited, including the Portland, the Vindicator, the Cresson and several smaller operations. At the Cresson mine the novel opportunity was afforded of seeing the vugg from which the bonanza ore was extracted which created so much excitement in the camp last spring. Out of a comparatively small cavern over $1,200,000 worth of gold tellurides were extracted in a few months. The leasing system peculiar to the Cripple district proves that the mining industry still offers unique opportunities for the man without capital.

From Cripple Creek the class went via the scenic Royal Gorge route to Salt Lake City and spent a profitable week in the adjoining mining districts, as well as bathing in the brine at Saltair. At Bingham the huge operation of the Utah Copper Company was visited and an underground trip made in the Highland Boy mine. The Garfield Smelter and the Arthur mill of the Utah

Copper Company and the Midvale smelter were also visited. At the Arthur mill the new oil flotation installation and the laboratory practice in making flotation experiments were inspected and fully explained. The smoke prevention work at the Midvale smelter and the electrostatic concentrating mill connected with the smelter was also visited.

From Salt Lake the final sessions of the class were held at Tooele and in the Tintic district. The unique methods of lead smelting practice at Tooele were greatly appreciated, as well as the interesting experimental flotation work also being done in their laboratories. The Centennial Eureka and the Chief Consolidated mines were visited.

The formal session ended here, several of the class obtaining positions in various camps and ultimately all of them went on to the Exposition at San Francisco, returning east by various routes.

The party received many courtesies and open handed western hospitality at the various properties visited, and among the especial pleasures of the trip was a Wisconsin dinner at the University Club in Salt Lake on July 2 given by a number of the local engineering alumni. We also had the pleasure of meeting P. C. Brintnall, mining engineer of the class of '13, at Tooele, and E. W. Crane, e '95 who gave us an illuminating lecture on the geology of Tintic, where he is geologist for the Chief Consolidated Company.

The trip, both as an educational and pleasure trip, was a thorough success. PROF. R. S. MCCAFFERY.

* * *

COURSE IN CITY PLANNING

The subject of city planning in Europe has received a remarkable amount of attention in the past fifty years. The fundamental benefits proceeding from an understanding of sound principles of city planning is sufficient explanation for much of the progress made by such countries as Germany, France and England. This is so well understood that practically all the universities provide a chair of city planning. The lecture courses in these universities are extremely popular. As a result of the broad understanding of the subject, not only the large but even many of the smaller cities are undergoing a replanning process which will have a most profound effect on the welfare of the people.

In view of its importance, it is surprising that at only three or four of the universities in America is any attention given to this subject of town and city planning. At the present time over a hundred American cities have awakened to the benefits derived from replanning and sane planning, so that the demand for properly prepared men as town planners far exceeds the supply.

A course in city planing has been given by Prof. L. S. Smith at the University of Wisconsin for over ten years. This course has been very much expanded in the past three or four years. In this course emphasis is not laid as much on the theoretical as on the practical considerations for the welfare of our people. It is interesting to note, however, that the "City Beautiful" was the first vision that came to our people.

Members of this class are assigned definite city planning problems in their own or nearby cities. Each student prepares a report, which is given to the class. In this way it is hoped that members of the class may exert a wholesome and important influence in their communities along the line that promises much for the most pressing needs of our cities.

Prof. Smith has gathered an extensive collection of lantern slides as well as a fine exhibit of both European and American city plans for use in this class.

* * *

On October 30 the seniors of the mechanical and electrical departments will leave for their annual trip. They will take in the Chicago game and visit and a number of places of engineering interest in that place. There will then be two parties made up, one to take the eastern trip and the other the western. The eastern trip will include in order Niagara Falls, Buffalo, Pittsburgh, Cleveland and Gary. Plans have been formulated for receptions given by the Alumni at Pittsburgh and Cleveland. There will be about fifty in this party. The western trip will include Gary, Buffington, Lockport, Waukegan, Kenosha, and Milwaukee. Both parties will be gone a week.

Dow Harvey will act as official photographer of THE WISCONSIN ENGINEER on the eastern trip.

The senior civils will be in Milwaukee from November 1 to 4 on an inspection of a number of engineering works of interest and importance in the vicinity of that place.

* * *

Mr. L. E. A. Kelso, of the electrical department, has a boy.

* * *

Mr. G. H. Gray, of the electrical department, was recently married.

* * *

We are informed that all of the electrical staff have committed matrimony—save one. Our news chaser has already accumulated a few gray hairs awaiting the final closing of the circuit by the tardy one, Bob Disque, but so far there hasn't been even a spark across the gap.

* * *

Mr. L. B. McMillan, of the steam and gas department, was recently married. We had our suspicions last February, but didn't possess sufficient data to advance our editorial hand in congratulatory gestures.

* * *

The second edition of "Water Power Engineering" by Prof. Daniel W. Mead has been off the press about a week. Considerable changes have been made, chiefly the elimination of parts of the text of which a full discussion would be found elsewhere. The book is unusually full of cuts and illustrations.

* * *

Prof. Leonard S. Smith is this fall offering a new course in the highway department, called "Country Roads." The intention of this course is to present to the students in agriculture a thorough and comprehensive study of the building of simple roads. At present there are about thirty enrolled. Inspection of country roads are to be an important feature of the classwork. One credit is given.

* * *

A number of additions are to be noted in the hydraulic laboratory. A new reservoir of reinforced concrete has been built on the hill immediately above the laboratory. The reservoir is circular in plan, being fifty feet in diameter and fifteen feet in depth. It has a capacity of 220,000 gals. A 10″ supply main connects it to the pumping station. There is an observation pit on the north side that facilitates accurate measurement of the level of the water in the reservoir. A 16″ service main carries the water to the experimental machines.

* * *

The new machinery recently supplied to the laboratory include medium head Trump and Gerard turbines which are being connected to the service main from the reservoir. A Laursen automatic pump has been supplied recently by the Laursen Automatic Pump Co., of Eau Claire. The pump is novel in that it combines the principle both of the ram and that of the reciprocating pump as well. The Fitz Water Wheel Co., of Hanover, Pa., have placed a four-foot overshot wheel at the disposal of the laboratory.

* * *

The Lecture committee has begun to plan the engineering lectures for the current year. The negotiations have not proceeded to a point where the names of speakers can be announced; but a tentative list has been prepared which contains the names of engineers prominent in a variety of fields. According to the usual custom an effort will be made to secure some prominent alumnus of this college as one of the speakers. An interesting and instructive program is assured. Attention is called to the point that these lectures constitute a valuable opportunity from several points of view, not the least of which is the privilege of seeing at close range men who have found the road to success in the engineering profession.

* * *

Among the books recently placed on the shelves of the Engineering Library is "Working Data for Irrigation Engineers," by E. A. Moritz, c '04, C. E. '05. Mr. Moritz, who has for some years been an engineer in the United States Reclamation Service, has assembled a vast amount of data pertaining to every phase of irrigation work. The book treats with the successive steps of the investigation and survey of the irrigation project; flow of water in channels and canals; evaporation and seepage; and irrigation structures. The greater part of the book is given to tables and diagrams based upon the theory developed on the earlier pages, arranged in a convenient form for rapid working reference and use. Its author may feel assured of a welcome to the book from the many engineers who have frequently to deal with the subject of irrigation engineering.

* * *

Beginning this fall, it is required that all freshmen of the College of Engineering attend a series of lectures addressed to them on every other Tuesday throughout the year. It is intended to keep before the student a broader outlook upon his field both through the lectures themselves, and the prominent men who make up the list of speakers. On September 28, Prof. Sharp lectured on "How to Study," and on October 12, Dean Turneaure addressed them.

* * *

From the department of drawing there comes this fall a text on "Mechanical Drawing," by Prof. J. D. Phillips and H. D. Orth. The book has been prepared for use as a text in that department.

ALUMNI NOTES

Hearken Ye Alumni! No more shall your brother engineer, who labored at your side a decade or score of years ago, who tugged in the same harness, be miles away from you. No more shall it seem to you as though he had been wiped from the face of the earth. No more shall that dark cloud hide you from the friend that was so dear to you during your college days. THE WISCONSIN ENGINEER with the co-operation of the alumni, will bring to you words from that friend whom you haven't seen nor heard from all this time. That dark cloud will be torn asunder by the novel plan which THE WISCONSIN ENGINEER is launching for the first time. Upon the receipt of the December issue, seek some quiet spot, look into the alumni section and you will hear your old classmate speaking in his old characteristic fashion. The way by which the ENGINEER proposes to accomplish this is as follows:

Each issue, begining with the December issue will be devoted to three classes, differing in years, by one *decade*. The December issue will be given over to '11, '01, '91; the January to '06, '96, '86; February to '12, '02, '92; March to '07, '97, '87; April to '13, '03, '93; May to '08, '98, '88. In this way we will cover a large number of classes and thus offer an opportunity for many to participate in our plan.

Every member in the above named classes is put under an obligation, and it will be up to the individual members of each class to make this plan a far reaching success.

Some time during the month preceding the month in which the issue goes to press, letters will be sent out to every living graduate of the class to which the issue is devoted. Every member will be asked to contribute a few lines or a paragraph descriptive of what he is doing, or anything of a nature that would be of interest to his classmates. This will amount to a letter to all the rest of his classmates. Many graduates, as they say goodbye to their friends after commencement days promise to write, but as the distance between them becomes greater and the individual troubles more numerous, the friend is forgotten. In this new plan we offer a substitute that if it is used properly will prove to be of great interest. Let us once more ask for the sincere co-operation of our alumni and again let us hope to see this plan prove to be a success.

* * *

The members of the class of 1915 from the Chemical Engineering department have obtained employment in various industries as follows:

Michael Agazim, Coke Plant, Illinois Steel Co., Gary, Ind.
R. E. Baker, Chemist, North East Electric Co., Rochester, N. Y.
H. R. Boehmer, Standard Oil Co., Whiting, Ind.
J. B. Edwards, Acid Dept. Illinois Zinc Co., Peru, Il..
J. M. Gillet, Moore & Co. (Paint Work), Chicago, Ill.
A. J. Helfrecht, C. F. Burgess Laboratories, Madison, Wis.
E. C. Herthel, Standard Oil Co., Whiting, Ind.
H. B. Heyn, Harbison-Walker Refractories Co., Pittsburgh, Pa.
H. V. Higley, Sales Dept., General Roofing Mfg. Co., E. St. Louis, Ill.
L. S. Loeb, International Silver Co., Meridan, Conn.
W. R. Lacey, Waukesha Gas & Electric Co., Waukesha, Wis.
H. R. Parker, Coke Plant, Laclede Gas Light Co., St. Louis, Mo.
R. A. Schmid, Patton Paint Co., Milwaukee, Wis.
M. S. Thompson, Du Pont Powder Co., Chester, Pa.
N. B. Thompson, Allegheny By-Product Coke Co., McKeesport, Pa.
J. Trantin, Metallographist, Illinois Steel Co., South Chicago, Ill.

* * *

Edward H. Carus, '12, who taught mathematics at the University of Kansas last year is now located at his home at La Salle, Illinois, where he is experimenting on the manufacture of certain chemicals.

Mr. O. W. Storey, '10, has resigned his position with the Bureau of Mines at Pittsburgh and has become associated with the C. F. Burgess Laboratories at Madison.

The announcement of the marriage of D. S. Grenfell, Ch. E. '14, to Miss Blanchard, has been received. They are at home in Caney, Kansas.

Karl W. Klotsch, '14, is confined to his bed with tuberculosis. (A letter from his class mates will be highly appreciated.)

MORE ABOUT THE 1915 ELECTRICALS

R. H. Hardin, e '15, is with the Chicago Central Station Institute of that city.

F. O. Jorstad, e '15, has accepted a position with the Mississippi River Power Company of Keokuk, Iowa.

V. Poston, e '15, is operating engineer at the Waukesha Gas and Electric Plant, at Waukesha, Wis.

J. W. Reed, e '15, is with the General Electric Co. at Schnectady, N. Y.

T. S. Burns, e '15, has accepted a position with Burns Bros., Watertown, New York. His uncle is interested in the concern.

P. N. Elderkin, e '15, is working on the municipal electric light plant at Westby, Wis.

F. C. Ellis, e '15, who graduated in February, is now private secretary to R. E. Richardson of New York City. Mr. Richardson is at present in Boise, Idaho, where he will be engaged in merging several large hydro electric companies into one.

CHANGES OF ADDRESS

Howard A. Parker, c '08, who was formerly engineer at the Knoxville Power Co. at Alcoa, Tenn., is now located at 716-11th St., Sacramento, Cal.

Fred H. Ripley, ch '09, who has been a chemist for several years is now superintendent of the Greeley Gas and Fuel Co., Greeley, Colo.

R. H. Morrison, m '03, graduate of Wis., is now instructor in the Machine Design department here at Wisconsin.

Ralph Moody, e '13, has recently been elected secretary of the T. M. E. R. & L. section of the N. E. L. A. which has a membership of 250.

It certainly is of great interest to learn that Ed. Ryan, e '14, who had a very serious accident this summer, has recovered, and left for his home at Portland, Oregon.

Roy Palmer, e '01, has hung out his shingle as consulting engineer. He is located at 714 Hartford Bldg., Chicago, Ill.

O. F. Gayton, c '09, who used to be assistant engineer for Alvord & Burdick, is now valuation supervisor in the Public Service Department of Chicago.

Geo. G. Thorpe, m '91, has been promoted from second to first vice president of the Illinois Steel Co. His address is 208 S. La Salle St., Chicago, Ill.

F. E. Kruesi, e '08, is now manager of the Freeport Railway & Light Co., Freeport, Ill. Mr. Kruesi, formerly was operating engineer with the Illinois Northern Utilities.

Carl Zapffe, '07, is now geologist for the Northwestern Improvement Co. at Brainerd, Minn.

R. T. Herdegen, e '06, is now residing at 371 E. Grand Blvd., Detroit, Mich.

Walter Alexander, who was recently appointed as a member on the Railroad Commission of this state, is now located at 1811 Jefferson St., Madison, Wis.

Chas L. Byron, c '08, has changed his home address from Chicago to 926 Oak St., Winnetka, Ill.

B. G. Elliot, m '13, has been appointed associate professor of mechanical engineering at the University of Nebraska.

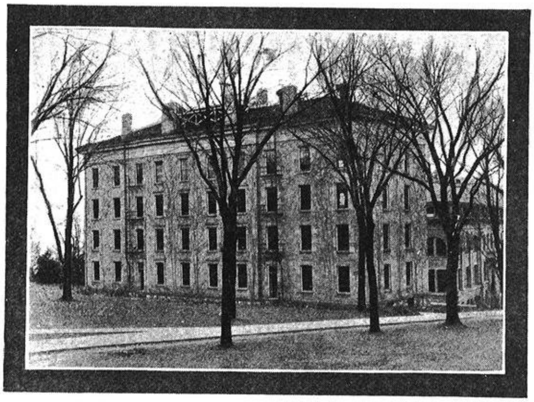
F. H. Ripley, 09, is with the Greeley Gas & Electric Co., Colo.

H. E. Pulver, c '10, is now professor of civil engineering at the Gov. Inst. of Technology, Shanghai, China.

E. E. Riele, '14, is working for his father at Benford, N. D.

J. Zimmerman is with a concern producing a new style of magnet at Sumter, S. C.

Don't forget to watch for the letter asking for your own little message. And most of all don't forget to answer it *as soon as you get it.*



RESEARCH

By Dr. W. R. Whitney
Director of Research Laboratory, General Electric Company

The president of a manufacturing company who was hestitatingly considering the possible recovery of valuable waste solvents from a chemical process said: "You know we are making photographic paper and are not interested in the solvents. We buy them, use them and make a profit on the product." In other words, the existing condition was not unsatisfactory. It seemed, in fact, perfectly satisfactory. Nevertheless, he realized that this view was not foresighted and he corrected it to his advantage. A process or product susceptible of economical improvement, as are all of them, cannot be looked upon as an entity, enduring and unalterable. It changes like everything else. What this man wanted was that his process instead of continuing as it was, the best among its contemporaries, should become as it was not, the best among its future competitors. He really wanted continuing profit. Perhaps it is the impossibility of actually seeing what is not which accounts for our faith in what is: but who can name a product, a process, or even a faith which does not alter with time? One might almost say that the most typical impossibilities of one decade often become the liveliest realities of the next. Darius Green and Captain Nemo certainly taught us something. Rather than suppose that we will ever reach a stationary state of perfection in anything, it is more interesting and probable to assume that for some reason, either highly complex like the union of heredity and environment, or simply mechanical like the grain size in our gray matter, we cannot really conceive a physical impossibility. A good working hypothesis is: If it can really be conceived, then it may be made. If one deliberately analyzes the history of any manufactured article he is struck with its active mutation. This ought to jar one's feeling of complacency, but usually it does not. The things laboriously made in units by hand today will be made in dozens by machines or assembled on endless conveyors tomorrow.

Even in the oldest business of the world the continuous order of change is evident. The wooden plow was displaced by one forged from the battle ax. Someone invented the coulters, and then came the moldboards of all shapes and sizes, and the wheel. Some Americans produced the light chilled plow, and others discovered that a man could ride and still plow. Then, before the plow business stopped growing, the double Michigan plows came along (a little one in front of a larger one), and then two large ones in echelon (for making a double furrow), next, multiple plows drawn by rope or windlass with steam power, then steam tractors and then gasolene tractors with twenty or thirty units, and perhaps then just dynamite,—who knows? How simple and familiar they all look up to the last one, and how difficult to see just beyond that point.

Confine yourself to your own day. Do you remember the big one-cylinder gasoline engine you put into that boat? It was easier and safer to row the boat than to start the engine. It was largely the love of the risk involved that made you use the engine. It weighed one or two hundred pounds per horse power. The ignition system was an engine by itself, and when it was operating it made you feel like a locomotive engineer, it had so much useless motion. Recall how perfect some of those little improved yacht engines looked and how natural it seemed to go to a two-cylinder engine? The next gas engine you saw was a four-cylinder, costing about the same as your first single cylinder, but quite a different animal. Of course the improvements need not consist of merely added cylinders and you laughed when someone suggested more, but sixes, eights, and even twelves are making the fours look a little old already. You guess now that from twelve the advance will be to twenty or more, or to a turbine type with many blades to take the thrust, or even infinite blades which means the plain rotating disks already described in the newspapers. No matter what you guess, the changes will come and always in one direction: ''More for the money.'' Paradoxical as it may look, when we stand still we are going backward. If we want to stay we have to go forward.

That Allegheny Indian who first rubbed the rock oil on his aching bones started the line of research which now lets us run about so easily in automobiles. The petroleum industry has always been and ever will be a living, moving, growing thing. If we want to, we shall probably eat modified vaseline and wear clothes colored with modified paraffin, but it will not be done by being satisfied with what is, afraid to try what is to come.

Nature does not supply us with baskets and a sunny spot to place them so that we can catch the falling futures, but she shows us that swimming may be learned almost entirely by getting into the water, or at least by adding some push and a little kicking.

It was not my intention to discuss preparation for national defence, which is only a single one of those fields in which, when we want to advance beyond others, we shall probably have to excel in our efforts. Nor do I care to devote too much of this note on research to a comparison of the industrial situations in such leading countries as England and Germany. But, a few words chosen from modern English literature seem very pertinent. More on this point may be found in an editorial in the Journal of Industrial and Engineering Chemistry for October, 1915, from which I quote:

"The attitude of the government toward science was well illustrated during the debate of British Dyes, Ltd., when the Parliamentary Secretary of the Board of Trade stated that:

" 'A man conversant with the science and practice of dye manufacture was unfit to go on the directorate because, as he would know something of the business, the whole of the other directors, being but business men, would be in his hands.'

"As Prof. Meldola points out:

" 'One feature of the new scheme which the chemical profession can view with favor is the distinct recognition of research as a necessity for the development of the industry. The Government will, for ten years, grant not more than 100,000 pounds for experimental and laboratory work. That is certainly a concession which marks an advance in official opinion. It will be for the satirist of the future to point out that it required a European war of unparalleled magnitude to bring about this official recognition of the bearing of science upon industry.'

"According to Sir Ronald Ross:

" 'The war now raging will at least demonstrate one thing to humanity—that in wars at least, the scientific attitude, the careful investigation of details, the preliminary preparation, and the well thought out procedure bring success, where the absence of these leads only to disaster. So also in everything. After all, the necessity for research is the most evident of all propositions.'

"As S. Roy Illingworth puts it:

"'The inexorable law of the survival of the fittest is as true of nations as of animals and only those nations that are the most efficient in industry can have any chance of maintaining their entity.'

"Dr. J. A. Fleming writes:

"'A few days ago an eminent electrical engineer was sitting in my room here, and said to me,—"I am too old to enlist or even do manual work in the manufacture of shells, but I have a considerable scientific knowledge which I am just yearning to employ in the service of the country, yet I cannot find any person in authority who will tell me how to do it."

"'This sentence expressed concisely not only my friend's feelings, but my own, and I am confident that of hundreds of other scientific men as well. At the present moment, after ten months of scientific warfare, I myself have not received one word of request to serve on any committee, co-operate in any experimental work, or place expert knowledge, which it has been the work of a lifetime to obtain, at the disposal of the forces of the crown.'

"Sir William Ramsay says:

"'It is bad policy to regret what might have been; it is much better to try to devise plans to make up for lost time; and the first essential is organization. It is notorious that there is little intercommunication between the various Government Departments: many of them are confronted by the same difficulties; many of these difficulties would be overcome if scientific advice were asked for; and the prime necessity at the present moment is a central body of scientific men to whom the various Governmental Departments should be compelled to apply for advice and assistance.'

"In July Mr. Henderson, successor to Mr. Pease as President of the Board of Education, issued a White Paper outlining a 'Scheme Designed to Establish a Permanent Organization for the Promotion of Industrial and Scientific Research' by the establishment of a single responsible body entrusted with the disbursement of a considerable fund. This consists of a Committee of the Privy Council with

"'............a small Advisory Council composed mainly of eminent scientific men and men actually engaged in industries dependent upon scientific research, which shall be responsible to the Committee.'

"The first members of the Council will be Lord Rayleigh, Messrs. Beilby, Duddell, McCormick, and Threfall, Profs. Hopkinson, M'Clelland, and Meldola, and the Committee of the Privy Council consists of Lord Haldane and Messrs. Ockland and Pease.

"In this way does the English Government announce at last a change of policy and propose to retrieve its past inaction. Of this scheme *Nature* remarks:

"'By its inception and publication the Government acknowledges and proclaims its appreciation of the work of science and by this acknowledgment alone gives scientific workers that encouragement and prestige in the eyes of the country which has too long been withheld.'

"Thus England has awakened after the most costly delay to a situation which she must probably work for years, at the best, to remedy, a situation which threatens not only her future supremacy but even her present existence."

Research is not a word to conjure with. As a magic it is exactly like a grindstone. You can tie it around your neck or you can work it. The dictionary says that "*Research* is diligent protracted investigation especially for the purpose of adding to human knowledge." The dictionary is right. The man who investigated boron was diligent; he observed all its peculiar qualities and measured its quantities. When it failed to make a suitable incandescent filament as had been hoped and the "addition to human knowledge" of its low melting-point was made, his protracted diligence had already taught him that it was a great oxygen-eater. It would take oxygen even from aluminum oxide. So it happened that it was investigated in connection with copper castings. It took oxygen from copper. It made a perfect electrical and physical product of what had before been a failure. At that time magnesium was used in the manufacture of boron. The war came on and the price of magnesium rose. It was made only in Germany. Another research, or "diligent investigation" was started and for five or six months the "protraction" continued until a manufacturing method using American raw materials was devised. There is now little probability that this metal will ever cease to be made in America. This illustration is given because it is fairly typical of research. The point attained is not always that particular spot aimed at, so far as knowledge is concerned. A yield is obtained, nevertheless, and the knowledge acquired is a perpetually enlarging accertion, so long as the diligent investigation is under way.

The impossibility of foreseeing the applications of a research and the certainty that all knowledge is of use might be illustrated by a thousand cases. No one fact, well known, can exist without reacting on the remainder of knowledge. In 1895 and 1898 the first discoveries of X-rays and radium rays were made.

The facts as they were disclosed fed every science. Chemistry was given a jolt it had thought could never occur. Physics went back to the consideration of dimensions thousands of times smaller than before. Electricity's views of conduction were enlightened and the phenomena of electrical insulation of gases and oils were clarified. Medical diagnosis and surgery were given additional eyes and therapeutics a new reagent. From the man who today sees the gas holes in iron castings to the one who studies heredity by exposing eggs and sperms separately to the rays all have to thank those who carried out the necessary researches on these rays. Few or none of these applications could have been predicted prior to 1895. What could have been predicted, however, with certainty was that some uses could be made of such disclosed facts.

(From the G. E. Review.)

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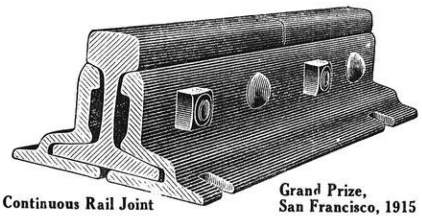

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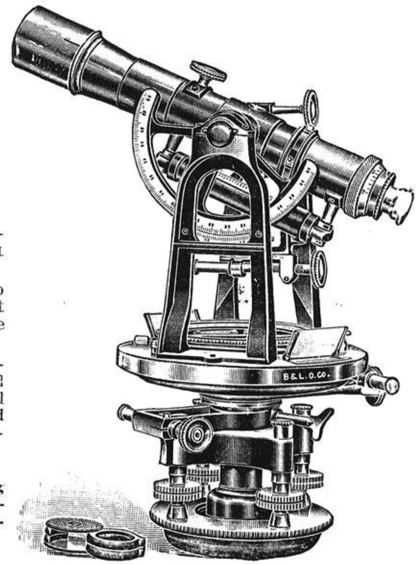

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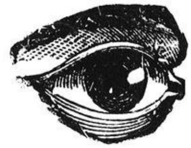

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