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of the
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ENGINEERING SOCIETY

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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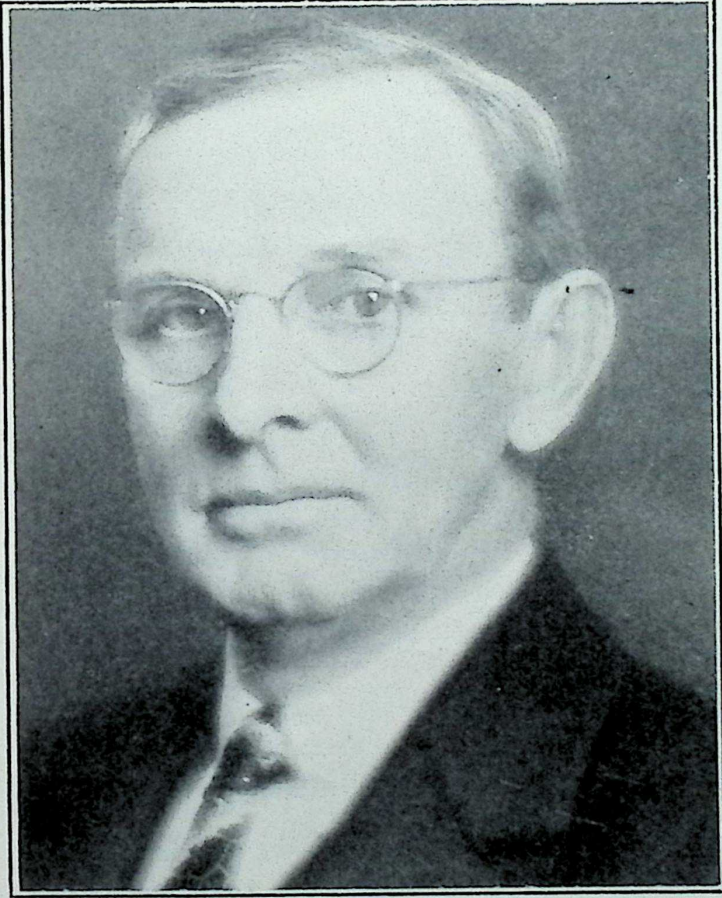
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CHARLES S. WILLIAMSON, JR.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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No. 1

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EDITORIAL NOTES AND COMMENT

Our New President. Professor C. S. Williamson, Jr., was born on August 7, 1879, at Culleoka, Tennessee. His early education was obtained in the Culleoka Training School. He later attended Vanderbilt University, from which he was graduated with the B. S. degree in 1902. In 1903 he received the degree of Master of Science from the same institution.

His professional and teaching experience has been widely varied. It includes such activities as Assistant in Chemistry, Vanderbilt University; Teaching Fellow in Geology, Vander-

bilt University; Professor of Chemistry and Biology, Wofford College; Head Instructor in Chemistry, Michigan Agricultural College; biological work for Frederick Stearns & Company; Chemist, Smith Laboratories, Mt. Pleasant, Tenn.; Chemical Laboratory, Titcomb & Williamson, Columbia, Tenn.; Assistant Professor of Chemistry, Alabama Polytechnic Institute; and at present Professor of Chemical Engineering and Head of the School of Chemical Engineering, Tulane University.

In addition to the above, Professor Williamson has had extensive experience as a consultant on chemical engineering problems in many commercial fields. He is past-president of Louisiana Section, American Chemical Society; president, Louisiana-Mississippi Section, American Institute of Chemical Engineers.

Other Officers for 1937. Mr. B. H. Grehan was elected First Vice-President and Dean L. J. Lassalle Second Vice-President for 1937. Professor A. M. Hill was elected Secretary-Treasurer. Messrs. L. L. Newman and C. G. Cappel were elected to the Board of Direction. The other elective member of the Board is Mr. David W. Godat, who holds over from last year. Mr. Carroll J. Peirce was appointed to fill the vacancy on the Board caused by the automatic resignation of Mr. B. H. Grehan.

Major Allen S. Hackett, as retiring President automatically becomes a member of the Board, taking the place thereon of the preceding retiring President, Colonel Edward S. Bres.

The Annual Meeting and Dinner Dance. The Annual Meeting Dinner Dance was held in the Crystal Room of La Louisiane on Saturday night, January 23.

The toastmaster was Mr. J. T. Bullen of Shreveport. Other performers before the microphone of the address system were Mr. Fred Billingsley, Chairman of the General Committee, Col. Bres, and Dean Lassalle. President Charlie (alias Professor Williamson) furnished the correct pH background. Just what real business was transacted other than presenting retiring President Hackett with an electric clock is hard to say. Ye

Editor was detained by illness, but rumor hath it that the turkey was plentiful and tender, the dance floor smooth and the hour late before horn tooting and balloon blowing were ended.

The Proceedings Sustains Another Loss. Another regrettable loss has accrued in the death of Mr. Albert J. Dickerson, manager of the Press which prints the Proceedings.

He has been responsible for the physical make-up and press-work of this publication since its inception.

He was always loyal, willing, and earnest in any matter which concerned the betterment of the Proceedings.

All of his friends in the Society and in particular those of us who have anything to do with this publication shall miss him greatly.

Annual Meeting Papers. Again the two-day annual meeting was productive of a wealth of interesting and instructive papers—so many, in fact, that we can not present them all in this issue. We are publishing two of them this time, and will publish others in future issues. The two published in this issue are by members of the Society—both of them outstanding men in their chosen fields of endeavor.

PAPERS AND DISCUSSIONS

CHEMICAL ENGINEERING PROGRESS IN THE CANE SUGAR INDUSTRY

GEORGE P. MEADE *

Read at the Annual Meeting, January 23, 1937.

The cane sugar industry needs no introduction to a gathering of Louisiana engineers, but the relationship of the industry to chemical engineering is such that a full discussion from the chemical engineer's standpoint would seem to be warranted.

The sugar industry has a highly developed and specialized technology entirely dependent on chemical control. This control was an early introduction and it is certain that few, if any, of the industries antedate sugar in their dependence on the laboratory and the chemist. The three branches of sugar production—raw sugar manufacture, cane sugar refining and beet sugar manufacture—all serve as excellent illustrations of the definition of chemical engineering—"that branch of engineering, the basis of which is those unit operations which in their proper sequence and co-ordination constitute a chemical process as conducted on the industrial scale".

It should be added that chemical engineering also includes, or has taken over, many unit operations in which no chemical change is involved, but which require accurate regulation or automatic control. Heat transference, crushing and grinding, and mechanical separation are a few of the operations not chemical in character in which the chemical engineer specializes.

Not only does the industry employ a majority of the unit processes of chemical engineering, but it can point proudly to the fact that many of these processes and the apparatus by which they are carried out have been developed specifically for use in sugar work. They were first invented for sugar,

* Member, and Manager of the Colonial Sugars Gramercy Refinery, Gramercy, La.

then elaborated in the industry, before they were adopted by other industries employing chemical processes. The historical record on these points should prove of interest.

The Vacuum pan with which you are all familiar and which is widely used in other industries was invented by Howard and first employed in English sugar refineries in 1830. Howard is also credited with the invention of the plate and frame filter press, and its use in refining dates from about 1820. The Taylor bag-filter was a development of about this same time.

Boneblack filtration first came into use in English refineries in 1828 and it is employed in sugar refining today for decolorizing purposes in essentially the same way as it was then. Vegetable carbons, generally referred to as "recent innovations," were put into use at this same time but the superiority of boneblack from both the practical and economic standpoint prevented their commercial development until recently.

As will be shown later, Louisiana has contributed much to the scientific and technical advancement of the sugar industry. The earliest and possibly the greatest of these contributions occurred in 1834, when Norbert Rillieux, who was born at Destrehan, Louisiana, first stated the principles of multiple effect evaporation and devised a double effect evaporator along similar lines to the evaporators which are in use today. It was not until about ten years later that he was able to install any of these multiple effects, but by 1850 many factories reported "Rillieux system" in the published tabulations of sugar statistics. In 1852 Weston patented the first suspended centrifugal which was put into use that year in cane factories in Hawaii. Many of the centrifugals in service today are referred to as the "Weston Type."

Crystallization in motion, the invention of no one man, was devised for sugar work about 1880 and has been developed and perfected in the industry.

The polariscope was devised in the middle of the last century and its use in routine control and commercial analysis spread fairly rapidly until it became the universal guide in all sugar work.

In addition to these specific pieces of apparatus now generally used in other industries, the sugar industry was the first to carry certain processes to a high degree of perfection. Crushing and grinding in the milling of cane has gradually been elaborated into a huge operation, controlled with great accuracy, since the first three-roller steam driven mills were installed in Jamaica about 1790. Steam production with wet fuel was first made possible by the invention of green bagasse furnaces about 1890, by Fiske in Louisiana and Cook in Cuba. These furnaces to take the crushed cane fibre direct from the mills were responsible for the development of milling on the modern scale. Many forms of filters and filtration equipment have been perfected for use in sugar refining before being adopted by other industries.

Reference has been made to Louisiana's contribution to the development of the cane-sugar industry and two important instances have already been mentioned—Rillieux's multiple effect evaporators and Fiske's green bagasse burner. The first shredders and the first crushers for preparing cane for the mills were installed in Louisiana in the early eighties and their use spread rapidly to other parts of the world.

The diffusion process in cane work was perfected by Dr. G. L. Spencer at "Magnolia," Louisiana, in the eighties. This process although never generally adopted undoubtedly was instrumental in forcing mill designers to improve extractions in order to prevent the general adoption of diffusion. It was at "Magnolia" that the filter press was first used in a cane factory in the Western Hemisphere. Boiling back of molasses, to improve vacuum pan work and to obtain higher yields of sugar, was first practiced in Louisiana (about 1875) and simultaneously in Java. The first nine-roller mill in the world was installed at Cora Plantation, near Donaldsonville, Louisiana, in 1898, and for many years the word "Cora" on the name-plate of the Fulton Iron Works mills carried the name of this plantation to every cane producing country on the globe. More recently the manufacture in Louisiana of bagasse into wall-board under the name of "Celotex" has marked the first successful use of bagasse in a commercial way.

Possibly Louisiana's greatest contribution to cane-sugar technology has been the Audubon Sugar School of L. S. U. under the direction of Dr. Charles E. Coates. This school, founded in 1898, has been called the "first experiment in Chemical Engineering education in the United States." Its students have come from all over the world, and have carried back to their respective countries the influence of Louisiana's scientific and technologic progress in cane sugar production.

Turning from the historical to the present, the extent to which the unit processes of chemical engineering enter into the manufacture and refining of cane sugar is best shown by the tabulations appended at the end of this paper.

RAW SUGAR MANUFACTURE

The manufacture of raw cane sugar has seen little change in fundamentals in the last quarter century. Extraction of the juice by crushing and grinding in mills; treatment with lime and heat; removal of the precipitate by sedimentation; evaporation in multiple effect; boiling to grain in vacuum pans with further crystallization in motion; and separating the crystals and molasses in centrifugal machines are still the same process steps that were used at the beginning of the century and even before that. There have been great changes, however, in the capacity and design of the machinery used and in the application of scientific methods.

Milling the Cane.

In milling machinery the increase in the size, strength, power and capacity is illustrative of the changes that have taken place in the industry. Twenty-five years ago the usual mill train consisted of a crusher (two deeply grooved rolls for breaking up the cane) and two or three sets of mills of three rollers each. The capacity of such a combination was 50 or 60 tons of cane an hour. Today, the larger factories have several trains of 18 or 21 rollers preceded by double crushers or shredders and knives for cutting the cane into chips, and with capacities of 250 tons per hour. The extraction of the sucrose from the cane has increased from below 90 per cent in the older installations to 96 per cent and above in the modern plants.

The modern train of mills with crushers, carriers, driving mechanism and accessories, is one of the largest machinery combinations in use in any industry, and a mill room with three such trains in full operation is a truly impressive sight. So far as the mills themselves are concerned the only important change has been the introduction of juice grooves to provide readier drainage and improve extraction and capacities.

Great improvements have been made in the accessories, particularly in the preparation of the cane for the mill and the handling of the juices for maceration purposes. Shredders and crushers for breaking up the cane were introduced many years ago in Louisiana, the crushers consisting of two (rarely three) deeply grooved rollers, which break the cane and express a part of the juice, while shredders are rapidly revolving toothed wheels which act as the name implies, but do not extract any juice. Most of the mills throughout the world are equipped with crushers, and when shredders are employed these are usually auxiliary to the crushers. Many mills are equipped with double crushers and several have three sets of crushers of two rollers each. Revolving knives have been added for preliminary preparation of the cane entering the crushers and are now quite general. The knives consist of a set of blades on a rapidly rotating shaft (about 500 R.P.M.) located about one-third of the way up the cane carrier. The purpose is to cut the cane into short pieces or chips and also to level the mat so that there is a much more even feed to the crushers, with corresponding increase in capacity or extraction of juice, or both, for a given grinding equipment.

The latest innovation is the Morgan cane disintegrator, in use in a few mills, which takes the place of the crusher. In effect the disintegrator is a large centrifugal pump with a solid steel impeller revolving at a speed of 600 R.P.M. The vanes on this impeller correspond to similar vanes in the casing, the clearance being small. The cane, cut into chips by knives, passes into the casing and is torn into a fluffy mass by the impact between the revolving and stationary vanes, after which it goes through the regular grinding process. No juice is extracted by the disintegrator.

Since the earliest days of multiple mills it has been the practice to spray water on the partly extracted bagasse before it enters the last set of mills in order to increase the extraction of sugar. This process, known as simple maceration, was later extended to double maceration by having the thin juice from the last mills returned to the bagasse on the carriers entering the previous set of mills. With the increase in the number of sets of mills, "compound maceration" was developed in which the juices from two or more sets of mills were returned separately to the carriers of preceding mills. This was a logical procedure but it multiplied accessory apparatus such as juice strainers, juice tanks, pumps and piping under the mills to such a point that the increased extraction was offset by increased sugar losses, due to souring and fermentation. During the past few years the introduction of strainerless juice pumps such as are used for sewage and dredging work has made it possible to pump juices back to the mills without straining, resulting in great improvement in sucrose extraction and in sanitation around the mills.

Mill Sanitation.

The matter of cleanliness around the mills has received special attention lately because of the recognition of huge sugar losses (largely undeterminable) through fermentation in the troughs, tanks, and strainers under the mills. Since the technical control of the factory starts after the juice has been extracted, sugar losses at the mills are not determinable by the ordinary control methods. Bacteriologists have shown that a handful of sour bagasse or cane trash can infect the whole stream of warm juice flowing over it. Mill designers now avoid all projecting bolts and dead corners in juice troughs; bagasse conveyors or carriers between the mills have been introduced which have fewer parts than the older type slat conveyor; screens for straining the juice before sending it to the process have been made more accessible for cleaning and new designs of strainers are being employed which may be placed above the mills. There is no doubt that incalculable savings have been effected by this increased cleanliness, which is due to improved engineering based on bacteriologic findings.

Bagasse and Its Use.

The bagasse or cane residue from the mills is the regular fuel of the cane factory, but until recent years it was rarely sufficient for the full needs of the boiler house. Electrification of milling machinery, more efficient bagasse furnaces, power plant control, and steam economies in the factory (particularly at the evaporator station) have all combined to leave an excess of bagasse in the more modern factories and attention has been turned to uses for this excess. The cellulose which can readily be separated by sifting has been found to have certain specialized value, as in the making of explosives and rayon. The residue after sifting is now being dried and sterilized at high temperatures (1400° F.) and sold for use as a mulch for flowers and plants, as "litter" for small chicks, as cattle bedding and for other agricultural purposes.

Fibre Board From Bagasse.

In Louisiana and a few other cane-producing districts, the employment of bagasse as a fuel has been almost entirely discontinued, to permit of the manufacture of the building and insulating board "Celotex." The bagasse is stored in bales for some months to "weather," after which it is fed to a cooker to remove the waxes, resins, and pecto-cellulose, and to toughen the fibre and render it more flexible. From there it goes to washers and paper-mill beaters, after which a waterproofing material is added and the fibre and water are fed to the machine forming the board, and thence to the driers.

Vascane Process.

The Vascane process is still in the experimental stage in Cuba for the simultaneous manufacture of sugar and fibre board from the cane. The cane is disintegrated by shredding it against an abrasive wheel, after which it is put through a regular counter-current diffusion process, the extraction being better than 99 per cent, leaving the cane fibre so pure that it goes direct to the manufacture of the fibre board. The juice to process has a dilution of about 30 per cent, the same as that obtained by the regular milling process. Here is a return to diffusion, abandoned in the cane industry many years ago be-

cause of the high cost of excess fuel, now possibly made practicable because of a more valuable use for the bagasse.

Clarification of Juice.

The raw juice is now weighed in tank scales as it comes from the mills, a great improvement in control methods over the older practice of measuring and calculating the weight. Heat and lime continue to be the universal clarifying agents, followed by sedimentation of the precipitated impurities and decantation of the clear juice. The addition of a small amount of soluble phosphate to increase the precipitate is a recent improvement where juices are difficult to clarify. Sulphur dioxide has long been in use in Louisiana and in many other countries, notably Mauritius, to increase the volume of the precipitate and to act as a bleach on the coloring matter. Carbonatation, similar to the process used in beet factories, is extensively used in Java for the manufacture of semi-white sugars.

The technology of clarification has been profoundly altered by two contributions of pure science, the use of pH (hydrogen-ion concentration) control and the application of colloid chemistry. Practically all factories now control the addition of the lime at the clarification station by colorimetric pH tests and many of the larger plants have automatic electrical recording apparatus to determine pH continuously. A few factories are actually carrying out the addition of the lime automatically by electrical devices operated by pH recorders. The knowledge of what happens during clarification of juice has been greatly increased by members of the Carbohydrate Division of the Bureau of Chemistry at Washington and others who have studied colloid elimination and its effect on subsequent steps in the process and the final quality of the raw sugar. A further refinement of clarification is promised by the continuous determination of dissolved lime salts by conductivity methods.

Continuous settling systems have been tried for many years but none of these was successful until the introduction of the Dorr Clarifier, a modification of the apparatus used for many years in mining work. Less mud draw-off, clearer juice and reduced sugar losses are advantages of the Dorr.

The removal of the mud from the scum waters in the defecation process is still generally carried out on plate-and-frame filter presses although vacuum filters of the Oliver type have been successfully used in a few factories during recent years. A clarification system which completely eliminates the filter station is the Petree-Dorr process which used a double set of Dorr clarifiers, the heavier juices from the first mills being defecated in the primary clarifier and the scums from this system together with the thin juices from the other mills re-defecated in a secondary clarifier. The scums from the secondary clarifier are sprayed on the mills, the blanket of bagasse acting as a filter, while the mud goes to the boilers with the bagasse. The Petree-Dorr system has the advantage of simplicity because it does away with the need for filter presses but it requires a complete change of control methods since the cold juice cannot be weighed and tested as in the ordinary defecation system. This means that the chemical control of the factory does not start until after clarification has been completed so that any losses in the clarification system are not determined. It also means that the juice must be weighed or measured hot instead of cold, a much more difficult operation. The Petree system which returns the muds to the mills has been discontinued in many countries for this and other reasons.

The compound clarification which is a part of the Petree-Dorr system (but filter-pressing the mud waters instead of returning them to the mills) has been found advantageous and is practiced in many mills. The scums from the primary Dorr together with the thin mill juices are defecated in a secondary Dorr. This gives a greater colloid elimination according to several investigators.

Evaporation of Juice

The clarified juice containing from 12 to 18 per cent of solids is evaporated to a heavy syrup of 60 deg. Brix or above in multiple-effect evaporators, usually of the "standard" type in quadruple effect. Great changes in practice at this station have come about by the introduction of steam economy methods which "rob" some of the vapors from the first effects and use these for juice heating, thereby giving double-effect

results in the heating of the juices. An elaboration of this idea is the addition of a vapor cell ahead of the effects in which the juice is heated by exhaust steam, all the vapors from this cell being used in juice heating. This has been carried still farther by having a double-effect dead-end vapor cell ahead of the evaporator. The Pauly-Greiner pre-evaporator uses live steam at about 40 lb. pressure, the vapors in this case being sent to the exhaust steam system of the factory. The "Pauly" acts substantially as a reducing valve and is not in general favor in raw-sugar houses. Thermo-compressors in conjunction with the evaporators are in use in some factories where there is a deficiency of exhaust steam.

Crystallization.

The evaporated syrup goes to single-effect vacuum pans for concentration to a massecuite, the calandria pan having almost entirely superseded the coil pan in raw-sugar factory work. Notable studies by A. L. Webre have shown the necessity for artificial circulation and he has designed vacuum pans with stirring devices which have been introduced in some of the newer installations. This is a return to ideas which were in vogue in the last century. The design of calandria pans has recently been changed to improve circulation by having larger down-takes.

Great changes in pan boiling practice have taken place in the re-boiling of molasses. Elaborate and apparently complicated systems of handling the various grades of massecuites have been worked out in order that the factory may turn out one grade of sugar only, which is of good refining quality. The older methods of producing two or even three grades of sugar and the use of hot room cars for crystallization of "string-proof" sugars were largely discontinued about twenty-five years ago, and "molasses sugars," "muscovadoes," and "seconds" have disappeared from the market. These newer pan-boiling systems have been steadily improved with a view to greater exhaustion of residual molasses, less in-boiling of impurities, greater fuel economy and the improvement of the final product.

Within the last few years crystallizers have been equipped with cooling-coils for the more rapid working of low-grade products. In the simplest form, the Kopke coils, banks of tubes are placed between the rotating arms of the crystallizer through which cold water is circulated until the desired temperature is reached (about 95-100 F.). Just before sending the cooled massecuites to the centrifugals hot water is circulated through the coils until the mass is about 125 F. This warming facilitates centrifuging by reducing the viscosity of the molasses, and gives a cleaner sugar. A crystallizer equipped with cooling coils is said to have about 50 per cent greater efficiency than one without coils.

A still more elaborate cooler-crystallizer is the "La Feuille" rotary crystallizer, a longitudinally rotating drum, slowly turning on rollers and equipped with cooling pipes extending lengthwise. The rotary motion gives more effective cooling and the exhaustion of the molasses is about six times as fast as in the ordinary crystallizer. Experiments in Java indicate that with this apparatus it may be possible to reduce molasses purities of high test massecuites to such an extent that one re-boiling is avoided.

La Feuille has also patented a rotary vacuum pan and crystallizer combined which may result in a complete change in the boiling equipment of the raw sugar factory. This rotary vacuum crystallizer pan is similar to the La Feuille crystallizer but is equipped with connections for vacuum and for drawing in massecuite and molasses. The coils are fitted with steam inlets as well as connections for cold water. The method of operation is, first to take a footing of massecuite and build on this with molasses until the strike is brought to the proper density, evaporation being effected under vacuum by steam in the coils. With the crystallizer pan still rotating, cold water is introduced into the coils and the massecuite is cooled to about 105 F. after which the massecuite is purged in centrifugals in the ordinary way. Because of the regularity of grain and the high densities obtainable by this method, drops in purity of 30 degrees are possible and no crystallizers are needed. The pan boiling and cooling takes only seven to eight hours so that ma-

terial in process is greatly reduced. A raw sugar factory in the Philippines, grinding 1000 tons a day, has one small coil pan and two of these crystallizers of 1150 cu. ft. capacity for its entire boiling and crystallizer equipment.

Centrifuging.

Throughout the sugar industry the centrifugal is universally employed for the separation of crystals and the mother syrup. The self-discharging centrifugal is in great favor in the raw-factory, this type having a bottomless basket. The capacity is about double that of the old style machine. Accessories such as automatic washing devices and automatic starting and stopping arrangements are more generally used in refining than in factory work.

Great attention is now paid to the centrifuging of the raws as it has been proved beyond question that deterioration of raws in storage is entirely preventable by a proper control of the moisture content of the raw sugar. The relationship between moisture and polarization must be such that the moisture divided by 100 minus the polarization is less than 0.25. General adherence to this "safety factor" has largely eliminated a loss that formerly ran to hundreds of thousands of dollars annually. Other factors, such as proper clarification of the juice, and grain size and shape, indirectly affect the keeping qualities of raws by making it easier to attain the proper "safety factor." Gross contamination by yeasts, moulds, and bacteria is also to be avoided and dry storage conditions are essential to prevent "sweating" of bags and absorption of moisture beyond proper safety limits.

Refining Quality of Raws.

Possibly no phase of sugar work has received so much scientific attention in recent years as the refining quality of raw sugars. Instigated largely by the refiners in an attempt to get better sugars for their process, the investigations have been taken up by government chemists and by raw sugar manufacturers with a view to improving the working qualities of their product. A review of this work is not within the scope of this paper but the result has been that raw sugars are now studied

as to grain size and conformation, color constituents, colloid content, pH, character of the ash and filtrability; where a dozen years ago the polarization was the only point of general interest. The raw manufacturing process, particularly the clarification and the pan boiling systems, are directed toward this idea of producing a product satisfactory to the refiner in these various respects, but the improvements along these lines have more than paid for themselves in increased yields. Storage qualities and the moisture content, already referred to, are also of deep interest to both buyer and seller.

Sugar Refining.

Advances in the refining field during the past decade have been greatly aided by a more liberal policy on the part of refinery technologists in the matter of publications as well as by a freer interchange of ideas between the refineries themselves. The mistaken policy of secrecy in vogue formerly was certainly a factor in preventing advancement along broad lines in this branch of the industry.

The refining process begins with the removal of the film of molasses from the crystal of raw sugar. The raw sugar is "washed" by mingling with a heavy syrup, centrifuging and spraying with water. Self-discharging centrifugals with automatic water sprays and automatic timing devices are now general for wash plant work.

Defecation and Filtration.

The washed sugar dissolved in hot water or high test sweet waters must undergo some form of defecation and filtration before it is sent to the char filters. A complete revolution at these stations has taken place since 1915. The Taylor bag filter, formerly universally used, has almost entirely disappeared, being generally replaced by pressure filters of the Sweetland or Vallez type. The preparation of the liquor for filtration has also changed markedly, the majority of refineries replacing the old phosphoric acid-line treatment with kieselguhr an inert filter-aid. This is put on the market in several grades of different filtration rates, the practice being to add sufficient lime to the liquor to bring the reaction to neutrality,

after which from 4 to 7 lbs. of filter-aid per ton of solids are added and the treated liquor sent through the presses. Regeneration of the kieselguhr by heating in Wedge furnaces is practiced in a few of the larger refineries. Some few plants use paper pulp as the filter-aid in conjunction with the Vallez rotary press, the paper pulp being recovered for re-use by sending the press cake through counter-current pulp washing systems. Small amounts of phosphoric acid or some form of soluble phosphate are used in certain refineries in conjunction with paper pulp or mineral filter-aids.

The most recent variation in technique is heavy density pressure filtration which works with liquors of 67°-68° Brix instead of the lower density of 62°-64° Brix more generally employed. Fuel savings, greater clarity of char-filtered liquors, and reduction in the quantity of filter-aid are some of the advantages claimed for this heavy density filtration.

The Williamson defecation system in use in one or two refineries was patented by George B. Williamson of Louisiana about 18 years ago. This does not depend on filtration, but is in effect an air-flotation system. The washed sugar liquor at about 160 deg. F. is treated with phosphoric acid and lime as in the old bag-filter days, then impregnated with air by forcing it through siphon jets, after which it is allowed to flow into shallow tanks having steam tubes in the bottom. As the air-charged liquor flows continuously over the heating surface the temperature is raised to 210 deg. F. and the air bubbles rise carrying the flocs of tricalcium phosphate precipitate with them, entrapping the colloidal and suspensoid impurities. A heavy blanket of scum is thus formed which is pulled over a lip at the end of the tank by a slowly moving roller. The scums are diluted and filtered through plate-and-frame presses.

It will be seen from the above that very few plants in the United States employ identical defecation technique or have the same apparatus at the filtration station. This wide divergence in defecation and filtration practice possibly indicates a transitional state from which may emerge a more uniform procedure embodying the advantages of several of the systems. During the past few years there has been a revival of interest

on the part of refiners in phosphoric acid defecation either in conjunction with or to replace pressure filtration.

Within the last few months successful experiments have been carried out on the use of hydrogen peroxide as a decolorizing agent preliminary to char filtration. From 25% to 40% of the color in washed sugar liquors from the filtration station are removed by the addition of a fraction of a percent of strong peroxide.

Char Filtration.

During the hundred or more years that bone black or "char" has been in use in refining, char filtration has developed into a highly specialized industrial art. Outwardly there has been little change in the boneblack filtration process. A modern char house appears much the same as one built 30 or 40 years ago, though there have been some recent improvements in char driers and char kilns. Percolation through char in cistern-like filters and revivification in vertical pipe-retort kilns continues as it has for many years. But a great deal more has been learned about bone black and its action on sugar liquors in the past ten years than was ever known before.

The application of colloid chemistry and the recognition that bone black acts by absorption according to Freundlich's equation have been points brought out in extensive investigations. Two advances in analytical procedure have made most of these investigations possible. Hydrogen-ion (pH) determinations on both the liquors and the bone black itself opened up a new field of research besides being of inestimable value as an aid in the routine control of the char-house in actual practice. The second analytical contribution was the introduction of spectrophotometric methods of color analysis largely through investigations made at the Bureau of Standards.

A distinct advance in handling char-filters is the practice of "wet-filling" which consists in adding the char and liquor simultaneously to the filter instead of char first and liquor afterwards as in the older method. Channelling is almost entirely eliminated and "washing off" the filter with hot water is greatly facilitated by wet filling.

Cast iron retorts are now being replaced by thin wall chromium steel tubes which do not burn out and which give much readier heat transfer to the char. The temperature of the char kilns is generally regulated by recording pyrometers instead of by the older sight methods.

Refining With Vegetable Carbons.

While generally referred to as separate processes, the use of activated carbons in powdered form is essentially the regular refining process with the carbon substituted for bone black. There is a vast difference in the actual practice, naturally, since the carbons are used in relatively small proportions and are added to the liquor and then filtered out by filter pressing after decolorization has taken place. About one per cent of carbon on the solids in the melt is used in a double step process, and the carbon is now generally discarded without revivification.

The activated carbons have so far been used only as an adjunct of the raw factory for the refining of sugar in the tropics. They have not replaced the use of bone black in any standard refinery on this side of the water, but they may prove of value as a pre-treatment in conjunction with bone black.

Pan Boiling, Centrifuging, Drying and Finishing.

Such apparatus as multiple effect evaporators, vacuum pans, crystallizers and centrifugals, which are common to both raw manufacturer and refining, follow much the same changes in both branches. Coil pans are largely used in white sugar boiling with calandria pans in favor for remelts and soft sugars. The Webre calandria pan which has internal paddles for forced circulation and specially designed down-take is in use for soft sugar work in certain refineries. Boiling temperatures as low as 110 deg. F. are recorded with it. Shock seeding with powdered sugar is generally practiced in all refinery pan boiling for granulated sugars. Pan seeding with sufficient grain for the entire strike is used for making large grain sugars for confectioners' and manufacturers' purposes.

Automatic control of pan boiling has made definite advances in recent years. The first work along these lines was

done with the refractometer to determine the densities of the boiling massecuite. Later work in Java was carried out by use of electro-metric measurements of conductivity and these have been fairly successful in raw sugar work, but for high test liquors such as are encountered in refining they cannot be used. The latest steps in this direction depend upon the differential in the temperatures of the massecuite and the vapor from boiling water in a pilot pan working under the same pressure. By means of this temperature differential one refinery in the West is actually operating a pan, liquor intakes, changes of vacuum and the making of grain, all being done mechanically. Unskilled operatives are now able to boil a pan of sugar by this means with greater efficiency than can a highly skilled pan boiler with the old methods.

High speed gear-driven centrifugals are a recent innovation applicable to both raw and refined work. They have a speed of 1600 R.P.M. as against 1000 R.P.M. for the ordinary type. As accessories they use hot mingling to keep the massecuite more fluid, automatic washing devices and automatic separation of the run-off and wash syrups. Greater capacities, cleaner sugar, increased purity drops, and better yields are claimed for this improved centrifugal.

Rotary drum dryers or "granulators" have been employed for drying sugar crystals for half a century but certain changes such as saw-toothed flights for even distribution of the falling sugar have increased capacity in the past 25 years. Dust collecting systems of the "cyclone" type have replaced the old dust-box and a more recent form is the "vorticoise" dust collector in which the dust is caught by a series of staggered vertical baffles. A possibility of improved dust collecting is offered in the "Rotoclone," which is a suction fan of the centrifugal type with blades accurately calculated to throw any dust to the periphery of the fan where it may be collected.

The dried refined sugar from the granulators was formerly passed through reel bolters to remove lumps but vibrating screens of the Hummer and Newaygo types have now largely replaced these. Gyrotory screens of the "Rotex" type are employed for accurate grading of grain sizes for confectioners'

purposes. A recent powder mill, called the "Mikro Pulverizer," claims a finer powdered sugar, greater capacity and less power than the old swing hammer types.

As in all other phases of food manufacture, automatic packaging has become an important part of the sugar refining industry. Because of the multiplicity of grades of sugar and kinds of packages and the automatic machinery necessary, the packing department of a modern sugar refiner is an elaborate institution.

An ever-present problem in the warehousing of refined sugars in moist climates has been the caking and hardening due to moisture absorption and subsequent chilling or drying out. This has been solved in certain refineries in the past 5 years by the installation of air conditioning systems in refined sugar warehouses. Heated air is circulated through the warehouse so that the relative humidity inside is always lower than that of the outside atmosphere.

In conclusion, it may be said that future progress in the industry will be along chemical engineering lines following the trends already indicated. In the raw sugar factory we shall probably see further improvements in the preparation of the cane for milling with even greater elaboration of compound maceration with a view to giving the highest possible extractions. Additional uses for bagasse may be developed; automatic control of clarification for greater colloid removal should become general; pan-boiling and crystallization in motion can be combined into one operation. In the refinery, improvements at the defecation station appear certain, most likely by a combination of some of the best features of the present diverse methods; decolorization by peroxide preliminary to char filtration may develop; further extension of the use of vegetable carbons, possibly as an adjunct to bone black, seems likely; automatic control of pan boiling will become general while high-speed centrifugals equipped with automatic control accessories are already assured both for raw and refined work.

RAW SUGAR MANUFACTURE

General:

- Waste product steam production
- Transfer of Heat
- Handling of materials, both liquid and solid.

Milling:

- Shredding
- Crushing and grinding
- Extraction of juices
- Maceration
- Diffusion (not general)
- Screening (solids from liquid).

Clarification System:

- Chemical treatment (with lime; sulphurous acid; phosphates)
- Heating (closed and open heaters)
- Decantation (continuous or intermittent)
- Sedimentation
 - Press filtration of scums, or,
 - Vacuum filtration of scums.

Evaporation:

- Multiple effect vacuum evaporation
- Pressure evaporation.

Crystallization:

- Single effect evaporation in vacuum
- Crystallization in motion.

Centrifuging:

- Centrifugal separation, syrup and crystals.

SUGAR REFINING

Affination:

- Mingling
- Washing of crystals
- Centrifugal separation, syrup and crystals.
- Dissolving.

Defecation:

Chemical treatment with lime and heat or with lime and phosphoric acid and heat

Mechanical filtration

Bag filters, or

Pressure filters

Air flotation (Williamson System)

Filtration of muds

Plate and frame presses, or,

Vacuum filters

Regeneration of filter-aid

Roasting (Kieselguhr)

Counter-current washing (paper-pulp).

Bone-Char Filtration:

Percolation

Absorption

Washing (leaching)

Drying

Calcination (in retort kilns).

Evaporation:

Multiple effect vacuum evaporation (sweetwaters).

Crystallization:

Single effect vacuum evaporation

Crystallization in motion.

Centrifuging:

Centrifugal separation, crystal and syrup.

Drying and Finishing:

Rotary dryers (air drying)

Dust collection (air separation)

Sizing and grading

Pulverizing (powdered sugar)

Oven drying (loaf sugar).

Air Conditioning (for storage warehouses).

DISCUSSION

By C. B. DICKS, JR.

Mr. President, Members and Friends of the Louisiana Engineering Society:

Yesterday, Mr. Todd before delivering his keynote address jokingly inquired as to just what a keynote might be. If he should ask the question now, I could draw a very good example for him from Mr. Meade's paper, and I would point out that the keynote to the recent advances in the Sugar Industry is the recognition and acceptance of hydrogen-ion control throughout the entire plant.

In the past, acidity of juices and syrups was determined by their titration with a standard alkali. Unfortunately, the results were in terms of total acidity and not in hydrogen ion concentration or pH, and it has now been shown beyond a shadow of a doubt that the total acidity might have very little effect one way or the other as compared to the hydrogen ion concentration effect.

If we mention the term pH to a layman or to a large percentage of professional men, there is a raising of the eyebrows and sudden change of conversation. I judge this is because most people think of pH as being something very complex and highly theoretical, whereas in reality it is nothing more than a simplification of a rather complex setup.

If we attempt to evaluate hydrogen-ion concentration in gram atoms per liter, we have to deal with very small decimal figures which are hard to handle and equally hard to visualize.

Recognizing this, Sorensen in 1909 proposed the pH scale, in

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which setup he lets $\text{pH} = \log \frac{1}{\text{hydrogen ion concentration}}$. Such

a scale would range from 0 to 14 and would run the entire gamut of hydrogen ion concentrations possible to be found from a 1 normal HCl solution to a 1 normal Na OH solution. On it we would find a pH of 7 representing absolute neutrality, indicating the same number of hydrogen ions as hydroxyl ions. Below 7 would be the realm of acidity, and between 7 and 14 we would find alkalinity indicated.

Now let us see just why pH is so important. The Sugar Manufacturer is attempting to produce and sell pure cane sugar, the chemical name for which is Sucrose. Under normal conditions and when dry, sucrose is a stable body, but put some of it into a little water and bring on some hydrogen ions and we find sucrose a very unstable proposition. In fact it will break down into two new substances, namely, levulose and dextrose, or as these two new sugars are called, invert sugar. The process of changing over from sucrose to invert sugar is spoken of as inversion. Every molecule of sucrose so inverted represents just that much loss in dollars and cents, besides causing a great deal of trouble in the granulating process later on.

Further, it has been shown that the rate of this inversion is practically directly proportional to the hydrogen ion concentration or the *degree* of acidity and that the total *acidity* may have little direct effect.

In this connection it is of utmost importance that we think in terms of, and express the results of our analysis in terms of hydrogen ions and not in total acidity.

In order to clarify this differentiation a little more, if we were to take 50cc's of 1 normal hydrochloric acid and 50cc's of 1 normal acetic acid and titrate each separately with a standard alkali, we would find that in each case the same amount of alkali would be required, thus indicating the same total acidity.

However, a measurement of the pH of the two acids would show that the hydrochloric acid solution had about 95 times as many hydrogen ions present as the acetic acid and therefore it would be 95 times as effective in its inverting power. Hardly comparable you will admit, but nevertheless, we would be led to believe so if we had to rely solely on titration methods.

Meade, George Peterkin, born Cumberland, Maryland, December 26, 1883; B.S., New York University 1905; Chemical Engineer 1921; graduate study University of Michigan, summer of 1914; married Eleanore Felicia Hussey, August 7, 1912.

Assistant Chemist, National Sugar Refining Company, Yonkers, N. Y., summers 1901-1905, full time, 1905-1907; same

Fajardo (Porto Rico) Sugar Company, 1908; chemist and assistant superintendent, Colonial Sugars Company, Gramercy, La., 1909-1913; superintendent and manager, Cuban Sugar Refining Company, Gardenas, Cuba; also Director Central Control Laboratory Cuban American Sugar Company, 1913-1923; general superintendent, Colonial Sugars Company, Gramercy, La., 1923-1928, manager since 1928.

Member, Sugar Committee 8th International Congress of Applied Chemistry, 1912; Fellow, American Association for the Advancement of Science; Fellow, American Institute of Chemists; delegate to the International Commission for Uniform Methods of Sugar Analysis, London, 1936; member, American Chemical Society, American Institute of Chemical Engineers; International Association Cane Sugar Technologists; Association de Technicos Azucareros de Cuba; Member Phi Beta Kappa, Iota Alpha and Alpha Chi Sigma (all honorary fraternities).

Co-author "Handbook for Cane Sugar Manufacturers and their Chemists" with G. L. Spencer (7th edition, 1929). Has contributed technical articles to Industrial and Engineering Chemistry, International Sugar Journal, etc.

Home, Gramercy, La.

SOME OPERATING FEATURES OF THE ELECTRICAL SYSTEM OF THE SEWERAGE AND WATER BOARD OF NEW ORLEANS, LA.

By L. T. FRANTZ *

Read at the Annual Meeting, January 23, 1937.

INTRODUCTION

All of the drainage, all of the sewage disposal, all water pumped from the river to the purifying reservoirs and over 40% of the purified water pumped into the city mains at 70 lbs. pressure is done by means of electrically driven pumps. The total connected pump load for all these purposes is over 60,000 hp.

The kilowatt hours consumed for drainage, sewage and water during 1935 were as follows:

Drainage	11,000,000
Sewerage	12,000,000
Water	10,000,000

The operation of the electrical system of the Sewerage and Water Board differs in many respects from many electrical systems in the country. A few of the outstanding features, believed to be different, are:

1. Maximum peak load conditions are reached on the average of thirteen times a year, and may come at any time during a storm. The average load during dry weather is about 4,000 kw. Peak loads may last from one to eight hours and are usually between 20,000 and 25,000 kw, but have reached as high as 33,000 kw.
2. All power generated by the system is consumed by the system.

*Member. Electrical Engineer of the Sewerage and Water Board, New Orleans, La.

3. There are two combinations in one station of two synchronous motors and a pump mounted on the same shaft so that each unit may act as a frequency changer and pump, or either a frequency changer or pump.
4. In another station there is a combination of three sets of units, each consisting of two synchronous motors on the same shaft, which is magnetically coupled to a pump, thus allowing for twenty-four variations in available pumping capacity from 63 hp to 1,104 hp, and also for eight ranges of frequency from 12.5 cycles to 33.4 cycles, which may be transmitted to other stations if needed.

BRIEF DESCRIPTION OF GENERATING PLANT.

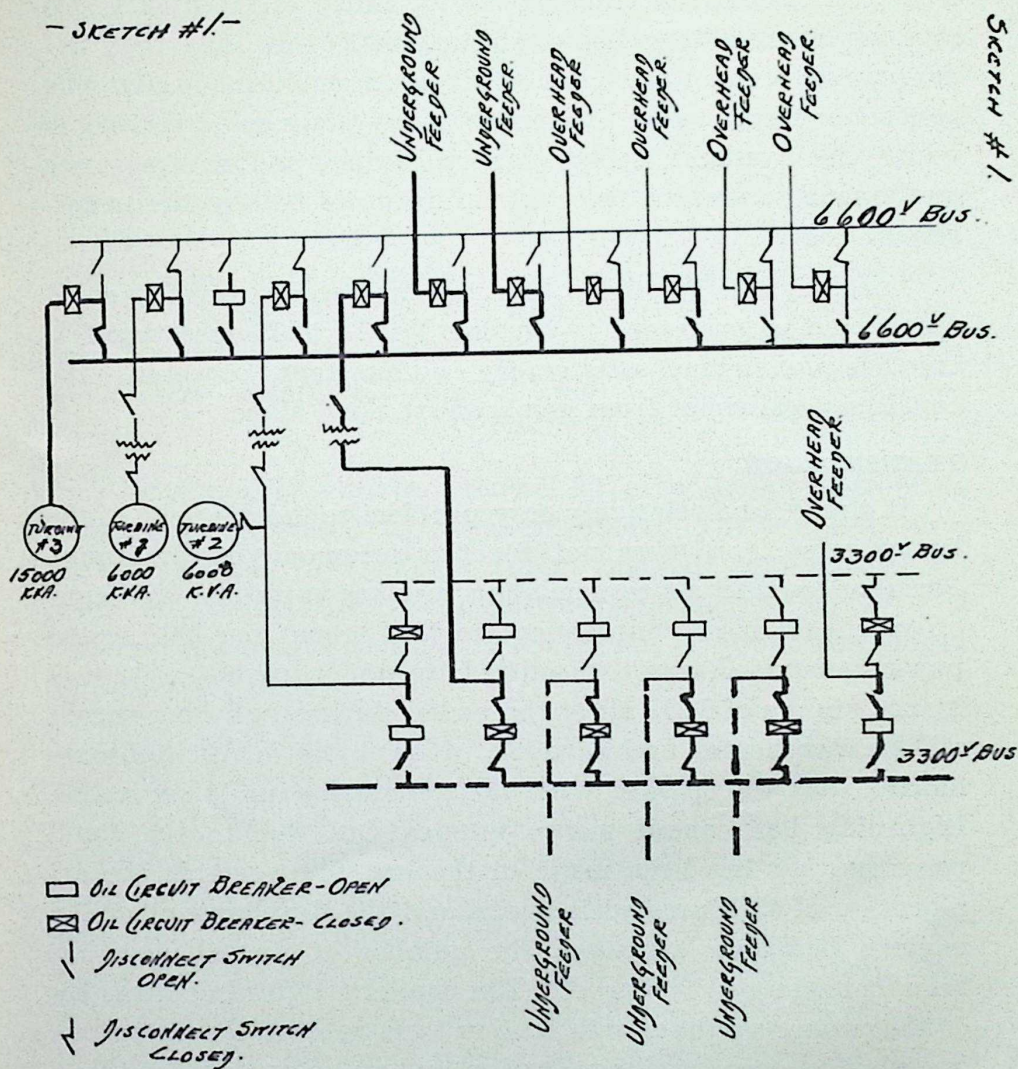
When the electrical system of the Sewerage and Water Board was contemplated previous to 1900, the engineers of the General Electric Company were consulted. After considering the size and speed of the units, a frequency of 25 cycles and a voltage of 3300 were chosen. It must be remembered that in those days the frequency of 60 cycles was not a generally recognized standard as at present. Even if such a system were contemplated today, it is doubtful that a frequency of 60 cycles would be chosen since most of the load consists of motors driving slow speed centrifugal and screw pumps, and a frequency of 25 cycles is more favorable for this type of load.

The Sewerage and Water Board used the one voltage of 3300 v. until the year 1914, when it was decided to enlarge the system, and in order to transmit this increased power over the same transmission lines, the voltage was doubled and all new apparatus purchased was for 6600 volts.

In the generating station, located on the water works grounds, are three generating units—one of 15,000 kva at 6600 volts, and two of 6,000 kva at 3300 volts. The one line diagram of Sketch No. 1 shows the interesting features of oper-

- SKETCH #1/-

SKETCH #1.



ONE LINE DIAGRAM
POWER HOUSE #2.

SEWERAGE & WATER BOARD
NEW ORLEANS, LA.
OCT. 1-1936.

ating the generating station during rainstorms. It is seen from this sketch that turbine No. 3, which is rated at 15,000 kva, feeds one 6600 volt bus and one 3300 volt bus. Only underground feeders are connected to these busses which this generator feeds. This eliminates many sources of trouble to which the overhead feeders are subjected and assures more continuous service to those pumping units fed by the underground cables.

Turbines No. 1 and No. 2 carry the overhead and provide service not so preferred as turbine No. 3. This operating feature has proven most satisfactory and has kept the water in the canals several times from going above flood slope.

TRANSMISSION.

It would be a relatively easy problem to handle most of the heavy rains if it were not for the accompanying lightning. Previous to 1928 all transmission was accomplished by means of overhead lines. Subsequent to 1928 about one-half of the power generated was transmitted by underground cable, and by the middle of 1937 all of the power during lightning storms will be transmitted underground. It is partly for the lightning hazard that we operate with the generating units separated. Lightning has caused many outages, but due to the rapid progress that has been made in the last few years in the exploration of lightning phenomena and the development of the modern lightning arresters, the number of disturbances has been considerably reduced. The modern lightning arresters of the proper voltage, both station type and outdoor type, are installed in every drainage station and on every overhead line.

Some years ago much trouble was experienced with high voltages on station bus and at the end of short lengths of cable which connected the overhead lines to the oil switches. The failures on the cables took place on the switch end. At that time no one who was consulted could give any information as to the cause. It was suggested that perhaps the insulators were dirty and that the cable was damaged on re-

moving the lead. These were not the causes, but there was no better answer.

With the development of the cathode ray oscillograph and the surge generator, much knowledge has been gained concerning the abnormal surge conditions. This knowledge has led to the development of improved methods of application of lightning arresters to systems subjected to lightning disturbances. It might be of interest to note here a quotation that has been taken from a pamphlet entitled, "Advance Guards", as published by the Westinghouse Company shortly after the year 1931. Our experience in lightning arrester application seems to confirm the information contained therein:

"Reflection of voltage becomes of great importance when cables are connected to overhead lines. The velocity of a travelling wave in a cable is about one-half that in an open wire line, so that as far as the propagation of transients is concerned, a length of cable is equivalent to twice that length of open wire line.

"It is well known that a cable will exert a considerable reducing effect on a travelling wave entering it from an open wire overhead line. The initial effect of the cable is usually to reduce the magnitude of the transient which enters the cable to about one-fifth of the magnitude it had in the open wire line. When, however, this reduced voltage reaches the far end of the cable it is reflected back into the cable. The same process takes place again at the junction of the open wire line with the cable where the reflected cable voltage is again reflected. By such successive reflections the voltages in the cable may build up to values of the same order as would exist if the line terminated in an open end instead of the cable. The magnitude to which the voltage in the cable may build up depends on the length of the cable and the magnitude and length of the travelling wave in the open wire line. If the cable is short in comparison to the length of the wire,

then successive reflections will be additive and cause high voltages in the cable. Where a circuit enters a station through a cable connected to an overhead line, protection should be provided for the station apparatus at the station end of the cable. If the cable is short this protection may also provide adequate protection for the cable and the cable entrance."

A pole type lightning arrester installed at station end of the cable gives very satisfactory results.

At the present writing the underground transmission system is capable of delivering 12,000 kw from the power house.

On December 10, 1935, the Sewerage and Water Board opened bids for 73,676 feet of underground cable divided as follows: 34,660 ft. of 600,000 CM, three conductor, 7500 volt; 17,850 ft. of 400,000 CM and 21,257 ft. of 4/O.

The cost of this contract amounted to \$221,889.82 including reels. The reels were billed as \$13,755.00.

This cable is interesting as to size, construction, and method of installing.

It is a rubber insulated cable. The thickness of the rubber wall surrounding the core is 18/64" and the rubber content is not less than 35% by weight. This cable is designed for a continuous operating temperature of 75 deg. Centigrade, which is 15 deg. higher than ordinary rubber compound. Heat resisting rubber is a late development. For the same size conductor, the heat resistant rubber cable will carry about 20% more load. The lead sheath surrounding the three conductors is 9/64" thick; over the lead is a jute wrapping of 4/64" and over the jute are two spiral wrappings of band steel .030" x 1.750".

This cable comes in lengths of approximately 1500 feet and is trench laid, being completely embedded in reinforced concrete. A trench, 300 feet in length at a time, is opened about 10" wide, and a slab of concrete 3" thick is poured on the bottom of the trench. While still fresh the cable is placed on this slab and covered to a depth of 3". The trench is then back-filled. A section of concrete and cable would be approximately 10" square with the cable in the center of the

SKETCH 1/A.

ARRANGEMENT OF
DRAINAGE STATION FEEDERS
AS OF OCT. 1-1-1936.
SEWERAGE & WATER BOARD
NEW ORLEANS, LA.

6600' OVERHEAD
SUPPLY BY
FREQUENCY CHANGER
& POWER HOUSE #2.
6600V UNDERGROUND
FEED POWER HOUSE #2.

BLUE BUS - 6600V
POWER HOUSE #2
WHITE BUS - 6600V

UNDERGROUND

DRAINAGE STA. #1
CLOSED SW.
OPEN SW.

DRAINAGE STA. #2
UNDERGROUND
TO SEWER
UNDERGROUND

DRAINAGE STA. #3
SEWER STATION
FREQUENCY CHANGER
DRAINAGE STATION #5

DRAINAGE STA. #6
DRAINAGE STA. #7

ARRANGEMENT OF
DRAINAGE STATION FEEDERS
AS OF OCT. 1-1936.
ENGINEER & WATER BOARD
NEW ORLEANS, LA.

6600 ✓ OVERHEAD
= SUPPLIED BY
FREQUENCY CHANGER
POWER HOUSE #2.
- 6600 ✓ UNDERGROUND
FROM POWER HOUSE #2.

DRAINAGE STA. #2.

To Sewer

To Station A

Drainage STA #1

☒ CLOSE Jm.

section. Test manholes are placed where the cables are spliced. This method of installing cable without ducts and pull manholes has been common practice with the Sewerage and Water Board for many years and from the results, both as to cost and service, will continue to do so.

Sketch No. 1-A shows the present operation from the power house. About one-half of the load is transmitted overhead, whereas in the near future, as shown in sketch No. 1-B, all the power generated will be transmitted underground with the exception of the 3300 volt system which will be supplied through transformers at Drainage Station No. 6.

With the complete installation of this additional cable, the operating department of the Sewerage and Water Board will be much better equipped to handle the drainage problem of the City of New Orleans.

OPERATION OF DRAINAGE PUMPING STATIONS.

Sketch No. 2 shows a typical bus arrangement at the present time of a drainage station during a rainstorm. It will be seen that there are three busses in no way connected. Each bus is fed from a separate and distinct source. Each bus is a separate operating unit—feeders, pumps, motor generator set for excitation, vacuum pump for priming purposes, and other auxiliaries. The advantage of such arrangement is readily seen.

All drainage stations have strict orders never to let the water in the suction canal at the station exceed 14 C. D. If necessary, every pump in the station is put to work to hold the water at this elevation. This means that the boiler room and power house must be ready, feeders and generators must be separated and everything must be in readiness for storm operation. In less than an hour the load may change from 4,000 kw to over 20,000 kw. At the beginning of a rain the power house is a scene of activity.

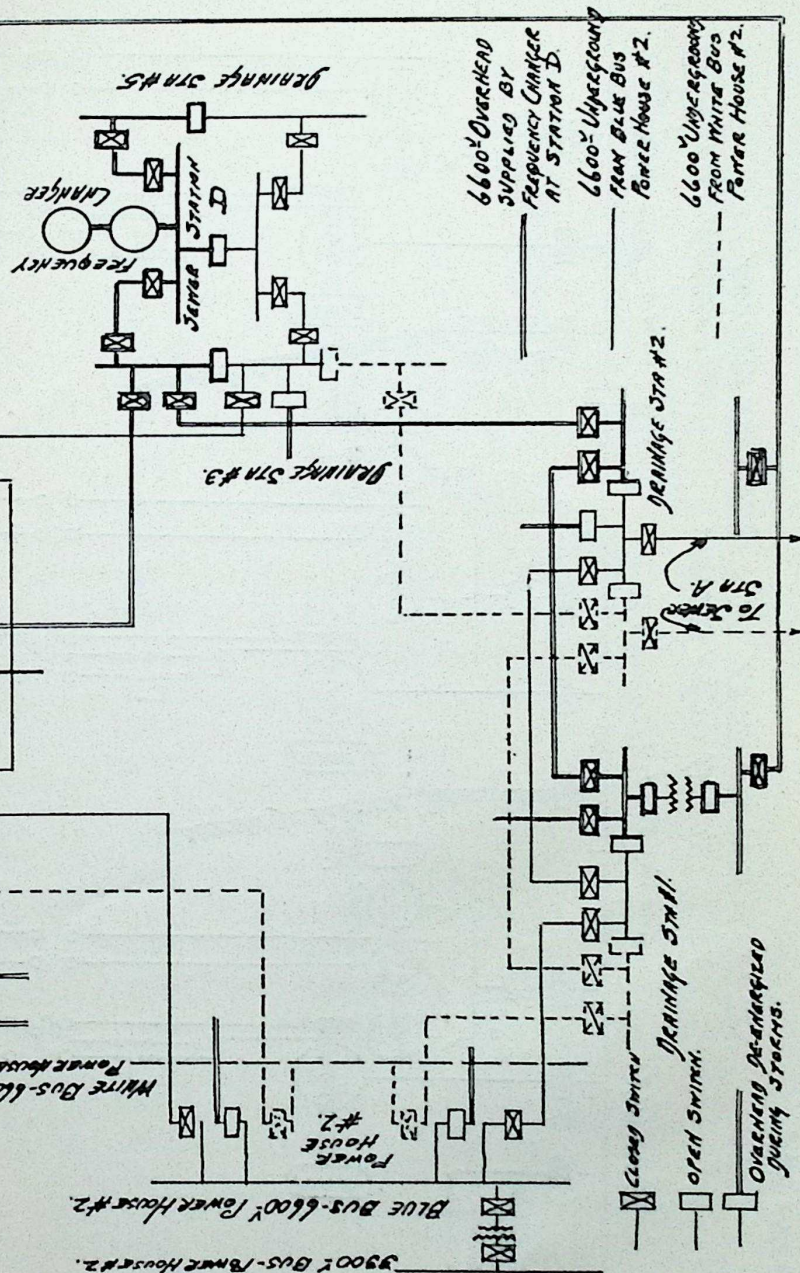
To hold back a pump from starting may have serious results and to stop a pump during a rain may cause flooding. It takes from eight (8) to ten (10) minutes to prime a pump

3300V SYSTEM - ENERGIZED BY TRANSFORMERS AT STAG.

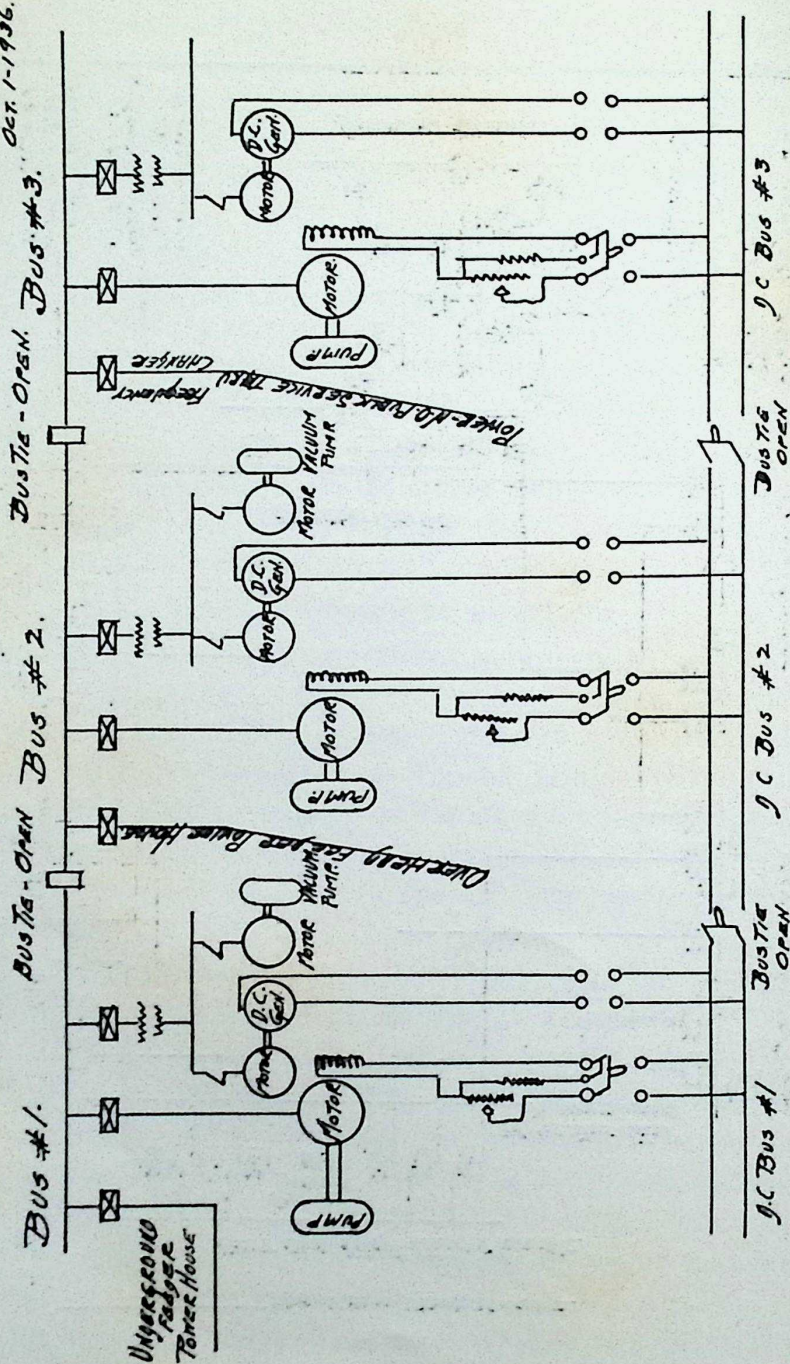
SKETCH 1B.

Arrangement of Drainage
Station Feeders BY
June 1937.

SEWERS & WATER CO.
NEW ORLEANS, LA.



BUS ARRANGEMENT AT DRAINAGE STATION
DURING RAIN STORM.
 SEWERAGE & WATER BOARD
 N.O.L.A.
 OCT. 1-1936.
 BUS TO - OPEN BUS #2.
 BUS TO - OPEN BUS #3.



☐	OIL CIRCUIT BREAKER- OPEN.
☒	OIL CIRCUIT BREAKER- CLOSED

Electrical Operating Features of Sewerage and Water Board 43

and if there is just a flicker in the service, eight to ten minutes are lost.

The size of the pumps and motors in the drainage stations are as follows:

Station Number	Number of Units	Capacity per Pump Unit in Cubic Feet per Second	Motor Size in Horse Power per Unit	Total Capacity Cubic Feet per Second	Total Connected Motor Horse Power
1	3	1000	1200	.....	.....
1	2	600	600	.....	.....
1	3	250	300	.....	.....
				4950	5700
2	2	1000	1200	.....	.....
2	2	600	600	.....	.....
				3200	3600
3	3	1000	2000	.....	.....
3	2	600	1200	.....	.....
				4200	8400
5	2	600	1200	.....	.....
5	2	160	350	.....	.....
				1520	3100
6	4	1000	2000	.....	.....
6	2	600	1200	.....	.....
6	4	300	450	.....	.....
				6400	12200
7	2	1000	2000	.....	.....
7	1	600	1200	.....	.....
7	3	300	450	3500	6550
9	2	1000	Syphons	.....	.....
9	2	400	500	.....	.....
9	1	150	300	.....	.....
				2950	1300

This gives a total pumping capacity of 26,720 cu. ft. per second with a connected motor load of 40,850 horse power.

During the year 1935 there were twenty-six storms with a precipitation of 1" or more in twenty-four hours. The maximum was 4.82". Of those twenty-six storms, thirteen storms exceeded 1" the first hour with a maximum of 2.26" per hour, and of these thirteen, four had 1" or more during the first fifteen minutes. It can easily be seen that under these drastic peak load conditions everything must operate smoothly. In order to operate smoothly, all must be held in readiness. It has been learned that forecasting a rainfall is folly. It may be interesting to note that a 1" rainfall in one hour does not necessarily produce peak conditions. Peak loads, such as have been mentioned above, occur on the average of thirteen times per year and last for a period ranging from one hour to eight hours. A failure on any part of the system during one of these storms causes a great deal of criticism. It is hard to operate perfectly during all storms, yet one failure may mean so much.

One of the problems encountered in keeping the electrical apparatus always in readiness is to keep the electrical insulation dry. Electrical windings would lose their insulating qualities if permitted to remain idle for any length of time, especially in the winter time when the humidity suddenly becomes high and air comes in contact with cold surfaces, causing "Sweating." To overcome this, a program of "baking out" the insulation was instituted. Once a week every motor in the station is baked out for twenty-four hours at a predetermined current rating that will produce sufficient temperature in the windings to keep them dry.

However, this schedule did not keep the motors from "sweating" in the winter time. It was then decided to heat the stations electrically and do away with the coal stoves. The heating units are the field windings of the synchronous motors. The results are very pleasing. There is no more "sweat-

ing'' of electrical apparatus, no apparent pitting of field rings, no dirt from coal and ash, more uniform heat through the station and, best of all, the insulation resistance is kept up to normal. Incidentally, the station operator missed the concentrated heat of a stove on a real cold night. This objection was overcome by placing some grids near his desk. This method of heating is commendable.

METHODS USED IN STARTING LARGE PUMPS.

Most of the pumps are driven by large synchronous motors that range in size from 350 hp to 2000 hp. There is but one large induction motor of 1200 hp on the system. There are, however, many induction motors of 100 hp and less in the automatic sewer stations. Almost every known method of starting synchronous motors is used. Some motors, even as large as 600 hp, are thrown across the line, but some are started by means of compensators, some by reactors in the wye and some by series-parallel arrangement of the windings. Those pumps whose impellers are submerged are first dewatered by forcing air under pressure into the casing, or by pumping the pits dry, or by connecting pumps and motors by means of friction clutches, or by starting the pumps before they become submerged.

In the old days when most of the pumps were of the submerged type and before clutches and air compressors were installed, each station had a starting bus and a running bus. The generating plant also had a starting bus and a running bus. The loaded pumps were carried on the running bus. If another pump was needed, a generator was started and operated at low voltage and low frequency on the starting bus. This reduced voltage and frequency was transmitted to the station and the pumps "picked up." After the motor fell in step, the frequency and voltage were raised to normal and the starting bus was paralleled with the running bus. All motor switches were single pole, double throw, permitting the motors to be thrown over phase by phase from the starting

bus to the running bus. Some of these single pole, double throw switches are still in service today but not under the same conditions.

DESCRIPTION AND OPERATION OF THE LOW LIFT STATION.

The low lift station is a very important link in the Sewerage and Water Board system. This station is used for pumping water from the river into the reservoirs. In the preliminary design two methods of drive were considered: first, the variable speed induction motor rigidly connected to the pump; second, two synchronous motor units on one shaft coupled to the pump by means of a magnetic clutch.

There were three pumps involved in the design of this station: One pump with the capacity of 90 million gallons per day; one of 80 million gallons per day; and the third pump with the capacity of 70 million gallons per day. The average pumping need for the city is about 48 million gallons per day, with rates varying from 21,500,000 to 101,600,000. There are, of course, variations in the pumping requirements throughout the day. It was necessary to have some speed variation. Throttling the valves was impracticable and inefficient. Induction motors would show a low efficiency when operated at reduced speeds. After due consideration, it was decided to use two synchronous motors of different speeds mounted on the same shaft. The decision proved to be a most fortunate one.

The horse power and speeds of each pumping unit are as follows: (The pumping capacity is based on 250 rpm.)

90,000,000 gal. per day unit consisting of one 1500 hp motor at 250 rpm. and 1—1000 hp motor at 214 rpm.

80,000,000 gal. per day unit consisting of one 1500 hp motor at 250 rpm. and 1—750 hp motor at 187 rpm.

70,000,000 gal. per day unit consisting of one 1000 hp motor at 250 rpm. and 1—750 hp motor at 167 rpm.

The following tabulations will show clearly that the efficiencies of these motors at various speeds and various loads are comparatively high:

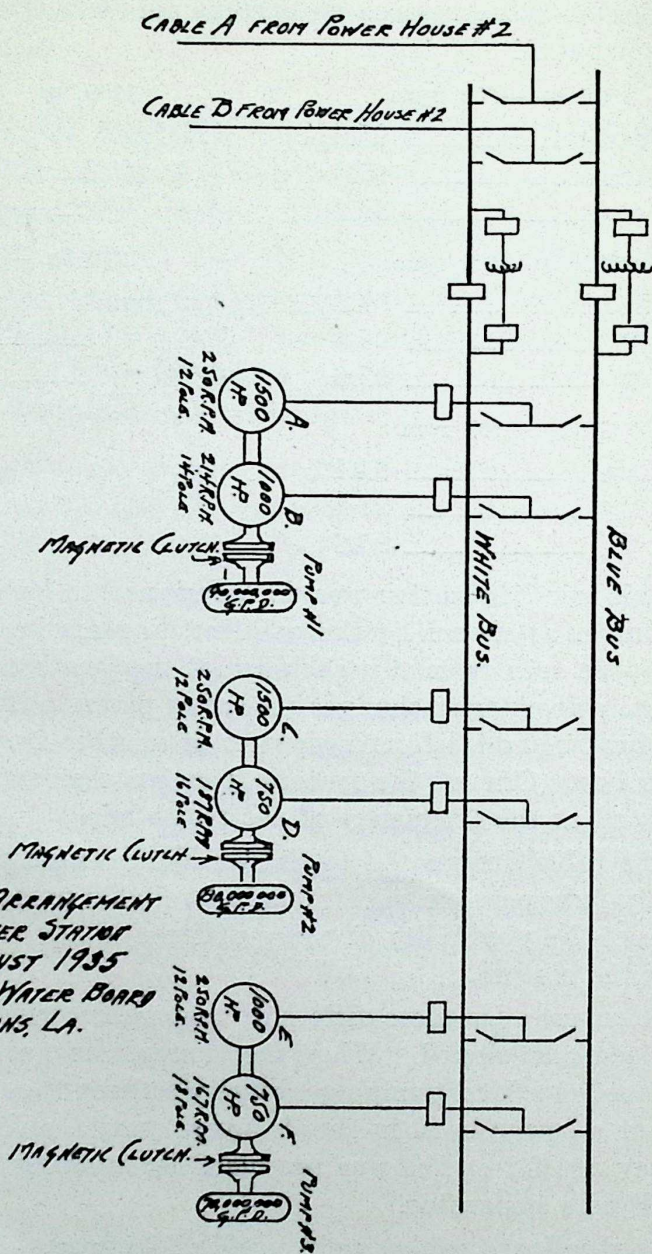
1500 hp.—250 rpm.		1000 hp.—214 rpm.	
1/2 load	95.4%	1/2 Load	94.8%
3/4 "	95.8	3/4 "	95.5
4/4 "	96.2	4/4 "	95.7
1000 hp.—250 rpm.		750 hp.—167 rpm.	
1/2 Load	94.6%	1/2 Load	94.1%
3/4 "	95.4	3/4 "	95.1
4/4 "	95.6	4/4 "	95.4
750 hp.—187 rpm.			
1/2 Load	94.4%		
3/4 "	95.4		
4/4 "	95.6		

This low lift station was first designed to have two operating busses as shown by the one line diagram in Sketch No. 3. It may be seen from this sketch that any one set may be operated as a frequency changer receiving power at 25 cycles from the blue bus and delivering power at another frequency to the white bus. One of the motors from another set can then be operated at the frequency of the white bus.

The table designated as Sketch No. 5 shows that there are twenty-four possible variations in available pump capacity because of the possibility of using different frequencies for operating the motors.

Other uses for these different frequencies, which were available, soon developed. When the contractors were doing work and needed added pumping capacity to keep the constant duty flow at a lower level in the drainage canals, an increased frequency of 29.2 cycles was produced by running A as a motor and B as a generator.

As duplicate cables were installed between the generating station and this river station, it became possible to supply power to the river station at 25 cycles and then to receive this power at the generating station at a changed frequency, and send it out on the system where needed.



TWO BUS ARRANGEMENT
AT LOW LIFT RIVER STATION
PREVIOUS TO AUGUST 1935
SEWERAGE & WATER BOARD
NEW ORLEANS, LA.

SKETCH #5.

VARIOUS SPEEDS OBTAINABLE FROM THE 3 SYNCHRONOUS MOTOR SETS
AT THE LOW LIFT RIVER STATION. SEWERAGE & WATER BD. N.O.L.A.

OCT. 1-1936.

SKETCH #5.

NO.	ARRANGEMENT	PUMP R.P.M.	PUMP OPERATING	WATER HP.	CYCLES & MOTOR DRIVING PUMP
1.	AM-Bo	250	#1.	1104	25.
2.	CM-Do	250	#2.	983.	25.
3.	EM-Fo	250	#3.	798.	25.
4.	CM-Bq-FM-Eo	222	#3.	560	33.4
5.	AM-Bq-Di-Lo	219.	#2.	661.	29.2
6.	BM-Ao	214	#1.	695	25.0
7.	BM-Aq-CM-Do	214	#2.	616	21.4
8.	BM-Aq-EM-FO	214	#3.	501.	21.4
9.	AM-Bq-FM-Eo	194	#3.	374.	29.2
10.	DM-Cq-AM-Bo	187.	#1.	463	18.7
11.	DM-Co	187	#2	411	25.
12.	DM-Cq-EM-FO	187	#3	334	18.7
13.	FM-Eq-AM-Bo	167	#1	330	16.7
14.	FM-Eq-CM-Do	167	#2.	293.	16.7
15.	FM-Eo	167	#3	238	25.
16.	DM-Cq-BM-Ao	160	#1.	291.	18.7
17.	DM-Aq-DM-Co	160	#2	258	21.4
18.	FM-Eq-BM-Ao	143	#1.	207	16.7
19.	BM-Aq-FM-Eo	143	#3.	150	21.4
20.	FM-Eq-DM-Co	125	#2	123	16.7
21.	DM-Cq-FM-Eo	125	#3.	100	18.7
22.	DM-Cq-FM-Eq-AM-Bo	125	#1.	138	12.5
23.	DM-Cq-FM-Eq-BM-Ao	107	#1.	87	12.5
24.	DM-Cq-BM-Aq-FM-Eo	107	#3.	63	16.

Key:- SUBSCRIPT "M" - SYNCHRONOUS MACHINE ACTING AS A MOTOR.
"G" - " " " " " GENERATOR.
"O" - " " " " " RUNNING IDLE.

It soon became evident that frequencies lower than 25 cycles would prove more economical. During dry weather the capacity of some of the pumps for the constant duty flow is too large, and throttling of valves would be necessary if pumps could not be operated at a lower speed. It was found that operation at 18.7 cycles was more suitable for this condition and 21.7 cycles was more suitable after the rainfall had been pumped off by the larger pumps.

As there were only two busses at the river station, as first designed, one for 25 cycles and one for 18.7 cycles, or 21.4 cycles, the supplying of power at these reduced frequencies interfered somewhat with the efficient pumping of raw water into the filtration system. It was then that the three bus systems as shown in Sketch No. 4 was developed.

When the river is at flood stage, the three bus arrangement allows for the pumping of water into the filtration system at slower speeds and greater efficiency and does not interfere with the possibility of using the other busses for frequencies other than 25 cycles. In order to get some idea of the flexibility that this arrangement provides, there are listed below two schemes that are possible. These operating schemes will be made clear by referring to Sketch No. 4:

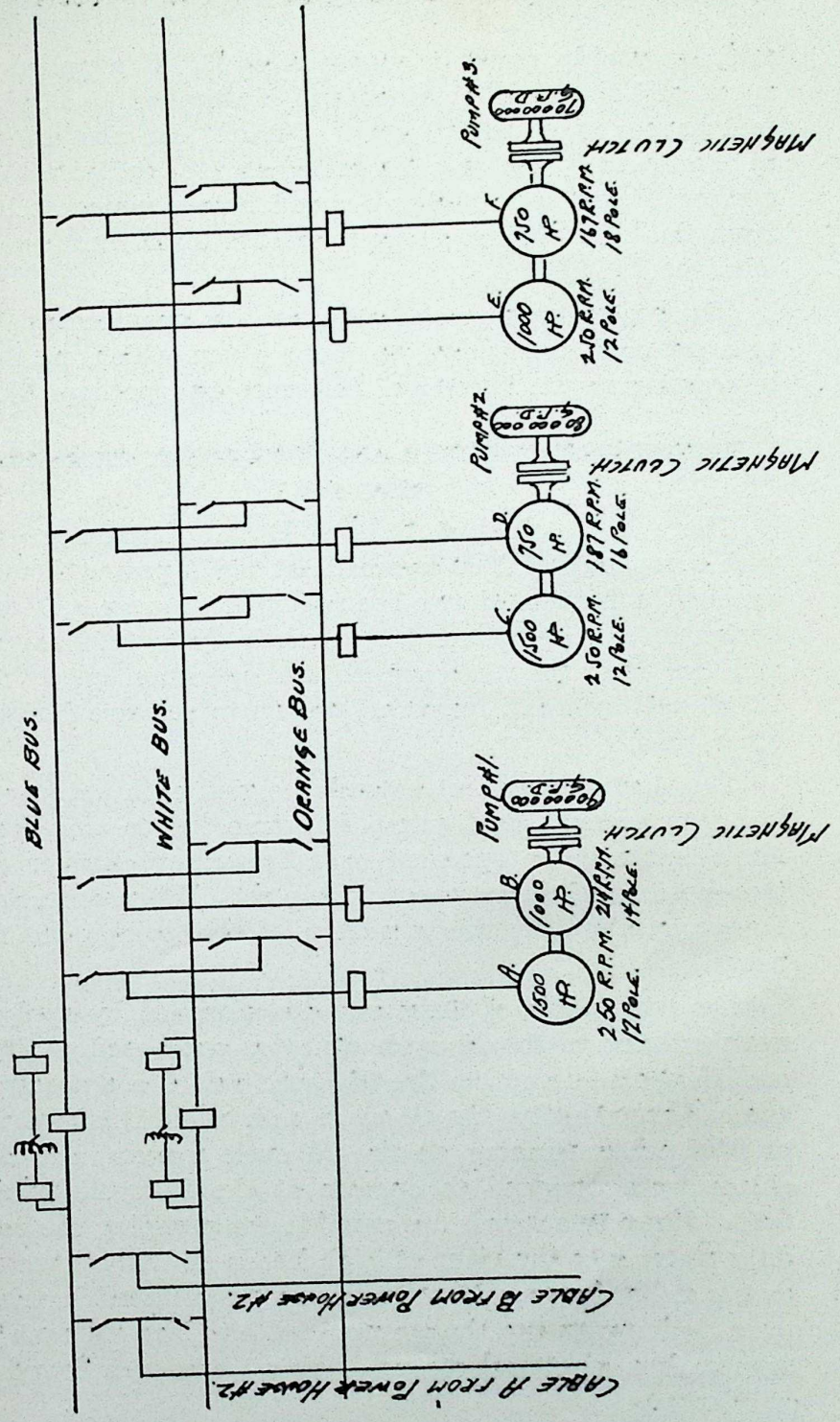
Motor D is operating at 25 cycles off the blue bus, which makes C a generator running at 18.7 cycles. This frequency will be sent to the power house over feeder B. At the same time, Motor F can be operated at 25 cycles off the blue bus and unit E as generator of 16.7 cycles placed on orange bus. Motor B can now receive this 16.7 cycles and run at 145 rpm which speed could be produced with the two bus arrangement, but not while 18.7 cycles were delivered to the system. If a smaller quantity of water is required, just change the order—Motor B off 25 cycles—A as generator on orange bus at 12.4 cycles—F on orange bus as motor, running pump at 143 rpm which is a smaller pump.

Another arrangement:

D running off 25 cycles, blue bus—C as generator of 18.7 cycles on white bus—F from 18.7 cycles running at 125 rpm—E as generator developing $12\frac{1}{2}$ cycles, is placed on orange bus

THREE BUS ARRANGEMENT AT LOW LIFT
 RIVER STATION SUBSEQUENT TO AUGUST 1935.
 SEWERAGE & WATER BOARD
 NEW ORLEANS, LA.

SKETCH #4.



and can supply power to either A or B. If supplied to A, a speed of 125 rpm is obtained and if supplied to B, the pump will have a speed of 107 rpm. Pump 3 can also be operated at this speed by making B a motor on 18.7 cycles with A generating 16 cycles to orange bus and F as a motor at 16 cycles from this bus. As the pump is smaller a different quantity is obtained.

The writer knows of no other station operated as this one, so a detailed description has been given which, no doubt, is interesting to the Electrical Engineer and perhaps to others.

DESCRIPTION OF PUMPS AND FREQUENCY CHANGERS AT STATION D.

There is installed at Station D two frequency changers with a capacity of 2500 kva each at 100% power factor. Each set is of a horizontal two-bearing type, one unit of which is designed for operation on a 3-phase, 25 cycle, 6600 volt system, and the other unit is designed for operation on a 60 cycle, 13,200 volt system. However, these two sets are designed for other uses.

The shaft of each set extends beyond each outboard bearing and a centrifugal pump is connected to the extension. Each unit may be operated as a frequency changer or as a two-speed synchronous motor pump set. When operating as a frequency changer, the impellers of the pumps are free of water.

The two speeds of these sets are obtained by applying 25 cycle current to the 25 cycle unit for one speed of 300 rpm, and 25 cycle current to the 60 cycle unit for a speed of 125 rpm. Theoretically, the 60 cycle unit should have a voltage of 5500 when running on the 25 cycle system, but the machines were designed to operate at the 25 cycle voltage of 6600. These two speeds are suitable for pumping the constant duty water into the river at high heads and storm water into canals at low heads. After these sets were installed, trial runs were made operating the system tied into New Orleans Public Service Inc. electrical system. This tie-in was found to be satisfactory.

Shortly after the purchase of these units, the Sewerage and Water Board bought a 6000 kw frequency changer and this unit is used exclusively as a frequency changer.

When the load at the Sewerage and Water Board power house reaches 10,000 kw the operator gets permission from the operator of the New Orleans Public Service Inc. to permit him to draw power from them. The large frequency changer at Station D is turned over and floated on the line. If the rain continues to fall, the pumps dedicated to the frequency changer are primed.

The co-operation and the service rendered by the New Orleans Public Service Inc. has been most pleasing. They are always agreeably willing and ready to take a load although it may require the cutting in of an additional boiler, or other inconveniences.

With the installation of additional pumping units in recent years, the frequency changes installation mentioned above and the new underground cables now being installed, the drainage system has become more flexible, simpler to operate and freer from possible shutdowns in case of failure on any part of the system.

DISCUSSION

A. S. ANDERSON—(NEW ORLEANS PUBLIC SERVICE INC.):

The average citizen of New Orleans does not realize the great extent of the Sewerage and Water Board system, nor does the electrical engineer quite realize the extent of the electrical system even after reading this splendid paper.

To my knowledge, there is no city in the country that has the drainage problem of the City of New Orleans. The problems dealing with electrical installations for the drainage system are therefore unique.

The author of the paper has emphasized that maximum demands may occur at any time and may range up to six or eight times the average demand. While this range from average demand to peak demand may be duplicated in other parts of the country, it is doubtful whether such a range would

occur at these irregular intervals. Even if it did occur at such irregular intervals there would, in general, be a possibility of predicting the time of occurrence in other parts of this country.

The clever arrangement of the motors and pumping equipment at the low lift plant should attract the attention of any engineer. After reading the details of the set-up in this station, it is very fitting and proper that a demonstration should be witnessed and it is hoped that the Sewerage and Water Board will make such a demonstration possible in the near future.

The author intimates that by the proper application of lightning arresters, disturbances from lightning have been practically eliminated. This is a very fortunate situation; however, I believe that there are some other factors that contribute to the lightning protection besides the proper application of lightning arresters. It is my understanding that an overhead ground wire is also used. The author might mention something about its influence as a protective feature. There is also a safety factor involved in the application of insulation to the cables, disconnect switches, bus insulators, etc., and in the extent of circuit between the overhead line terminals and the final utilization equipment such as the motors, generators, or frequency changers.

The practice of burying 1500 ft. lengths of cable in solid concrete is very different from the common practice of installing cable in duct. Since the Sewerage and Water Board has been doing this for many years and finds it satisfactory, a tabulation showing the number of failures per year and the cost of repairing these failures would be very interesting. I would like to hear the author tell how failures are located and how repairs are made.

I wish to take this opportunity to congratulate the author on his splendid paper and hope that at some future date he will take the time and trouble to tell us more about the system layout relaying schemes, and other pertinent information that would be of interest.

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- JAMES HOWARD COLLINS, (1929), General Outdoor Advertising Co., 2120 Canal St., 1310 Short St., New Orleans.
- J. B. CONVERSE, (N. R.), (1921), President, J. B. Converse & Co., Engineers, Mobile, Ala.
- HENRY BELL COOLEY, (N. R.), (1934), Engineer, 4 Cogswell Ave., Cambridge, Mass.
- ALFRED JOSEPH COOPER, JR., (N. R. J.), (1934), T. V. A., 2106 N. Broadway, Knoxville, Tenn.
- ERNEST A. COULOHERAS, (J.), (1933), Civil Engineer, 2627 Peniston St., New Orleans.
- CHARLES C. CRAWFORD, (1921), 1315 First St., New Orleans.
- WILLIAM H. CREIGHTON, (N. R. J.), (1933), 2226 S. Hobart Drive, Los Angeles, Calif.
- L. VILLERE CRESSY, (R. Aff.), (1930), Sales Engineer and Representative for C. A. Dunham Co., and Modine Mfg. Co., 1666 Abundance St., New Orleans.
- MARCEL EMILE CRETET, JR., (J.), (1933), Engineer, 5580 Woodlawn Place, New Orleans.
- HORACE E. CRUMP, (L. M.), (June 8, 1906), Office Engineer, Dock Board, No. 2 Canal St., New Orleans.
- LEONEL J. CUCULLU, (J.), (1928), Sales Engineer, New Orleans Public Service Inc., 1426 No. Tonti St., New Orleans.
- DAVID L. CULLOM, (1916), Assistant Engineer, Board of Commissioners of the Port of New Orleans, 4032 Prytanla St., New Orleans.
- ORRIS J. DAVIESON, (1937), Mechanical Engineer, Assistant Director, Delgado Trades School, 3101 Milan St., New Orleans.
- ALBERT BAKER DAVIS, JR., (N. R.), (1928), 1101 23rd St., Galveston, Tex.
- B. N. DAVIS, (1913), Engineer and Contractor, 1006 Tchoupitoulas St., New Orleans.
- GEORGE H. DAVIS, (N. R.), (Oct. 14, 1909), Member, Ford, Bacon & Davis, Inc., 39 Broadway, New York City.
- GEORGE T. DeLa MATYR, (J.), (1933), Engineer, 235 W. Carter St., Route 1, Box 34, Hynes, Calif.

- J. P. DEAN, (1935), Capt. Corps Engineers U. S. Army, 2339 Octavia St., New Orleans.
- DONALD DERICKSON, (1912), Professor of Civil Engineer, Tulane University, New Orleans.
- L. DEVAL, (1935), 2120 Milan St., New Orleans.
- ARTHUR A. DEFRAITES, (1928), Secretary-Treasurer, J. W. DeFraites, Inc., 8002 Jeannette St., New Orleans.
- JACQUES de TARNOWSKY, (1915), Structural Engineer, Room 25, City Hall, 1937 Esplanade Ave., New Orleans.
- SALVADOR DI BENEDETTO, (J.), (1925), Assistant Engineer, S. & W. Board, 526 Carondelet St., New Orleans.
- CHARLES B. DICKS, JR., (1936), Professor of Industrial Chemistry, Tulane University, Consultant and Chemical Advisor to Specialty Products Co., New Orleans.
- C. E. DOLHONDE, (N. R.), (1933), Shell Petroleum Co., Houston, Tex.
- WILLIAM JOSEPH DRAWWE, JR., (J.), (1933), Engineer, New Orleans Public Service Inc., 4235 Gen. Pershing St., New Orleans.
- ROBERT J. DRUEDING, (J.), (1935), Assistant Chief Engineer, Orleans Levee Board, 321 S. Jeff. Davis Parkway, New Orleans.
- MARCEL T. DUCROS, (1935), Division Engineer, Drainage Department, Sewerage and Water Board, No. 7 Fontainebleau Drive, New Orleans.
- ARCHIBALD LEE DUNLAP, (1925), Associate Professor of Mechanical Engineering, Tulane University, 1318 Nashville Ave., New Orleans.
- LOUIS C. DUPONT, (J.), (1935), Engineer, American Can Co., New Orleans, 1455 Calhoun St., New Orleans.
- B. H. DUPUY, (1932), Designer Mechanical Appliances, 1421 Harmony St., New Orleans.
- ALLAN T. DUSENBURY, (May 25, 1909), Consulting Engineer, 2108 American Bank Bldg., New Orleans.
- GEORGE G. EARL, (L. M.), (Jan. 1, 1900), Consulting Engineer, 635 Whitney Bldg., New Orleans.
- RALPH EARL, (1913), Consulting Engineer, Earl Engineering Co., 635 Whitney Bldg., New Orleans.
- JOHN T. EASTWOOD, (L. M.), (Jan. 18, 1901), Consulting Engineer, 1926 Milan St., New Orleans.
- JOHN P. EGAN, (R. Aff.), (1931), Assistant Chief Engineer in Charge of Maintenance and Operation for New Orleans Public Service Inc., at Market Street Steam Electric General Station, 5436 S. Claiborne Ave., New Orleans.
- L. P. ELBERSON, (N. R.), (1911), Chief Engineer, Louisiana Irrigation & Mill Co., Crowley, La.
- S. W. ELBERSON, (N. R.), (1911), General Superintendent, Louisiana Public Utilities Co., Lafayette, La.
- DANIEL STANLEY ELLIOTT, (1921), Professor of Physics, Tulane University, New Orleans.
- O. H. ELVERUM, (N. R.), (1936), Bridge Engineer, Louisiana Highway Commission, Morgan City, La.
- HERMAN G. ENGELHARDT, (J.), (1932), Engineer, 706 Moss St., New Orleans.
- THEODOSE L. ESTORGE, (J.), (1933), Engineer, 614 State St., New Orleans.
- CHARLES D. EVANS, (1936), Resident Engineer, Inspector, P. W. A., 2108 Broadway, New Orleans.
- JAMES P. EWIN, (1915), Vice-President and General Manager, Doullut & Ewin, Inc., 3503 Prytanla St., New Orleans.
- CHARLES A. FAYROT, (1919), 18 Richmond Place, New Orleans.
- FRED H. FENN, (J.), (1930), Instructor, College of Engineering, L. S. U., 204 Church St., Baton Rouge, La.
- CHARLES H. FENSTERMAKER, (1914), Chief Engineer, Industrial Lumber Co., Elizabeth, La.
- FREDERICK H. FOX, (1922), Associate Professor, Civil Engineering, Tulane University, New Orleans.
- ALBERT J. FRANSEN, (J.), (1934), Engineer, Gulf Engineering Co., Inc., 1926 Napoleon Ave., New Orleans.
- LOUIS T. FRANTZ, (1936), Electrical Engineer, Sewerage and Water Board, 8735 Apricot St., New Orleans.
- ACHEE FRICK, (1935), Consulting Engineer, Box 4004, Station F, New Orleans.

- JOSEPH J. FRIEDLEB, JR., (1930), Southern District Manager, Ilg Electric Ventilating Co., 203 Natchez Bldg., New Orleans.
- ALVIN M. FROMHERZ, (1915), District Manager, PWA Housing Division, Birmingham, Ala., 1207 Henry Clay Ave., New Orleans.
- FRANK G. FROST, (1919), General Superintendent, Electrical Dept., New Orleans Public Service Inc., New Orleans.
- JOHN D. FORD, (1936), Inspector of Pressure Vessels, Hartford Steam Boiler & Inspection Co., 2431 State St., New Orleans.
- RANDALL B. FOWLER, (N. R.), (1935), Dist. and Area Engineer, ERA, 2412 Vance St., Alexandria, La.
- HERBERT M. GALLAGHER, (1921), State Engineer, ERA, Associated with J. F. Coleman Engineering Co., 1951 Calhoun St., New Orleans.
- JOHN B. GATES, (1937), Parish and Field Engineer WPA, Pollock, La.
- JOHN V. GAUDET, (N. R.), (1927), Chemical Engineer, Skelly Oil Co., 507 N. Summit St., El Dorado, Kansas.
- JOHN B. GEIGER, (J.), (1933), Chemical Engineer, Southern Cotton Oil Co., 902 Eighth St., Gretna, La.
- JOHN F. GEIS, (R. Aff.), (1929), Industrial Representative, Johns-Manville Corporation, 1900 Broadway, New Orleans.
- JOHN S. GENTILICH, (N. R. J.), (1933), U. S. Waterways Experiment Station, Vicksburg, Miss.
- EDWARD H. GESSNER, (N. R. J.), (1933), Engineer, Martin Engineering Co., Apt. 370, Maracabo, Venezuela.
- JOHN HARRY GILLUM, (N. R.), (1934), Engineer, Process Design, Standard Oil Co., Jackson, La.
- DAVID W. GODAT, (1924), Bridge Engineer, City Engineer's Office, 7826 Zimple St., New Orleans.
- JULES GODCHAUX, (L. M.), (Jan. 1, 1899), Vice-President and Engineer of Operation, Godchaux Sugars, Inc., 1007 Masonic Temple, New Orleans.
- JOSEPH McCORMACK GONDEAN, (1924), Structural Engineer with Jones & Laughlin Steel Corp., Box 66, New Orleans.
- ROBERT E. GOSA, (1929), Vice-President, W. Horace Williams, Inc., 833 Howard Ave., New Orleans.
- WALTER K. GRANT, (1922), 1527 Audubon St., New Orleans.
- W. B. GREGORY, (1907), Professor of Experimental Engineering and Hydraulics, Tulane University, New Orleans.
- B. H. GREHAN, (1914), Vice-President of Geo. J. Glover Co., Inc., 1670 Soniat St., New Orleans.
- FRANCIS B. GREVEMBERG, (1935), 532 Royal St., New Orleans.
- JOSEPH E. GUIDRY, JR., (J.), (1933), Engineer, ERA, 5121 Danneel St., New Orleans.
- JOHN M. GUILLORY, (1928), Sales Supervisor, New Orleans Public Service Inc., 4128 Monroe St., New Orleans.
- A. H. GUILLOT, (1917), Roadway Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- JOHN A. HAASE, III, (J.), (1933), Assistant Purchasing Clerk, U. S. Treasury, 8604 Pritchard Place, New Orleans.
- ALLEN H. HACKETT, (1912), Consulting Engineer, 511 Whitney Bldg., New Orleans.
- CALLENDER FAYSSOUX HADDEN, (1928), Secretary-Treasurer, Standard Supply & Hardware Co., P. O. Drawer 620, New Orleans.
- E. J. HAGSTETTE, JR., (N. R. J.), (1935), Assistant Chemical Engineer, Jefferson Lake Oil Co., Erath, La.
- FARRAR PETRIE HAMILTON, (1915), Civil Engineer, 408 Walnut St., New Orleans.
- FLOYD HAMILTON, (N. R.), (1919), Lake Charles, La.
- GEORGE R. HAMMETT, (1920), Sales Engineer, A. M. Lockett & Co., 505 Queen & Crescent Bldg., New Orleans.
- ERIC J. HANEMANN, (N. R. J.), (1933), Junior Highway Engineer, Bureau of Public Roads, Austin, Tex.
- ALLAN J. HARRIS, (1924), President, Walter Castenado, Inc., 329 Balter Bldg., New Orleans.
- M. V. HAULARD, (L. M.), (Jan. 13, 1906), Superintendent, Municipal Repair Plant, 4154 Iberville St., New Orleans.

- WILLIAM WALLACE HAY, (1928), Technical Engineer, Inland Waterways Corporation, 211 Camp St., New Orleans.
- NUMA J. HELWICK, (1936), Engineer with American Heating & Plumbing Co., 809 Greenwood St., New Orleans.
- HARRY B. HENDERLITE, (N. R.), (1929), Engineer, Louisiana Highway Commission, 403 Evergreen Drive, Baton Rouge, La.
- W. S. HENNING, (N. R.), (1919), Civil Engineer, 502 Lakeland Drive, Baton Rouge, La.
- RUDOLPH HERPICH, (N. R.), (1926), Union Brewery, N. O., 3904 Delgado Ave., Ave., New Orleans.
New Orleans.
Rosewood Drive, New Orleans.
- OSCAR HIGGINBOTHAM, (N. R.), (1934), with Compania Ongenios Azaucaveros Mat, S. A. Central Espana, Prov. Matanzas, Cuba.
- ARTHUR M. HILL, (1934), Assistant Professor, Mechanical Engineering, Tulane University, New Orleans.
- GEORGE W. HILL, (1936), Sales Engineering, Westinghouse Electric & Mfg. Co., 2800 Audubon St., New Orleans.
- W. T. HOGG, (1913), Principal Assistant Engineer, Board of Commissioners, Port of New Orleans, 8000 Nelson St., New Orleans.
- WALTER HOLLOWAY, (N. R.), (1923), Division Engineer, Mississippi Power Co., Gulfport, Miss., 34 Washington Ave., Ocean Springs, Miss.
- PAUL FROST HOOTS, (1927), Chief Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- ALVIN E. HOTARD, (J.), (1933), Parish Engineer, Jefferson Parish, City Engineer, City of Gretna, 328 Amelia Ave., Gretna, La.
- SAMUEL E. HOTTINGER, JR., (1932), Engineer in Charge Utilities Engineering Division, Department of Public Utilities, City of New Orleans, 4204 S. Derbigny St., New Orleans.
- J. B. HOWZE, JR., (N. R.), (1935), Supervisor WPA Division Operations, 901 Fairview, Shreveport, La.
- S. E. HUEY, (N. R.), (1937), Consulting Engineer, Monroe, La.
- EDWARD F. HUGHES, (1933), Assistant Engineer, Sewerage and Water Board, New Orleans.
- POWELL H. HUMPHRIES, (N. R.), (1936), Electrical Engineer, 12 Kenneth St., W. Roxbury, Mass.
- EDWARD C. HYATT, (1925), Civil Engineer, 2328 St. Charles Ave., New Orleans.
- LYALL GIBSON IRELAND, (1929), Vice-President, New Orleans Public Service Inc., 1460 Henry Clay Ave., New Orleans.
- C. A. IVES, JR., (N. R.), (1922), Construction Engineer, Louisiana Highway Commission, 940 Park Blvd., Baton Rouge, La.
- HARRY JACOBS, (1919), Chief State Engineer, 207 New Orleans Court Bldg., New Orleans.
- ERNEST LEE JAHNCKE, (L. M.), (Jan. 1, 1900), Jahncke Service, Inc., 814 Howard Ave., New Orleans.
- PAUL F. JAHNCKE, SR., (Jan. 1, 1908), President Jahncke Service, Inc., 814 Howard Ave., New Orleans.
- JAMES S. JANSSEN, (N. R. J.), (1933), Civil Engineer, 8213 Neron St., New Orleans.
- JOSEPH W. JOACHIM, (1919), President and Manager of Home Ice Co., 5117 Prytania St., New Orleans.
- WARREN JOHNSON, (L. M.), (1903), President and General Manager, Johnson Iron Works, Dry Dock and Shipbuilding Company, Inc., P. O. Box 840, New Orleans.
- C. LEONARD JONES, (1923), Structural Designer, with Dock Board, 2747 Audubon St., New Orleans.
- CHARLES E. JOUBERT, (N. R.), (Jan. 1, 1909), Civil Engineer, 504 Auburn Ave., Monroe, La.
- F. NOEL KAMMER, (1906), Engineer, Flintkote Co., 1453 Arabella St., New Orleans.
- KARL P. KAMMER, (1931), Efficiency Engineer, Market Street Station, New Orleans Public Service Inc., Market Street Station, New Orleans.
- CLAUDE J. KELLY, (1936), Vice-President, New Orleans Cement Products Co., 4600 S. Tontl St., New Orleans.
- JAMES P. KEMPER, (N. R.), (May 25, 1909), Civil Engineer in Private Practice, For-doche, La.
- CHARLES MACDONALD KERR, (1914), Sales Engineer, 5831 So. Robertson St., New Orleans.

- LEE W. KING, (1936), Civil Engineer, 2107 Broadway, New Orleans.
- LEONARD R. KIRST, (1928), Civil Engineer, with Board of State Engineers, 8122 Birch St., New Orleans.
- JOHN KLOSER, (L. M.), (Jan. 23, 1898), Planning and Consulting Engineer, New Orleans Sewerage and Water Board, 526 Carondelet St., New Orleans.
- WILHELM E. KOCH, (J.), (1913), Civil Engineer, 2627 Coliseum St., New Orleans.
- R. B. KOHNKE, (1910), Assistant State Engineer, Member Board of State Engineers, 932 Picheloup Place, New Orleans.
- LOUIS I. KORN, (J.), (1933), Computing Engineer, Louisiana Geodetic Survey, 6030 Garfield St., New Orleans.
- GUS C. KRAUSS, (R. Aff.), (1929), Assistant to Superintendent, Rolling Stock and Shops Dept., New Orleans Public Service Inc., 3223 Magazine St., New Orleans.
- J. J. KREBS, (1923), Civil Engineer, Municipal Engineering, 403 Baronne St., New Orleans.
- PERCY C. KUHN, (1937), District Sales Manager, Truscon Steel Co., 2121 Octavia St., New Orleans.
- ROBERT J. KUHN, (1925), Consulting Engineer, 1127 Canal Bank Bldg., New Orleans.
- HERNICK J. LANE, (1922), Secretary, W. Horace Williams, Inc., 833 Howard Ave., New Orleans.
- EDWARD S. LANPHER, (1918), Senior Lighthouse Engineer (Superintendent of Light-houses), Room, 328, Custom House Bldg., New Orleans.
- LEO J. LASSALLE, (1936), Dean of College of Engineering, Louisiana State University, Baton Rouge, La.
- G. W. LAWES, (L. M.), (March 5, 1898), Civil Engineer, 314 Balter Bldg., New Orleans.
- W. STONE LEAKE, (1934), Sales Engineer, 1064 Union Bldg., New Orleans.
- STANLEY M. LECOURT, (J.), (1933), Civil Engineer with Theodore Brent, 407 Board of Trade, 320 Magazine St., New Orleans.
- RANDALL FRANK LEGER, (1923), Industrial Gas Engineer, New Orleans Public Service Inc., 317 Baronne St., 3830 Nashville Ave., New Orleans.
- JOSEPH E. LEININGER, (N. R.), (1931), Air Conditioning Engineer, 920 Music St., New Orleans.
- HAROLD A. LEVEY, (1937), President, American Products Mfg. Co., Consulting Engineer, 311 Audubon Blvd., New Orleans.
- NEVILLE LEVY, (1929), President, Equitable Equipment Co., 410 Camp St., New Orleans.
- J. H. LEWIS, (June 1, 1908), President, Lewis-Chalmers Construction Co., 707 Baronne Bldg., New Orleans.
- RALPH E. LIND, (1930), Civil Engineer, 2000 Peniston St., New Orleans.
- A. M. LOCKETT, (L. M.), (Jan. 1, 1900), President, A. M. Lockett & Co., Queen & Crescent Bldg., New Orleans.
- ROBERT P. LOCKETT, (R. Aff.), (1931), Sales Manager, A. M. Lockett & Co., 2130 Palmer Ave., New Orleans.
- GERVAIS LOMBARD, (Jan. 1, 1898), (C. M. and H. M.), Research Engineer, Board of State Engineers, 574 Walnut St., New Orleans.
- JULES A. LORIO, (1921), Service Foundry, Inc., 1153 S. Peters St., New Orleans.
- L. A. LOUSTALOT, (N. R.), (1913), Civil Engineer, Hammond, La.
- FRANK M. MACDONALD, (N. R. J.), (1933), Engineer, 2820 Gen. Pershing St., New Orleans.
- HENRY J. MALOCHEE, (L. M.), (March 5, 1898), Engineer, PWA, 714 Masonic Bldg., 1125 Pine St., New Orleans.
- RALPH H. MANN, (N. R.), (1921), Field Engineer, Service Bureau, Am. Wood Preservers Ass'n., 60 E. 42nd St., New York City, N. Y.
- CHARLES J. MANNEY, (1936), Instructor, College of Engineering, Tulane University, New Orleans.
- ALBERT E. MARKS, (J.), (1925), Engineer, 3320 Palmyra St., New Orleans.
- SEBASTIAN V. MASSIMINI, (R. Aff.), (1931), President, Gulf Engineering Co., Inc., 916-30 S. Peters St., New Orleans.
- GEORGE C. MATTISON, (1936), Lieutenant Commander, U. S. Coast and Geodetic Survey, Inspector, New Orleans Field Station, 314 Custom House, New Orleans.
- JOHN K. MAYER, (J.), (1933), Instructor in Engineering Laboratories, Tulane University, 1738 Carrollton Ave., New Orleans.

- THOMAS MICHAEL MCCARROLL, (1926), State Board of Engineers, 2036 Marengo St., New Orleans.
- A. J. McCORKLE, (N. R.), (1930), Engineer, U. S. C. & G., 608 Blount Bldg., Pensacola, Fla.
- HERBERT H. McGEHEE, (N. R.), (1920), Air Conditioning Engineer, 17529 Wisconsin, Detroit, Mich.
- JOHN McINERNEY, (N. R.), (1920), Manager Construction, 350 5th Ave., New York City, N. Y.
- GORDON J. McLEAN, (J.), (1933), Engineer, Assistant Supervisor, E R A, 1544 Henry Clay Ave., New Orleans.
- H. L. McLEAN, (1930), Consulting Mechanical Engineer, 2314 Calhoun St., New Orleans.
- LEAL C. H. McLEAN, (J.), (1933), Engineer, Jones & Laughlin Steel Corp., 5008 Camp St., New Orleans.
- J. A. McNIVEN, (1922), Chief Engineer, Dock Board, No. 2 Canal St., New Orleans.
- GEORGE P. MEADE, (N. R.), (1936), Manager, Gramercy Refinery, Colonial Sugars, Inc., Gramercy, La.
- FREDERIC B. MEDFORD, (N. R.), (1936), City Engineer, Donaldsonville, La.
- ODON O. MELANCON, (1930), Member, State Board of Engineers, 2227 Jefferson Ave., New Orleans.
- F. ROBERT MENDOW, (J.), (1930), Engineer, A. M. Lockett Co., 2927 Pine St., New Orleans.
- CARL MEUNCH, (1927), Vice-President, Charge of Engineering Construction and Operation The Celotex Co., 193 Audubon Blvd., New Orleans.
- A. J. MEYERS, (N. R. J.), (1933), Industrial Engineer, Shell Petroleum Corp., Norco, La.
- JOHN M. MIDDLETON, (N. R.), (1936), Assistant to State Director of Operations WPA, Hammond, La.
- MICHAEL MICHEL, (J.), (1936), Assistant Engineer, Calmes Engineering Co., 323 Allx St., New Orleans.
- HENRI J. MOLAISSON, (N. R. J.), (1934), Testing Laboratory, Shell Petroleum Corp., Norco, La., 5458 Canal Blvd., New Orleans.
- JOHN W. MONTGOMERY, (1924), Sales Engineer, 4109 Tchoupitoulas St., New Orleans.
- CHARLES MONTEIRO, (J.), (1933), Assistant Lighthouse Engineer, U. S. Lighthouse Service, 327 Custom House, New Orleans.
- A. S. MONTZ, (1919), Architect and Engineer, 740 Poydras St., New Orleans.
- DAVID MOODIE, (1934), Engineer in Charge of Boiler Room Operations at Market Street Elec. Gen. Station, New Orleans Public Service Inc., 2832 Broadway, New Orleans.
- EARLE B. MORDEN, (N. R.), (1928), Chief Engineer, Standard Fruit and Steamship Co., Administration Facility, Biloxi, Miss.
- WALTER B. MOSES, (1912), Consulting Engineer, 425 S. Peters St., New Orleans.
- JACOB F. MULLER, JR., (J.), (1932), Vice-President, Muller Furniture Mfg. Co., No. 3 Fairview Court, New Orleans.
- HU. B. MYERS, JR., (J.), (1929), Civil Engineer, 1028 Nashville Ave., New Orleans.
- EDWARD M. NABERSCHNIG, JR., (1923), Assistant to Works Superintendent, Southern Cotton Oil Co., Box 360, New Orleans.
- CLAYTON L. NAIRNE, (J.), (1929), with New Orleans Public Service Inc., 1403 Calhoun St., New Orleans.
- ROBERT L. NALL, (1936), Engineer, Flintkote Co., 730 Dumaine St., New Orleans.
- ARTHUR A. NAQUIN, (1924), Superintendent of Schedules, New Orleans Public Service Inc., 7445 Maple St., New Orleans.
- ALLEN J. NEGROTTTO, (1920), State Director of Operations W P A, 4037 Banks St., New Orleans.
- BERNARD STANLEY NELSON, (1911), Chief Engineer, A. M. Lockett & Co., Ltd., 501 Queen and Crescent Bldg., New Orleans.
- WALDEMAR, STANLEY NELSON, (1936), (J.), Draughtsman, 7319 Panola St., New Orleans.
- LEROY L. NEWMAN, (1923), Superintendent of Distribution, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- WILLIAM T. NEWTON, (1915), Senior Superintendent, U. S. Engineers, 1206 Short St., New Orleans.

- J. CHRIS NIELSEN, JR., (J.), (1933), Surveying (Transitman), 2118 Dublin St., New Orleans.
- C. BOYD NORRIS, (1936), Instructor Electrical Engineering, Tulane University, New Orleans.
- MYRTIS M. NORTON, (J.), (1933), Instructor, Tulane University, 354 Lowerline St., New Orleans.
- WILLIAM F. OAKES, (1918), General Contractor, 344 Camp St., New Orleans.
- BERNY OAKLAND, (N. R.), (1934), with La-Del Oil Properties, Inc., 603 Auachita Bank Bldg., Monroe, La.
- CHARLES W. OKEY, (N. R.), (1911), Principal Engineer, Tennessee Valley Authority, Knoxville, Tenn.
- H. N. OLD, (1935), District Engineer, U. S. Public Health Service, Marine Hospital, New Orleans.
- OLE K. OLSEN, (May 5, 1905), Construction Engineer, 833 Howard Ave., New Orleans.
- JOHN H. O'NEILL, (1916), Sanitary Engineer, Director Bureau of Sanitary Engineering, Louisiana State Board of Health, 637 Lowerline St., New Orleans.
- WILLIAM P. OSTER, (J.), (1928), Sales Engineer with Equitable Equipment Co., Inc., 4651 Baccich St., New Orleans.
- PASCAL PARETI, JR., (1933), Engineer, 619 Bourbon St., New Orleans.
- ALBERT B. PATERSON, (1923), President, New Orleans Public Service Inc., 15 Audubon Place, New Orleans.
- BOYKIN W. PEGUES, (N. R.), (July 1, 1907), Head of Department of Civil Engineering, Louisiana State University, Baton Rouge, La.
- PHILLIP FRANK PHILLIPS, (1933), Engineer, 4424 So. Claiborne Ave., New Orleans.
- BRISTER BLAKE PIERCE, (N. R. J.), (1929), Assistant Plant Engineer, Bogalusa Paper Co., Bogalusa, La.
- CARROLL J. PEIRCE, JR., (J.), (1933), Civil Engineer, with Sewerage and Water Board, 526 Carondelet St., New Orleans.
- FREDERICK F. PILLET, (N. R.), (1922), Associate Professor, Civil Engineering, Louisiana State University, 730 N. 10th St., Baton Rouge, La.
- JOHN L. PORTER, (1924), Consulting Engineer, 8407 Panola St., New Orleans.
- RAYMOND C. PROUET, (J.), (1933), Drafting Engineer, 4902 Franklin Ave., New Orleans.
- PAT H. QUINLAN, Drainage Engineer, Sewerage and Water Board, 526 Carondelet St., New Orleans.
- GROVER CLEVELAND RACKERBY, (1926), Permit Section, U. S. Engineers, 1st New Orleans District, 51 Neron Place, New Orleans.
- WALTER S. RAINVILLE, JR., (1934), Director of Research Department, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- CHARLES FREDERICK RANTZ, (1924), Refrigerating Engineer, 222 Homer St., Algiers, La.
- JOHN REINHARD, (R. Aff.), (1931), Sales Engineer, Johns-Manville Corp., 3719 Camp St., New Orleans.
- ARTHUR de R. REMANJON, (1937), Assistant Ship Surveyor, United Fruit Co., 1509 Pine St., New Orleans.
- FRANK LOUIS REYNOLDS, (N. R.), (1916), Superintendent of Construction, Todd & Brown, Inc., Rockefeller Center, New York City, 115 Ocean Ave., Brooklyn, N. Y.
- GERALD L. RHODES, (1934), Electrical Engineer, Power Department, New Orleans Public Service Inc., 2810 Napoleon Ave., New Orleans.
- W. H. RHODES, (1927), Asphalt Sales, Shell Petroleum Corp., Canal Bank Bldg., New Orleans.
- GEORGE P. RICE, (1924), Rice and Staples, Consulting Engineer, 1006 Baronne Bldg., New Orleans.
- CLAIRE W. RICKER, (1928), Professor of Electrical Engineering, Tulane University, New Orleans.
- JOHN RIESS, (L. M.), (1906), Civil Engineer and Contractor, 807 New Orleans Bank Bldg., New Orleans.
- PAUL L. RISTROPH, (1937), Traffic Engineer, City of New Orleans, 6407 So. Claiborne Ave., New Orleans.
- C. L. RITTENBERG, (J.), Engineer with Myers Whitty & Hodge, 20 Newcomb Blvd., New Orleans.
- JAMES M. ROBERT, (1908), Dean of Engineering, Tulane University, New Orleans.

- JAMES M. ROBERT, JR., (J.), (1933), Attorney; Engineer; 317 Baronne St., New Orleans.
- THOMAS H. ROBERTS, (1923), Consulting Mechanical Engineer, 1530 N. Broad St., New Orleans.
- EDWIN J. H. RODRIGUEZ, (N. R.), (1918), care Johns-Manville Corp., 143 Sherwood Forest Drive, New Orleans.
- EVERETT G. ROESSLE, (1926), Engineer, with Geo. P. Rice, 1019 Leontine St., New Orleans.
- LEON de SALIGNAC, (1936), Chief Engineer, Pan-American Petroleum Corp., 944 St. Charles Ave., 5124 Baronne St., New Orleans.
- H. S. SALZER, (J.), (1927), Assistant Lighthouse Engineer, U. S. Lighthouse Service, 6028 Catina St., New Orleans.
- WALTER HOWARD SCALES, (1930), Southern Manager, National Lumber Mfgs. Assn., American Forest Products Industries, Inc., 706 Interstate Bank Bldg., 2319 Lowerline St., New Orleans.
- J. G. SCHEIB, (1935), District Engineer, WPA, 7931 Fig St., New Orleans.
- REGINALD McC. SCHMIDT, (1915), Assistant Engineer, 2nd N. O. District, 4414 So. Tonti St., New Orleans.
- HARRY D. SCOTT, (1920), Manager, Bragman's Bluff Lumber Co., Puerto Cabezas, Nicaragua.
- PAUL T. SEASHORE, (1934), Engineer, La. Land and Exploration Co., Houma, La.
- GEORGE ARTHUR SEAVER, (1920), Chief Engineer, George J. Glover Co., Inc., 1219 Eleonore St., New Orleans.
- P. E. SEEPE, (1936), Sales Engineer, 5935 Freret St., New Orleans.
- SOLIS SEIFERTH, (1927), Architect, Secretary-Treasurer, Weiss, Dreyfous and Seifert, Inc., 600 Maison Blanche Bldg., New Orleans.
- REGINALD F. SEILER, (N. R.), (1935), Assistant Area Engineer, FERA, 601 Springhill St., Shreveport, La.
- ARTHUR M. SHAW, (Nov. 14, 1910), Engineer-Examiner, PWA, 1529 Jefferson Ave., New Orleans.
- HEMBERT M. SHILSTONE, (1932), Consulting Chemist, 1662 Valmont St., New Orleans.
- HERBERT M. SHILSTONE, JR., (J.), (1933), Testing Engineer, Shilstone Testing Laboratory, 301 M. and M. Bldg., Houston, Texas.
- HARRY H. SHUTTS, (N. R.), (1935), Civil Engineer, Lake Charles, La.
- CHESTER P. SIESS, (J.), (1936), Soils Laboratory, Louisiana Highway Commission, 525 St. Hypolite St., Baton Rouge, La.
- WALTER S. SIMPSON, (J.), (1933), Engineer, 19 Audubon Place, New Orleans.
- HENRY F. SIRGO, (J.), (1932), with Todd Dry Dock, Engineering and Repair Co., Inc., Engineering Division, 1215 St. Anthony St., New Orleans.
- LESTER C. SMITH, (1920), Vice-President, Doullut & Ewin, Inc., 3503 Prytania St., New Orleans.
- T. BAKER SMITH, (N. R.), (1919), Civil Engineer, P. O. Box 266, Houma, La.
- JOHN Y. SNYDER, (N. R.), (1918), Engineer, 902 Delaware St., Shreveport, La.
- W. HOBSON SPAAR, (1934), Office Engineer, State Board of Engineers, 5705 Willow St., New Orleans.
- LEROY AUGUSTUS STAPLES, (1931), Structural Engineer, with Geo. P. Rice, Consulting Engineer, 5101 Pitt St., New Orleans.
- DAVID STAYER, (N. R.), (1933), R. C. A. Mfg. Co., Division Supervisor, 31 Harvard Ave., Collingswood, N. J.
- REINHARD A. STEINMAYER, (1925), Associate Professor of Geology, Tulane University, 7933 Oak St., New Orleans.
- F. W. STEVENS, (L. M.), (Oct. 14, 1909), Manager, New Orleans District Sales Office, Allis-Chalmers Mfg. Co., 1124 Canal Bank Bldg., New Orleans.
- DAVID WHITE STEWART, (1920), Chief Engineer, Market Street Station, New Orleans Public Service Inc., Market and So. Peters Sts., New Orleans.
- H. H. STOCKMANN, (J.), (1935), Engineer, 5665 Ada Place, New Orleans.
- BRUNO STOLLEY, (N. R. Associate Mem.), (1933), with Shell Petroleum Corp., Box 788, Wood River, Ill.
- FRANK M. STONE, (1937), Engineer, Sam Stone Jr. & Co., 7529 Oak St., New Orleans.
- HERBERT C. SWAN, (1923), Assistant Engineer, Sewerage and Water Board, 6316 Magazine St., New Orleans.

- IRA W. SYLVESTER, (L. M.), (Mar. 25, 1901), Consulting Engineer, Rapides Bank Bldg., Alexandria, La.
- PAUL EDWARD TERROY, (R. Aff.), (1934), Chief Inspector for Hartford Steam Boiler, Inspection and Insurance Co., 205 Fairway Drive, New Orleans.
- ALFRED F. THEARD, (Jan. 1, 1898), (C. M. and H. M.), Drainage Engineer, Sewerage and Water Board Bldg., New Orleans.
- S. A. THEARD, (N. R.), (1920), Engineer and District Sales Manager, Oyster Shell Products Corp., Inc., Morgan City, La.
- STEWART TICKNOR, (N. R.), (1922), Civil Engineer, 155 Royal St., Baton Rouge, La.
- JAMES M. TODD, (1923), Consulting Mechanical and Electrical Engineer, 315-317 Balter Bldg., 1561 Exposition Blvd., New Orleans.
- LOUIS M. TOGNONI, (J.), (1933), New Orleans Public Service Inc., 4609 Arts St., New Orleans.
- JAMES F. TOMPKINS, (N. R.), (1932), Engineer Salesman, Tennessee Coal, Iron & R. R. Co., Carnegie Steel Co., Box 159, Houston, Texas.
- NELSON W. TREMBLAY, (J.), (1933), M. & E. Engineer, Lago Oil & Transport Co., Box 817 San Nicholas Aruba, Netherland, West Indies.
- J. H. TREPAGNIER, (J.), (1933), Engineer, 1424 Henry Clay Ave., New Orleans.
- SID E. TROUARD, JR., (J.), (1928), Electrolysis Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- WILLIAM N. TULLER, (J.), (1937), with U. S. Engineers, Foot of Prytania St., New Orleans.
- W. O. TURNER, (1931), Chief Engineer, Louisiana Power & Light Co., 142 Delaronde St., Algiers, La.
- THOMAS H. TUTWILER, (L. M.), (April 2, 1898), Retired, 1488 Vinton Ave., Memphis, Tenn.
- LUCIEN T. VIVIEN, JR., (1926), Construction Engineer, with Gulf Refining Co., Maison Blanche Bldg., New Orleans.
- WM. VON PHUL, (N. R.), (July 1, 1908), President, Ford, Bacon and Davis, Inc., 39 Broadway, New York, N. Y.
- ALVIN A. VOSS, (N. R. J.), (1929), Civil Engineer, Box 195 Milton, Fla.
- FRANK H. WADDILL, (L. M.), (April 2, 1898), Consulting Civil Engineer, 407 Tulane-Newcomb Bldg., New Orleans.
- GEORGE D. WADDILL, (1911), Assistant Engineer, U. S. Engineer Office, 7433 Maple St., New Orleans.
- RICHARD E. WAGNER, (J.), (1933), Civil Engineer, Resettlement Administration, 5th Region, 1818 So. Gayoso St., New Orleans.
- J. D. WALKER, (Jan. 8, 1908), Engineer for Craven & Lang, American Bank Bldg., New Orleans.
- WAYNE PAUL WALLACE, (J.), (1936), Instructor, College of Engineering, Louisiana State University, 131 No. Jefferson Davis Parkway, New Orleans.
- WILLIAM WALLACE, (R. Aff.), (1931), General Contractor, 131 No. Jefferson Davis Parkway, New Orleans.
- STEPHEN J. WALLBILICH, (1926), Engineer, 1415 Adams St., New Orleans.
- PHILIP A. WEBER, (N. R. J.), (1933), U. S. Coast and Geodetic Survey, P. O. Box 10, Key West Fla.
- LEO S. WEIL, (1918), Consulting Engineer; President, Engineering Sales Co., Inc., 425 So. Peters St., New Orleans.
- LEON C. WEISS, (1918), Weiss, Dreyfous & Seiferth, Architects, 600 Maison Blanche Bldg., New Orleans.
- HORACE C. WELMAN, (J.), (1934), Draftsman for Air Reduction Sales Company, New York, N. Y.
- WILLIAM WHIPPLE, (N. R.), (1936), Professor of Steam Engineering, Louisiana State University, Baton Rouge, La.
- W. S. WHITE, (L. M.), (Jan. 1, 1898), Civil Engineer, Surveying, Box 82, Sulphur, La.
- CHARLES WIGGIN, JR., (1927), Mechanical Sales Engineer, Walter Castenedo, Inc., 329 Baker Bldg., New Orleans.
- BEN WILLARD, (L. M.), (Jan. 1, 1900), Retired, 1710 Audubon St., New Orleans.
- W. HORACE WILLIAMS, (1908), President and General Manager, W. Horace Williams Co., Inc., Engineer and General Contractor, Southern Bldg., 833 Howard Ave., New Orleans.
- C. S. WILLIAMSON, JR., (1916), Head of School of Chemical Engineering, Tulane University, New Orleans.

- ARMAND L. WILLOZ, (1922), Chief Engineer, Orleans Levee Board, 3517 Jena St., New Orleans.
- VICTOR L. WILLOZ, (L. M.), (Jan. 1, 1900), Distribution Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.
- J. NORMAN WILSON, (1911), Asssitant Engineer, Mechinal Engineering Department, Sewerage and Water Board, 2425 Audubon St., New Orleans.
- JOHN W. WILSON, (J.), (1933), Construction Superintendent, Gervais F Favrot, Contractor, 7916 Oak St., New Orleans.
- A. R. WINGATE, JR., (1924), Jones and Laughlin Steel Corp., 1525 Exposition Blvd., New Orleans.
- WALTER E. WINSHIP, (1921), 608 Common St., New Orleans.
- CARROLL L. WOOD, JR., (J.), Engineer, 819 Calhoun St., New Orleans.
- A. A. WOODS, (N. R.), (1914), Chief Engineer, Maintenance of Way and Structures, Southern Railway System, Lines West, 307 East Fourth St., Cincinnati, Ohio.
- D. F. WOODS, (N. R.), (1922), Lutchet, La.
- CHARLES J. WYLEE, (1919), Principal Assistant Engineer, A. M. Lockett & Co., Ltd., 530 Jackson Ave., New Orleans.
- ROBERT W. ZIFLE, (J.), (1937), Research Department, New Orleans Public Service Inc.

STUDENT MEMBERS

- G. G. AURIOLES, 570 Walnut St., New Orleans.
- R. R. BASTIAN, JR., 303 Audubon St., New Orleans.
- PHILIP A. BECNEL, JR., 610 Flood St., New Orleans.
- LAURANCE H. BOHNE, 1445 Nashville Ave., New Orleans.
- WILLIAM H. BOHNE, 1445 Nashville Ave., New Orleans.
- LESTER I. BOONE, 1034 So. Carrollton Ave., New Orleans.
- JOHN M. BOPP, 1326 Marigny St., New Orleans.
- HAMILTON J. BOUDREAUX, JR., 726 Broadway, New Orleans.
- LIONEL J. BOURGEOIS, JR., 702 No. Carrollton Ave., New Orleans.
- HARWOOD I. BROWN, 622 Seguin St., Algiers, La.
- EUGENE J. CAZENAVE, JR., 6326 Cromwell Place, New Orleans.
- GODFREY T. COATE, 1218 Joseph St., New Orleans.
- JOHN . DE MAJO, 1819 Esplanade Ave., New Orleans.
- JOHN KNIGHT DIXON, 2624 Verbena St., New Orleans.
- JAMES N. EUSTIS, 1732 Amelia St., New Orleans.
- HAROLD F. FAVRET, 4837 St. Claude Ave., New Orleans.
- JACQUES L. FORTIER, 1831 Bordeaux St., New Orleans.
- JOHN M. GABRIEL, 3331 Canal St., New Orleans.
- MARTIN M. GURTLE, II, 624 City Park Ave., New Orleans.
- DONALD E. JAHNCKE, 1807 Calhoun St., New Orleans.
- LONNIE E. KEES, 1218 Pine St., New Orleans.
- M. J. LASKEY, 319 Oliver St., New Orleans.
- JOHN M. McBRIDE, 64 Neron Place, New Orleans.
- MARTIN W. McDONOUGH, JR., 4702 Franklin Ave., New Orleans.
- EDWARD J. McNAMARA, 6505 West End Blvd., New Orleans.
- GEORGE H. MENEFE, 5133 St. Charles Ave., New Orleans.
- DEWITT L. MORRIS, 6040 Prytania St., New Orleans.
- FERDIE A. NOBILE, 1013 Pine St., New Orleans.
- ALBERT B. PATTERSON, JR., 15 Audubon Place, New Orleans.
- WILLIAM M. PAYNE, 1025 Soniat St., New Orleans.
- MILTON E. PICK, 8009 St. Charles Ave., New Orleans.
- HENRY R. RICHMOND, JR., 5528 Hurst St., New Orleans.
- LAWRENCE E. ROBINS, 2606 State St., New Orleans.
- PERRY R. ROEHM, 1315 Louisiana Ave., New Orleans.
- R. C. P. SCHOENBERGER, 916 Fern St., New Orleans.
- HUGH F. SMITH, 7223 Freret St., New Orleans.
- HORACE A. THOMPSON, 2616 Robert St., New Orleans.
- EDWARD A. WELSCH, JR., 642 Broadway, New Orleans.

SUMMARY

Resident Honorary Members.....	4
Life Members	22
Resident Members	170
Non-Resident Members	52
Associate Members	2
Non-Resident Associate Members.....	1
Affiliate Members	17
Non-Resident Affiliate Members.....	4
Junior Members	65
Non-Resident Junior Members.....	19
Student Members	38
Total.....	394

PAST PRESIDENTS

Sidney F. Lewis.....	1898	John Klorer	1918
Thos. L. Raymond.....	1899	Ole K. Olsen.....	1919
Henry J. Malochee.....	1900	John Riess	1920
Frank M. Kerr.....	1901	R. S. Manley.....	1921
Alf. F. Theard.....	1902	Dona'd Derickson.....	1922
Alf. Raymond	1903	J. S. Barelli	1923
J. F. Coleman.....	1904	James M. Robert.....	1924
W. B. Wright.....	1905	Marcel Garsaud	1925
W. H. Hoffman.....	1906	Farrar P. Hamilton.....	1926
G. W. Lawes.....	1907	Edward S. Lanphier.....	1927
C. W. Wood.....	1908	John L. Porter.....	1928
J. T. Eastwood.....	1909	Frederick H. Fox.....	1929
W. B. Gregory.....	1910	James M. Todd.....	1930
J. C. Haugh.....	1911	Frank G. Frost.....	1931
D. S. Anderson.....	1912	Frederick N. Billingsley.....	1932
A. M. Shaw.....	1913	John H. O'Neill.....	1933
W. H. Williams.....	1914	A. Lee Dunlap.....	1934
L. C. Datz.....	1915	Edward S. Bres.....	1935
Samuel M. Young.....	1916	Allen S. Hackett.....	1936
A. T. Dusenbury.....	1917		

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CUBA

Central Espana
Higginbotham, O.

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Key West
Weber, P. A.
Pensacola
McCorkle, A. J.
Milton
Voss, A. A.

ILLINOIS

Wood River
Stolley, B.

KANSAS

Eldorado
Gaudet, J. D.

LOUISIANA

Alexandria
Fowler, R. B.
Sylvester, I. W.

Algiers

Rantz, C. F.
Turner, W. O.

Baton Rouge

Bowman, C. M.
Fenn, F. H.
Henderlite, H. B.
Henning, W. S.
Ives, C. A., Jr.
Lassalle, L. J.
Pegues, B. W.
Pillet, F. F.
Sless, C. P.
Ticknor, S.
Whipple, W.

Bogalusa

Pierce, B. B.

Crowley

Elberson, L. P.

Donaldsonville

Medford, F. B.

Elizabeth

Fenstermaker, C. H.

Erath

Hagstette, E. J., Jr.

Fordoche

Kemper, J. P.

Gramercy

Meade, G. P.

Gretna

Geigler, J. B.
Hotard, A. E.

Hammond

Loustalot, L. A.
Middleton, J. M.

Houma

Seashore, P. T.
Smith, T. B.

Jackson

Gillum, J. H.

Lafayette

Elberson, S. W.

Lake Charles

Clanton, H. M.
Hamilton, F.
Shutts, H. H.

Lake Providence

Adams, J. R.

Lutcher

Woods, D. F.

Monroe

Huey, S. E.
Joubert, C. E.
Oakland, B.

Morgan City

Theard, S. A.
Elverum, O. H.

New Orleans

Abrahm, M. C.
Alcus, F. L.
Alcus, L. S.
Alexander, L. F.
Anderson, D. S.
Applewhite, S. B.
Baehr, J. C.
Barnes, M. H.
Barnett, Wade
Bassich, R. P.

Baumbach, R. H.

Bean, C. N.
Beard, D. M.
Beck, J. D.
Bedell, C. J.
Bell, B. H.
Bender, C. A.
Bernhard, J. H.
Billingsley, F. N.
Blumer, A. F.
Boardman, W. T., Jr.
Boelte, A. R.
Borden, F. S.
Bott, C. N.
Braselman, S. C.
Bres, E. S.
Brodman, J. P.
Brodtmann, A. J., Jr.
Brousseau, A. R.
Brune, L. C.
Buja, L. M.
Bulliung, J. J.
Burwell, R. T.
Campbell, P. H.
Cappel, C. G.
Chaffe, D. B. H., Jr.
Church, R. H.
Code, A. G.
Coleman, J. F.
Collins, J. H.
Couloheras, E. A.
Crawford, C. C.
Cressy, L. V.
Crettet, M. E., Jr.
Crump, H. E.
Cucullu, L. J.
Cullom, D. L.
Davieson, O. J.
Davis, B. N.
Dean, J. T.
Derickson, D.
Devall, L.
deFraites, A. A.
deTarnowsky, J.
Di Benedetto, S.
Dicks, C. B., Jr.
Drawe, W. J., Jr.
Dreuding, R. J.
Ducros, M. T.
Dunlap, A. L.
Dupont, L. C.
Dupui, B. H.
Dusenbury, A. T.

- | | | |
|-----------------------|-------------------------|-----------------------|
| Earl, G. G. | Kammer, F. N. | Negrotto, A. J. |
| Earl, R. | Kammer, K. P. | Nelson, B. S. |
| Eastwood, J. T. | Kelly, C. J. | Nelson, W. S. |
| Egan, J. T. | Kerr, C. M. | Newman, L. L. |
| Elliott, D. S. | King, L. W. | Newton, W. T. |
| Engelhardt, H. G. | Kirst, L. R. | Nielsen, J. C., Jr. |
| Estorge, T. L. | Klorer, J. | Norris, C. B. |
| Evans, C. D. | Koch, W. E. | Norton, M. M. |
| Ewing, J. P. | Kohnke, R. B. | Oakes, W. F. |
| Favrot, C. A. | Korn, L. I. | Old, H. N. |
| Ford, J. D. | Krauss, G. C. | Olsen, O. K. |
| Fox, F. H. | Krebs, J. J. | O'Neill, J. H. |
| Fransen, A. J. | Kuhn, P. C. | Oster, W. P. |
| Frantz, L. T. | Kuhn, R. J. | Pareti, P. |
| Frick, A. | Lane, H. J. | Paterson, A. B. |
| Friedler, J. J., Jr. | Lamphier, E. S. | Phillips, P. F. |
| Fromherz, A. M. | Lawes, C. W. | Peirce, C. J., Jr. |
| Frost, F. G. | Leake, W. S. | Porter, J. L. |
| Gallagher, H. M. | Lecourt, S. M. | Prouet, R. C. |
| Geis, J. F. | Legeai, R. F. | Quinlan, P. H. |
| Godat, G. W. | Leininger, J. E. | Rackerby, G. C. |
| Godchaux, J. | Levy, N. | Rainville, W. S., Jr. |
| Gondran, J. M. | Levey, H. A. | Reinhard, J. |
| Gosa, R. E. | Lewis, J. H. | Remanjon, A. De R. |
| Grant, W. K. | Lind, R. E. | Rhodes, G. L. |
| Gregory, W. B. | Lockett, A. M. | Rhodes, W. H. |
| Grehan, B. H. | Lockett, R. P. | Rice, G. P. |
| Gravenberg, F. B. | Lombard, G. | Ricker, C. W. |
| Guidry, J. E., Jr. | Lorio, J. A. | Riess, J. |
| Guillory, J. M. | Macdonald, F. M. | Ristroph, P. L. |
| Guillot, A. H. | Malochee, H. J. | Rittenberg, C. L. |
| Haase, J. A. III | Manney, C. J. | Robert, J. M. |
| Hackett, A. H. | Marks, A. E. | Robert, J. M., Jr. |
| Hadden, C. F. | Massimini, S. V. | Roberts, T. H. |
| Hamilton, F. P. | Mattison, G. C. | Rodriguez, E. J. H. |
| Hammett, G. R. | Mayer, J. K. | Roessle, E. G. |
| Harris, A. J. | McCarroll, T. M. | deSalignac, L. |
| Haulard, M. V. | McLean, G. J. | Salzer, H. S. |
| Hay, W. W. | McLean, H. L. | Scales, W. H. |
| Helwick, N. J. | McLean, L. C. H. | Scheib, J. G. |
| Herpich, R. | McNiven, J. A. | Schmidt, R. McC. |
| Hess, W. T. | Melancon, O. O. | Seaver, G. A. |
| Hill, A. M. | Mendow, F. R. | Seepe, P. E. |
| Hill, G. W. | Meunch, C. | Seiferth, S. |
| Hogg, W. T. | Meyers, H. J. | Shaw, A. M. |
| Hoots, P. F. | Michel, M. | Shilstone, H. M. |
| Hottinger, S. E., Jr. | Molaison, H. J. | Simpson, W. S. |
| Hughes, E. F. | Montgomery, J. W. | Sirgo, H. F. |
| Hyatt, E. C. | Montz, A. S. | Smith, L. C. |
| Ireland, L. G. | Moodie, D. | Spaar, W. H. |
| Jacobs, H. | Moses, W. B. | Staples, L. A. |
| Jahncke, E. L. | Muller, J. F., Jr. | Steinmayer, R. A. |
| Jahncke, P. F., Sr. | Myers, H. B., Jr. | Stevens, F. W. |
| Janssen, J. S. | Naberschnig, E. M., Jr. | Stewart, B. W. |
| Joachim, J. W. | Nairne, C. L. | Stockmann, H. H. |
| Johnson, W. | Nall, R. L. | Swan, H. C. |
| Jones, C. L. | Naquin, A. A. | Stone, F. M. |

Terroy, T. E.	Seiler, R. F.	Mann, R. H.
Theard, F. F.	Snyder, J. Y.	McInerny, J.
Todd, J. M.	Sulphur	Von Phul, W.
Tognoni, L. M.	White, W. S.	Welman, H. C.
Trepagnier, J. H.	Thibodaux	NICARAGUA
Trouard, S. E., Jr.	Chenet, T. T.	Puerto Cabezas
Tuller, W. N.	MASSACHUSETTS	Scott, H. D.
Vivien, L. T., Jr.	Cambridge	
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Waddill, G. D.	West Roxbury	Cincinnati
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Wallbillich, S. J.	McGehee, H. H.	Cooper, A. J., Jr.
Weil, L. S.	MINNESOTA	Okey, C. W.
Weiss, L. C.	Duluth	Memphis
Wiggin, C., Jr.	Monteiro, C. R.	Tutwiler, T. H.
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Williamson, C. S., Jr.	Morden, E. B.	Austin
Willoz, A. L.	Ocean Springs	Hanemann, E. J.
Willoz, V. L.	Holloway, W.	Galveston
Wilson, J. N.	Vicksburg	Davis, A. B., Jr.
Wilson, J. W.	Gentilich, J. S.	Houston
Wingate, A. R., Jr.	NEW JERSEY	Dolhonde, C. E.
Winship, W. E.	Collingswood	Eblen, W. F.
Wood, C. L., Jr.	Stayer, D.	Shilstone, H. M., Jr.
Wyler, C. J.		Tompkins, J. F.
Ziifle, R. W.	NEW YORK	VENEZUELA
Norco	Brooklyn	Maracarbo
Myers, A. J.	Reynolds, F. L.	Gessner, E. H.
Pollock	New York City	WEST INDIES
Gates, J. B.	Black, A. L., Jr.	Netherland
Shreveport	Davis, G. H.	Tremblay, N. W.
Bullen, J. T.		
Howze, J. B., Jr.		

MINUTES OF THE MEETING OF THE BOARD OF DIRECTION

Regular Meeting of the Board of Direction, December 14, 1936.

The meeting was called to order at 7:50 P. M. in the rooms of the Society. In the absence of President Hackett and Vice-President Williamson, Col. Bres presided, in accordance with President Hackett's telephone request. Members present: Godat, Grehan, Hill, Moses, Ricker.

Mr. John Young, an engineer from the Southern Bell Telephone and Telegraph Company, was present by invitation. He explained the type of equipment he was able to furnish for an amplifying system for use at the meetings of the Society. The Board requested that he furnish written quotations covering cost of rental, and cost if the set were purchased.

A letter from Mr. Billingsley, Chairman of the General Committee for 1937 Annual Meeting, was read. The Board voted that \$300 be appropriated for the 1937 Annual Meeting, in accordance with his request.

ARTHUR M. HILL, Secretary.

Minutes of the Regular Meeting of the Society, December 14, 1936.

The meeting was called to order by Vice-President Williamson with 70 members and guests present.

The minutes of the last meeting were read, and after one correction were approved.

Mr. Klorer, Chairman of the Nominating Committee, made the following report:

For President.....	C. S. Williamson, Jr.
For First Vice-President.....	Bernard H. Grehan
For Second Vice-President.....	Leo J. Lassalle
For Secretary-Treasurer.....	A. M. Hill
For Director 1 Year.....	L. L. Newman
For Director 2 Years.....	C. G. Cappel

Reports of the Employment Committee for the months of October and November were read.

Prof. Ricker made an announcement concerning the A. I. E. E. meeting on December 18.

The Secretary read a letter giving the prices on pins, somewhat smaller than those now used. Action however was deferred, as it was felt that the present emblem might be made according to some fixed size, and this size could not be changed except by vote of the membership.

The Secretary exhibited the certificate of membership which is suitable for framing.

Mr. Godat, Chairman of the Technical Papers Committee, told briefly the plans of the Annual Meeting, January 22 and 23.

Col. Bres showed a few slides in connection with last year's meeting. New members and student members were introduced.

The first paper of the evening was presented by Mr. Albert Fransen, of the Gulf Engineering Company. It was entitled "General Ship Repairs."

The second paper was entitled "From Rags to Roofs," and was given by Mr. Robert L. Nall of the Flintkote Company.

The third paper was presented by Mr. Wayne Paul Wallace of the engineering faculty of Louisiana State University and was entitled "Some Practical Applications of the Column Analogy."

At the end of the third paper, discussion of all three papers occurred. After the discussion, a rising vote of thanks was tendered the speakers.

The meeting then adjourned to the collation.

Minutes of the Meeting of the Board, January 29, 1937.

The meeting was called to order at 7:30 P. M. by President Williamson, with the following members present: L. L. Newman, C. G. Cappel, D. W. Godat, A. M. Hill.

The minutes of the last meeting were read and approved.

Mr. Carroll J. Peirce, Jr., was suggested as a member of the Board to fill the vacancy caused by the automatic resignation of Mr. B. H. Grehan, who was elected 1st Vice-President in January. It was suggested that the President convey this recommendation to the membership at the February meeting.

It was voted that the next regular meeting be held on Monday, February 22.

It was voted that the entrance fees be abolished until the October meeting.

In connection with a plan to increase the membership it was suggested that each Board member contact personally a number of members who could and would interest other engineers in joining the Society.

It was voted to suggest to the New Orleans Association of Commerce that they ask prominent engineers to discuss flood control conditions on the radio. Such a series of talks would be particularly desirable because of the Carnival visitors.

President Williamson promised to carry this message to the Association of Commerce personally, so there would be no delay in these talks sponsored by the Louisiana Engineering Society.

Adjournment.

ARTHUR M. HILL, Secretary.

Minutes of the Meeting of the Board of Direction, January 18, 1937.

The meeting was called to order by President Hackett with the following members present: Bres, Grehan, Hill, Ricker, Williamson.

The minutes of the last meeting were read and approved.

The resignation of Mr. A. J. Sarre was accepted with regret.

It was voted to accept the proposal of Mr. John Young to furnish the Society with an amplifying system as follows: 1 amplifier, 1 microphone on stand, 1 lapel microphone, 2 twelve-inch speakers, carrying cases and necessary cable, price \$150.00.

Favorable action was taken on a letter from the U. S. Constitution Sesquicentennial Commission.

Consideration was given to some names to be dropped from the rolls of the Society, but it was decided to delay action until after the Annual Meeting.

The motion was made and passed that members whose dues are one year in arrears will not receive publications, only notices of meetings.

After some general discussion concerning the Annual Meeting, the Board adjourned.

ARTHUR M. HILL, Secretary.

**Minutes of the General Session of the Annual Meeting,
January 22, 1937.**

In the unavoidable absence of President Hackett, Vice-President Williamson called the meeting to order in the Hunt Room of the St. Charles Hotel at 11:20 A. M. One hundred eighty members and guests were present.

Announcements about the buffet luncheon and the inspection trips were made. An address of welcome was made by Mr. Jesse Cave, commissioner of Finance and Acting Mayor of New Orleans.

A short key note address was given by Mr. James M. Todd.

Mr. A. J. Naquin, Chairman of the Plant Visitation Committee, gave some directions in connection with the afternoon trip.

The minutes of the December meeting were read and approved.

The reports of the President and Board of Direction and of the Secretary were read and approved.

After the reading of the reports, Vice-President Williamson turned the chair over to Mr. Billingsley, Chairman of the Committee on General Arrangements for the 1937 Annual Meeting.

Mr. D. W. Godat reported the results of the balloting for officers, and the following were declared elected: C. S. Williamson, Jr., President; B. H. Grehan, 1st Vice-President; L. J. Lassalle, 2nd Vice-President; A. M. Hill, Secretary-Treasurer; Director to serve one year, L. L. Newman; Director for three years, C. G. Cappel.

President Williamson was escorted to the chair by Mr. Allen T. Dusenbury and Mr. J. T. Bullen. The President then made a short address, other newly-elected officers were asked to stand for a moment.

Mr. Todd reported that the attendance at the student meeting was only half that of last year due to the conflict with examinations. The motion was made and passed that steps be taken to change the date of the Annual Meeting.

Mr. Godat, Chairman of the Technical Papers Committee, made announcement about coming events on the program.

Adjournment.

ARTHUR M. HILL, Secretary.

ANNUAL REPORT OF THE SECRETARY

New Orleans, La., January 2, 1937.

To the Board of Direction,
Louisiana Engineering Society.

Gentlemen:

As Secretary of the Society, I herewith submit the following report for the year 1936:

During the past year the Board of Direction has held fourteen meetings. Ten regular meetings of the Society were held, several of these were with local sections of national societies. The meetings were:

Jan. 24 & 25—Two-day Annual Meeting of the Society.

Feb. 7—"Moving a Five-Story Reinforced Concrete and Brick Building in One Hour and Fifty-eight Minutes." Speaker, Mr. C. G. Cappel, Vice-President of W. Horace Williams Co.

Mar. 9—"A Modern Rice Irrigation System." Speaker, Prof. W. B. Gregory, Tulane University.

April 20—"Integral Combinations of Structural Timber and Cement Concrete in Composite Construction." Speaker, Mr. James F. Seiler, Field Engineer of the American Wood Preservers Association.

May 11—"The Petroleum Industry in Louisiana." Speaker, Prof. B. C. Craft, of L. S. U. This meeting was held in Baton Rouge.

June 8—"The Sulphur Industry." Speaker, Mr. D. T. McIver, Asst. General Manager of the Freeport Sulphur Co.

Sept. 14—"The Public Belt Railroad." Speaker, Mr. V. J. Bedell, Chief Engineer of the Public Belt Railroad.

Oct. 12—Open meeting for general discussion. Some descriptions of the recent Third World Power Congress.

Nov. 16—A day time meeting in co-operation and as guests of the Society of American Military Engineers, consisting of a trip up the river to asphalt plant, and down the river to the point where mats were being laid.

Dec. 14—At the December meeting three papers were given. "General Ship Repairs," by Mr. Albert J. Fransen, Junior Member, and of the firm the Gulf Engineering Co. "From Rags to Roofs," by Mr. Robert L. Nall, Engineer with the Flintkote Co. and member of the Society.

"Some Practical Applications of the Column Analogy," by Mr. W. P. Wallace, Junior Member, and of the faculty of Louisiana State University, College of Engineering.

The membership has increased, with a net gain of fifty-five members.

GRADE	On Rolls Jan. 1, 1936	Elected	Reinstated	Transferred to	Transferred from	Dropped	Died	On Rolls Jan. 1, 1937
Honorary Members	5	---	---	---	---	---	1	4
Life Members	20	3	---	3	---	---	1	22
Resident Members	156	20	1	1	4	1	2	171
Non-Res. Members	49	6	---	2	1	4	---	52
Associate Members	2	---	---	---	---	---	---	2
Non-Res. Asso. Members.....	1	---	---	---	---	---	---	1
Affiliate Members	17	---	---	---	---	---	---	17
Non-Res. Affiliate Members.....	4	---	---	---	---	---	---	4
Junior Members	68	3	---	---	3	3	---	65
Non-Res. Junior Members.....	17	1	---	2	---	1	---	19
Student Members	---	37	---	---	---	---	---	37
Totals.....	339	67	1	8	8	9	4	394

It is with regret that the deaths of Mr. Walter Hoffman, Mr. O. O. Melancon, Mr. W. T. Newton and Mr. Henry L. Zander are reported.

FINANCIAL STATEMENT

January 1, 1937.

Assets:

Cash in Whitney Checking Account.....\$ 721.52

Accounts Receivable

Membership dues, 1936..... 377.00
 Advertisers 103.16
 Investments 4,208.76
 Frozen Funds 4,359.09

Total.....\$9,768.53

Cash Received, 1936.

1934 Dues\$ 110.50
 1935 Dues 261.00
 1936 Dues 1,747.50
 1937 Dues 32.34
 Advertisers 385.55
 Entrance Fees 30.00
 Contribution, Local Sections 37.50
 N. O. Security Note, Final Payment..... 45.90
 Dividends, Interstate Account..... 575.33
 Proceedings Sales 5.05

\$3,230.67

Add to this 1935 balance..... 741.41

Total.....\$3,972.08

Cash Spent, 1936.

Cost of Proceedings.....	\$1,381.07
Golf Tournament and Smoker.....	163.00
Scholarship	50.00
Printing and Postage.....	300.66
Secretary's Salary	600.00
Assistant to Treasurer.....	20.00
Gavel and Present for President.....	30.00
Library Expenses	70.64
Bond for Treasurer	10.00
Porterage	48.00
Refreshments	135.80
American Engineering Council.....	25.00
General Expenses and 1936 Annual Meeting.....	413.24
Exchange on Checks.....	3.15
	<u>3,250.56</u>
Balance on January 1, 1937.....	\$ 721.52

Investments *

2—\$100 1st Liberty Loan.....	\$ 200.00
1—\$ 50 1st Liberty Loan.....	50.00
5—\$ 50 1917 Liberty Loan.....	250.00
Greater New Orleans Homestead.....	1,208.76 ✓
Union Homestead	500.00 ✓
Italian Homestead	500.00 ✓
Standard Homestead	500.00 ✓
Security Homestead	500.00 ✓
Columbia Homestead	500.00 ✓
Deferred Account, Canal Bank	403.69
National Bank of Commerce, Savings.....	685.14
Deferred Account, Interstate.....	3,260.26
	<u>\$8,557.85</u>

Appreciation is expressed to the officers and members of the Society for their co-operation.

Respectfully submitted,

ARTHUR M. HILL, Secretary.

ANNUAL REPORT OF THE BOARD OF DIRECTION FOR 1936

To the Members of the Society:

Gentlemen:

Your Board of Direction begs to report that during the year 1936 there were held a total of fourteen meetings for the transaction of business of the Society.

The Technical Papers Committee has given excellent programs of high grade papers covering a variety of subjects. Most of these papers have been printed in the Proceedings.

* From the Treasurer's Report.

The Library Committee has purchased some new books, and continued subscriptions to the magazines of technical nature. For the benefit of those who have only a few minutes to spend in the rooms on occasion the magazine "Life" has also been added. During the year a book list was issued.

The Membership Committee secured a number of members during the year. The net gain in membership was fifty-five.

The Publication Committee has carried on its good work in issuing the Proceedings, and the Editor deserves the highest praise for the tone and quality of the publication.

The Committee on Employment has kept up its fine record in securing positions for unemployed engineers. The committee has rendered a report at each monthly meeting of the Society which was of interest to the members.

The Committee on Entertainment and Outings has operated very efficiently. The sixth annual golf tournament was held in May. A number of trophies, generously donated for the tournament, were awarded during the entertainment which followed the buffet supper at the Colonial Country Club.

The Committee on Legislation was very active in preparing a bill for registration of engineers. While it developed that it was not possible at that time to pass the bill, yet the committee was untiring in their efforts.

The first Annual Meeting covering a two-day session was held in 1936. Technical papers were given, plant visits were made, and visiting wives were entertained by the Auxiliary. The meeting ended on January 25 with a banquet and dance. The attendance at the sessions was approximately four hundred.

The Society awarded a Junior Membership for one year to Mr. C. P. Seiss, of L. S. U., and to Mr. A. J. Brodtman, Jr., of Tulane. A Scholarship award was made to Mr. A. C. Porter, of Tulane.

The Board wishes to express its appreciation to the various committees and members, and of the efficient service of the Secretary.

Respectfully submitted,

ALLEN S. HACKETT, President,
C. S. WILLIAMSON, JR., Vice-President,
A. M. HILL, Secretary,
W. B. MOSES, Treasurer.

C. W. RICKER,
B. H. GREHAN,
D. W. GODAT,
E. S. BRES, Directors.

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A. J. NEGROTTO
Secretary-Treasurer,
J. A. McNIVEN



STUDENT CHAPTERS
Louisiana State Univ.
Baton Rouge
Tulane University
New Orleans
Special Meetings at
call of President

At a meeting of the Board of Direction on March 1, 1937, President H. A. Sawyer announced the following committee appointments:

Membership Committee:
F. P. Hamilton, Chairman.....408 Walnut St., New Orleans
J. T. Bullen.....913 Dalzelle St., Shreveport
I. W. Sylvester.....City Hall, Alexandria
E. E. Shutts.....Box 655, Lake Charles
J. R. Wendt, Sr.....2320 Kleinert St., Baton Rouge
James McC. Fourmy.....Hammond

Aims and Activities:
Edw. S. Bres, Chairman.....388 Broadway, New Orleans
Geo. P. Rice.....1004 Baronne Bldg., New Orleans
A. J. Negrotto.....4037 Banks St., New Orleans

Scholarship Awards Committee: (Present Committee continued pending receipt of final report):
Edw. S. Bres, Chairman.....388 Broadway, New Orleans
Prof. Donald Derickson.....Tulane University, New Orleans
Prof. B. W. Pegues.....Louisiana State University, Baton Rouge
F. P. Hamilton.....408 Walnut St., New Orleans
W. H. Rhodes.....Canal Bank Bldg., New Orleans

Committee on Annual Meetings:
Ole K. Olsen, Chairman.....833 Howard Ave., New Orleans
Two members to be appointed by Mr. Olsen.

Publicity Committee:
B. Dornblatt, Chairman.....Box 254, New Orleans
F. P. Hamilton.....408 Walnut St., New Orleans
The Board of Governors comprises: President H. A. Sawyer; 1st Vice-President W. H. Rhodes; 2nd Vice-President A. J. Negrotto; Past President C. H. Stem; and Past President F. P. Hamilton; and Secretary-Treasurer J. A. McNiven.

The next meeting of the Section will be held in Baton Rouge on Wednesday, April 28th, and the program announced by Prof. B. W. Pegues, Chairman, is as follows:

Buffet Supper, University Campus, 7:00 P. M.
Short Business Sessions of Tulane and L. S. U. student Chapters.
Business session of the Louisiana Section, President Sawyer presiding.
Address by Lester J. White, Chairman State Planning Board of Baton Rouge.
The cost of the dinner and its location will be announced later.

On March 16, 1937, the Tulane University Student Chapter was addressed by Dr. A. A. Potter, Dean of College of Engineering, Purdue University; and Dr. L. E. Konrad, head of School of Civil Engineering, Kansas State College. Inspection trips were made to Bonnet Carre Spillway; Foundations—Charity Hospital Laundry and Ambulance Building; Sewerage and Drainage Pumping Station.

The Chapter is looking forward to an article in the April issue of "Civil Engineering" by one of its members: Harold Favret, who has written on "Transferring Linoleum Effects to Reinforced Concrete."

On April 7th the Tulane University Student Chapter will be joint sponsor with the A. S. M. E. and A. I. E. E. student chapters and Alpha Chi Sigma of a Field Day. Its purpose is to acquaint the graduating classes of the High Schools with the College of Engineering at Tulane.

We have no news of the L. S. U. student chapter, through no fault of their own, but expect to have an article regularly from now on.

Have you paid your 1937 dues to the Secretary-Treasurer?

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

FEBRUARY, 1937

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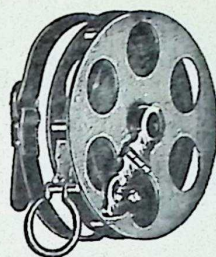
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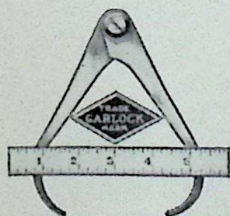
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Published bi-monthly, February, April, June, August, October, December,
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JAMES M. ROBERT, Editor.

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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EDITORIAL NOTES AND COMMENT

Building for the Future. The enhancement of the status of engineers has occupied the attention of many organizations for a considerable period of time. Activity has been more or less spasmodic, however. Before the war, each organization was more or less "on its own." During the war, when the United States government required a considerable amount of technical advice, the different branches of engineering were organized for the purpose. Out of this came, in 1920, the American Engineering Council associating national and local societies "to further the public welfare wherever technical and engineering

knowledge are involved, and to consider and act upon matters of common concern to the engineering and allied professions."

While the American Engineering Council has done a considerable amount of good work, it could not do all. The younger element in some of the societies, has recently developed the thought that, in addition to the good work of the American Engineering Council, other activities to improve the economic status of the engineer should be developed. Heretofore the thought was that the societies had been interested mainly with scientific and technical advance, but now it was found that the improvement of the quality of the individual engineer is the basic solution of many problems concerning the profession. As the outcome of the general thought and attitude, the *Engineers' Council for Professional Development* was organized in October 1932. The several constituents represent the professional, educational, and public or legal aspect of engineering.

The purpose of the council is to enhance the status of the engineer by improving his quality through:

1. Selection and guidance of those who seek to enter engineering.
2. Formulation of criteria for colleges of engineering.
3. Encouragement of training of the young engineer of post college age.
4. Recognition of engineers who have met suitable standards.

The Committee on Student Selection and Guidance and on engineering schools are doing excellent work. The program (which is now in progress) of inspecting the engineering schools of the country with a view to accrediting, cannot help but have a beneficial effect on undergraduate education in engineering. It seems to us, however, that an organization such as our own could possibly be of great assistance to young engineers by getting whole heartedly behind items 3 and 4 above.

All too frequently do we see the young engineer, after graduation, enter some organization and more or less cease to grow. They cease to grow apparently, from either one of two mistaken notions. First, that having graduated from college, their education is finished, or secondly, that their advancement in the profession is a matter of inevitable routine as long as they do their work.

It is an incontrovertible fact—and the way of the world—that we progress more by what we do *outside* of the job we get paid for rather than by what we do *in* that job. When we stop burning the midnight oil in the study of our job and in self-improvement we cease to advance.

All too frequently, young engineers settle down to their job in orderly routine and take what comes as a matter of course. They spend no time in self-improvement and then wonder why advancement in the profession is not more rapid. Eternal self-improvement is the price of progress in any profession, particularly the profession of engineering. The development of this thought and this attitude among the younger members of our society by those older in the profession will be a great contribution not only to the younger members but to the profession as a whole. No profession can be any better than the members who compose it. If in any way we can raise the average status of the individual member we automatically raise the level of the whole profession.

Engineering in its largest sense is romantic and vital. The only routine that should be permitted within the scope of its activity should be the routine of deadly precision and continual advancement.

When the young engineer progresses to the point that he makes himself a professional personality rather than a routine person, it will not be quite so difficult to force the public and private recognition of professional engineers to a much greater extent than is now possible.

Our New Members. The Society welcomes to its ranks the following new members:

Resident Members

Albert S. Anderson	John F. Mays
Mace Hudson Bell	John E. Pottharst
Frank S. Borden	Arthur de R. Remanjon
Orris J. Davieson	George J. Richaud
Frank E. Johnson, Jr.	Paul L. Ristroph
Percy C. Kuhn	Charles O. Roome
John David Malone, Jr.	Frank M. Stone
	Mario G. Zervigon

Non-Resident Members

James O. Dyal	S. E. Huey
John B. Gates	William H. Vincent

Affiliate Members

Marshall Ballard, Jr.	Harry Fletcher
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Junior Members

Albert R. Boelte	Arthur F. Landry
Allen K. Ford	Frank G. Perschall
John H. Frederickson, Jr.	William N. Tuller
	Robert W. Ziifle

Student Members

G. G. Auriolles	J. M. Gabriel
R. R. Bastian	D. E. Jahneke
P. W. Becnel	L. W. Kees
L. H. Bohne	J. D. McBride
L. S. Bourgeois	D. L. Morris
G. T. Coate	W. M. Payne
J. K. Dixon	H. R. Richmond
J. N. Eustis	R. C. P. Schoenberger
J. L. Fortier	H. F. Smith

H. A. Thompson

Shallow Draft Fathometer. We print in this issue a paper by Mr. David W. Bowman, Assistant Engineer, Second New Orleans District, on a radio device for taking shallow draft soundings.

The principle underlying the operation of this device is fully explained. It is to be noted, however, that the device is inoperable in depth of water less than fifteen feet.

With so much of our local water area having a depth of less than fifteen feet, and with a convenient and accurate sounding device at these shallow depths, the problem of still further improving the device or of designing an entirely new one is intriguing, indeed.

Exposing the Termite. There has come to the desk of the editor a pamphlet containing much valuable information about termite damage and methods of preventing it.

This pamphlet is published by the National Lumber Manufacturers' Association, 706 Interstate Bank Building, New Orleans.

Members of the Society may obtain this publication free by writing the manufacturers at the above address.

Annual Meeting Papers. We continue in this issue the publication of some of the papers presented at the annual meeting.

Due to the wealth of material which was offered at the annual meeting, it is impossible to publish all in one number. The policy has been adopted therefore, of dividing these papers and publishing a few of them in each of several successive issues.

In this issue we present the abstracted highlights of a paper by Colonel Park, entitled, "*The Engineer in Panama.*" This is the paper which was delivered at Dixon Hall, Newcomb College, on the night of Friday, January 22nd.

It is regrettable indeed, that space limitations do not permit us to publish the paper in full.

General Ship Repairs. This number of the Proceedings contains a paper by one of the younger members of the Society. Mr. Albert J. Fransen has written a very instructive and interesting paper on a type of work that we do not ordinarily hear much about.

His thoughts regarding dimensioning of drawings and the laying out of work will be read with interest by those who have puzzled in their early experience over this question.

It is encouraging, indeed, to note papers written by younger members of the Society. We hope that more younger members will emulate the example of Mr. Fransen.

Society Scholarships for Engineering Students. We wish to call attention to the fact that each year the Louisiana Engineering Society awards one scholarship at Tulane University and one scholarship at Louisiana State University to deserving students in engineering. The rules for making awards were amended some time ago and we print below the amended rules:

1. The announcement of the Scholarship Award shall be set up and carried in the *Proceedings*.

2. The cards sent out by the Secretary for the notice of the April meeting shall include a statement relative to the Scholarship Award and request members to make recommendations or nominations. The April issue of the *Proceedings* shall also carry an article on the Award.

3. The scholarships shall be set up as honor awards to the children of the members of the Society or to other worthy students who are financially unable to begin or continue their Engineering studies. Awards shall be made, preferably, to a dependent of a member of the Society or of an Engineer.

4. The scholarships shall be awarded in the Colleges of Engineering for undergraduate study only. The scholarships awarded to a student in Tulane University will be \$125.00 per annum, and to a student in Louisiana State University \$40.00 per annum.

5. The Award shall be made for one year and may be renewed annually until the undergraduate course of study has been completed, provided proper scholastic grades have been maintained in accordance with the

regulations set up by the Universities for the annual renewal of scholarships.

6. An Awards Committee consisting of three members of the Society shall be appointed annually by the President.

7. Applications for Scholarship appointments shall be made to the Awards Committee. In the event that no award is made by the Awards Committee, the Dean of the College in question shall be requested to nominate a candidate for the scholarship.

8. All applications shall be referred to the dean of the College of Engineering of the proper university. The dean shall rate the applications and submit the entire list to the Awards Committee together with all available information and such recommendations as he may deem fit.

9. The President shall make the award on the recommendation of the Awards Committee.

RESOLUTION

(Passed by the Board of Direction, March 8, 1937)

In regard to the 1937 Annual Meeting of the Louisiana Engineering Society, the Board of Direction feels that special appreciation should be extended to the General Committee and the Chairmen of the Sub-Committees and their co-workers for the efficient, willing and successful service they rendered in organizing and carrying through this second two-day Annual Meeting.

Although letters of specific recognition have already been sent to the chairmen, a general expression of gratitude should be made to all those who co-operated in achieving this year's satisfactory meeting.

SHALLOW DRAFT FATHOMETER

By DAVID W. BOWMAN *

Read Before the Society, February 22, 1937.

The device is the design of the U. S. C. & G. S. under the direction of Dr. Dorsey of the U. S. C. & G. S. at Washington. This design is not of commercial manufacture but was designed and built by them at their offices in Washington.

The system is typical in fundamental principle to other sonic, supersonic or electrical sounding machines in that an impulse is transmitted, the echo received and the time interval measured, which is reduced directly by the indicator to fathoms or feet. In its present state of development the equipment is somewhat bulky, although not necessarily large or cumbersome. Including the power plant ($1\frac{1}{2}$ kilowatt, 110 volt, 60 cycle) the total weight is perhaps 1200 pounds. Stability of power supply is a necessity. The usual source of power supply on a boat is too variable to use, due to the changing outside loads imposed on the circuit.

In its simplest form it consists of an oscillator which transmits an impulse at 17,500 cycles, and a receiver with a timing device that measures the time interval between the emitted impulse and the echo impulse. The speed with which the outfit must work will be brought to mind when it is remembered that the velocity of sound in water is about 4800 feet per second. The temperature and salinity affect the velocity to an extent of less than 3 per cent. This means that the time interval between the emitted impulse and the received echo in 18 feet of water is about $8/1000$ of a second. This particular unit is designed to operate in depths between 15 feet and 200 feet.

The entire outfit essentially consists of 9 units, as follows:

1. Power supply—gasoline driven generator $1\frac{1}{2}$ kilowatt, 110 volt, 60 cycle.
2. Power supply rectifier unit for the 17,500 oscillator and 1000 cycle oscillator.

* Assistant Engineer, Second New Orleans District.

4. 17,500 cycle oscillator.
5. Magneto-striction oscillator.
6. Polarizing field power supply for the magneto-striction oscillator.
7. Power supply rectifier unit for the signal amplifier.
8. Signal amplifier (super-heterodyne type).
9. Indicator unit.

Unit No. 1 is a $1\frac{1}{2}$ kilowatt, 110 volt, 60 cycle self excited generator driven by a two-cylinder gasoline motor manufactured by United States Motors.

Unit No. 2 is a typical high voltage rectifier system using 866 type tubes for the high voltage and an 83 for the bias voltage. This unit furnishes the power to drive both the 17,500 cycle and the 1000 cycle oscillators.

Unit No. 3. The 1000 cycle oscillator is used for driving the synchronous motor that turns the disc on the indicating unit. It is absolutely necessary that the disc, which is the visual recording device acting as a timer for the impulses, should run with great precision. To obtain this a 58 and a 2 A 3 are coupled to a 1000 cycle tuning fork. The output is then built up by means of push pull 800s to sufficient power to drive the synchronous motor.

Unit No. 4. The 17,500 cycle generator is self excited. This unit consists of two thyrotrons F G 65s, two R K 20s, two 830 Bs in the final.

The thyrotrons are the keying tubes and are the tubes that control the impulse to the transmitter. These tubes are mercury vapor tubes with a control grid. This grid when charged with a negative bias has the faculty of withholding the passage of current from the filament to the plate. However, when the grid is made positive the tube becomes ionized and can carry considerable current and will still pass current even though the grid is again made negative. To repeat the action it is necessary to shut off the current passing through the tube; when this is done the grid again obtains control. Two are used in a circuit in which the second tube is interposed in the plate to filament return lead of the first tube.

The R K 20s are in a standard push-pull self excited oscillator circuit except that the oscillation control is by passing the screen bias from negative to positive.

The push pull 830 Bs are standard except that a very low impedance output is used, no transformer, just a center top 750 turn coil.

Unit No. 5. The magneto-striction oscillator is the transmitting and receiving device and is mounted so that the diaphragm is in the water. This unit consists of a heavy diaphragm some $\frac{1}{2}$ inch thick, circular in shape. Upon this are mounted 400 to 500 thin walled nickel tubes and a heavy cap. Around the nickel tubes are wound two coils, one of which carries the polarizing current and the other the exciting 17,500 cycle current.

Nickel has the property of elongation when magnetized. The polarizing current builds up a dense magnetic field. The 17,500 cycle current tends to buck this field on each half cycle; therefore, the nickel tubes are alternately magnetized and demagnetized each cycle. This causes an elongation of the nickel tubes each cycle which in turn causes the diaphragm to vibrate at that frequency. This is not a particularly efficient device and probably could be improved upon.

Unit No. 6. This unit supplies the polarizing current to the field coil of the magneto-striction oscillator. In this instance transformers were used with rectox rectification and developing 25 volts D. C. at 1 to $1\frac{1}{2}$ amperes. This installation is dependent upon the type of current available for use. In the polarizing current circuit is placed a 17,500 cycle filter to prevent the waste of dissipation of energy in the rectifier system.

Unit No. 7. This unit is similar to power supplier used extensively in radio receivers and has nothing special in its design.

Unit No. 8. This is a standard super-heterodyne amplifier with a 58 R. F. input 57 first detector 58 oscillator, two 58 in the intermediate frequency stages and a 2 B 7 second detector. The I. F. stages operate on 175 KC. The output is then passed

through two thyrotrons in about the same circuit as is used for Unit No. 4, except that the output of the second thyrotron is transformer coupled to the neon tube. It is the collapse of the field in this transformer that flashes the neon bulb in the indicator unit.

This amplifier also has a 56 tube to amplify the photo-electric cell of Unit No. 9 which actuate the thyrotrons of Unit No. 4 and create the transmission impulses.

Unit No. 9. This is the indicating and timing unit. The unit is composed of a neon bulb bent in the shape of a circle. This bulb is stationary. A disc mounted on a shaft rotates directly in front of the neon bulb. On this shaft is also mounted a gear having 100 teeth and a very small concave mirror. Directly above the mirror there is an arrow shaped slot in the disc through which you can see the neon bulb.

The gear is the entire mechanism of the synchronous motor. Above the gear and a few thousandths away is mounted several other teeth projecting from a 1000 cycle solenoid. This solenoid is driven by Unit No. 3 which generates the 1000 cycle current. Above the mirror, which is mounted on the shaft, is mounted a 6 volt light source and a photo-electric cell so arranged that the light is directed for an instant during each revolution upon the cell. The cell then through the amplifier and the Keying thyrotron creates the transmitting impulse, which in turn flashes the neon bulb. This action occurs when the arrow shaped slot in the disc is at the top. The echo occurring some instants later has allowed the disc to turn a portion of its revolution so that when the echo flashed the neon bulb the time interval is graduated directly in depth on a transparent glass scale covering the disc. It may seem at first glance that this flash would be hard to read but such is not the case. These flashes occur at the rate of 20 per second and your persistence of vision allows you to see only a red arrow moving slowly up or down the glass scale.

There is also a small starting motor mounted within this case to bring the gear and disc into synchronism with the 1000 cycle oscillator. Now let us follow the operation of the appara-

tus during the time of one sounding; there are 20 taken per second.

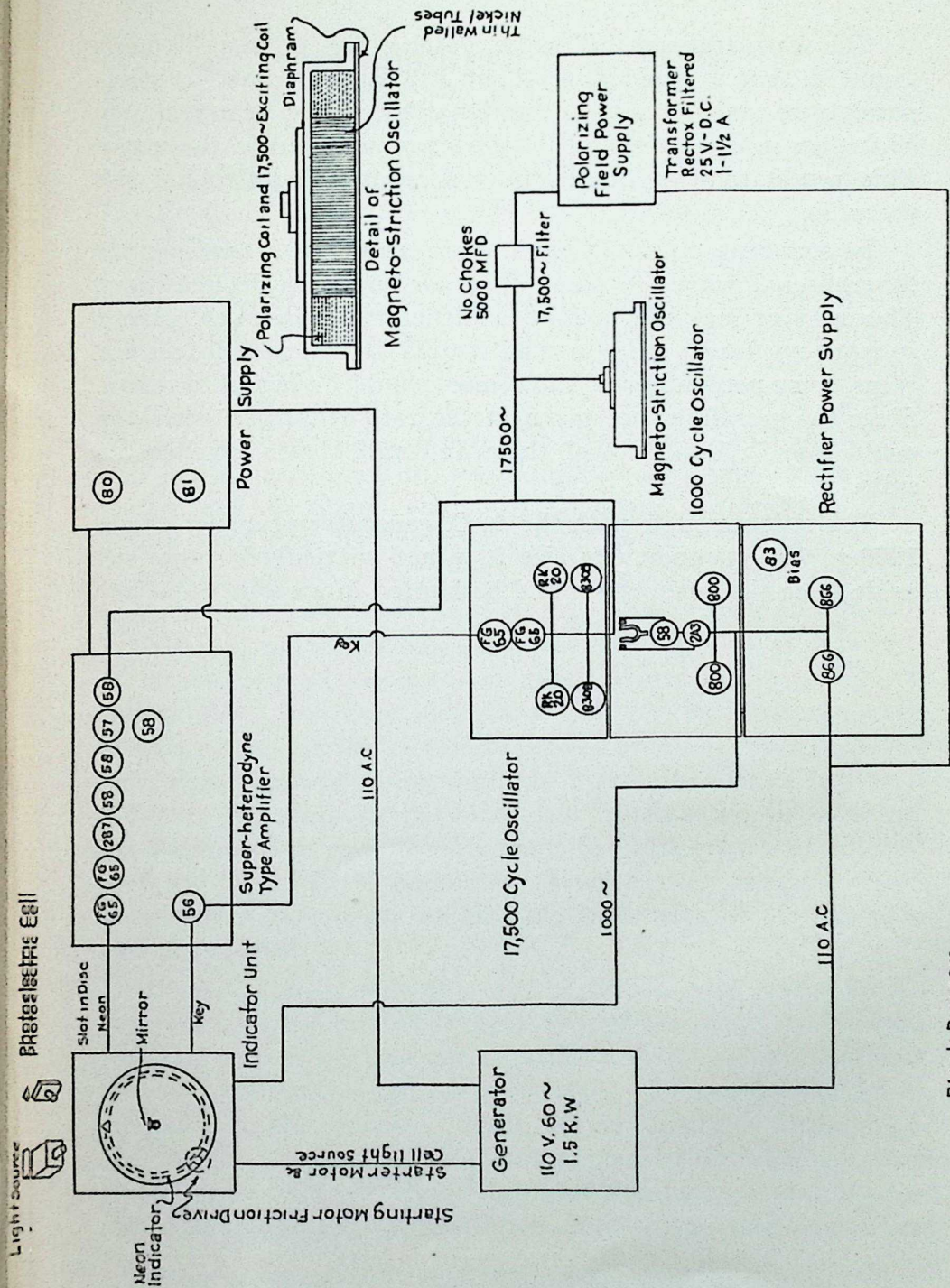
As the disc rotates the mirror actuates the photo-electric cell which in turn through the 56 amplifier actuates the trigger or keying thyrotrons of the 17,500 oscillator. The oscillator clicks off the impulse which actuates the magneto-striction oscillator, at the same time this impulse passes up through the amplifier and flashes the neon bulb.

The echo returning strikes the magneto-striction oscillator generating a very weak impulse which passes up to the super-heterodyne amplifier to the thyrotrons, which in turn flash the neon bulb for the second time. The travel of the slot between the two flashes indicates the time interval from which the depth is known, by means of the calibrated scale.

A superficial analysis indicates the following: The apparatus is the result of some study and much ingenuity. The apparatus has several poor features. The magneto-striction oscillator is a very inefficient device for the transfer of energy to the water.

The super-heterodyne amplifier has a tendency to be paralyzed for about $7/1000$ of a second after the transmitting impulse is sent. This obviously limits the time of the echo to more than $7/1000$ of a second which in terms of depth is about 14 feet. What is needed is an amplifier that will recover this $1/1000$ to $2/1000$ of a second to obtain soundings from 5 feet up. Personally, I would not have put the entire output of the 830 Bs (which are quite powerful tubes) directly into the 58 the first tube of the super-heterodyne amplifier. Possibly the answer is to use two amplifiers to the neon tube, one to excite it with transmitted impulse, and another (which will be always in readiness to take it) to excite it with the echo. This idea looks feasible but is probably much more difficult in its execution than it appears.

The length (in time) of the transmitted impulse is about $6/17,500$ of a second or about 6 cycles of the 17,500 cycle frequency.



To Accompany Report of July 20, 1935
Submitted by D. W. Bowman, Asst. Engineer
Second New Orleans District

Block Diagram
SHALLOW DRAFT FATHOMETER
Dorsey Type

The wave transmitted to the water seems to be quite directional in that it spreads on about a 20 degree cone. It seems possible to make it more directional by means of a tube, say 18 inches in diameter and 8 feet long, mounted in the water. This would tend to direct the transmitted impulse and also the echo.

In sounding on a 45° bank there would be a tendency for the reflected waves to pass off at an angle, as do light rays. This may or may not present a difficulty. Inasmuch as most subaqueous banks are somewhat rough and present ledges and steps, some percentage of the echoes would be bound to return. Since the soundings are taken at the rate of 20 per second, we could lose 75% to 95% of them and still obtain excellent results.

The unit complete with the A. C. generator probably weighs 1200 to 1500 pounds. In size it is not particularly large and aside from the generator could be housed in a cabinet 6'x2'x3'.

THE ENGINEER IN PANAMA

By COLONEL RICHARD PARK *

Read at the Annual Meeting, January 22, 1937.

NOTE: We regret that limitations of space prevent the publication of the excellent discourse of Colonel Park in full. Below, however, are given the abstracted highlights of his paper.

EDITOR.

Not even our pilgrim fathers ever had the chance to gossip about the weather being colder than 12° above zero around Boston, Massachusetts, and it was never known to be colder there until the winter of 1933-34, when it dropped to 24° below. About that time I was transferred from duty as District Engineer of the Boston District to the command of the 11th Engineers, United States Army, Corozal, Canal Zone, and there it was 90° above zero under the shade of the royal palms during the middle half of the daylight hours.

After a week's voyage, the ship passed through the entrance to Limon Bay between two long breakwaters and docked at Cristobal on the Atlantic side of the Isthmus of Panama. We drove over all the roads on the Atlantic side passable for automobiles. The tour took three and one-half hours, as the roads are short and soon end at the sea or jungle edge. As yet there is no trans-isthmian highway although a route has been surveyed and plans prepared by the Panamanian Government for a connecting link to run from the little town of Catival near the Canal Zone boundary through very rugged jungle country to a connection at Madden Dam with the Pacific side highway system.

On the Atlantic side the city of Colon, with about 33,000 population, is the second largest city of the Republic of Panama. It contains a number of sizable stores where excellent quality merchandise can be purchased. Of course, they cater especially to the tourist. There are innumerable little shops and tiendas that supply the native population with all their hearts desire. The Panama Railroad Company, a corporation owned and operated by the United States, operates large com-

* Corps of Engineers, U. S. A. District Engineer, Mobile, Ala.

missaries which supply most of the needs of the Army, Navy, and Canal Zone personnel and their families. One of these is in Cristobal just across the street from Colon but in the Canal Zone. Fort De Lesseps, housing the headquarters of the Atlantic Sector and a small garrison of the Army, is located in the north end of Colon and nearby is the fine Washington Hotel, owned and operated by the Panama Railroad, catering to the best tourist trade. The Canal Zone also operates a large and well equipped hospital in the city of Colon for the care of employees on the Atlantic side.

Nearest the sea on the east side of Limon Bay is Fort Randolph, a seacoast fort that houses a part of the 1st Coast Artillery Anti-Air. Coco Solo, a Navy submarine base, is a mile or so to the south; France Field, an Army air field, is about two miles farther south. Fort Davis houses the 14th U. S. Infantry and the Panama Atlantic depot. It is situated about two miles north of Gatun Lake about a mile east of the Canal. Fort Sherman, another coast artillery post, is located near Toro Point on the Caribbean Sea on the east side of Limon Bay. It is obviously impossible to keep secret the general location of the various army and navy establishments. They are all sizable communities and every one knows where they are and roughly the size and character of their garrisons. Every effort is made to keep secret the number, size, and locations of the guns and other defensive features. Utmost care is taken to keep secret the actual plans for defense, which are issued only to those who must carry them out in whole or in part in case of need.

The importance of the Panama Canal from the standpoint of national defense can hardly be overestimated. Its importance might be evaluated in a certain measure as the extra cost of maintaining a navy from 75% to 100% larger than the navy needed now, less the cost of maintaining the defense forces. This might be around \$300,000,000 per year. Saving the taxpayers \$300,000,000 per year, with equal security against aggression, was a worth while undertaking for the United States.

Cristobal is the Atlantic terminus of the canal. It is a well laid out and administered American town where the employees

of the Panama Canal live whose work is on the Atlantic end at the port or nearby. The Cristobal docks are equipped with the necessary facilities for expeditious loading and unloading of the largest ships. The coaling plant is the largest of its kind in the world. Fuel oil is available in any desired quantities with ample facilities for bunkering ships. At Mt. Hope is located the general supply depot for the canal organization.

About five miles southeast of Fort Sherman at the mouth of the Chagres River are the ruins of Fort San Lorenzo, built and manned for many years by the Spaniards to prevent enemy access to the interior by way of the Chagres River. Before the days of the Panama Railroad, completed in 1855, much of the traffic across the Isthmus was by water up the Chagres in shallow draft boats to Las Cruces, about 35 miles, thence over a cobble stone paved oxcart trail about 25 miles to Panama City. This trail is several hundred years old. Portions are still in use for foot troops and pack transportation, where they cut through the military reservations, but the pavement has largely disappeared.

Northeast of Colon about 20 miles lies Porto Bello, the principal Caribbean port of old Spanish days. This port was connected with Panama City by a stone paved road which was in commercial use up to about 1860. It can be followed today with great difficulty and only by foot or pack transportation. Once in disuse Panama trails are quickly closed by jungle growth. Some years ago a small party from the 11th Engineers got lost in the mountains near the Atlantic side while trying to follow the trail to Porto Bello, were arrested by the native authorities who thought the white soldiers had come to capture their country, and were extricated only after much diplomatic and tribal negotiation.

Limon Bay had little to offer in the way of historical interest prior to the construction of the Panama Railroad. The railroad's caribbean terminus, now Colon, was named Aspinwall and was long noted as one of the most unsanitary and unhealthy spots on earth. One of the first jobs of the Americans was to clean up the native cities and habitations. This they did in effective fashion. It had to be done not only for humanity's

sake but for the practical reason that enough workers could not be kept alive otherwise to accomplish the job of canal construction which after all was the real object. Had the French realized this and taken as effective measures as we did the story of the Panama Canal would read far differently.

Of all the things that interest the tourist, the transit through the Gatun Locks thrills him most. As the ship slowly approached the lower lock, swiftly and with precision lines were thrown to the ship from the approach walls and later from the lock walls opposite. These were used to haul the steel cables aboard. The cables were made fast and heavy electric towing locomotives quickly took up the slack and with three on a side towed the ship into the lock. The rear locomotives kept back far enough to hold the stern of the ship well centered, and stopped the forward movement at the proper time. The giant gates closed and the filling valves opened, all operated from a central control house, and in a few minutes nearly 40,000 tons of ship had been lifted one-third the distance to the level of Gatun Lake, 85 feet above the Caribbean Sea. In about an hour the climb up the flight of three locks had been accomplished and the ship steamed due south through the first stretch of the Gatun Lake channel, passing Gatun Dam, whose alignment is oblique to the channel, at rapidly increasing distances with the spillway gates about 800 yards off to the right.

The total amount of fill placed in Gatun Dam was 23,000,000 cubic yards. It is nearly one-half mile through at the base, 100 feet wide at the top and about one and one-half miles long including the spillway section. The spillway, founded on rock, is a concrete structure with fourteen regulating gates. It is 808 feet long built in the form of an arc. Gatun Lake was formed when the waters of the Chagres watershed were backed up behind the dam. The lake has an area of 163 square miles, the largest artificially made lake in the world except the one formed by Boulder Dam. It drains a watershed of 1,320 square miles and contains 183,126,000,000 cubic feet of water at normal level. The object was to form and maintain a summit lake at the level that would best balance the cost of excavation through the divide with the cost of construction and opera-

tion of the locks, dam and spillways, due consideration being given also to the length of time required for construction.

Directions of the compass are oftentimes confusing to Canal Zone visitors, because the Atlantic terminus is not the Eastern terminus but the Western. Furthermore, in Colon the sun sets in the Atlantic Ocean, while in the city of Panama it rises in the Pacific Ocean. This all comes about from natural causes, because the axis of the isthmus here runs about northeast by southwest, and the canal runs in general at right angles thereto. The Bay of Panama is southeast of Limon Bay and the Pacific entrance is 27 miles east of the Atlantic entrance.

After entering Gatun Lake the course was south for four miles, with islands showing up at intervals to the east, but with two miles and more of open water to the west. Then the course turned southeast, strange to say, for nearly five miles, northeast for a mile, then southeast for three miles past Barro Colorado Island, which is the wild life preserve maintained by the Institute for Research in Tropical America. Barro Colorado is by far the largest island in Gatun Lake and hills rise highest there. When the waters began to rise in Gatun Lake the beasts and the reptiles (and the birds as well) flocked there for refuge. They chose well because they are there protected by the Government against the assaults of man and are subject only to the studious investigations of the scientists and the curious gaze of the tourists.

After proceeding almost south from Colorado Island for three miles, the course turns east for eight miles to where the Chagres River joins the Lake at Gamboa. The Canal Zone prison colony is at Gamboa as well as the pumping plant that furnishes water to the Pacific side. The shops and other facilities pertaining to the dredging division now at Paraiso are soon to be moved to a new location where necessary construction is now under way at Gamboa on the north bank of the Chagres.

About ten miles up the Chagres from Gamboa the Canal Government has constructed Madden Dam and power stations for the purpose of conserving the water needed for lockage of ships through the canal, controlling the floods of the river and

to furnish electric power. Some 20,000,000 cubic feet of active storage is provided, making available about 15,400 KW of energy. Two 10,000 K V A generators are now installed, driven by 11,200 h. p. turbines at 125 feet effective head. Provision is made for a third unit. The dam is about 1,000 feet long, of the concrete gravity type, and is 220 feet high from lowest foundation to the roadway across the top. In addition to the dam proper, some 20 or so saddle dams were constructed, several of them of sizeable dimensions. In order to keep leakage from the reservoir to a minimum, extensive grouting operations were necessary to seal numerous subterranean channels through the rock of some of the containing ridges. A fine concrete highway about 20 miles long was constructed from a connection with the Gamboa road to the dam, initially for construction purposes. The highway, for a considerable distance, traverses a magnificent tropical forest which has been set aside as a reserve by the Canal Government. The trip by auto from Panama to the Madden Dam is one that no tourist should miss.

At Gamboa the ship left the lake and entered Gailliard cut which is 8 miles long running southeasterly to Pedro Miguel. The lowest point in the saddle between Gold Hill and Contractors Hill was 305 feet above sea level. The maximum cut therefore was about 260 feet deep. The canal is 300 feet wide on the bottom and 40 feet deep. The top width of the cut at the deepest place was about 3,000 feet. 146,000,000 cubic yards were excavated from the cut alone before the canal was opened to traffic. Many millions of yards have since been removed taking care of slides and in better maintenance.

As the ship passed through the cut we looked up at the gaunt rocky slopes of Gold Hill with its summit towering 600 feet above us, and many of those on board remembered those worrisome days of twenty years ago when it seemed as though it just would never stop sliding into the canal prism. Even as we passed, one of the big hydraulic dredges was busy pumping away from the base of the hill the material that was being brought down from the upper slopes by hydraulic jets with a view to relieving for all time the pressures that were forcing material to slide out from the bottom of the hill into the canal.

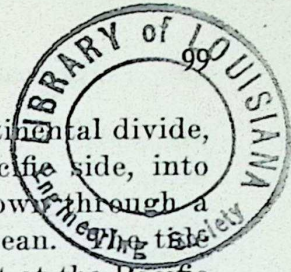
The Engineer in Panama

At Pedro Miguel, 3 miles southeast of the continental divide, the canal makes the first drop toward the Pacific side, into Miraflores Lake, and two miles beyond steps down through a flight of two locks to the level of the Pacific Ocean. The tele on the Atlantic side has a very narrow range, but at the Pacific entrance its maximum range is over 20 feet, so the lower gates at Miraflores are the highest of all.

From the level of Miraflores Lake as we entered the upper lock chamber we saw, off to the east, what seemed to be a very large community with many fine buildings. It was Fort Clayton, where the 33rd U. S. Infantry and a battalion of the 2nd Field Artillery was stationed. About a mile below the locks we passed some fine looking quarters not far from the canal. That was where the Department Ordnance officer lived. Beyond it in the distance was a motley collection of wooden barracks, storehouses, and quarters, composing the post of Corozal. About 5 miles from Miraflores locks the ship warped in to Balboa docks and the voyage was ended.

There is little wonder that so many thousands of tourists make the trip through the Panama Canal. The magnitude of the engineering features involved in the construction and operation are apparent on every side. The general appearance of the structures, of the waterway itself and of the country traversed, gives one a sense of beauty and vastness. In Gaillard Cut the greatest ships look like toy boats in a giant chasm. In the locks, even the largest ones are raised and lowered as easily as though they were made of cork instead of weighing tens of thousands of tons.

Balboa is the American community on the Pacific side where most of the civil government officials and the employees operating the Pacific terminal facilities live and work. The mechanical division maintains up to date marine and general repair shops, where large vessels can be dry docked and repaired, supply sections where every replacement item necessary for the operations can be had on proper requisition, and other facilities required by shipping. The port contains adequate dock and warehouse space, and cargo handling accessories, a coaling station, a tank farm supplying bunker oil to shipside and is



otherwise fully equipped to serve the enormous vessel traffic using the canal.

The Panama Railroad operates the commissaries, including a large cold storage plant. The administration building for the Canal Zone Government is beautifully situated on the western slopes of Ancon Hill. Over near the City of Panama is Gorgas Hospital, which takes care of all the sick on the Pacific side, including the cases sent over from the hospital at Colon, not only those in the employment of the canal but also the serious cases amongst the Army and Navy personnel.

La Boca, at the head of the Pacific entrance channel, houses most of the colored employees. Close to the City of Panama boundary line, the Tivoli Hotel, run by the Panama Railroad, furnishes the best of accommodations to high class trade. The Governor and his staff and other officials live on Balboa Heights. Quarry Heights, also on Ancon Hill, is the military reservation where the Panama Canal Department Headquarters of the Army is located. Two miles south of Balboa is the beautiful post of Fort Amador, where the 4th Coast Artillery is stationed. One mile north of Balboa is Albrook Field, the Army air field, and a short distance north of Albrook begins the Post of Corozal, housing the 11th Engineers, the 1st Chemical Company, and the Panama Pacific General Depot.

Between Ancon Hill and the bay lies the City of Panama, with a population of 70,000. It is the capital of the Republic of Panama, and boasts of a famous old cathedral, several fine government and municipal buildings, and plenty of interesting old places. Five miles northeast of Panama by air line are the interesting ruins of old Panama which was destroyed by the buccaneer, Sir Henry Morgan, in 1671. Old Panama was the port of transshipment of the enormous wealth of gold, silver, and emeralds that poured into Spain from the Inca temples of Peru. After old Panama was destroyed, the city was rebuilt on its present site. In the 18th century the flood of Peruvian treasure began to subside and the importance of Panama grew less, but with the construction of the canal came a new pros-

perity, and it is now a busy, interesting, thriving, Spanish-type city.

In Panama on the Pacific side May rains follow April showers, June is pretty wet, July wetter, and the next four months wettest. December is the transition month and New Year ushers in the dry season, when scarcely a drop of rain can be expected for three months. During the rainy season it is next to impossible to conduct extended military operations off the paved roads. It is true that pack transportation can flounder over or rather through the muddy trails for most of the year in a small way but continuous use of dirt and clay roads and trails make them literally impassable for long columns and military operations on a large scale are virtually impossible. However, in garrison, training can go on throughout the year because the rains are not steady but intermittent, and it was our experience at Corozal that the downpour could be expected to start daily between 12 and 1 p. m.

Without detracting in the least from the charm and interest that attaches to the Panamanian cities of Colon and Panama, next in interest to the Panama Canal and the associations of the military and civil life of the Canal Zone, come the people and lands of the interior of the Republic. Panama and Colon hardly end before the "Interior" begins.

About twelve miles from Balboa the island of Taboga juts up out of the sea. Its shore is about seven miles around and its summit 1,250 feet above the water. Nearby is Taboguilla, not so large or so high. El Morro is a tiny island with sides sloping sharply up to about 200 feet at the top, connecting at lower tides with Taboga by a sand spit forming a wonderful bathing beach. Taboga Bay seen from the sea at sunset time is beautiful. Nestled along the crescent shore is the little village of Taboga, purely a native town, but better kept than most of them. The main street is paved and many of the houses are of wood, concrete, or masonry. A small stone church stands in the center of the town. The sweetest pineapples in the world are grown on the Island of Taboga, but they never get farther than the markets of Panama and the Canal Zone commissaries. The little pineapple plantations dot the slopes, clinging on in

places that seem too steep for anything to grow. In the ravines that scar the sides of the mountain iguanas thrive. These are huge green lizards weighing from a pound up to many pounds each, a great delicacy to native palates. When properly cooked they taste like the tenderest parts of chicken, so I am informed.

All troops in the department were busy training for the annual maneuvers to be directed by the commanding general. These were the most instructive in which I had ever participated and the most strenuous. The entire command operated as they would be expected to do in war in so far as everything except the use of ball ammunition was concerned. Baggage was reduced to the minimum. Officers slept under tent flies and the soldiers in pup tents. When the war was on, the fighting, marching, and camping had to be concealed from the air. It was almost beyond belief to see long columns go into camp after a night march. Daylight would come and the entire establishment would be concealed in the dense tropical growth well screened from the air. Six or seven thousand troops with hundreds of trucks and wagons would disappear from sight within an hour or two of arrival in the camping areas, assuming of course that the general's staff had selected suitable areas. Generally this camouflage of camps and operations involved an immense amount of human labor cutting the brush and clearing the ground of enough of the roots and debris to form a place for the tents and cutting more brush for use in covering over such transportation and facilities as the jungle cover did not conceal.

The soldier takes a chance when he dives into a Panama jungle and starts to hew out a hole for his pup tent. I was standing near a squad that was just starting to work on one occasion. A recruit, recently arrived from New York City, was on his hands and knees hacking away at a tangle of brush with his machete and was already half way in. Suddenly with a yell he crawled backwards with unbelievable rapidity with a twelve-foot boa constrictor following him out. The boa was easily decapitated much to some of the old timers' disgust, for they are quite gentle if properly handled.

During past years there has been expressed by some the thought that road and trail work on the Isthmus should be kept to a minimum, that the jungle was the best defense. That theory has been repeatedly exploded. Under cover of the jungle enemy troops can approach and operate in numbers sufficiently large to badly cripple the defense. There are in fact many square miles of jungle area that are easily traversed on foot or horseback. Some of the forest areas are relatively free of underbrush and except in the valley bottoms, the swamps and the lowlands around the lakes and bordering some of the streams, most of the jungle can be marched through by foot troops at the rate of about 1 mile per hour, with the necessary cutting parties in the lead clearing the way. It does not take long for the supporting troops in rear to open up wide trails over which supplies, artillery and ammunition can be packed in. Naturally, the progress of large commands will be slow through the jungle, and the labor involved much greater than operations in the open. On the other hand, better concealment of operations is obtained and greater freedom from attack from the air.

Much time is spent by the troops training for jungle warfare, but there are thousands of square miles of rolling hills and plains country that is either entirely bare of forest growth or sparsely grown to brush and trees, over which troops and transportation can move almost at will in the dry season, and with little difficulty during the bordering months of the rainy season. During September, October, and November, operation of motor transportation off the metaled roads is out of the question on a large scale.

The engineers in Panama must be trained and equipped to construct and maintain throughout all seasons of the year all the roads, trails, and bridges needed not only for rapid intercommunication between the planned defensive installations pertaining to the defense of the canal, but also for rapid movement of the mobile defense forces against the enemy wherever he may land or operate.

The closer in defense of the Panama Canal should be such as to prevent the locks, shipping terminals, and other facili-

ties from being damaged by bombs dropped from enemy aircraft, by raids of enemy ground troops, by naval attack, or by sabotage such as the sinking of ships in the canal or locks by someone on board. Enemy air plants can be kept out of range only by an adequate air force, and by anti-aircraft artillery and machine guns suitably located supported by searchlight batteries to spot and light up approaching planes long before they come in range of their targets.

One of the principal missions of the engineer troops in Panama has always been surveying the canal zone and the Panamanian territory adjacent thereto. Military operations can not be well planned and executed without the use of topographical maps showing all the features of the land and water areas. The hill and mountain tops in thousands of square miles of Isthmian territory show the triangulation stations placed there by the engineer soldiers. Much of the work was in dense jungle country. The regiment became well acquainted with all the wild life of the jungles and especially with the sleek, snarling black panther, and became known as the Black Panther Regiment.

The only survey work underway when I arrived in Panama was the selection and preparation of control points for use in the aerial photography of the areas to be surveyed. This involved the placing of a great many panel points and the necessary triangulation and other control work to complete the frame work to which was to be adjusted some 1,400 square miles of photographic data.

The Panama national highway extends easterly toward Chepo some 40 miles and not far beyond it ends abruptly for motor vehicles when it hits the Rio Chepo. There are no roads beyond and the few trails are passable only on foot or horseback, generally the small native pack and saddle ponies being preferred. Much of the country is fairly open between Panama and Chepo, very low and marshy close to the coast, with rolling open sabanas extended northward to where the mountains begin, about 10 or 15 miles inland, and continue higher toward the continental divide near the Atlantic side, where they rise to several thousand feet, in rugged, wild confusion.

It is in the interior west of the canal where most of the development lies. Crossing the canal at La Boca on a ferry operated on a frequent schedule by the Canal Zone government, one can motor for about 200 miles southwesterly toward Costa Rica on a paved and gravel surfaced highway. During the dry season one can motor all the way to the city of David 100 miles beyond over dirt roads impassable most of the rainy season. Work is in progress putting this section in shape for year round travel. A few miles beyond the Rio Santa Maria 1125 miles from Panama an excellent metalled highway extends southeast from this road along the coast some 50 miles, to the little port of Mensabi on the Gulf of Panama. A few all year branch roads run southwest from this road for short distances to little towns tucked away in the foothills of the mountains bordering the Gulf of Montijo. Northerly from the national highway the roads are few and the good trails scarce, because the mountainous country begins so close. The International Highway has been surveyed from Mexico City to David and construction work on portions of it are under way.

It was the area between Parita Bay and Montijo Bay that the 11th Engineers mapped between the middle of April and the middle of June, 1935. For the first time in the history of the Corps of Engineers an entire regiment was placed in the field one hundred and forty miles from its base of supplies and given three months in which to survey 1,343 square miles. The military survey of Panama began in 1916 and last year's work brought the total up to 4,855 square miles extending from Chepo, about 40 miles east of the canal, to Santiago, 160 miles west of the canal.

The regiment and its supplies were moved by motor convoy over a four-day period to a regimental camp at Divisa, 140 miles from Corozal.

In addition to the triangulation stations, a great number of panel points for added control of aerial photographs had been established during the preceding year by "E" Company. Each of these had been marked with a whitewash cross sixty feet across and showed up well on the photographs, aiding materially in the adjustment. The work sheets furnished to the

plane table men were one minute quadrangles on a 1:20000 scale, on which the stream lines, woods, roads, trails, villages and general ground forms had been printed from the aerial photographic data adjusted to the control system.

Those parties that were working in areas accessible by road or ox cart trails were quartered at the company base camps and transported to and from work in company trucks. Two 1½-ton Ford trucks and one ½-ton Dodge truck were furnished each company by the regiment. All the trucks did yeomen service and the Fords were especially valuable in traversing inconceivably bad roads.

Much apprehension was felt by the Department Medical authorities as to the possible health conditions in a whole regiment remaining in the interior for three months during the rainy season. As a consequence every precaution possible was taken. During the entire time in the survey area all water was chlorinated; every man was on a daily ration of either quinine (15 grains) or the new atabrine (.1 grams) as a malaria prophylaxis; no local fresh milk could be used for fear of contracting "Fiebre de Mayo", a form of dysentery prevalent in May after the first heavy rains; and finally, there was a constant fight against the various serious skin infections so common in the tropics.

The results of this "protection campaign" were extremely gratifying. During the early part of the work the number of men sick ran around three per cent. Toward the last, in the very wet weather, it crept up to four and one-half per cent.

The value of the data taken from the aerial photographs cannot be over estimated. The general shape and location of the hills and mountains, the locations of roads, trails, streams, huts, towns, and shore lines, in general were very accurate and saved probably forty per cent in the total time necessary for the job.

Finally, the life in the interior, the association with the natives, their customs, and traits of character, the products and industries of the country, were of vast interest and a revelation to all who had not been out during previous survey seasons.

The administration of the affairs of the Panama Canal enterprise involves three main elements—(a) The operation and maintenance of the Canal itself, which primarily involves the maintenance of the waterway, the operation of the locks, and the control of traffic through the Canal; (b) the operation of the auxiliary enterprises necessary to provide adequately for the needs of shipping and of the Canal operating forces, such as coal and fuel-oil plants, storehouses for foodstuffs, ship chandlery, and other essential supplies, marine and railway repair shops, terminal facilities for the trans-shipment of cargo and passengers, a railroad line across the Isthmus and a steamship line between New York and Panama, quarters for the operating force, and other adjuncts essential to the economical and efficient operation of the Canal; and (c) the government of the Canal Zone, populated by American civilians, native or tropical workers and their families, and by the United States Army and Navy defense forces, in which are embraced education, sanitation, hospital service, police and fire protection, customs service, quarantine and immigration services, postal service, etc.

The immediate supervision of the administration of these various activities rests with the heads of the nine major departments and divisions reporting to the Governor, in whom is centered responsibility and control of the entire organization either in his capacity as Governor of the Panama Canal or as President of the Panama Railroad Company, an adjunct of the Canal enterprise, organized as a Government-owned corporation.

The Governor is an officer of the Corps of Engineers, selected for demonstrated administrative and executive ability after long experience in handling large army engineer organizations. The department of operation and maintenance is headed by an army engineer selected with a view to becoming the successor of the Governor. He has an assistant who is also an army engineer and who may or may not later on in life be the Governor. The head of the mechanical division is a naval officer, as also are the marine superintendent and the two port captains and one or two others. An army medical officer of high

rank heads the health department which has jurisdiction over public health and sanitation within the Canal Zone and the cities of Panama and Colon, and operation of the government hospitals. Army medical officers are in charge of the hospitals and their staffs, including quite a number of medical officers along with a fine corps of civilian doctors. The supply, accounting and executive departments and the rest of the divisions and lower units are headed by highly competent civilian employees. There are nowhere any more competent and loyal workers either in or out of the government service. It requires some 3,200 gold employees and about 9,700 silver employees to operate and maintain the canal, the Panama railroad and civil government. Their salaries are authorized to exceed 25% those of employees in the United States on similar work. The civilian population, exclusive of officers, warrant officers, and enlisted men of the military and naval services, is over 30,000.

The capital investment at the beginning of the fiscal year 1936 stood at \$547,000,000. The net revenues during the fiscal year were about \$15,452,000, a little short of 3% of the capital investment. During each of the past three years about 5,300 vessels transited the canal, measuring 28,000,000 net tonnage, carrying 25,500,000 short tons of cargo and earning \$23,600,000 in tolls.

The Panama Canal is as efficiently operated and the Canal Zone government as efficiently administered as any large organization in the world, and better than most. The reason for this is, and has been for the past thirty years, that its activities have been supervised by officers of the Corps of Engineers, United States Army, who have been accustomed to handling similar work in Engineer districts and divisions, covering large areas, and including the construction and operation of other great waterways with their locks and dams, and river and harbor channels. This work gives the army engineer a broad experience in the operation, maintenance, and repair of large fleets of inland and ocean going dredges and other floating plant, and in the effective control of large forces of workers.

GENERAL SHIP REPAIRS

By ALBERT J. FRANSEN *

Read Before the Society, December 14, 1936.

"General Ship Repairs" is a rather broad and far-reaching title. Volumes could be written on the subject without exhausting the material. I will try to bring out the things about which people have questioned me most often.

I am often asked, "What are the qualifications for this particular type of engineering work?"

It would be difficult to give a direct answer to that question, because one must be ready to bring into play most every engineering subject, coupled with good sound judgment.

It is very seldom that a job is duplicated and it is rarer still that the job is carried out as originally laid out.

The main subject is probably dimensioning, since a ship is built to close dimensions and of steel. These facts do not allow very much for the correction of mistakes. Furthermore, by being able to take dimensions correctly, putting them down on paper, and working them out, the work can largely be done in the shop, resulting in a job done better, quicker and cheaper than if done out in the field.

Naturally the first thing to look for is the main reference line. Sometimes it takes a while to determine what would make the best reference line. But it is worth the time, because a reference line well chosen makes dimensions easier and surer.

The accuracy of the dimensions varies with the type of work. In replacing castings it is close enough to get within $1/16$ to $1/32$ of an inch. Sometimes thousandths of an inch must be considered. Rods and shafts are generally made of standard cold rolled steel; yet it is best to check them with micrometers. In plate work, or boiler work, as it is termed, measurements do not have to be so close. Here as a rule $1/4$ to $1/8$ of an inch is sufficiently accurate. Of course there is no set rule and one's judgment must be his guide.

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The method of taking dimensions varies. It depends upon the object being measured and its accessibility. Sometimes to obtain one dimension it is necessary to take as many as three or four, and then add or subtract them. With a set of calipers, dividers, a combination square and a rule, most of the work can be done. The level is used only in very special cases.

The work is most interesting when angles have to be determined as between faces of flanges, in the large Y's of exhaust pipes. Here the use of protractors is impractical, as a slight error might result in a misfit. Instead of obtaining the angle in terms of degrees, one gets it by measuring the vertical distance from the face of one flange to the center of the other, at the same time measuring the distance from the center of the first flange to the point of intersection of the two vertical lines. Then checking by getting the vertical distance from the face of the second flange to the center of the first, again measuring the distance from the center of the second flange to the point of intersection of the two vertical lines. As a second check the distance from center of flange to center of flange is taken. As the third check a template is made of the angle between branches, marking the corners of the flanges.

Again, the question is asked if one has to do much drawing.

By making an accurate drawing with the dimensions taken, one has the most economical way of checking and making corrections. It is true that most dimensioning can be checked mathematically. But when several pieces fit closely together and moving parts are involved, a drawing is the only logical check.

A drawing will reveal the accuracy of the dimensions taken and will often lead to the discovery of unsuspected errors. A drawing which does not look right as a rule is not right. So, if the drawing does not look like the thing we want it to be, nine chances out of ten there is a mistake somewhere. It is then the responsibility of the individual to decide on the best thing to do. As a rule one can have the castings made a little heavier in the parts which are doubtful as they can always be machined down.

In replacing pieces of machinery, alterations are often called for. The dimensions are sometimes given at random without thoughtful consideration of the final result. By making a drawing including the alterations, corrections may be made to give a more practical product with better appearance.

It may sometimes seem that making a drawing is an unnecessary expense and loss of time. But it is the sensible way of going about doing big jobs. A mistake in one dimension may mislead the location of several other points which would render the casting useless. So, even though it may not pay to make a drawing for every job, it does pay in the long run. Besides serving as a check it also gives the machinists better assurance that they are not working blindly and can therefore work quicker. Without a drawing, points would have to be transferred, one at a time, from the old casting to the new.

The question of laying out work is the most interesting one as it is there that one has to use everything he knows.

In laying out machine work, extreme accuracy must be used.

The work is set on a bed plate, which is a heavy steel plate with a true and horizontal plane surface.

The procedure followed in laying out the work is pretty much the same as that used in making the drawing, and the main reference line or plane is usually the same.

The bed plate is first smeared with chalk. The work is also smeared with chalk, about the locus of the lines and points to be determined. The center of holes is located by jamming a piece of wood in the hole and smearing it with chalk. With a pair of hermaphrodite calipers, the center is scribed on the wood.

The necessary lines are scribed on the bed plate. Distances are then measured on them and the points are transferred vertically upward to the work by means of straight edges and squares.

A template of wood may sometimes be used as a vertical plane to bring points up to the work.

Dimensions are checked to see that there is no creepage.

Lines are described by light center punch marks closely spaced.

Bolt centers are centerpunched. A ring, the size of the hole to be drilled is scribed with dividers and four points on it are punched. In laying off large holes there are naturally more points marked.

Work which is to be machined on the shaper must have the center punch marks closer together because some of them may be lost by a piece of the material chipping off. This applies more to cast iron than it does to steel.

In laying out boiler work, negligence to allow for the thickness of steel plate and of angle iron, the projection of bolts, nuts and rivets, may cause very embarrassing corrections and often result in the scrapping of the material. One cannot be too careful in dealing with boiler plates and angle iron.

The manner in which plates and angle iron are fastened requires special attention. In a given structure, plates which have been cut for butt welding will be too short for lap welding. And, plates intended for lap welding will have to be cut if they are to be butt welded.

Drawings usually give the overall or the inside dimensions, or the volume of the structure. It is necessary then to decide how the members are going to be joined. When this is determined the dimensions are given each member. Some may have to be shorter, or longer, than the dimensions shown in the blue print, according to the type of joint being made.

Evidently it is cheaper to punch rivet holes in the shop. So, if the plates are to be riveted to angle iron, the holes must be punched according to whether they are to fit inside of the angle or on the outside of it. Rivet holes will not line up when the plates are set inside the angle if they have been punched to fit on the outside, and vice versa. This is particularly true in dealing with heavy materials where the ratio of thickness to length of angle leg is high.

Fortunately with the modern development of the oxy-acetylene torch and electric welding, these difficulties have been greatly minimized with respect to some types of jobs. We

can now go out in the field with the raw materials and cut them to any shape we desire. Plates can be welded at any angle without the necessity of special angles made by the blacksmith.

In laying out work on a ship, nothing should be overlooked. All obstacles must be given due consideration and if necessary, removed, with the permission of the owners.

The method in which material will be lowered or raised must be determined. Sometimes it may be necessary to burn out a skylight or even part of the deck. In working in the engine room, floor plates, grilles, and pipes often must be removed. It must be predetermined whether or not the equipment will pass by the different openings.

In handling very large work it is even sometimes advisable to make a wooden template with the greatest dimensions on it and try it to see if all the space necessary has been cleared before bringing on the heavy work. Dimensions are taken in every direction for every position in which the work may be turned while getting it in place.

The measurements for the location of the equipment are always taken from permanent points. In this way there is no danger of losing reference points by the removal of some part bearing a reference point or surface.

Another question often asked is how bids are worked up.

Bids can be worked up by itemizing the work, by weight and by experience.

The specifications are first carefully read and studied so that the contents are well understood.

From past experience one can determine more or less about how much can be expected for the type of work. If the job is very big it can be broken up in parts and each part given a price. The sum of these prices is then submitted in the bid.

The safest and the most scientific method is by dividing up the work into parts and itemizing each part. For instance one may divide the work into the following parts: Clearing the space, dismantling, manufacturing, and assembling.

Each part is itemized separately. The number of men and the time required to do each step in each part is calculated. This involves the subdividing of the work between machinists, boiler makers, pipe fitters, tin smiths, welders, and carpenters. Every step is run through in one's mind and marked down with its price. The amount and cost of material to be furnished is also included.

The third method, by weight, is used when dealing with boiler maker's work. In this method, the weight of the material to be handled or furnished is calculated. A unit price per pound is then chosen according to the nature of the work. The price is then obtained by multiplying the unit price by the total weight.

On any job two of the three methods outlined can be used. The second method is more reliable than the other two, but they make a good check.

In making a quick estimate the first and third methods may serve the purpose very satisfactorily.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board of Direction, March 8, 1937.

President Williamson called the meeting to order at 7 p. m. with the following members present: Cappel, Godat, Lassalle, Newman, Peirce, Hill.

The minutes of the previous meeting were read and approved.

President Williamson asked Dean Lassalle to secure information concerning vacancies on the Board of Engineering Examiners from the office of the Secretary of State.

It was asked that the President of the Local Section of the American Society of Civil Engineers submit a list of names in connection with the vacancies on the Board of Examiners.

A report from the Chairman of the General Committee on Arrangements for the 1937 Annual Meeting, Mr. F. N. Billingsley, was read. It was voted that a resolution of thanks be extended to the Committees and Sub-Committees which assisted in the Annual Meeting.

Mr. Cappel read two letters in connection with the obtaining of new members for the Society. The Board authorized the mimeographing of these letters and sending them to members of the Membership Committee, Division "A".

The following names were added to the Legislative Committee: James M. Robert, James M. Robert, Jr., Fred H. Fenn.

It was voted to hold the next meeting of the Board on Friday, March 19.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Society, March 8, 1937.

President Williamson called the meeting to order with 73 members and guests present.

The minutes of the last meeting were read and approved.

The report of the Employment Committee was read and accepted.

President Williamson called attention to the amplifying system and asked that it be used in asking and answering questions.

The address of the evening was given by Mr. Gerald C. Kerr, Acoustical Engineer of the Taylor Seidenbach Co., Inc. Its title was "Modern Research in Sound."

An interesting discussion followed the paper.

A rising vote of thanks was extended to Mr. Kerr, and the meeting adjourned to the collation.

A. M. HILL, Secretary-Treasurer.

Minutes of the Regular Meeting of the Society, April 12, 1937.

The meeting was called to order in the Hunt Room of the St. Charles Hotel, with Vice-President B. H. Grehan presiding. President Williamson was not able to attend because of illness. Eighty members and guests were present.

The minutes of the last meeting were read and approved.

The report of the Chairman of the Employment Committee was read.

A letter from the President of the National Rivers and Harbors Congress was read.

A list of new members was presented, and those present were asked to rise.

Mr. E. F. Sterne gave a very interesting and graphic account of some of the phases of "Engineering in Canada." A varied discussion followed his talk.

Mr. Walter H. Scales made an announcement concerning a booklet recently published on Termite Control. He asked that an announcement of this free publication be carried in the *Proceedings*.

Mr. Carroll J. Peirce, Jr., made some announcements about the Baton Rouge trip.

Dean Lassalle outlined some of the proposed program, and extended a cordial invitation to the members to attend.

After tendering a rising vote of thanks to the speaker, the meeting adjourned to the usual collation.

A. M. HILL, Secretary-Treasurer.

ACTIVITIES OF LOCAL SECTIONS

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STUDENT CHAPTERS
Louisiana State Univ.
Baton Rouge
Tulane University
New Orleans
Special Meetings at
call of President

A luncheon was tendered Dr. William Bowie, recently retired as head of the U. S. Coast & Geodetic Survey, by the Section in New Orleans on April 27th.

The spring meeting of the Section was held in Baton Rouge at Louisiana State University on the evening of April 28th, at which time a joint meeting of the Tulane and L. S. U. student chapters was held, and an address delivered by Mr. J. Lester White, M. A. S. C. E., Chairman of the Louisiana State Planning Commission, on: "The Reasons for State Planning and Its Purposes."

The Section was also honored on this occasion by having as its guest Past President Daniel Mead of the Parent Society, who stopped over on his return home from the San Antonio meeting, and former Director A. T. Dusenbery. Dr. Mead made a short talk drawing upon his personal experiences to stress rugged individualism and sound theory as a basis for Engineering Education.

This meeting was so successful that it was voted to make it an annual event for the fall meeting of the Section.

The Section also announces that the two recipients for Junior Membership Awards, Am. Soc. C. E., given yearly by the Louisiana Section, are:

Mr. Octave Leon Fontenot of Hammond, Louisiana, Graduate of L. S. U., and Mr. Harold Francis Favret, 4837 St. Claude Avenue, New Orleans, graduate of Tulane University.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

APRIL, 1937

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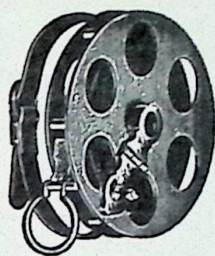
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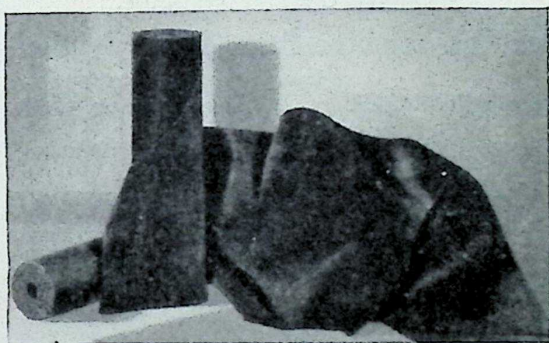
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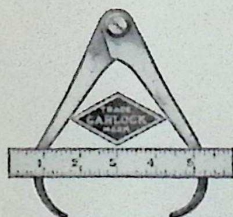
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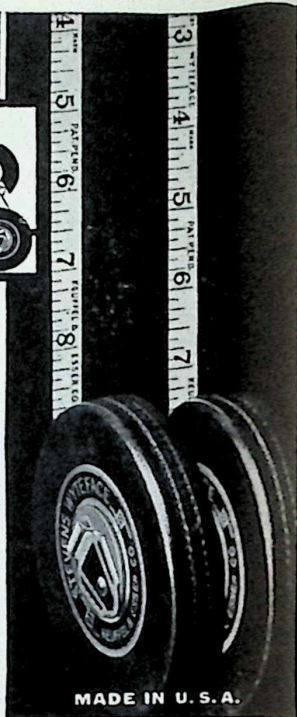
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JAMES M. ROBERT, Editor.

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. XXIII.

JUNE, 1937

No. 3

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EDITORIAL NOTES AND COMMENT

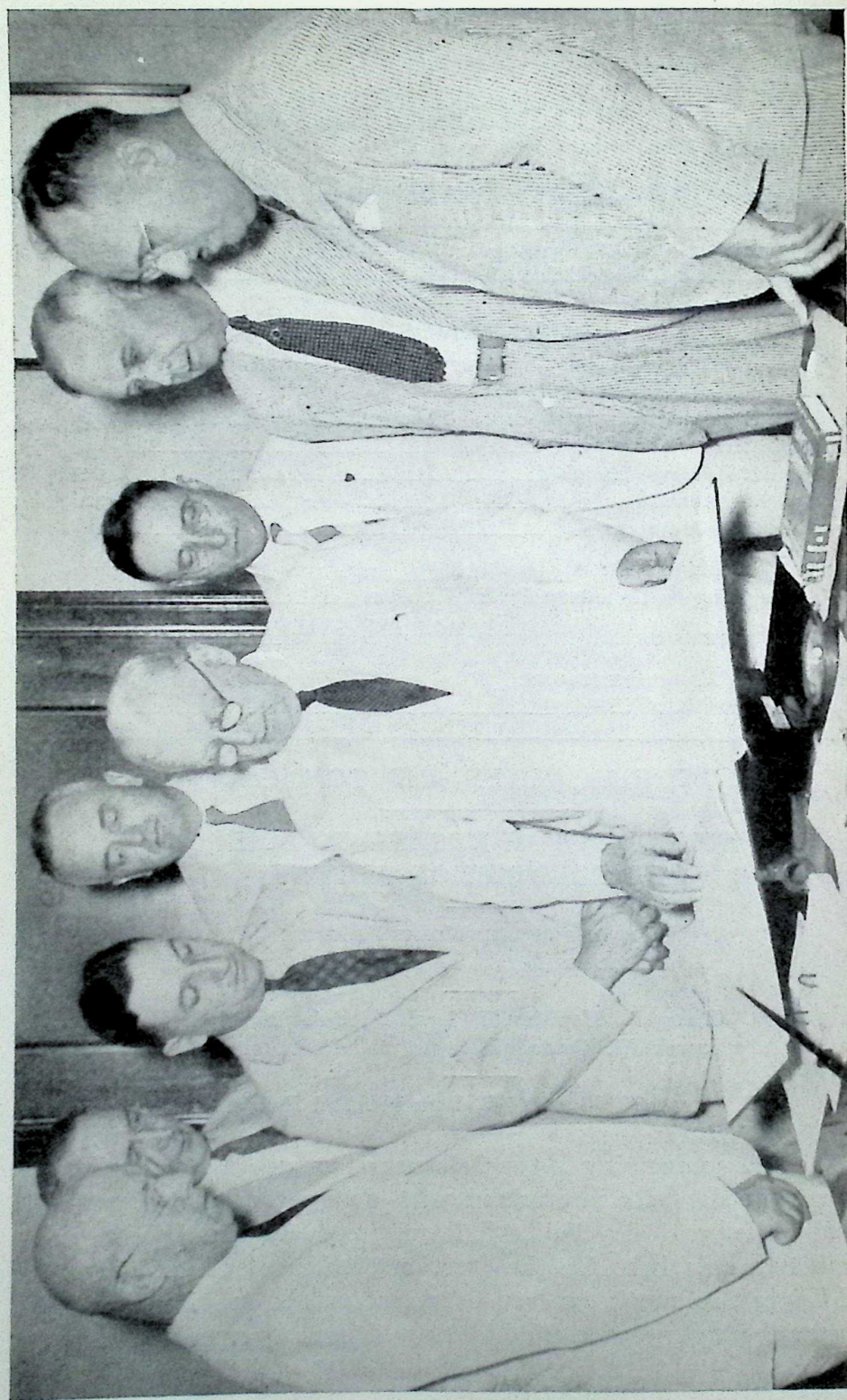
SOME DATA IN REGARD TO SOIL AND FOUNDATION SURVEY

A PROJECT OF THE WORKS PROGRESS
ADMINISTRATION OF LOUISIANA

Harry L. Hopkins, Federal Administrator
James H. Crutcher, State Administrator

277 Pages, 12½" x 15½", Bound in Red Fabrikoid.

The soil underlying New Orleans is composed of alluvial and marine deposits intermixed with decayed vegetable matter of earlier periods. This soil formation is an unsatisfactory foundation as a base for the erection of homes and buildings and has caused much concern to engineers and architects and expense to owners since the building of the city was begun.



OFFICIAL PRESENTATION OF SOIL AND FOUNDATION SURVEY REPORT—Reading from left to right: Professor Donald Derickson, Mr. H. M. Gallagher, Colonel Edward S. Breen, Mr. James H. Crutcher, Mr. John Klover, Mr. John H. O'Connell, Mr. P. P. Hamilton, Mr. A. J. Neff.

Because of the variable conditions, years of experience and the use of sound judgment has been required by our engineers and architects in the determination of satisfactory solutions of the problems which have arisen.

Early in 1935 Donald Derickson, Professor of Civil Engineering in Tulane University, brought to the attention of the then recently installed President of the Louisiana Engineering Society, Colonel Edward S. Bres, the need of information and the beneficial results which might be expected from the collection, study and compilation of the available factual data pertaining to the soil and foundation in New Orleans and vicinity.

Professor Derickson stressed the undertaking as a worthwhile project for some of the governmental relief agencies, as it would afford employment of a professional nature to engineers, architects and draftsmen, many of whom, at that time, were approaching dire circumstances combatting the existing depression. Approved by the Federal Emergency Relief Administration and sponsored by them as a Soil and Foundation survey project, work was begun in April, 1935, and completed with the publication of the report in June, 1937. It is worthy of note that the book which embraces the results of this research, the only book of its kind, bears, in its somewhat lengthy title, the words "*As Requested by the Louisiana Engineering Society.*"

The publication is a fine example of offset printing and the book maker's art. It contains much of interest to the layman. There are numerous reproductions of old maps and other items of general interest. Four chapters are devoted to Historical and Geological Considerations; Test Borings and Stratagraphs; Pile Foundations; and Spread Footings. These chapters give much factual data of value which heretofore have not been available.

Reflected in the work is the civic spirit of the Engineers and Architects in and nearby New Orleans, who together with contractors and others, have made the project possible. These persons have made available their funds of private information—of great value to them and prized as business assets in their pro-

fession and work. Many agencies also contributed to the success of the project. A few of these should be mentioned.

Tulane University, for more than two years, provided heat, light and quarters. The sympathetic attitude of Doctor Douglas Anderson of the College of Engineering and his successor, Dean James M. Robert, did much to facilitate the enterprise. The State Board of Engineers, with John Klorer as Chief Engineer, acted as sponsor and assisted in every possible way. Mr. H. M. Gallagher, as State Engineer for the Emergency Relief Administration, headed the project in its inception in the right direction, and it is largely due to him and his successors, Mr. A. R. Brousseau and Mr. A. J. Negrotto, State Director, Division of Operations, W. P. A., that the survey reached its final conclusion.

In December, 1935, when it appeared that the Federal Government might discontinue the Soil and Foundation Survey, our Society entered a vigorous protest and requested the assistance of the American Engineering Council. The Council promptly conferred with the Works Program Administration in Washington and acting with Mr. J. F. Coleman, who at that time was Council President, prevailed on the W. P. A. to continue the project.

Mr. N. C. Curtis, who in 1935 was President of the Louisiana Chapter, American Institute of Architects, through his endorsement and co-operation opened many doors which otherwise might have remained closed. Among the consultants were Douglas Anderson, F. N. Billingsley, Allen Blakemore, C. N. Bott, C. G. Cappel, E. H. Christie, J. F. Coleman, N. C. Curtis, George G. Earl, James P. Ewin, Lionel Favret, C. A. Favrot, Mortimer Favrot, A. M. Fromherz, H. M. Gallagher, B. H. Grehan, the late O. M. Gwin, M. H. Goldstein, Orloff Henry, Jens B. Jensen, John Klorer, N. E. Lant, J. A. McNiven, Allison Owen, John L. Porter, P. H. Quinlan, Geo. P. Rice, John Riess, Sam Stone, Jr., A. F. Theard, Emile Weil, Leon C. Weiss, Victor Wogan, and others who rendered service of distinct value.

Mr. F. P. Hamilton, who at the time was President of the Louisiana Section of the American Society of Civil Engineers, was appointed Supervising Engineer of the project. His was a difficult task. He was called upon to do something of an original

and unique nature. It is needless to add that he discharged his duties in a remarkably fine and creditable manner; his work speaks for him.

The committee appointed to supervise the work was composed of four members:—

Colonel Edward S. Bres represented the Louisiana Engineering Society. From the beginning Colonel Bres as President of the Society had been instrumental in placing the matter in such light that it became a Governmental Relief Project, and throughout the course of its progress he aided the project in many ways.

Mr. John H. O'Niell represented the Louisiana Section of the American Society of Civil Engineers. His work on the committee was invaluable.

Mr. A. J. Negrotto, State Director of Operations W. P. A., always found time to give careful consideration to those things which affected favorably the welfare of the work.

Professor Donald Derickson represented Tulane University. As Chairman of the committee it fell to him to devote many hours in getting the work started, outlining methods and discharging manifold duties which go with an undertaking of this kind.

Then there were the employees of the W. P. A. who were assigned to this project. So it may well be said that the S. & F. S. is the work of many.

Several hundred copies of the publication have been distributed throughout the United States and requests for copies are now being received from professional persons and agencies of foreign countries.

Judging from the large number of letters which are received daily by the Works Progress Administration from Engineering Colleges, Engineering Societies, Consulting Engineers, Architects, Railroad Contractors and those governmental agencies having to do with engineering, it might be said that the book has met with a most favorable reception, a statement further confirmed by the many articles appearing in the New Orleans newspapers.

Following are a few typical comments taken at random from an extremely large number which have been received:

From a distinguished Architect:

"Among the many aspects of the work worthy of high praise I will single out its value as an historical document showing what the architects and engineers of our generation have been able to accomplish in providing safe foundations for important structures under conditions of unique and often extraordinary difficulty."

From a firm of nationally known Engineers:

"There is no question that the data contained is of value to the engineering and architectural profession for reference on factual data in connection with foundations in the territory covered. My firm and I personally have done a very large amount of engineering work in Louisiana and had such data as you have compiled been available it would have been extremely helpful."

From the Professor of Structural Engineering of an ancient foreign University:

"It is undoubtedly a great contribution to the solution of foundation problems, and it evidences the degree of co-operation that is a peculiarity of the engineering profession."

From the Bridge Engineer of one of the largest railroad systems entering New Orleans:

"The information contained in this publication will be of very great benefit to engineers in connection with construction of new work or maintenance of existing structures in the New Orleans area."

Other Civic Contributions. On more than one occasion in the past the Louisiana Engineering Society has given generously of the varied and many talents which distinguish its membership.

The movement for one-way streets had its inception in our Society through the efforts of Mr. W. T. Hogg, who at numerous times defended his thesis against much opposition, as the meetings of our Society were thrown open to outsiders. Still further and valuable contributions to the traffic problem have been made by Mr. A. J. Naquin.

In the matter of the present building code—although it was too great an undertaking to be confined to the limitations of any one organization—the services of Colonel Marcel Garsaud, Professor Donald Derickson, and Dr. Douglas Anderson were invaluable in connection with this code, which annually affects construction in our city and vicinity, worth many millions of dollars. New Orleans, as a metropolis, is looked to for many things. Its building code, which is used and consulted extensively in municipalities and localities having no code of their own, is no exception.

Again, the Louisiana Engineering Society has come forward in the matter of civic progress, in the matter of the Soil and Foundation Survey, the results of which were recently published and are reviewed in this issue. This report has met with universal favorable reception. The comments relating thereto from authoritative sources, confirm us in our opinion (which coincides with that expressed in an engineering magazine of extensive circulation) that this undertaking has been a decided contribution to the engineering profession and one whose benefits will be better appreciated as time passes.

That this project was undertaken at the request of our Society, that it was inspired by members of our Society, and carried out by them, must be a source of satisfaction to our membership.

The Baton Rouge Meeting. Once again a delightful meeting is a memory.

On May 12, the meeting of the Society was held at Louisiana State University at Baton Rouge. The University was the gracious host at a supper meeting held in Highland Hall. With one hundred and twenty-five members and guests present, the meeting was a gala affair indeed.

The presiding officer of the meeting was Dr. L. J. Lassalle, Dean of Engineering at L. S. U., and the technical paper of the evening was presented by Professor J. H. Bateman.

After an inspection of the Electrical and Civil Engineering exhibits, which were a part of "Engineers' Day" at the University, another fine Baton Rouge Meeting had become a part of the Society's history.

Our New Members. We welcome to membership in the Society the new members listed below:

PETER B. CALLAC, Junior Member. Endorsed by P. H. Quinlan, M. T. Ducros, C. J. Pierce. Age 29. Instrumentman for Sewerage and Water Board during 1927-1930, and from 1935 to present date. Address: 7842 Apricot Street.

JOSEPH F. COURTNEY, Member. Endorsed by A. L. Dunlap, R. A. Steinmayer, W. H. Scales. Age 44. Seventeen years master mechanic for the International Harvester Co. at St. Paul, Minn. and New Orleans. Two years chief inspector, eight months assistant superintendent, International Harvester Company. Address: 59 Fontainebleau Drive.

FRANK W. EDWARDS, Member. Endorsed by Arthur M. Shaw, J. C. Baehr, John S. Gentilich. Age 32. B. S. in General Engineering, M. S. in Hydraulic Engineering, both of U. of Iowa 1928 and 1930. 1928 Budget Bureau, Commonwealth Edison Co., Chicago; 1929-1932, research, engineering of hydro plant operation and construction, hydro site surveys, stream flow measurements, stage records, etc.,—all this experience with Management and Engineering Corporation, Chicago. 1932-1933 research assistant on hydraulic laboratory studies, U. S. Bureau of Agricultural Engineering, Iowa City, Iowa. September, 1933-June, 1934, U. S. Waterways Experiment Station, Vicksburg. June, 1934-September, 1935, assistant to chief Research Section on Muskingum Flood Control project, U. S. Engineer Office, Zanesville, Ohio. September, 1935-March, 1936, U. S. Engineer Office, Los Angeles, Cal.; March, 1936-September, 1936, U. S. Waterways Experiment Station, Vicksburg, in charge of research studies on silling basins for Conchas Dam, New Mexico

and Possum Kingdom Dam, Texas; September, 1936, to date, head hydraulic design section for flood control on Mississippi River, U. S. Engineers, 2nd N. O. District.

EDGAR J. HAAS, Junior Member. Endorsed by James M. Robert, Arthur M. Hill, M. M. Norton. Age 22. Graduated in Mechanical Engineering Tulane University June, 1935. Engineering draftsman Celotex Corporation, June, 1935-August, 1936. Junior draftsman, Sewerage and Water Board, August, 1936-September, 1936. Engineering draftsman, Celotex Corporation September, 1936, to date. Address: 3101 Napoleon Avenue.

WILLIAM HARDY, Member. Endorsed by C. G. Cappel, H. J. Lane, R. E. Gosa. Age 47. Estimator, Caldwell Bros and Hart, N. O. Senior examiner W. P. A. Amarillo, Texas. 15 months. Estimator, Johnson Construction Co., Birmingham, Ala. Superintendent building construction, Hugger Bros., Montgomery, Ala. One year estimator, Kilgus Construction Company, Baltimore, Md. Two years construction engineer, Baltimore Sewerage Commission. Two years chief of party L. V. R. R., and other minor positions 6 years. Address 2014 Marengo Street.

GERALD C. KERR, Member. Endorsed by D. W. Godat, D. S. Elliott, Leo Weil. Age 34. A. B. University of British Columbia, Vancouver, B. C. 1923. Research Dept. Celite Corp., Lompac, Cal., 1926-29. Acoustical Dept., Johns-Manville Corp., Manville, N. J., 1929-34. With Johns-Manville in acoustical engineering, New York City, 1935-36. Acoustical engineer with Taylor-Seidenbach, Inc., New Orleans, 1936-date. Address: 7120 Willow Street.

WARREN A. MACKIE, Member. Endorsed by A. F. Theard, P. H. Quinlan, C. J. Pierce. Age 53. Resident Engineer, N. O. G. N. R. R., J. F. Coleman, Chief Engineer, 1906-17; Asst. Engineer N. O. Public Belt R. R., 1908-9. Construction Superintendent Chalmette Cypress Co., 1910-11; Superintendent Construction Post Office, N. O., 1911-12; Superintendent construction J. H. Wickersham, Lancaster, Pa., 1913-14; construction superintendent N. O. Cotton Warehouses 1915. Private practice 1915-

1926. Parish and town engineer St. Francisville, La., 1926-30. Private practice 1930-35. Assistant engineer in Drainage Dept. N. O. Sewerage and Water Board, 1935-date. Address: 526 Carondelet Street.

J. H. MALAIN, Junior Member. Endorsed by P. H. Quinlan, M. T. Ducros, C. J. Pierce. Age 31. Draftsman: City Engr. N. O., La., 1927-29; Celotex Co., Marrero, La., 1929-30; Sewerage and Water Board, N. O., 1930-31; Sewerage and Water Board, N. O., 1933 to date. Address: 424 Eliza Street.

JOHN J. PORTE, Junior Member. Endorsed by Alfred F. Theard, M. T. Ducros, C. J. Pierce. Age 30. Draftsman, 3 years, Harlan Bartholomew and Associates, St. Louis, 1926-29. Draftsman, 8 years, in designing and drafting, Dept. Sewerage and Water Board of N. O. April 8 to date. Address: 2024 Congress Street.

ANSON F. RIDEOUT. Non-Resident Member. Endorsed by J. J. Krebs, J. H. O'Neill, H. M. Clanton. Age 42. Graduate forester, majored in mathematics and has taken university extension work in civil engineering. Twenty years experience in Central and South America in construction and drainage work. At present employed as City Engineer of De Ridder, La. Address: De Ridder, La.

CORWIN A. ROBERT. Member. Endorsed by C. G. Cappel, J. F. Coleman, P. H. Quinlan. Age 49. Resident engineer for highway, sewerage, water and drainage construction for ten years. Past eighteen years experience has been in private practice of surveying. Address: 127 N. Jefferson Davis Parkway, New Orleans.

RICHARD M. SHAW. Junior Member. Endorsed by Profs. W. B. Gregory, J. M. Robert, Mr. B. S. Nelson. Age 29. Two and one-half years in mechanical-electrical engineering, Tulane University. Part time surveyor for R. P. Rordam while at Tulane. Since December, 1932, employed by the U. S. Engineers Dept. 2nd N. O. District. Present rating, surveyman. Work is in hydraulic design Dept. Address: 1529 Jefferson Avenue, New Orleans.

MERCER M. SMITH. Affiliate Member. Endorsed by L. T. Frantz, D. W. Godat, B. H. Bell. Age 45. Engineer, operating department Electric Storage Battery Co., 1920-36. Address: 428 Balter Bldg., New Orleans.

WILLIAM W. TENNANT. Non-Resident Member. Endorsed by Profs. L. J. Lassalle, W. Whipple, Mr. C. G. Cappel. Age 49. Employed by Standard Oil Company, Baton Rouge, as gauge table computer, July, 1910. Transferred to Crude Dept. September, 1910. Transferred to Yield and Cost. Dept. 1913. Took charge of the department June, 1917. Transferred to statistician to Vice-President February, 1919. Appointed Asst. General Supt., Baton Rouge Refinery, August, 1921. Appointed Director of Standard Pipe Line Co., Inc., January, 1923. Appointed head of Co-ordination Division, S. O. Co. of La., August, 1931. Address: 520 Convention Street, Baton Rouge, La.

S. J. VAN NORMAN. Member. Endorsed by C. J. Peirce, Jr., A. F. Theard, H. B. Myers. Age 50. Assistant Engineer, Sewerage and Water Board 1910-29. Supervising engineer, S. & W. Board in charge of sewer contracts 1929-32. Division Engineer, S. & W. Board in charge of sewer and water construction and maintenance 1932-date. Address: 4211 S. Rocheblave Street, New Orleans.

Other New Members. In addition to the above, special mention should be made of the following new Junior Members:

The Society award of Junior Membership for outstanding work done at Louisiana State University was awarded to Mr. Bennet Battaile. The Society Junior Membership for outstanding work done at Tulane University was awarded to Mr. Godfrey Thomas Coate. Mr. Coate was already a student member of the Society.

In addition to these two Junior Memberships, another Junior Membership was offered by Tulane University as a part of the Brown Ayres Award for excellence in Physics. This Junior Membership was won by Mr. Barremore B. Brown.

We congratulate these gentlemen and welcome them to membership.

PAPERS AND DISCUSSIONS

ENGINEERING IN CANADA

By E. F. STERNE *

Read Before the Society April 12, 1937.

It gives me a great deal of pleasure to have the opportunity of speaking to you tonight, and I fully appreciate the privilege that has been granted.

Canada, as you know, is a large country, just a little bit bigger than the United States and Alaska, but unfortunately we haven't so many people, and a great deal of the country which we do have is not, shall I say, as friendly as Louisiana is. There is a large portion of our country where the population per square mile is exceedingly low. But because we have this large country, sparsely settled, the development of our natural resources is the channel by which we must grow.

In the development of those natural resources, the engineer, of course, plays an ever-increasing part.

The day has passed when a country, like Topsy, can just grow. It has to be developed. And the engineering profession is the only profession that can adequately develop the natural resources of a country. We know that in the past there have been developments made without the engineering profession, and we know how costly those developments have been.

Canada, like the United States, has, in a great many of its areas, practically the same resources, or a similar set of resources. We have our trees, you have yours; we have water-power and we have our mines. Now, in speaking to you tonight, I do not propose to go into detail and go into engineering figures on any of the problems. But because I am so far away from home I would like, with your permission, to take you on an engineering Cook's Tour and try to give you a gen-

* General Manager, Sterne & Sons, Bradford, Ontario.

eralized survey, rather than a detailed picture, of what is going on north of the 49th parallel of latitude. I wish to show you, if I can, just the type of country which we have and how we are trying to go about making the most of it.

We, like yourselves, have the great good fortune to be living under the traditions and the institutions that our common parentage developed perhaps a thousand years ago. Our laws are similar in many respects to your laws, and our language being the same language, we can move across the border with ease. We have the opportunity of welcoming into Canada a great many engineers from this side of the border, who are doing good work for Canada and who are building up great credit to the engineering profession in the United States. We welcome those engineers and are happy to work with them. It is much too big a country for us to do it all ourselves, and we look with nearly the same eyes at the problems that lie before us as the people of your great country down here.

Canada, like the United States, is divided into nine provinces—you call them states. we call them provinces—with the provincial governments and the Federal Government, and in certain branches of work each province has its own legislative enactments that do affect engineering work. We have our various engineering societies, our big engineering institutes, and then we have our professional bodies throughout the country, each province having its own professional body. It was to the Ontario professional body, with about 1300 members, that it was my privilege to try to give some guidance back in 1930.

Now, these nine provinces lying across the continent obviously have many different natural resources and have to be developed in different ways. There are large sections of the country, however, that do have much in common. I suppose that some of the lands that I have seen here growing luxurious crops probably came down from Canada, because considerable Canadian area has been glaciated two or three times and has been stripped bare. There has left exposed in that area what we know as the great pre-Cambrian shield, and part of the natural resources of Canada, some of our most important re-

sources and some of the most important fields for engineering work lie in that shield. The rocks, however, with the exception of the lower part of the provinces, which carry on into your states of South Dakota and Montana, are exposed in practically all the provinces, and as I say, naturally these rocks form a good deal of the raw materials by which we practice engineering.

I wouldn't like to go into the question of bridges and ditches and what-have-you, because you build them larger down here. If possible, I would just like to keep to some of the things that may be more peculiarly local conditions as we have them in Canada.

If we go to the east of the country, we find that the most easterly point is Cape Breton Island. It is within a hundred yards of the sea and is practically the stepping-off point of the continent. I recall being out there fishing one day and I asked the man that took us out, "Well, what is over there?" He said, "Ireland." Within a hundred yards of the sea is the first shaft of the Nova Scotia coal mines. The great coal beds of Nova Scotia lie right at the point of Cape Breton Island. There are some further away from the sea but the largest are nearer the coast, and as I say, the shaft of the first one is within a hundred yards of the ocean. There the coal treasures are laid down in three seams, all tipping under the ocean bed, so that all of the coal that is mined in that section of Nova Scotia is actually mined under the Atlantic Ocean. They are working four miles out underneath the bottom of the sea. They have to sink their shafts and then drift to hit the seams, because the first seam is actually, as I say, right at the water's edge, the next one back maybe 4 or 5 hundred yards, and the next one back a quarter of a mile beyond that. All of them are mined underneath the sea, however, and there are very large tonnages of coal taken out of that area.

It is a peculiar thing that Canada has coal in Alberta, but the main industrial area of Canada, Ontario, is adjacent to the American coal supplies and we draw most of our coal, although not all, from the United States. Because the idea of national development sometimes shows a tendency to run

rampant in all countries (and we are not entirely free of it) they are bringing more and more Nova Scotia coal into the central district. All of this coal which does come to the central district and which is used there is mined underneath the ocean.

Now, there is a big steel plant at Sydney, and it is rather interesting to note that the steel plant is on a coal bed. Their iron is secured from the Island of Newfoundland. They have their own mines and their own boats and bring it across. The Dominion Iron & Steel do all their working in Cape Breton.

There is a certain amount of gold down the coast of Nova Scotia in some of the workings there, and probably you are familiar with the account of the three men who were buried alive in a mine in Nova Scotia about a year ago. They were rescued. I am familiar with that rock. I have been at some of the mines that have been laid by. The mines there were highly pocketed—very, very rich, and then nothing, very rich and nothing. The result was that they would carry on. They would get the rich ore out, after which it would run into a lean streak and the money which they had made in the rich pocket was gone before they struck another one. A number of the mines were closed down for a great many years. The rock in which the cave-in occurred is really more of a shale than a rock, and it rots very easily. A great deal of the workings were in pretty bad state of repair when I was there—so bad that there was one at Tangier where I was that I wouldn't take a chance going down. The men who were buried, a doctor and a lawyer and I think the other was a stock broker, had been sold the mine by someone. They went down, the mine caved in and they had to sink another shaft and drift over to get them. The men that rescued them were a crew of draegermen, that is, a rescue crew from the coal mine; otherwise, I do not think that they would have gotten out.

In Nova Scotia there are some very fine timber lands, and one or two good pulp mills. In this Louisiana country you will be rather interested to know along the Bay of Fundy is our

“Cajin” country, and it is from the section around Grand Pre where took place the deportations of the people whose descendants you find now in your Teche country.

New Brunswick, the next province in our Cook’s Tour, is a timber country, flat, no mines, all of it maritime, of course, and has a great deal of fishing—lobsters and oysters—I think they are just about as good as New Orleans oysters—and fish. Outside, along Cape Breton, the great fish is the swordfish. They fish for the swordfish and ship them into New York for the steaks. Swordfishing is great sport.

There isn’t much in New Brunswick except trees and the products that come from trees—paper. They do make a great deal of bleached sulphite in New Brunswick for the fabrication of Rayon, as well as the ordinary newsprint. The International Paper Company, that have mills here in the South, also have a large mill in New Brunswick. They have a large mill also in Newfoundland, and in Quebec they have a couple of very large mills. When you come into Quebec, however, you come onto the pre-Cambrian shield. And because you do come to that pre-Cambrian shield, the activities of the people are largely different. This is because there we come into the Laurentian Hills, which give us water power and all of the things that go with water power. There we have the timber and the pulp industry, the paper industry, and the chemical industry at Shawinigan Falls.

In addition to that, Quebec is developing very rapidly now as a mining country, and particularly a gold-mining country. The development of gold mining in Canada is now stretching in a very wide band and therefore Quebec is starting to reap its own reward in that field also. But before touching on the mining, I would like to touch a little bit on the power development and the paper industry and the chemical industry that is in Quebec itself and is not found to the same extent in the other provinces.

Around the Lake St. John area, which is at the head of the Saguenay River. If you gentlemen want to take a nice holiday some year and can get up as far as the Great Lakes and can take a boat down the St. Lawrence and up the Saguenay, I

think you would find it very much to your liking. It is magnificent scenery,—rocky, wild, the waters are peculiar to that whole shed, a bit brown, but deep and dark, and they have some mighty good fishing up there too. But at Lake St. John is developed a very large paper industry and also a very important chemical development, because situated at Lake St. John is the large plant of the Aluminum Company, at Arvida. I believe that when the Aluminum Corporation took over the bauxite deposits in British Guiana, it was rather suggested that it would be very nice if those deposits were not brought in their natural state to the United States, but converted into the metal itself on British soil, and there at Arvida they were able to be on tidewater and at the same time be very close to very large power development. And those power projects were very interesting in their development. It was at one of them where one of the dams was built on end and then tipped over into place. In the center of the discharge, right in the mouth, where Lake St. John pours into the Saguenay River, is an island, and on one side is the petit discharge and on the other side the grand discharge. There was no difficulty damming the little discharge, notwithstanding the power plant was put in, but it was quite another matter when the time came to dam the large discharge, and they were not able to do it by ordinary cofferdam methods. The method which was finally evolved was to build the wing-walls of the dam and then carefully match the contour of the river bottom and cast the concrete dam on end and then just tip it over. It was very successfully done. So far as I know, that is the only knowledge I have of building dams straight up in the air. It was successful, however, and they have built a plant there.

There are, as I say, several paper mills around that lake. It has a road all around it. The road is over 200 miles long. So you see, the lake is a real sizeable lake.

The farthest-east gold mine in the Province of Quebec is rather interesting, because everything that has been transported in there has had to go in by airplane—even their cows and horses. Our own company, shipped a part of a single shipment of 100,000 pounds of material in by airplane. They

shipped two water-tube boilers with complete settings. The water-tube boilers were designed so that the drums would just go into the big Junker planes that were used for transportation. And, by the way, the freight from St. Feliciana, where they picked it up by plane, was 8 cents a pound—\$8.00 a hundred. But even at that price, they were able to more than afford it, because they reduced their power cost at the mines as against Diesel engines and similar airplane transportation of fuel.

At Shawinigan Falls, in the St. Lawrence Valley, there is a great chemical industry developed which makes aluminum. It is the plant of the Aluminum Company. There is also the large plant of the Shawinigan Water & Power Company, making calcium carbide, and from calcium carbide acetic acid, acetone, aldehyde, acetate, fusel alcohol,—all from the electric energy and the coke and limestone that they use in making carbide. They ship from there all over the world, and it is an industry that has been built solely on research, solely on engineering, in this case chemical engineering. They started from nothing. Five men—I happen to know them all very well personally—were put in there by this power company and proceeded to carry on their researches, and were able to produce acetone in large quantities during the war. After a time acetone was produced cheaper at Toronto, also by virtue of research, by the fermentation of corn, when this company changed their activities from acetone to acetic acid, and then, since the war, to all of the various solvents that have been developed through these various gas reactions.

Three Rivers is essentially a paper mill town. There are four mills there, including the very large mill of the International Paper Company. They are producing about 1500 or 2000 tons of paper a day in that town. And that, really, is rather interesting, from the standpoint of engineering, to you in Louisiana, because the St. Lawrence River is a controlled river, and by virtue of its control they have been able to make use of the water several times over, that they would not have been able to do had not the river been controlled by storage dams.

I notice in the papers where you are going to do a great deal of back-country damming in the Mississippi Valley. In the St. Lawrence Valley, they started off by damming—putting a storage dam for power purposes — and they have already four power plants on the river, with two projected. In that case, they will use the same water six times on the various falls. And by virtue of their storage dams, they are able to equalize their fall, so that they have power all through the year, and the river is a perfectly controlled river. It is used, of course, to a very large extent, to bring timber down from the upper country.

At Quebec we have a bridge that won't compare with the San Francisco bridge, but it did give the engineers a lot of trouble in putting it over, and within itself it is a very fine bridge from an engineering standpoint.

And now we come to a very-much-argued project, and that is the St. Lawrence Waterway development. I believe there is a variation of opinion in the City of New Orleans, even though it is a long way from Quebec and from the St. Lawrence. The merits or demerits of it I am not prepared to argue, but there are many who do believe that the development of the international section, joint development, will be of material advantage to both peoples. The international section, of course, is a relatively small section, and I sometimes wonder if it is known how much of that which is purely Canadian is already in being. Sometimes it would appear as though that relatively short international section is all that is involved in it.

There is now developed at Beauharnois, connecting Lake St. Francis with Lake St. Louis, a canal that is now used entirely for power. It was built as a power canal, but it is a thousand feet wide and about 30 feet deep, and is available for the installation of locks.

Then Canada has built the Welland Canal. As an engineering project, that is no mean effort. There were 27 locks on the old Welland Canal; there are now 5, and those locks are 800 feet long and 80 feet wide,—almost as big as the locks in the Panama Canal. I think those in the Panama Canal are only about 800 feet long. They have 30 feet on the sills, so that they

will take a very sizeable vessel. There are 3 tandem locks and 2 single locks. Where they go down over the escarpment, there are two sets of locks, so that one boat can be coming up as another is going down. And then they move off into Lake Erie. I wouldn't want to be checked up on this, but I believe the lift is 43 feet. Canada has spent about 150 million on that canal, and for a little country of 9 million people, in the words of the prophet "That is a lot of money." However, it is an essential part of the whole St. Lawrence development, and it must be taken into consideration. If we develop the section that is not now developed for navigation purposes, there will be very much power development at the same time, and there will be real engineering work necessary.

Now, from an engineering standpoint, I would like to take you more into the mining areas of Canada, because the gold mining industry, particularly, is an industry that means much, not only to the engineering profession, but also to Canada as a whole. At the present time, it is almost impossible to get graduate mining engineers in Canada. There are openings for more than are being produced in our universities. There is no trouble for them to get jobs at all, because, as I say, fields are opening up from the east right straight through into northern Manitoba and up to Great Bear.

The Quebec area has some very interesting mines, some that you are probably familiar with, notably the Miranda, which was opened as a copper mine. Now there is some question in the minds of the mining industry of Canada as to whether Miranda is a copper mine carrying some gold or a gold mine carrying some copper. It is like the zebra, you know,—is it a black horse with white stripes or a white horse with black stripes?—because the ore, which has a very large body and mass, carries much more gold than is necessary to pay the smelting charges, and they have a big copper production there as well as their gold production. The copper is refined in their own refinery at Montreal. But east of Miranda the country is becoming dotted with gold mines, some big and some small. In Canada, most of them start with only these 50- or 100-ton mills, and from that they grow. Those mills

will make 10,000, 15,000, 20,000 dollars a month in their operations, and then they gradually increase in size until they are producing what some of them are producing in the Kirkland Lake area, maybe a million a month or a million and a half a month. They go down, some of them, pretty deep.

To me, that development of small mills through that area is an exceedingly hopeful sign. There is another sign that is very hopeful there, and that is that all the large producers now have one, two, three, four, five small mines that they are bringing on. They are adequately financed; they are run with the idea of mining Mother Earth and not the public, and they are soundly operated and managed and have good engineering and geological service. A great many of these mines,—for example, this one I spoke of in the east—is being operated by the Consolidated Mining & Smelting Company, which is another way of saying the C. P. I. We have our wildeats there, just the same as you have in your liquid gold down here, but in the main there is a great deal of good, solid mining development, and they are springing up all over. Almost wherever the rock is exposed, they are finding ore across that shield.

Now, that carries into Ontario, and in Ontario is a very interesting field from a geological standpoint. That is Kirkland Lake. At Kirkland Lake there is a fall which just slipped somewhere between 1 and 2 thousand feet and then it all eroded. There they have probably the richest individual mine in the world at the present time; it is very highgrade ore—the Lakeshore Mine. Their ore is running over \$20.00 a ton, and they are mining fairly cheap. They have workings down there as low as 7000 feet. Most of the working, however, is above that. There are three or four other mines there, and the same continuance comes over to Timmins, on the same pre-Cambrian shield, and there we have some other very large gold mines. The McIntyre—I have been down 5700 feet in the McIntyre, and you will be interested from an engineering standpoint in the tunnels and drifts of the McIntyre mine. After a drift has been put through, a concrete gang goes through and gunnites those portions of the mine that are not going to be mined.

Now we drop down to another very interesting development at Copper Cliff. That is the main working of the International Nickel Company. They are milling at the present time 14,000 tons of ore a day there, and they are smelting that to nickel mats or to copper blisters and refining it right at the same plant. They have three smokestacks there, one of them is 45 feet in diameter at the top, the other one is 42 feet in diameter at the top; they are both over 500 feet high; and then they have another one 15 feet in diameter and about 375 feet high. Well, gentlemen, I am going to say that a smokestack 45 feet inside diameter at the top, about 65 feet inside diameter at the bottom and 500 feet high takes a lot of drawing. Now, the idea for that was that they are putting a lot of sulphur into the air as sulphur dioxide, and the lower stacks just simply killed vegetation. Under the old working, around that plant, in certain sections of that plant, there is no more vegetation than there is on that floor. It is just a bald rock. But now, by putting the gases up, they get diluted with air and are carried far enough away that they do no damage.

The plant itself is an extraordinarily interesting one to work on. It has been my good fortune to work very closely with the Nickel Company for a good many years in two or three different lines; consequently, I am up there a great deal, and I always come back from that plant very, very humble. The great things that that group of men are doing in mining the rock, the nickel ore, and in the tremendous flotation plant, to separate the values, and then the smelting and that are all co-ordinated and operating, and are operating at a higher efficiency than was thought possible when the plant was designed, shows the type of engineering that was done. I think they have spent somewhere between 70 and 80 million dollars on that property, and they are getting the results back. While they spent all that money, I think the last time I saw a report they had something like 40 or 50 millions in the bank which they had gotten back, which was not so bad.

And now, so much for the Nickel Company. There are about 7000 men employed there. Right in close location there is a ring in what is known as the Sudbury Basin, and nickel mines

are distributed all around that ring. They are practically all controlled by that one company, the International Nickel Company.

And now there is another phase which has contributed partly to the development of the gold-mining of that area, in fact, has contributed largely, and is doing more and more so all the time. Mine engineers up there have airplanes where we have automobiles, because this whole country is a country of lakes. They land on the ice in the winter time and they land in the water in summer. There is a period of about two weeks in spring and fall when there is no flying, but the rest of the time they just get up and flop here and there wherever they want to go. The managers of all the big mines have their own planes and their own pilots, and the airplane has been of untold value in the development of all of that north country. There are no roads, practically. You can go very quickly and very cheaply by plane from Timmins to Copper Cliff. It takes you 24 hours by train to go around by North Bay; it takes you an hour and a half by plane; and the result is that everybody, even the prospectors, travel by plane. They decide on which lake they want, the plane takes them up and drops them on the lake; they make their camp and do their work; they have arranged for the plane to come back for them on a certain day; it comes back, picks them up, brings them to civilization, or takes them to another lake. And that goes on throughout the year.

In Canada, by the way, also has been developed to a very high degree the science of aerial survey. Nearly all of this country now either has been or is being surveyed by means of aerial photography. And air freighting is obviously another one of the most important services that the airplane can give to that country. You will be interested to know that with 9 million people as against 130 in the United States, Canada transports about four times the poundage by airplane that the United States does, and it is simply because of the necessity of taking it into these outlying places. There is no other way of getting in. In Northern Manitoba is the Flinflon area, where the copper mines are located, and then we come up into Great

Bear. From Flinflon to Great Bear is 1400 miles. Not only do they carry much of their supplies in by airplane—because it takes a month or six weeks to go down the Mackenzie River by barge—but they bring ore out by airplane. They bring the radium ore by airplane from Great Bear to Flinflon and then transport it to destination on Lake Ontario, where they extract the radium from the pitchblende that is found on Cameron Bay. There is a very nice little plant for the refining of radium, and it is interesting to note that the method used for producing radium from the uraninite and the pitchblende at Great Bear Lake is the same method that Madam Curie developed to produce radium from the pitchblende from the mountains of Bohemia. They have tried other methods, but they haven't worked as well.

There are quite a number of likely lakes of copper sulphate and two or three of them are being developed. One is being developed in the south of Saskatchewan by the International Nickel Company for the separation of copper and nickel in their nickel mat. It is rather an interesting thing that they fuse the nickel mat, which is a nickel, copper, sulphur and iron mat, with an acid sodium sulphate and they make it by acidulating the natural sodium sulphate from ore. The nickel sulphite is separate completely.

And then we drop over to the mountains of British Columbia, and there is only one engineering development that I want to speak of in British Columbia, because my talk is getting already much too long, and that is the development of the Consolidated Mining & Smelting Company. This development is another that is the direct result of engineering and chemical research. The Sullivan mine at Kimberly was an immense body of galena, zinc, with damned near everything else in. It would be all right if all of the metals behaved themselves, but they were nearly all polygamous, and sometimes one would be married to a certain one and sometimes it would be married to another one, with the result that in the system that they had at that time for the separation of the lead and the zinc, sometimes the gold, silver, cadmium and bismuth would go down with one and sometimes with the other, and they just had one

hell of a time. In fact, they were virtually ready to abandon the bulk of the values in the mines. They were able to make a certain amount of money cover-hauling, as they call it up there, and separating just a little bit of it, but the actual mine itself showed very little promise until the Consolidated Mining & Smelting Company, largely headed by the man who is at present manager of it, Mr. Blalock, two years ago president of the Engineering Institute of Canada, a chemical engineer, proceeded to work on the separation of these ores. Today they are able to separate all of the values and secure them in a pure form on an economical basis. And in addition to that, they have done a tremendous amount of research work on the conservation of products that heretofore have been lost.

I mentioned the stacks at Copper Cliff. The Consolidated Mining & Smelting Company also had the same trouble because they were dealing with sulphite ore, and that trouble was so bad that an international commission was set up to evaluate damage to the orchards in Washington, and the company has paid immense amounts of money to the farmers in Washington for damage done by the smelter just across the border a few miles. They have been making sulphuric acid from part of the fumes. They have a very large fertilizer plant, and the latest word that I have is that they have already cut in or are cutting in a plant for the production of native sulphur from the sulphur dioxide gas. They are in the position of course that against their operating expense they are able to put the money which otherwise they would pay to the farmers in Washington. In other words, there is a big nuisance value that they have as a reserve and that they have set up for many years. I believe now they are ready to produce sulphur from the sulphur dioxide which is going up the stack. If they produce it there, and at Copper Cliff, and other mining areas that are smelting sulphite ores, the tonnage of sulphur which is potentially available is, of course, tremendous.

Now, gentlemen, I have taken a long time, and I trust I haven't tired you in this Cook's Tour. There is another spot I should like to speak of, up at Great Bear, and that is a rather interesting development from an engineering standpoint. Many

years ago, a geologist by the name of Doctor Mackintosh Bell did some geological work up there and he noticed some cobalt blue, which is a paint coloring, that occurred along with cobalt ore. He reported them in his government report. A few years ago, a prospector by the name of Gilbert LaBine, reading over the report—and airplanes had come into being since then—noticed this, and was dropped by an airplane on the shores of Echo Bay in Great Bear Lake, found the blue, found the native silver, which is almost always present with that type of formation, and then noticed this exceedingly heavy, hard, dense rock, and from that there is quite a mining camp going in up there. Interesting also because at Fort Norman the Imperial Oil Company have quite a nice oil development actually in being. The wells are there and are usable, but it is too far away to bring it to transportation.

I don't know, gentlemen, whether I have given you sufficient of this picture. Thank you.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board of Direction, May 3, 1937.

The meeting was called to order by President Williamson with the following present: Cappel, Grehan, Hackett, Newman, Godat, Pierce, Hill.

The minutes of the last meeting were read and approved.

A letter from W. J. Everett, Secretary to the Governor, was read, stating the Governor had not yet had an opportunity to make appointments to the Board of Engineering Examiners from the list submitted.

It was voted that Charles H. Green, and Hampton Reynolds be re-instated as members of the Society.

The Secretary was asked to check up on the time of awarding Junior memberships in the Society, and Scholarships at Tulane and Louisiana State University.

A letter was read regarding the meeting of the American Engineering Council, and the Secretary was directed to make an abstract of the report submitted.

The budget as submitted by the Finance Committee was approved by the Board.

The following resolution was approved by the Board, it being subject to the approval of the membership at the next meeting: Resolved, That the Louisiana Engineering Society believes that a traffic bridge across the river at New Orleans, near the business district, is a much needed public utility, and therefore endorses the idea of having the New Orleans Commission Council appoint a Bridge Committee for the purpose of making a thorough investigation of the matter, and definite recommendation thereon."

The Secretary was directed to answer a letter from A. M. Lockett, and acknowledge the receipt of boiler design data.

It was voted that David W. Godat be made Chairman of the General Committee for the 1937 Annual Meeting.

Adjournment.

ARTHUR M. HILL, Secretary-Treasurer.

Minutes of the Regular Meeting of the Society, May 12, 1937.

This meeting of the Society was held in Baton Rouge on May 12, starting with a buffet supper at Highland Hall, Louisiana State University campus.

At 8 P. M. President Williamson called the meeting to order, with 125 guests and members present.

The reading of the minutes of the previous meeting was dispensed with.

Mr. C. G. Cappel gave a short talk on the advantages of membership in the Society.

Prof. Pegues asked that nominations for the L. S. U. Scholarship be sent to him.

The following resolution was adopted at the meeting: Resolved, "That the Louisiana Engineering Society believes that a traffic bridge across the river at New Orleans, near the business district, is a much needed public utility, and therefore endorses the idea of having the New Orleans Commission Council appoint a Bridge Committee for the purpose of making a thorough investigation of the matter, and definite recommendation thereon."

Mr. W. H. Scales urged that this be followed up by the members.

Mr. Mace H. Bell announced the showing of a film on the Oakland Bay Bridge.

The meeting was turned over to the 2nd Vice-President, Dean Lassalle.

The speaker of the evening was Prof. J. H. Bateman, Research Professor of Engineering and Assistant Director of the Engineering Experiment Station at L. S. U. His subject was "Recent Developments of Highway Practice."

The speaker was tendered a rising vote of thanks. Dean Lassalle extended a cordial invitation for those present to attend the electrical show and civil engineers' exhibit, which were being staged as part of "Engineer's Day" at the University.

Adjournment.

ARTHUR M. HILL, Secretary-Treasurer.

ACTIVITIES OF LOCAL SECTIONS

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STUDENT CHAPTERS
Louisiana State Univ.
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Special Meetings at
call of President

The Scholarship Award Committee of the Section is at work on the selection of the recipients for the two scholarships, one at Tulane University and the other at Louisiana State University, awarded annually by the Section.

Many members of the Section attended recently a joint meeting of all local engineers at which time an address on "The Reason for the Existence of the National Society of Professional Engineers, Its Aims and Activities" was delivered by Mr. W. S. Conlon, Executive Secretary of the National Society of Professional Engineers.

Our Secretary-Treasurer, Mr. J. A. McNiven, advises that many of our members are still in arrears for their 1937 Section dues, and that a check at this time would be greatly appreciated.

PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

JUNE, 1937

"PATRONIZE OUR ADVERTISERS"

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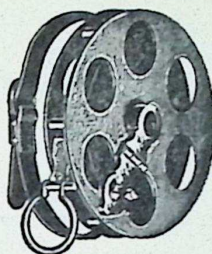
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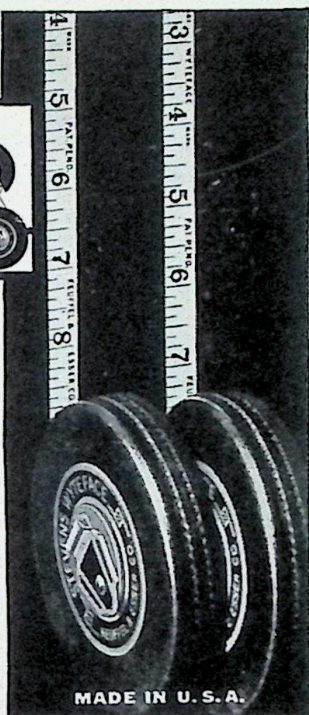
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VOL. XXIII.

AUGUST, 1937

No. 3

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EDITORIAL NOTES AND COMMENT

Random Rambles: Did you ever stop to wonder why it is—

That the ingenuity of man can build wonderful automobiles capable of going ninety or a hundred miles an hour and the assinity of man largely limits their use to fifteen and twenty-five miles per hour?

That such inefficiency is allowed to persist in so-called civilized communities?

That the control of such conditions is left to the small-time thinking of small-town politicians (even though the conditions exist in the largest cities)?

That traffic control is still largely believed to be a police rather than an engineering responsibility?

That *safety combined with speed* is still believed to be unobtainable?

That the engineering profession has not been given a *free hand* to work out this problem?

That there is even now so little really constructive thinking on the problem?

That the average motorist complains of being taxed to death?

That at the same time, he does not deem it worth while to join any organization of motorists which would and could successfully combat the condition of which he complains?

That the medical profession finds it advantageous to have one all-inclusive national organization with over 100,000 members to sponsor its interests?

That the legal profession also has only one national representative organization?

That the engineering profession on the other hand has over ninety national professional organizations, the largest of which consists of only a few thousand members?

That the engineering profession thinks it can get anywhere under these conditions?

That the engineering profession does not seriously consider it worth-while to organize along lines of complete solidarity?

That a "house divided against itself" can be considered to have any stability?

That highly salaried officials of many national organizations could be expected to vigorously oppose any such consolidation?

That the engineering profession is quite successful in organizing every interest with which it comes in contact?

That the engineering profession seems quite *unable* to successfully organize itself?

Changes Attending an Ice Age. We publish in this issue the first installment of a lengthy article by one of our charter members. Mr. Gervais Lombard has done a tremendous amount of research to develop the information contained in his paper. It is regrettable that the length of his paper prevents its being published completely in this issue. It will be concluded in another issue.

Modern Research in Sound. We publish in this issue a short, valuable and extremely interesting article on Modern Research in Sound by Mr. Gerald C. Kerr.

In the hurly-burly of present day civilization, it is being recognized more and more that the necessity of eliminating noise from our every-day life is paramount. Many of the nervous ills of the modern human being are directly traceable to noise. The abatement of unnecessary noise from modern life is an engineering necessity. More and more will engineers be called upon not only to devise ways and means of reducing noise in present structures and machines, but a large part of the design energy of the future must be put in eliminating noise from new structures.

Mr. Kerr's article is well-worth reading.

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You are urged, therefore, as a member of the Society interested in its welfare, to support as far as possible the advertisers in the Proceedings. Not only are you urged to do this yourself, but to prevail upon the other members of the Society to do so, too. A little team work on the part of the membership in this direction can not but have a beneficial effect upon the Proceedings.

Pay Your Dues Promptly. Not all of us put off paying our dues because we haven't the money.

We frequently put off paying them because it isn't physically convenient to do so—we haven't a stamp, or an envelope, or our check book isn't handy or some other trivial reason. Subconsciously, we feel that the amount is so small that the Society could not possibly be embarrassed by its non-receipt. When *nearly all* of us do so, however, practically all of the income of the Society is involved and the embarrassment becomes acute.

The officers are doing a tremendous job in improving the Society. Won't you co-operate by paying your dues NOW?

New Books Added to the Library. Mr. A. M. Lockett very kindly contributed the following books to the Library: "James Watt" and "Mathew Boulton," both by Dickinson. The books are attractively bound, and contain numerous illustrations.

The following books will be found on the shelves and listed in the card index:

Who's Who in Engineering, 1937 Edition.

Petroleum Refinery Engineering, Nelson.

Unit Processes in Organic Synthesis, Groggin.

Chemical Engineering Plant Design, Vilbrandt.

Industrial Chemical Calculations, Houghton & Watson.

Principles of Chemical Engineering, Walker Lewis and McAdams.

Chemical Engineers' Handbook, Perry.

PAPERS AND DISCUSSIONS

CHANGES ATTENDING AN ICE AGE

PRECESSION, CHANGES IN THE EARTH'S ORBIT, AND THEIR POSSIBLE EFFECT IN CAUSING AN ICE AGE

BY GERVAIS LOMBARD *

Read before the Society June 14, 1937.

NOTE: This article by one of our honorary members, who is also a charter member, is too lengthy to be published in one issue. Only part, therefore, is published herewith. It will be concluded in a succeeding number.—Editor.

INTRODUCTION.

Man's existence at the present time happens to be transpiring during one of the most genial, stable and quiescent periods of the earth's cycle of varied changes. The changes in mind were once believed by many to have resulted from the co-ordination of the eccentricity of the earth's orbit with the different phases of each of the successive complete cycles of the precession of the equinoxes.

Such a complete cycle of precession requires 21,000 years.

In addition to the forward motion that the earth has, in common with the Solar System, towards the bright star Vega, at the rate of 13 miles per second, the earth, as you may already know, has three other characteristic motions. It moves in its orbit completely around the sun, once each year; it revolves on its own axis, once each day; and it wobbles, like an unsteady top in slow motion, once in 21,000 years. It is towards this latter motion that I desire to direct your attention as one of the phenomena believed to be responsible for the truly astonishing changes in the earth's climate, sea-level, etc.,

* Charter Member. Honorary Member. Research Engineer, Board of State Engineers.

that have been noted by scientists as having occurred during the past, and that may be expected to recur.

Attention was called many years ago to certain physical evidences that were interpreted as indicating that very greatly changed conditions had prevailed at times in the past.

The most interesting, and at the same time most puzzling of these evidences were the advance and retreat of the Polar ice caps, and the fluctuations in sea level. Even today there is great diversity of opinion as to the extent of and the reason for these phenomena. It may be well to revert here to a brief outline of events which have led up to the subject chosen for discussion.

No doubt the earliest human beings who peopled the earth must have marveled at the reappearance of the sun by day and of the moon, stars, planets and occasional comets by night. The most observant of them must also have wondered at the more gradual seasonal changes and the shifting of the relative position of some of the heavenly bodies. Those among them who were sufficiently perplexed to ponder over these happenings must have furthermore wondered greatly as to the character of control that was being exerted. In the absence of any knowledge it was no wonder that they should have ascribed such phenomena to supernatural influence and should have personified them as deities.

However, the veil of mystery was gradually lifted beginning apparently about 4500 B. C., in China, India, Egypt and Babylonia. The Chaldaens, Assyrians and Babylonians have said to have been fairly proficient in astronomy as far back as records of these people extend. Sargon the First, King of Agade, wrote a work on Astronomy of which fragments have survived, estimated to have been written about 3800 B. C.¹ Thus it is a factual development that astronomy is the most ancient of the sciences.

It was not until the 6th century B. C. that a Greek named Pythagoras arrived at the fact that the earth traveled around the sun instead of the reverse as had been believed up to that

¹ National Encyclopedia; 1935 Ed., Vol. I, p. 430, Col. 2.

time; yet, more than two centuries later, Hipparcus (known as the greatest ancient astronomer) held to the theory that the earth was forever fixed in the center of the Universe.²

While Hipparcus is usually credited with the momentous discovery—about 120 to 125 B. C.³—of the phenomenon known as the *Precession of the Equinoxes*, or the motion of the Celestial Poles (points in the heavens intersected by prolongations of the earth's axis) among the stars in the heavens, Kid-dinna actually measured the *precession* during the 4th century B. C., and determined its period as 25,900 years.⁴ It remained for Newton, in 1687 A. D., to furnish the true explanation of the causes of the precession and nutation.⁵ During this interim of more than 1800 years, virtually no advance was made in astronomy; but, for the past 250 years, especially in the very recent past, the use of telescopes, photographs, spectroscopes, knowledge of the law of gravitation and of the speed at which light travels, etc., has brought about astonishing advances in astronomy.

The following definition is a typical dictionary definition of PRECESSION in astronomy, physics, etc.:

⁶ "Any motion analogous to that of the axis of the earth in the precession of the equinoxes; the slow steady motion in which the axis of a rapidly spinning top, or the like, describes a right circular cone about the vertical—*Precession of the Equinoxes in Astronomy*: the earlier occurrences of the equinoxes in each successive sidereal year because of a slow retrograde motion of the equinoxial points along the ecliptic, this being due to a gradual change in the direction of the earth's axis caused by the combined action of the sun, moon, etc., on the mass of matter accumulated about the earth's equator; hence this motion of the equinoxial points, or this change in direction of the earth's axis."

² National Encyclopedia; 1935 Ed., Vol. I, p. 431, Col. 2.

³ National Encyclopedia; 1935 Ed., Vol. I, p. 431, Col. 1; and Encyclopedia Britannica, 14th Ed. p. 831, *Rotation of the Earth*.

⁴ National Encyclopedia, 1935 Edition, Vol. I, p. 431, Col. 1.

⁵ Encyclopedia Brit. 14th Edition, *Rotation of the Earth*, Page 831.

⁶ Century Dictionary, 1935 Edition, Vol. II, p. 1376, Col. 1.

The ordinary layman is largely confused by such a definition. However, if one is told that the influence exerted in co-ordination with other factors is credited by many scientists as being sufficient to cause the glaciation of, 1st—the enormous areas in the Northern hemisphere which are recognized to have been deeply covered by polar blankets of ice, while, 2nd—at the same time causing a melting away of a corresponding polar ice cap in the Southern hemisphere, one's interest is more than apt to be instantly aroused.

ANCIENT RAISED BEACHES

It was on January 22, 1904, that a paper entitled "The Place of the Great Raised Beaches—In Geology" was read before the Detroit Engineering Society, by Herbert W. Pearson of Duluth, Minn.⁷

In his bibliography, Pearson included Sir Charles Lyell's "Manuel" and Sir A. Geikie's "Founders of Geology." The great raised beaches that Pearson referred to in his paper were active beaches during the occurrence of the Northern Glacial Ages, at which time the "great flood" in that part of the world extended (according to Pierson) from Northern Illinois to the Amazon and was evidenced by similar raised beaches found in Cuba, Yucatan and the Antilles. The raised beach at Duluth, Minn., known as Boulevard Beach, has an elevation of between 1075 and 1077 feet (depending on latitude) above present sea level, and has a slope of about 4.4' per mile of latitude⁸—the slope being downward towards the south.

Pearson constructed an elevation curve, based on observed elevations of this ancient raised beach, at various latitudes, and, when this curve was projected, its elevation at the North Pole reached 1467 feet above the sea level of today. Pearson explained that the reason the land in the Northern hemisphere appears to be elevated at this time, is because . . . "the precessional oscillation of the earth's axis and the eccentricity of

⁷ Published in the *Journal of Association of Engineering Societies* (copy on file in library of the Louisiana Engineering Society, Room 422 St. Charles Hotel in New Orleans, January-June Volume.)

⁸ This agrees with the slope of the natural surface of the land in the lower Mississippi Valley.

the earth's orbit, the effect of which is an Ice Age alternately in the Northern and Southern hemisphere, recurring in cycles of 21,000 years, a Genial Age being in one hemisphere while an Ice Age is in the other." So he postulated Ice Age cycles every 21,000 years.

According to him, the ice cap is now shifting from the North to the South Pole, and this shifting of ice causes a shifting of the center of gravity of the earth sufficient to account for the great changes that have taken place and that are plainly indicated by the old raised beaches heretofore mentioned. He estimated that the Arctic ice cap of today contains about 1,000,000 cubic miles of ice, while that of the Antarctic is 50,000,000 cubic miles in excess of this. Winter, he claims, now occurs in the Northern hemisphere while we are nearest the sun; and, in the Southern hemisphere, while we are furthest from the sun. Additionally, he claims that it was eleven thousand years ago when these relationships were last in reverse; and, that it will be ten thousand years in the future when the change to present relationships will recur.

CONJECTURES AS TO PROBABLE CONSEQUENCES

If these things transpire every 21,000 years, just think of the difference in conditions as between such time as virtually all of the Arctic ice cap shall have been melted away, and the accumulation of ice in the Antarctic Region shall have simultaneously reached its maximum; and, that other time when the Arctic Ice Cap shall have reached its maximum with no ice left in the Antarctic Region. The scientists have determined that the latter condition was repeatedly reached (several times during the Pleistocene Age) when in North America, its southern limit—as evidenced by the deposit of its glacial debris, Tillite,—was along the Ohio River. Under the circumstances, it would be only reasonable to presume that its southern limit in Europe, Asia and even across the intervening oceans would be found along the corresponding parallel of latitude. Yet, strange to say, most of the geologists claim that in the old world it was much further north.⁹ The extent of such an

⁹ National Encyclopedia, *Ice Age*, 1935 Edition, Vol. V, Map, p. 375 and *Glaciation*, Vol. IV, Map, Opp. p. 588..

accumulation of solid ice would embrace many millions of square miles, and its weight would be so great as to shift the center of gravity of the earth sufficiently to pull the liquid constituent of the earth (its water, oil and perhaps its molten core of lava, etc.) in its direction. Precisely what this would mean, expressed in changes of sea level, is problematical, and could be computed only if we actually knew the thickness and weight of such a polar ice cap,¹⁰ and the extent of the mass of sea water irresistably drawn to it. Since the scientists claim that the earth must be considered as being at best non-rigid, it is even more problematical if expressed in the form of volcanic action, faulting, earthquakes, flowing springs, artesian wells of oil or water, cataclysmic uplifts or subsidences of lands, gradual squeezing up or down of anticlines or synclines, and other related phenomena, many of which continue to suggest themselves.

ADDITIONAL DEFINITIONS AND EXPLANATIONS

It may be well, before attempting speculation concerning any of the above suggested possible resultant phenomena, to quote or present here some additional definitions, opinions, facts, beliefs, surmises, etc., put forth by such authorities as I was able to find in a cursory search, as follows:

1. ¹¹"The pole of the ecliptic is constant and fixed with relation to the pole of the earth's axis, which is constantly changing and revolves slowly around the former, taking about 26,000 years." . . .

2. Duncan's *Astronomy*¹² gives period of complete precession as 25,800 $\pm$ years; and, the nearest approach of earth to the sun, while traveling along its orbit, is termed its perihelion, while its farthest point away from the sun is called its aphelion—reached respectively January 1st and July 1st each year.

¹⁰ Actual thickness of the Antarctic Ice Cap was measured, in 1934, by the Byrd Expedition, through artificial seismic methods, the greatest thickness found being 2200 feet.)

¹¹ Newcomb and Holden's *Astronomy*, 1879, p. 208.

¹² 2nd Edition, Revised, pages 108 and 101, respectively.

3. ¹³ "The position of the axis, however, varies. The disturbances are known as precession, nutation and the variation of the latitude. Precession (often called precession of the equinoxes) is a motion of the earth's axis in a cone whose axis is perpendicular to the plane of the earth's orbit, so that the celestial pole appears to move in a circle about the pole of the ecliptic. The time taken for the complete revolution is about 25,800 years. The phenomenon was discovered by Hipparchus (120 B. C.) and was first explained by Newton."

4. ¹⁴ "The axis of the earth is inclined $23\frac{1}{2}^{\circ}$ from a right angle to the plane of the earth's orbit. Precession is not uniform, being affected by outer bodies, and these eccentricities are referred to as Nutation."

5. Moulton¹⁵ in treating the subject of Precession of the Equinoxes and Nutation lists among the disturbing bodies (other than Venus, Jupiter and the other planets) the moon and the "equatorial ring" beyond true sphere of the earth as causes of perturbances of the inclination of the earth's polar axis, and gives the cycle of precession as 26,000 years.

6. Fath, in his *Elements of Astronomy*¹⁶ states the moon polar radius of the earth is 3949.99 miles, while the equatorial radius is 3963.34 miles—a difference of 13.35, or of 26.7 miles in their respective diameters.

After having arrived at the fact that, owing to the presence of the equatorial bulge, the earth is, in reality, a spheroid, and not a sphere, Fath proceeded to show that it was this bulge that, in cooperation with the moon and sun, caused the slow movement of the plane of the equator known as precession, which is sometimes called the *precession of the equinoxes*, because the movement of the equenoxial points along the ecliptic depend upon the movement of the plane of the equator. He

¹³ Encyclopedia Britannica, 14th Edition, Caption "Rotation of the Earth, p. 831.

¹⁴ American Science Series, p. 209, on file at Tilton Library, Tulane University.

¹⁵ Celestial Mechanics, 2nd Edition, Art. 189, p. 344.

¹⁶ 1st Edition, 2nd Impression, 1926, Art. 13, p. 9.

compared this astronomical phenomenon with the precessional movement of a simple gyroscope.

According to Fath, the ring formed by the equatorial bulge of the earth corresponds to the wheel of the gyroscope, since the spherical portion, although attached to the equatorial bulge, can be ignored in so far as playing any part in the production of precessional movement is concerned.

The earth's axis, and, of course, its equatorial ring, is $23\frac{1}{2}^{\circ}$ from being at right angles to the plane of the ecliptic, and while the plane of the moon's orbit oscillates as much as 5° each way from the plane of the earth's equator, crossing it twice each month, the gravitational pull of the moon, for the greater part of the time, exerts sufficient force to induce precessional movement of the earth. To the moon's influence must be added that of the sun and the planets, other than earth. However, their very much greater distance from the earth gives the moon by far the greatest advantage. Again the sun does not always act in unison with the moon, for the reason that its influence is exerted in the attempt to pull the plane of the ring into the plane of the ecliptic (which is coincident, of course, with a part of the plane of the earth's orbit) while the moon is at the same time attempting to pull the plane of the ring into coincidence with the plane of the moon's orbit, thus creating perturbances in the orderly progress of the earth's precessional movement.

Due to the fact that during the time when the sun and the moon are crossing the plane of the equator they lose the effect of their processional forces, the rate of precession necessarily varies. Accordingly, it is usual to divide actual precession into two component parts: one, because of its constancy, being termed the precessional constant, amounting to $50''.2$ a year, and the other, or variable part, being termed nutation. Without nutation the precession of the equinox would progress completely around the circle of the ecliptic once about every 25,700 years. Due to nutation, however, the circling of the ecliptic is said to be completed once in every 21,000 years.

SHIFTING ICE ALSO A PROBABLE FACTOR OF PERTURBANCE

The part played by the so-called equatorial bulge, motivates the thought that perhaps the reputed alternate melting and accumulation of such a huge mass of solid ice on first one and then the other of the earth's poles, accompanied by the consequent shifting towards them of masses of the water of the sea, might contribute an appreciable part of the perturbances, the aggregate resultant effect of which during ordinary cycles, has generally been accepted to be the reduction of the cycle of the precessional movement of the earth from approximately 25,700 years to a net of 21,000. I venture this thought for whatever it may be worth.

COMPREHENSIVE TREATISE

The most comprehensive treatment of the general subject I was able to find was Sir Robert S. Ball's—"The Cause of An Ice Age," published in 1890-1.¹⁷ Sir Robert ascribes the occurrence of ice ages on earth to purely astronomical phenomena; yet many eminent scientists are not ready to entirely endorse either his hypothesis or the correctness of the data he employed in his computations. He lists certain bibliography, and, later on additionally mentions *Wright's Ice Age In North America*. He cites¹⁸ the Cloghvorra Stone, in Ireland, as positive evidence of the former presence there of the north polar ice cap, and contends that no other agency could have broken off a fragment of that size from a solid rock formation and transported it so far from its source.¹⁹

The cycle of occurrences of glacial ages is given²⁰ by Sir Robert Ball as 21,000 years and he claims that figure is "mathematically correct (a numerical fact)". Later on in his treatise he explains wherein this 21,000 year period is not coincident with the 25,694 year period of complete precession, due to the influence of Venus, Jupiter, etc., citing the astronomical theories

¹⁷ Copy on file at Tilton Library, Tulane University.

¹⁸ Page 1 of his work.

¹⁹ Shown in his frontispiece as being roughly a 20-ft. cube and described on p. 1 as being "more than a hundred tons in weight" and "fifty times as big" and "fifty times as heavy as one of the great Pyramid Stones."

²⁰ p. 36.

of Adhemar and Croll. It would seem, however, that since ". . . . Glaciation and Ice Ages are recorded by the deposits in some rocks of all the eras," (namely, the Archeozoic, Proterozoic Paleozoic, Mesozoic and Cenozoic—spanning perhaps, two or three billion years)²¹ and since, at same latitudes, the raised beaches described by Pearson are said to have reached the identical maximum elevation on each occasion of their existence, it is neither likely that there has been any material loss in the intrinsic heat radiation from the sun—nor is it likely that there has been any progressive variation in corresponding distances of the earth from the sun during such cycles. The evidence of the glacial deposits and of the ancient raised beaches (said to contain some specimen of both dry land and marine fossils of all ages during which plants and animals had developed structures sufficiently resistant to permit fossilization) should be conclusive with respect to the theories concerned.

Be that as it may, Sir Robert Ball avers that the planets Jupiter and Venus are the principal factors causing the perturbations mainly responsible for the production of the Ice Ages. Continuing he remarks—"Thus in the lapse of ages we perceive a slow waxing and waning in the ellipticity of the earth's orbit." Further on he adds—"The matter is, however, somewhat complicated by the movement of the major axis (of the ellipse) itself as planetary perturbation affects the eccentricity of ellipse. So, also, it affects the situation of its axis. The direction of this motion is opposite to that of the line of equinoxes and consequently the time of a complete revolution relatively to the ellipse is somewhat reduced. It follows that about every 21,000 years the line of equinoxes is so placed with reference to the elliptic path of the earth that the difference in duration between the two seasons attains a maximum; what that maximum is depends of course upon the eccentricity of the orbit at the time."

Ball claims that there are at present, in the northern hemisphere, 186 days of summer with receipt of 1.24 units of sun heat (14%); and, in winter, 179 days of 0.75. Moreover, that during glacial epochs the latter figure would be only 0.68, or 7%, and would be 33 days instead of only 7 days longer than the summer

²¹ National Encyclopedia, Geology, Vol. 4, 1935 Edition, p. 533, Col. 1.

period. Further on Sir Robert repeats the importance of the effect of true distribution of heat—63% in short summer and 37% in longer winter—and deduced the following LAW:
“Total heat received in course of a summer, whether long or short, was nearly twice as much as the total heat received in any winter whether short or long.”

Sir Robert Ball concluded his treatise on “*The Cause of An Ice Age*” with a repetition of what he termed the facts that the duration of complete precession is 25,694 years, and that the net period is 21,000, after the effect of the perturbations is allowed for; and with a repetition of his surmise that the Ice Ages are perhaps not constantly 21,000 years apart, but may come 21,000 years apart only at certain times.

PHYSICAL AND CIRCUMSTANTIAL EVIDENCE

(The record of the rocks)

I shall now proceed to list a few of the things that seem to serve as either physical or circumstantial evidence to support the theory so ably presented by Sir Robert Ball, Pearson and the other authorities cited in their bibliographies. You will notice that while the character of some of these approaches the legendary, most of them are physical evidences:

Item (a) Physical geographies, used in high schools more than half a century ago, set forth the fact that there was evidence that a great estuary of the sea extended, at times, from the Gulf of Mexico as far north as Cairo, Ill.; and Pearson related the fact that the ancient raised beach at Duluth, Minn., was more than 1075 feet above sea level of today, besides which, we now know that the coal in the coal fields of Illinois was deposited there as vegetable matter that was subsequently slowly metamorphosed into coal while covered by sea water for, at least, a part of the time, and that these coal seams have never suffered any great dislocation or folding of their structures.

Item (b) The Grand Canyon of the Colorado River, in Arizona, with its depth of more than a mile, and its top width of more than 15 miles, furnishes what is perhaps the greatest visible cross-section of the record of the rocks, found anywhere on earth. On March 13th and 14th, 1935, Douglas Johnson, D. Ph., D. Sc.,

Professor of Physiography at Columbia University, delivered two lectures at Rice Institute, in Houston, Texas, that were intensely interesting and informative.²² The first was on "Evolution of Grand Canyon District" and the second on "Scenery of the Atlantic Shoreline." In both of these lectures Dr. Johnson mentioned continental submergence and emergence, and the plates and drawings he submitted illustrated physical evidence of their occurrence, and established his claim that these phenomena were readily discernable to scientists. But Dr. Johnson made no attempt to account for these submersions and emersions. No one can question the fact, however, that the formations concerned in the case of the Grand Canyon are of submarine origin and that the canyon itself is of sub-aerial origin, having been river cut through strata of metamorphosed deposits of silt and sand, the uppermost of which have an elevation of 8,500 feet above sea level of to-day.²³

Item (c) Heligoland (Helgoland) a small but strategically located German island possession, in the North Sea, having an elevation of about 200 feet above sea level, and being eaten away by erosive wave action at unusually rapid rate, was described in the Review of Reviews in its July 1929 issue²⁴ as follows: "Thus the little island (Helgoland) supposed by geologists to be a projecting point of a vast plateau which disappeared under the North Sea in prehistoric times, is also on the way to extinction."

Item (d) Comparably, there is a record of a submerged "Stone Face and Altar" off the coast of Brittany, France, of which Professor Marcel Beudin took casts. The face is of distinct Mayan type and hoofprints of horses are a feature of the altar, indicating that it had been carved in the rock surface by inhabitants of the "Lost Continent," Atlantis, who are reputed

²² Published in pamphlet form by Rice Institute—Vol. XXII, No. 1.

²³ See The Bright Angel quadrangle of the U. S. Geological Survey's topographical sheets, Coconino County, Arizona, shown on Plate 2, Opp. p. 353, Vol. 47, No. 3, March 31 (1936) Issue of Bull. Geographical Society of America.

²⁴ Copy in Tilton Library, Tulane University, p. 68. Appeared in the Am. Weekly Inc., in 1928, on "Mystery of the Ancient Stone Face on the Ocean Covered Altar" on file in Department of Middle American Research, at Tulane University.

to have worshipped their God Poseidon, to whom they sacrificed horses. This rock was evidently carved when it was above sea level, then became deeply submerged and is now emerging and is within a few feet of the surface of the sea.

Item (e) Ancient writers recorded the legend of the Lost Continent, Atlantis.²⁵ One version is contained in a 2500 year old Greek manuscript²⁶ and is to the effect that Atlantis sank 7,000 to 9,000 years ago; and the people (Aztec, Mayans, and others in Northern Africa, near the Mediterranean, and in western portions of Europe) preserved the legend, as did also Central Americans. However, it was Plato²⁷ who first familiarized the world with the story of Atlantis. He died in 347 B. C. He credited it to Solon who claimed he got it from an Egyptian priest of the Goddess Nieth or Net, at Sais in Egypt, who related that a horde from beyond the Pillars of Hercules (Straights of Gibraltar) appeared and conquered the people dwelling along the Mediterranean, but were later conquered, in turn, by the Greeks, and driven into the Atlantic Ocean where their Continent had, in the meantime, suddenly sunk, leaving only dangerous rocky shallows—thought to be non-navigable waters. However, the most interesting, comprehensive, logical and scientific treatise on Atlantis is Ignatius Donnelly's "Antediluvian World"²⁸ published in book form by Harper Bros., N. Y., in 1882.

Item (f) In the files of the Department of Middle American Research at Tulane University, was found not only the article concerning the "Mystery of the Ancient Stone Face on the

²⁵ Published in the Smithsonian Report of 1915, pages 219-234.

²⁶ According to a clipping on file in Middle American Research Dept. at Tulane University.

²⁷ American Weekly, Inc., 1928. On file at Tulane University Department of Middle American Research.

²⁸ See New Orleans Public Library (R) also for a religious
(572.4)

treatise, see "Secret of the West" by Dmitri Merejkowski (R)
(901 M)

Ocean Covered Altar'' and mention of a Greek manuscript 2500 years old that tells of Atlantis, but also an article on Atlantis, and sunken continents, by Pierre Termier.²⁹ In this article Termier postulates that all that now protrudes above sea level of what was once Atlantis, the Lost Continent, is that portion comprising the islands—Canaries, Azores and Antilles (Cuba).

Item (g) Substantiating physical evidence of a lost continent was dredged from a depth of virtually two miles below sea level of today, near the middle of the Atlantic Ocean during the laying and repairing of the cable between Brest and Cape Cod, when lava that had been air-cooled was brought up in the grapple hooks.³⁰

Item (h) The presence of deeply submerged channels, revealed by various authentic coastal soundings extending through the submerged shelf and slope of each of the continents, furnishes what appears to be the very best of physical evidence that, in the past, there has been either a very great continental emergence, or (more probably) a very great lowering of sea level^{31, 32, 33}. In no other way can their existence be satisfactorily explained. These ancient submerged channels are distinctly traceable in some cases (the Hudson River, for instance), as much as nearly 100 miles beyond the present shoreline, and their outer ends, where the slope of the shelf breaks, have depths of as much as one and a half or more miles below the present level of the sea; and, in spite of the many thousands of years during which deposits have since been taking place, these incised outer ends are still veritable "canyons beneath the sea."³² Francis P. Shepard, also recognized as one of the foremost scientists of to-

²⁹ In Smithsonian Report of 1915, pp. 219-234.

³⁰ In Smithsonian Report of 1915, pp. 219-234.

³¹ Francis P. Shepard (Univ. of Ill.) "Canyons Beneath the Sea"; Scientific Monthly, Vol. 37, 1933, pp. 31-39.

³² Henry C. Stetson (for Woods Hole Institute) "Geology and Paleontology of the Georges Bank Canyons." Bull. Geol. Society of Am., Vol. 47, No. 3, March 31, 1936.

³³ R. A. Daly, "Origin of Submarine Canyons"; American Journal of Science, June, 1936, pp. 401-420. Filed in Tulane Chemical Library.

day, in an article published in the *Scientific Monthly*,³¹ discussed the several ways in which such channels might have been created, but arrived at the conclusion that they were best explained by the river cutting hypothesis—the cutting having occurred when the continents were much higher above the level of the sea than they are at present. He said, in part, “There are a number of reasons for believing that the submarine valleys were cut by rivers. They are found directly off the mouths of many large rivers, such as the Indus, the Ganges, the Congo, the Niger, the Hudson, the Mississippi and the Columbia.”³⁴ He mentioned that certain of these depressions were sinuous, like the rivers that caused them, then resumed “Since the valleys extend to a depth of one or more miles, this hypothesis (river cut valleys) would imply the storing of about one half of all the ocean water during the valley cutting stage. If stored on the lands as glaciers the ice would have had an average thickness of about 15 miles over the entire glacial territory. This seems impossible and incompatible with all the evidence.” The only thing seemingly wrong with his computation was that the vast quantity of sea water that had disappeared from the contiguous oceans at such times, was all figured as “glacial ice” accumulated on lands elsewhere. As a matter of fact, it is only reasonable to assume that under the general hypothesis being discussed only a small portion of it was transformed into “local glacial” ice in the nearest polar region, while still another portion—much larger—was transformed into a heavy general “ice age blanket” spread completely over the polar region furthest away at the time. The portion congealed as a general ice blanket would be of sufficient mass, however, to materially shift the center of gravity of the earth, thereby causing the shifting of the remainder of the absent water to the hemisphere that was then experiencing an ice age,—leaving the oceans in the genial hemisphere greatly depleted,—

³¹ Francis P. Shepard (Univ. of Ill.) “Canyons Beneath the Sea”; *Scientific Monthly*, Vol. 37, 1933, pp. 31-39.

³⁴ NOTE—To this list must be added one other mentioned by R. A. Daly “Origin of Submarine Canyons,” *Am. Journal of Science*, June, 1936, p. 401, namely: Ogowe (W. Coast of Africa). Besides, Daly declares that Submarine Canyons are world-wide phenomena—“planetary.”

while the oceans of the hemisphere completely blanketed with ice would be at complementary flood stage. Because of the fact that the superficial area of the oceans in the southern hemisphere is so much greater than that of the northern, it would, no doubt, follow that the fluctuation between maximum and minimum stages of sea level occurring in the northern hemisphere—accompanying an Ice in the northern hemisphere—would be considerably greater than would occur in the southern hemisphere, and that the greatest fluctuation in each hemisphere would be nearest the poles of the earth, or as near thereto as the existing solidly frozen polar ice cap would allow.

MODERN RESEARCH IN SOUND

By GERALD C. KERR *

Read before the Society March 8, 1937.

Modern Research in Sound can be discussed under two main headings: (a) methods of recording, transmitting, and reproducing sound; (b) control of sound. Since the first phase of this subject has been fully discussed recently before your organization, the present discussion will deal only with modern research in the control of sound.

The importance of sound in the modern world can hardly be over-estimated; we depend on it for communication by speech, for entertainment, danger signals—as an aid to navigation through air and on sea. As an aid to prospecting for oil, oscillograph records are made of echoes returning from deep down in the earth, enabling the oil geologist to more accurately predict good drilling locations. Ultra high frequency sound is also being used to sterilize milk.

The subject of sound and vibration is one of the oldest branches of science. That we have so recently awakened to the importance of sound and sound control is partly due to the whirlwind spread of the art of sound reproduction as evidenced by the sound motion picture and the radio, and is due even more to the clanking, screaming uproar of a berserk machine age. Medical science has given indisputable evidence of the damage uncontrolled sound is inflicting by increasing brain and blood pressure, increasing pulse rate, and by tearing at our nerves.

Some understanding of the physical nature of sound and its propagation will help us understand its control. Wherever and whenever a vibration occurs, be it in the string of a piano or violin, a column of air in an organ pipe, or the diaphragm in a telephone ear piece, the stage is set for the creation of sound waves. Any vibrating object, in its motion, pushes to and fro on the air particles surrounding it on all sides. These

* Acoustical Engineer of Taylor-Seidenbach Incorporated, New Orleans, La.

air particles in turn disturb their more remote neighbors. By this interaction of the air particles, the original vibration spreads out in the form of a bubble of ever increasing size, and if the creative vibration persists, this bubble is followed by similar bubbles, regularly spaced and moving hard on the heels of the first. As the bubbles grow very large, their walls will become so very thin they will finally melt into nothingness. The rate at which these bubbles travel outward determine the velocity of sound, approximately 1100 feet a second. The distance between these bubbles determines the wave length or the pitch of the sound. The strength of the surface of the bubble would correspond to the loudness or intensity of the sound.

A study of the Ear Response Curve of Dr. Fletcher's book, "Speech and Hearing," reveals many interesting facts.

1. The ear sensitivity varies with pitch. There is a whole world of sounds in the insect world too low in intensity and pitch to be heard. Some of these sounds have been amplified by the National Broadcasting Company recently in some radio programs—when the footfalls of a fly were amplified.
2. The ear registers the loudness of sounds in a logarithmic fashion. The unit for measuring the loudness of sound is the decibel. Noises will range from zero decibels to 130 decibels. A few typical noise level readings will aid in understanding the decibel unit.

Traffic noises will vary between 45 and 80 decibels.

Conversation will vary between 40 and 75 decibels.

Private residences will vary from 20 to 40 decibels.

General offices will vary from 45 to 60 decibels.

Office machine-room (tabulators, addressographs, etc.,
60 to 80 decibels.

Automobile horns, 75 to 110 decibels.

Air conditioning compressors, 75 to 110 decibels.

A tri-motored airplane will register 110 decibels.

Heavy gun fire, 130 decibels.

Noises louder than 130 decibels are felt rather than heard. Exposure for a long period of time will cause a loss in sensitivity of hearing corresponding to the length of the exposure. This accounts for the fact that individuals say, "We are used to that noise—we don't mind it." In reality they are sometimes as much as 25 to 40 per cent deaf.

3. The pitch of any sound depends upon the frequency of vibration. Most sounds are composed of energy in several pitches.

Middle C on a piano has 256 complete vibrations or cycles per second. The top note on a piano has 4100 complete vibrations or cycles per second. The lowest note on a piano has approximately 30 complete vibrations or cycles per second.

Office noises occur most frequently between 200 and 2000 vibrations per second.

Typewriter noises are usually between 1000 and 2000 cycles per second.

4. The quality, richness or timbre of a sound depends upon the presence of the high frequencies or overtones. Band-pass Analyzers are now available for measuring the energy in each octave band of the frequency scale. This is of great commercial importance in sound proofing work, especially to the air conditioning industry which is harrassed by many noise problems.

5. The velocity of sound is approximately 1100 feet a second or 700 miles per hour in air. In wood the velocity is 8000 feet per second, in steel 15,000 feet, in water 5000 feet, in earth 4000 feet, in stone or concrete 12,000 feet. The great speed of sound in commonly used building materials illustrates how effectively sound is transmitted through the building structure unless steps are taken to break solid contacts.

Modern research in sound dates to W. C. Sabine of Harvard. Difficult hearing conditions in the Physics Lecture room of the Fogg Museum required a remedy. The room had been built after the plan used for the Sanders Theater, which was noted for its good hearing conditions. It was semi-circular in shape. The Physics lecture room proved to be unusable. The intro-

duction of large numbers of soft pillows greatly improved conditions. The length of time a sound persisted, due to repeated reflections, was greatly reduced. The basic idea of using sound absorbing materials to cut down the repeated reflections was thus born. The term "Period of Reverberation" is now used to denote the length of time which a sound will persist after the source has been cut off. The sound absorbing value of common building materials was established by Prof. Sabine. The reference unit of sound absorbing value was one square foot of open window space, on the theory that all of the sound striking an open window would pass out without any of it being reflected. Thus wood was found to absorb approximately 4%, plaster 2½%-3%, stone, concrete, marble 1% to 1½%. Each member of an audience contributes approximately 4.7%. The importance of the audience on hearing conditions is obvious. The clothing on each member of an audience helps to absorb sound. Each person is equal to 4 to 6 square feet of reasonably good sound absorbing material. Speech requires a shorter period of reverberation than music for ideal conditions. A sound film theater requires a shorter period of reverberation than a concert hall because of the greater length of time which it takes for the louder sounds, louder because of the amplifications, to die away.

The early investigators in sound control devoted their energy almost exclusively to providing good hearing conditions. Prof. Sabine was retained by Johns-Manville and the expense of his researches borne by our company until the time of his death in 1919, because of our interest in the commercial application of his theories. Sabine's researches were continued, and are being continued at the Riverbank Laboratory by his nephew, Paul E. Sabine. Prof. Watson made important studies regarding the reflective characteristics of various surfaces with the use of mirrors at the University of Illinois. Dr. Knudsen has done much significant work in sound at the University of California. Small scale models of auditoriums have been made to study sound diffusion prior to erection of buildings. This is notably the case with the Radio City Music Hall. Ripple tank models have been set up and wave reflections studied by making photographs of the reflections.

The development of the radio industry and air conditioning necessitated further information on sound proofing and sound transmission. Consequently Johns-Manville constructed their acoustical laboratory under the direction of John S. Parkinson at Manville, New Jersey, in 1929. This laboratory consists of a Reverberation Chamber, for testing the sound absorbing qualities of each acoustical material. One hundred tests are made at each of 6 pitches to determine the value of each material. All tests are electrically made to increase the accuracy and reproducibility of the results. A Quiet Room is used for testing the damping effects of various materials, especially those materials such as Silento felt used in deadening the vibrations in automobile bodies, modern metal furniture and sheet metal ducts. Facilities for testing the sound transmission characteristics of various constructions employing full sized wall panels, ceiling and floor units, occupy the top floors of the building. Small scale duct systems have been set up and much information gained of value for the engineer and architect.

This laboratory carries on routine control tests. It also tests and develops new materials for sound proofing and acoustical correction, and co-operates with industry in solving special noise problems; e. g., sound proofing Douglas Airplanes, eliminating noise and vibration from Pullman Company coaches, and eliminating noise from automobiles. Sound proofed rooms have been designed for several companies in the air conditioning field such as General Electric and Frigidaire. A new material has been developed to assist in the control of the noise problems which have been raised by the advent of air conditioning. A new material has also been developed for broadcasting studios, which assists in preserving more of the high pitched sounds and therefore gives more "brightness" and "reality" to the music and speech. Tabulations have been made of noise levels in a great many situations which will be of invaluable assistance to engineers and architects, and others interested in removing objectionable noise from our civilization.

NEW MEMBERS

A letter ballot has been ordered by the Board of Direction on the following new members:

CHARLES CLIFTON BARNARD. Non-Resident Member, age 31. Endorsed by V. J. Bedell, J. T. Bullen, H. M. Gallagher. Four years as Asst. Engineer in charge of construction work of Illinois Terminal R. R., Alton, Ill. One and one-half years Asst. Engineer Wabash R. R.. One year valuation engineer, Frisco R. R. One year W. P. A., part of which was as parish engineer, Webster Parish. One and one-half years Project Engineer, Resettlement Administration. Rating, Junior Engineer on Construction, work includes two hydraulic dams. Address: Minden, La. (Present temporary address: 1603 Broadway, N. O.).

ISAAC C. DANIELS. Resident Member, Age 35. Endorsed by Harry Jacobs, W. Hobson Spaar, L. R. Kirst. Graduate Civil Engineer, Louisiana State University 1927. Draftsman (part time) La. Hwy. Com., November 1922- June 1927. Arkansas Hwy. Com. Bridge Dept., October 1927-1929. Truscon Steel Co., October 1929-February 1930. Ira G. Hedrick, Consulting Engineer, Hot Springs, Ark., March 1930-1931. La. Hwy Com. 1931-1932. Board of State Engineers, 1932-date. Address: 3515 Chestnut St.

ERIC L. ERICKSON. Non-Resident Member, Age 41. Endorsed by C. G. Cappel, H. R. Henderlite, L. J. Lassalle. Assistant Bridge Engineer 1923 to date, La. Hwy. Com. Address: Louisiana Highway Com., Baton Rouge, La.

WILFRED A. FISCHER. Resident Member, Age 32. Endorsed by Jerome Baehr, James S. Janssen, Ralph Lind B. S. from Texas A. & M. 1929. U. S. Engineer Office, 2nd N. O. Dist. June 1929-date in engineering and operations divisions. Present designation is Junior Engineer in Structural Design Section. Design has included steel and concrete, mechanical equipment; work has included mapping, surveying and inspection of construction. Address: 7825 St. Charles Ave.

HAMILTON JOHNSON. Non-Resident Member, age 65. Endorsed by L. J. Lassalle, B. J. Pegues, James M. Todd. B. A. degree, Rollins College, 1893. B. E. degree 1896 and M. S. degree 1897 from Vanderbilt. Designing and consulting engineer in private practice, City Engineer of Jackson, Miss. Engineer

for Mississippi State Bond Improvement Com. 1897-1923. Engineer to the architect of L. S. U. 1923-24. Since 1924 Professor of Mechanical Engineering, L. S. U. Address: 628 Park Blvd., Baton Rouge, La.

N. E. LANT. Non-Resident Member, age 47. Endorsed by C. G. Cappel, L. J. Lassalle, D. W. Godat. 1913-17 designer and detailer, Pan American Bridge Co. 1917-19 U. S. Army, 7th Engineers. 1919-21 Bridge Designer, Indiana Hwy Com. 1921-23 Highway Bridge Engineer, U. S. Bureau Public Roads. 1923-date, Bridge Engineer, La. Hwy. Com. Address: Louisiana Highway Commission, Baton Rouge, La.

H. L. LEHMANN. Non-Resident Member, age 36. Endorsed by N. E. Lant, L. J. Lassalle, H. B. Henderlite. June 1923-28 Chief Tester, N. O. Refining Co. (Now Shell at Norco). 1928-30 Chemist, La. Hwy. Commission. 1930-32 Chem. Test. Engineer; 1932-33 Asst. Test. Engineer, Testing Engineer May, 1933 to date. Address: Route No. 3, Baton Rouge, La.

RICHARD A. MORNHINVEG. Non-Resident Member, age 32. Endorsed by Wm. Whipple, L. J. Lassalle, Fred Fenn. Assistant Supt. for Cuban American Sugar Co. for 3 years; Supt. of Billand's Sugar Refinery in La., during same period. For the past 3 years construction engineer on buildings at L. S. U. Address: 653 Convention St., Baton Rouge, La.

CHARLES A. MYERS. Non-Resident Member, age 36. Endorsed by L. J. Lassalle, B. W. Pegues, H. B. Henderlite. Two years with the American Bridge Co. One year with Illinois Bridge Co. Ten years in the bridge dept. of the Louisiana Highway Commission. Address: La. Hwy. Commission, Baton Rouge.

CRAWFORD POWELL. Junior Member. Endorsed by C. S. Williamson, Wade Barnett, J. Norman Wilson, Age 22. Assistant Engineer, New Orleans Purification Plant. Address: 7725 Belfast St., New Orleans.

EDWARD S. RANDOLPH. Non-Resident Member, age 47. Endorsed by William Whipple, L. J. Lassalle, F. H. Fenn. 1910-date with U. S. Government as draftsman, estimator and designer; Junior Engineer; Assistant Engineer, Office Engineer; Designing Engineer and Construction Engineer. Specialized in design and engineering involving dams, reservoirs, navigation

canal, ports, industrial plants. On leave from U. S. Gov. consulted on harbor work, Nicaragua; wharf and waterworks Colombia; highways and bridges, brewery and smaller works in the Republic of Panama. Address: Balboa Heights, Panama.

R. B. RICHARDSON. Non-Resident Member, age 36. Endorsed by Harry B. Henderlite, J. T. Bullen, N. E. Lant. Two years as Instrumentman with the Louisiana Highway Commission. Ten years as Resident Engineer with the Louisiana Highway Commission. Two years as District Engineer with the Louisiana Highway Commission. At present employed as Engineer of Construction with the Louisiana Highway Commission (last $2\frac{1}{2}$ years). Address: Baton Rouge, La.

ROBERT H. SINGER. Junior Member, age 30. Endorsed by Charles A. Favrot, Armand L. Willoz, C. J. Pierce. Nine years experience in city planning as follows: Four years in employ of Harland Bartholomew and Associate of St. Louis. Five years in employ of City Planning and Zoning Commission of New Orleans. Four months in employ of W. P. A. at Orleans Levee Board Office. At present employed in Designing and Drafting Department of Sewerage and Water Board of New Orleans. Address: 4668 Painters St., New Orleans, La.

J. LESTER WHITE. Non-Resident Member, age 44. Endorsed by C. Glenn Cappel, C. S. Williamson, Jr., L. L. Newman. Three years Maintenance-of-way Department Southern Pac. R. R., Lafayette, La. One year Maintenance Department Louisiana & Arkansas R. R., Stamps, Ark. One year Construction Engineer, Red River and Gulf R. R., LeCompte, La. Two years U. S. Service, World War. Three years general practice, Rapides Parish. Fourteen years Highway and Bridge Engineer, Morehouse Parish. Chairman, Louisiana State Planning Commission, Nov. 16, 1936, to date.

Reinstatements: Charles H. Green, Non-Resident; Hampton Reynolds, Resident Member.

Junior Membership Awards: B. B. Brown, Tulane University, as part of Brown-Ayres Award for Excellency in Physics. B. B. Battaile, recommended by Dean Lassalle of L. S. U. as most outstanding student; Godfrey Coate, recommended by Dean Robert of Tulane.

ACTIVITIES OF LOCAL SECTIONS

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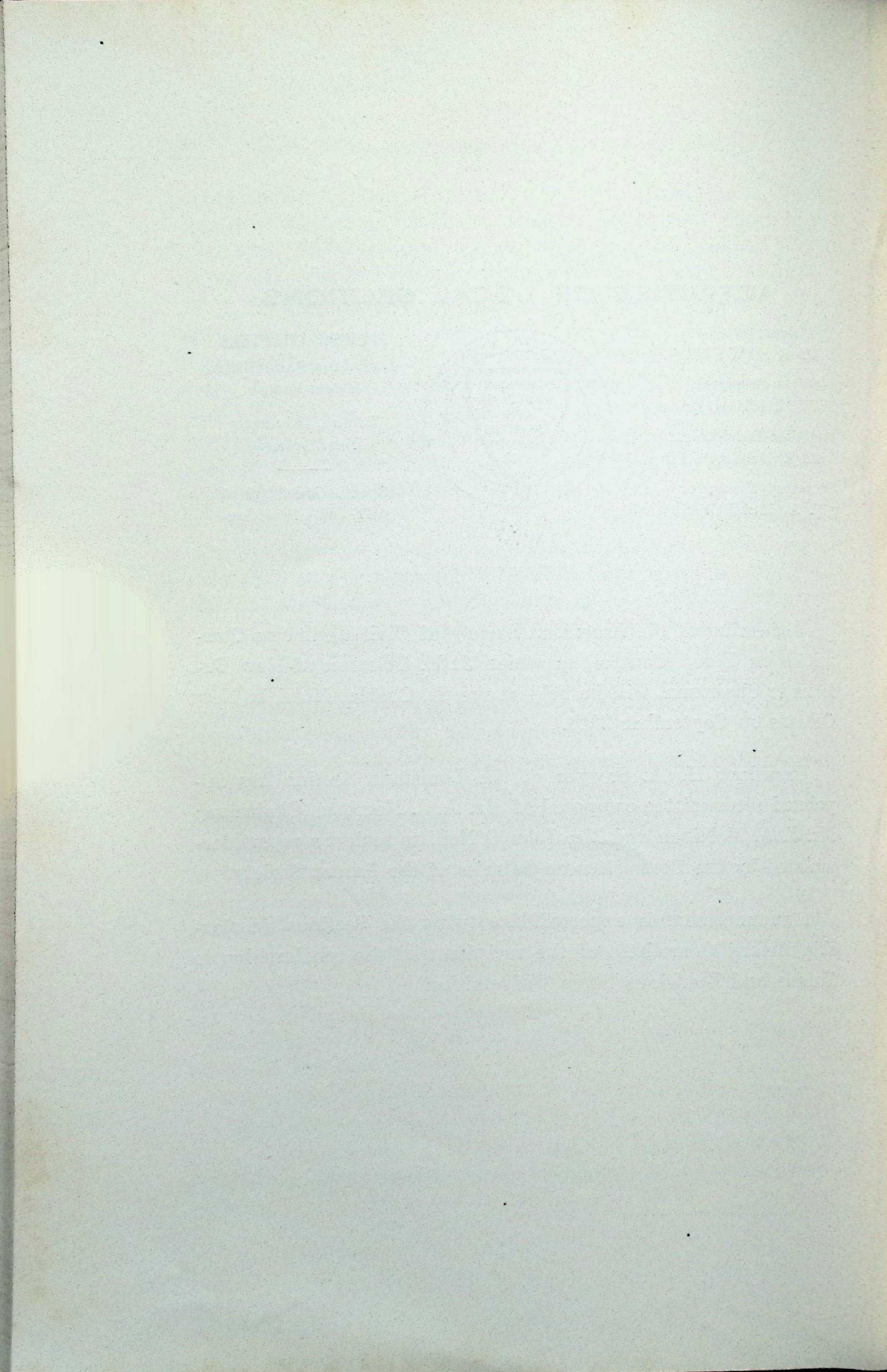
STUDENT CHAPTERS
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Tulane University
New Orleans

Special Meetings at
call of President

A meeting of the American Society of Civil Engineers Committee on Flood Control, of which J. F. Coleman of New Orleans is Chairman, will be held at the St. Charles Hotel in New Orleans on September 28th.

President H. A. Sawyer of the Louisiana Section has appointed a committee composed of Mr. A. J. Negrotto, Chairman; Mr. J. A. McNiven and Mr. John O'Neill to review a report formulated by the Committee on Salaries of the Parent Society.

Announcement is expected shortly by the Sections Scholarship Award Committee of the recipients of the scholarships to Tulane and Louisiana State Universities.



PROCEEDINGS

OF THE

LOUISIANA ENGINEERING SOCIETY

AUGUST, 1937

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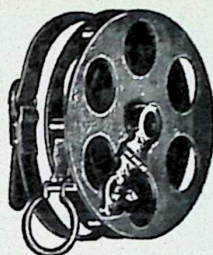
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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

VOL. XXIII.

OCTOBER, 1937

No. 5

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EDITORIAL NOTES AND COMMENT

The Approaching Annual Meeting. Another big two-day annual meeting is in the offing. Mark the dates on your calendar, January 7 and 8, 1938. The committee, headed by Mr. Dave Godat, is now hard at work completing plans for the get-together. This will be the third event of its kind. Each year has shown a steady growth, both in numbers who attend and in interest. The coming meeting will be no exception, and if we can judge by the labors of the committee, those who attend will be amply repaid.

And most especially do we desire the out-of-town ladies to come for the meeting. The Ladies' Auxiliary has planned long and earnestly to make the stay of the visiting ladies both comfortable and pleasant.

We hope that many, many ladies from outside New Orleans will grace our meeting with their presence.

Ample opportunity will be provided for shopping tours, inspections, historical trips, etc.

Herewith we print the technical program as far as it has been arranged.

TECHNICAL PROGRAM FOR 1938 ANNUAL MEETING
Louisiana Engineering Society

Friday Morning, January 7th,
(Hunt Room, St. Charles Hotel).

Keynote Address by Mr. J. Francis Coleman, Consulting Engineer, New Orleans, Past President A. S. C. E. (President C. S. Williamson, Jr., presiding).

Friday Night in Dixon Hall

The Golden Gate Bridge, by Mr. Joseph B. Strauss, (Incoming President of Louisiana Engineering Society, presiding). (Discussion led by Mr. Dave Godat).

* * *

Saturday Morning, January 8th
(Hunt Room, St. Charles Hotel).

The Design and Installation of an 850-pound, 900 Degree F., Boiler-Turbine Unit of 37,500 K. V. A. Capacity.

The Mechanical Features, by Mr. K. P. Kammer, Efficiency Engineer, New Orleans Public Service.

The Electrical Features, by Mr. G. L. Rhodes, Electrical Engineer, New Orleans Public Service.

(Mr. Frank G. Frost, Chairman of the Local Section of the A. I. E. E., will preside during papers and discussion).

A Discussion of the "Licensing of Engineers in Louisiana," led by the Chairman of the Committee on Legislation, Mr. James M. Todd, Consulting Engineer, New Orleans, La.

(Incoming President of Louisiana Engineering Society presiding).

Saturday Afternoon

"Oil Conservation from the Refinery Viewpoint," by Mr. M. J. Rothbone, President of The Standard Oil Co. of Louisiana, Baton Rouge, La.

(Mr. W. R. Stryker, Chairman of the Local Section of the American Institute of Chemical Engineers, will preside during the paper and the discussion).

Inauguration of President Harris. On January 18, 1938, Dr. Rufus C. Harris will be formally installed as the 10th President of Tulane University.

Scholars from all parts of the country will attend the three-day program, and will discourse on various topics in the educational world.

In these various discourses engineering will be represented by Dr. William E. Wickenden, President of Case School of Applied Science, Cleveland, Ohio. He is a speaker of rare magnetic attractiveness, coupled with a scintillating mind. Those who will hear him have in store a genuine intellectual treat.

Fabrication of Structural Steel. Another one of our younger members has come through. Mr. Leal McLean has written an exceedingly interesting article on the shop processes and problems of steel fabrication.

It is the hope that others among the younger members will follow the example of Mr. McLean. We all have a natural reluctance to recite our every-day experiences. They seem so simple to us that we feel others could not possibly be interested. That is a mistake. An interchange of ideas is always profitable to all concerned. We learn only by doing, and nothing is quite so helpful to the younger members as the opportunity to present discussions to the meetings.

It is considerable trouble and labor to get up a worth-while paper. It takes considerable practice and "savoir faire" to present it attractively. But it pays big dividends, particularly to the younger men.

RESOLUTIONS

WHEREAS:

A knowledge of sub-surface conditions, as they may affect the design of foundations is one of the most fundamental necessities of the engineering profession, and

WHEREAS:

Conditions peculiar to New Orleans and surrounding territory make it impossible to depend with safety on data gathered from other areas for the design of important foundations in this locality, and,

WHEREAS:

The collection of records from representative construction of the past, and the recording of such information in a form readily available for all who may have occasion to use it was conceived by members of the Louisiana Engineering Society, and was carried out as a "Project" of the Works Progress Administration, giving us a volume covering more than one hundred local cases, together with much other technical data of a general nature, and,

WHEREAS:

The data so made available to engineers, architects and others will be of inestimable value to the professional and business interests of this section,

BE IT RESOLVED:

That to those who first gave to the Louisiana Engineering Society the idea that such a record was needed and that it could be prepared, and to those who gave of their time and ability for the development of that idea into its present valuable and permanent form, the Louisiana Engineering Society, the engineering profession as a whole, and the people of New Orleans are deeply indebted.

Members of Committee
designated to draft resolution.

Signed: ARTHUR M. SHAW, *Chairman*;
C. J. PEIRCE.
DAVID W. GODAT.

New Orleans, October 11, 1937.

PAPERS AND DISCUSSIONS

FABRICATION OF STRUCTURAL STEEL

BY LEAL C. H. McLEAN *

Read before the Society October 11, 1937.

Mr. President, Members of the Louisiana Engineering Society, and guests:

Mr. Hill has asked me to speak to you tonight, and as he has allowed me to select my subject, I have naturally taken the one about which I know most, namely, the fabrication of structural steel. This item is, in general, familiar to all engineers, but quite often the details are very obscure. The following will be an attempt in very plain language, so that every one will be able to understand exactly what I am talking about.

The term "fabrication" is generally thought to be a simple process of cutting, punching, drilling, fitting together and riveting, with the ultimate result that the steel comes on the job ready to fall right in place. The process, however, is much more involved, and it is the matter of the various shop operations and all the details necessary to secure this end about which I will tell you.

Let us first take for example a typical contract of say one hundred tons, amounting to approximately \$10,000.00. Assume that we have prepared an estimate, which in itself is a detailed list of all the material that is expected to go into the job; that we have quoted on it and have received the order. One of the most important considerations in our business, as in most others, is the approval of the contract and the availability of funds to carry on the work. We must make an investigation whether the contract is a WPA contract, a PWA contract, or for some certain County Board of Supervisors, or some individual project. Naturally before we go into a great deal of work and order material, we must have definite assurance that the bills will be paid.

* Junior Member. Engineer, Jones & Laughlin Steel Corporation, New Orleans.

This brings us to the first step, namely the ordering of material. We have as sources of material the Pittsburg District, Chicago, Bethlehem and Birmingham Districts. With the exception of the Birmingham District, the others manufacture practically the full range of structural materials. Birmingham, however, does not roll any of the wide flange shapes, and up until recently they were somewhat limited on the size of plates. They have made quite extensive additions, and I now understand that they are practically unrestricted as far as plates are concerned.

As you know, each fabricator keeps a file of what we call mill rolling schedules, which are published each week by the various mills in the different districts. These schedules outline what materials and what sizes they intend to roll during the coming week. For instance, one week they may be rolling small angles, small beams and small channels. The following week they may be rolling plates and big channels; the following week possibly big beams and big angles. Practically any combination can exist and is based on the orders they have on hand for various tonnages of the different size materials.

Consequently, you see that our problem in ordering material for this typical job is to select the mill that is rolling the material we need soonest. We may order plates for the job from one mill, the beams from another mill and the angles from still a third mill. This is necessary to co-ordinate deliveries as much as possible, so that all the material will arrive in our plant at the same time.

Naturally in this process of ordering material, if it is impossible to secure some certain size beam either because the rolling of this size is infrequent, or because delivery will not fit in with the other material, we have recourse to substitutions. All this must be done ahead of time, and it is sometimes necessary that we absorb additional weight in substituting certain material to make the required delivery. Once this material is ordered, it is so noted on order sheets and becomes a permanent record which is seldom changed.

Next we come to the preparation of details and the approval of them. Quite frequently it is necessary to make certain changes to accommodate certain architectural details, or

perhaps we have interpreted the drawings in a little different manner from that intended by the architect. We prepare details showing exactly how we intend to furnish and fabricate the material and submit them for approval. The architect in turn will check our details, make whatever corrections are to be made, if any, and return them to us. If any changes have been made, it means changing our details accordingly and re-submitting them, so that before any fabrication is actually started we have a complete definite and permanent record of how the material will be fabricated piece by piece. It is essential that the records of the drawings which are finally approved be complete in every detail. These drawings are then sent to the shops slightly before the receipt of the material from the mill and go into the shop files. When the material is received from the mill, it means assembling same, marking, stacking, cutting from stock, so that everything will be at hand when work is actually begun.

In ordering material we attempt to order only the main members, long angles, big plates, heavy beams, etc. All of that material that goes into what we call the detail work, such as clip angles for beam connections, wall bearing plates, column base plates, bolts and rivets, we draw from our local stock. This local stock is complete in every respect, and in addition to selling the stock material to various users, we draw from this stock for our shop detail work. We have on hand some 10,000 to 12,000 tons of material of all sizes, shapes and description.

We come now to the beginning of actual fabrication, the first step of which is making of templates. These templates are of three kinds, steel, wood and paper.

When we say paper we mean a comparatively heavy cardboard. If, for instance, on any certain job there is a great deal of similarity, there will be any number of connection angles exactly the same; likewise bearing plates or small strut members, gusset plates, etc. The paper template is made, the holes laid out and this material is then punched from these paper templates. If the quantity of each of these items is large, instead of using paper templates the template would be made of light steel sheets, because the paper would get torn and ragged in handling.

Steel templates are also of another character—what you might call heavy steel templates used in cases of heavy truss members for bridge connections. Where it is necessary to drill the holes the drilling is done through these heavy metal templates. This likewise eliminates a great deal of the ordinary inaccuracies of punching, and to a great extent does away with reaming.

We come now to the wooden templates, which are used on our spacing table. This spacing table consists of a large size punch and a long steel track on which operates a carriage propelled by a big hand wheel similar to a pilot wheel on a boat. These wooden templates are made of cedar board, and in each case where a hole is required, a nail is driven into the board. These boards are then clamped in position on the runway and the carriage is operated above. The material to be punched is on a set of rollers and one end is clamped on the end of the carriage. The carriage is then propelled and a small trigger engages the first nail. This trips an automatic lock which holds the carriage in a fixed position while the man at the punch head pushes in a positive punching bar, the punch operates and the hole is punched. At any single operation we may punch 1, 2, 3, 4 holes, as the case may be. For instance, in punching the chord angles of a plate girder, cover plates which have four or six lines of rivets are punched in the same manner. The man operating the carriage then throws in a release, propels the carriage until the trigger hits the next nail, the locking device is tripped, the carriage locks and another set of holes punched, and so on throughout the entire operation of punching these holes. They may be spaced very closely, perhaps three, four or five inch centers throughout the length of material, the latter sometimes seventy or eighty feet.

During the time that the detail work is being done, an entirely different routine is being followed in the shop superintendent's office.

In routing and planning our work through the shop, we employ what we call the lot number system. This consists of a very accurate study of the drawings by the superintendent, separating all those pieces of the same character of work, (for

instance, all plain punched purlins or all purlins with connections, all plain punched beams, etc.), into certain groups to which is applied a lot number. This lot number is set up and marked for operation on the different machines. Each machine has different characteristics—a high speed punch for light work, a heavy slow punch for heavier work, and of course the drill press which takes that material which is too heavy to be punched. In this routing and planning and assigning lot numbers, the superintendent must take into account all the different classes of work and the speed with which each kind can be done, in considering the schedule which has been laid down for delivery or for erection. In other words, we would work in the first group, assigning different lot numbers to all that material that goes into, let us say, the South end of a certain building which would comprise the first shipment, the middle of the building a second shipment, and the North end a third shipment. Thus at the conclusion of the work we have a means of determining accurate costs on each of the different classes of fabrication by assembling the total shop labor applied to these different lot numbers which covered all the same class material.

This routing and planning is done for the sake of economy in operation, and to have and maintain an accurate cost record of the work which we apply from time to time to future work of the same character. Ultimately this routing through the shop should bring the material out to the end of the line of operation, or rather to the shipping department at the same time, so that shipment can be co-ordinated and the correct material shipped for that portion of the work which is required first.

In the actual fabrication we have the detailed work already referred to, the template work and the heavy work on the different machines. It has become a general practice here lately, for instance, in plate girder work, that instead of punching each individual member, such as web plates, chord angles, cover plates and stiffeners and then assembling, we assemble the material as a unit and tack weld it together. Then as a complete unit it is sent to the drill press and the holes drilled entirely through, which in some cases might mean through as

much as three or four inches of metal and take into account two or more cover plates, chord angles, etc. While this operation is very expensive, it ultimately saves considerable cost in assembling this unit, because frequently it would be necessary to ream each hole in order to drive fair rivets.

Each of the different machines is particularly adapted to different classes of work, and all this is taken into consideration in routing and planning of material through the shop. In this routing and planning, the cards for each worker are all made out, put into a rack and he has only to take his card to see what lot number and what material has been assigned to him for that particular day or part of the day.

When most of these operations have been completed, the material then goes to the assembly line, where it is put together, bolted, primed, squared, and moved down the line ready for reaming or riveting, as the case may be. Bear in mind that the holes are always punched slightly larger than the size of the rivets to be used, and each end connection of each beam must be squared up before the rivets are driven, so that when it is swung into place there will be a flush connection and the men in the field will be able to drive tight rivets. Also, it is important that connection angles, clip angles, etc., are put on the proper side of the beam, so that when it gets in the field everything will go together smoothly.

The reaming operation need not be gone into thoroughly. I am sure it is quite clear that (with the ordinary inaccuracies of fabrication) after material is assembled and put together, it may be that all of the holes do not fall exactly as they should and some little reaming is necessary in order to drive the rivets. Heavy work such as bridge girders, railroad girders, bridge trusses, etc., usually are specified to be completely assembled in the shop and every hole reamed and the pieces match marked. Thus when the material is erected each piece falls in exactly the same place as when it was assembled in the shop.

Riveting is the next operation and a very interesting one. We use three kinds of riveters, namely, stationary bull machines, movable bull machines and the ordinary hand guns. For light plate girder work, where there is a great number of

rivets all in a straight line without any obstruction, we would use the stationary bull machine. The material would be moved along, a hot rivet inserted, swung in place, the bull machine clamped and the rivet driven and the same operation repeated until each of the rivets, which may be on very close centers, are driven.

The movable bull machines are more flexible, but not quite so economical as the stationary bulls. These machines are hung from an overhead gantry crane system and the material is placed on horses, lined up and leveled. For instance, a heavy truss that would have big groups of rivets, perhaps fifty or more, within a radius of a few feet, are always done with movable bulls. The same procedure is followed, a rivet is heated, is thrown and caught, inserted in the hole, the machine clamped and that rivet driven. These bull machines operate on compressed air. After any certain group of rivets have been driven, the machine is then swung into a new position and a new group of rivets driven.

This brings us to the hand guns. These are used where the rivets are widely scattered or few in number, and consists of the ordinary driving guns with a buckler-up on the other side. Also, if the rivets are inaccessible to the bull machines, they must be hand driven; if the edge distance from the rivet to the edge of the material is too great for the throat of the bull machine, they must necessarily be driven by hand.

This takes our material along the assembly line to where it is marked in accordance with marks on the detail drawings and is then ready for the paint shop.

We employ a method of sandblasting which consists of a sandblast pit. It is nothing more than an enclosed area where every piece of material is gone over with a sandblaster. We have found that this produces a much better job and is more economical operation than ordinary wire brushing with a hand brush or with a rotary machine brush. Furthermore, it does more to remove the rust completely and also the mill scale. Mill scale is sometimes very difficult to remove with a wire brush and may remain in place until after the material is painted, and then, due to dampness, flake off, consequently

leaving an unpainted spot subject to corrosion. All this material, which has already been marked, must have the marks transferred and then painted with paint sprays, except in inaccessible places, which may have to be painted by hand. The material is stored, allowed to dry and is then ready for shipment. The sandblast process so thoroughly removes all the surface coating of rust and rust scale, that the material is actually reduced to the raw metal and greatly resembles a freshly galvanized piece of material.

After sandblasting in this condition, the material can be held prior to painting for about twenty-four hours. Longer than this, rust begins to collect of a fine dusty nature, which can in most cases be very easily removed with a broom or wire brush. However, in damp weather, or if the material should be rained upon, it is necessary to sandblast it over again.

With this in mind, you can see that it is necessary to co-ordinate the sandblasting and painting so that an attempt is made to sandblast only as much material as can actually be painted the same day.

All the above outline has been given with the idea that there is but a single job going through the shop at one time. All the co-ordination that I have outlined is necessary for any single job. Naturally you can well see what the problem becomes when there are 15, 20, or more jobs all to be co-ordinated at the same time.

In closing I would like to mention the fabricator's bugaboo, changes.

After drawings have been approved, the work placed in the shop, and in a great many cases the steel is actually fabricated, certain changes become necessary to accommodate a changed schedule of field construction, or perhaps some changed ideas of the owners or the architects, additions or omissions, as the work proceeds. These changes are governed by whether the job is spending more money than was anticipated or whether they find that additional money is available. Each of these changes, as you can see, goes back to the original drawings, and the same process of making drawing changes and having them approved must be followed. The changes, if

they are very extensive, will sometimes quite severely disrupt the shop schedule and hinder the work in progress.

This brings us to a completed job. The last thing to be touched on is the method of payment. Jobs may be taken on a pound price basis, a lump sum basis, or a cost plus basis. For the pound price jobs the weights are determined in accordance with the Code of American Institute of Steel Construction and are composed of a series of shop bills, which list each piece of material by mark, each clip angle, and the rivets, bolts, etc. These shop bills are weighed and the weights checked. From this sum total we arrive at the final weight for the job and usually submit blueprints of these shop bills to either the architect or the engineer or the Highway Department, in order to substantiate our own calculation of the weight involved.

On lump sum jobs, of course, no one is interested in the total ultimate weight except ourselves, and to us it is a very important consideration. Any changes which have been made because of substitutions, etc., must be accounted for, and naturally we work towards keeping the weight within our estimated limits.

On cost plus jobs, the determination of the final weights is exactly the same as on the pound price basis, except that instead of being billed at a fixed pound price the material is billed on a cost plus basis.

This about brings me to the end of my talk. I have enjoyed the opportunity of speaking to you.

Thank you.

“Mrs. Jones, dad wants to borrow your corkscrew.”

“All right, Jimmy, tell your dad I’ll bring it right over.”

CHANGES ATTENDING AN ICE AGE

BY GERVAIS LOMBARD.

(NOTE: This is the second and concluding installment of Mr. Lombard's article.—*Editor*.)

¹An illustration, under Item (h), is furnished by the existence of what has the appearance of being a submarine-canyon found off the mouth of the Mississippi River. This canyon is thought to have been incised by the Mississippi during the past when the Gulf of Mexico was depressed far below its present level.

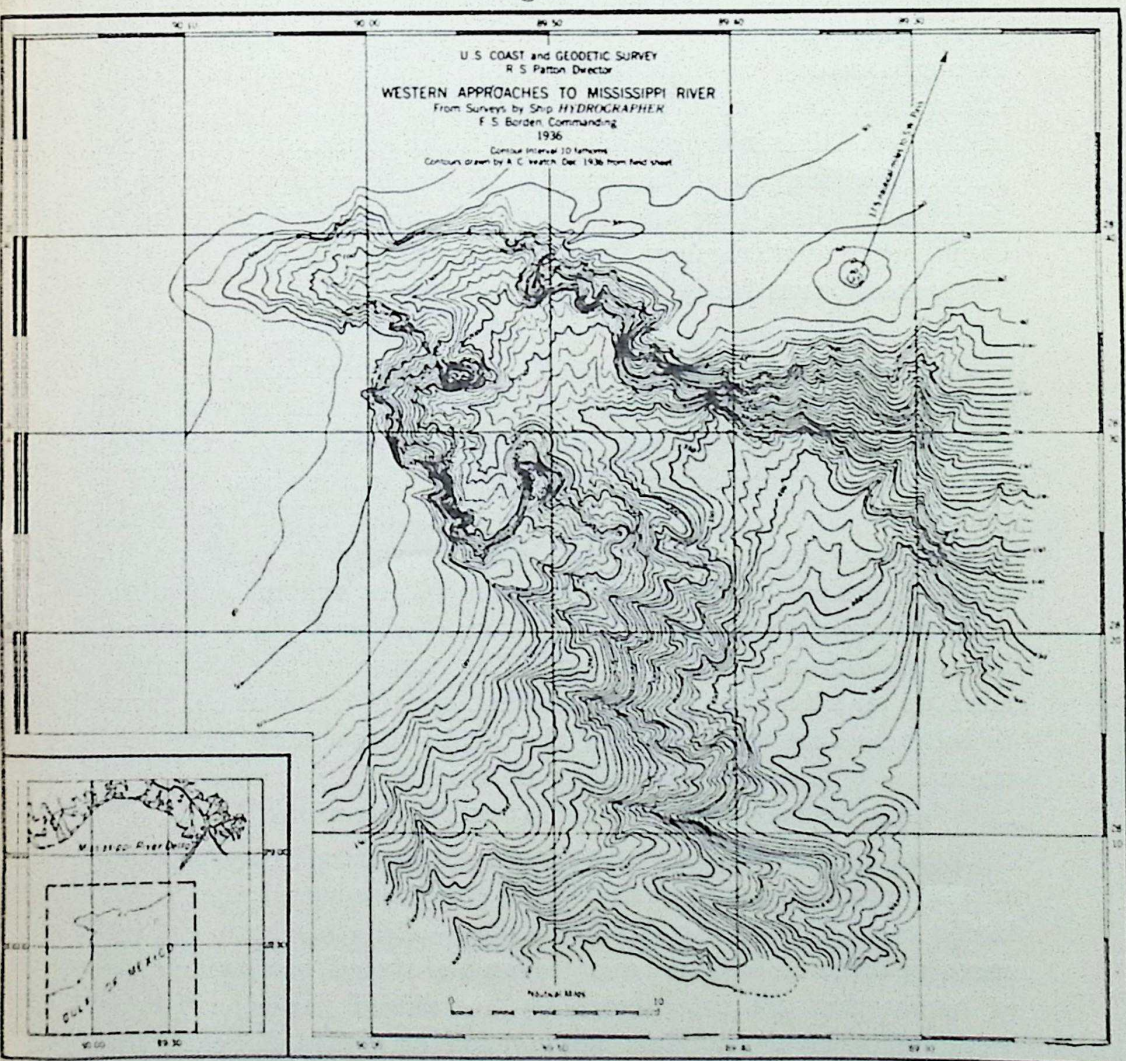
It was Dr. A. C. Veatch who compiled a chart styled by him "Western Approaches to the Mississippi," that shows the details of the contours of this submarine canyon. (Figure 1.) This canyon, which has recently been most accurately surveyed by Lieut. Commander F. S. Borden of U. S. Coast and Geodetic Survey, is not in straight alignment like the greater part of the remarkable off-shore canyon opposite the Hudson, but is curved or crescent shaped in a way that bears out Shepard's statement that some of these so-called "river-cut" submarine canyons are sinuous, like the rivers that were supposed to be responsible for their cutting. The shoreward ends show the most curvature, as a rule.

This Mississippi River canyon will be found to be a truly remarkable one; and, if exposed to view (as it must have been at the time it was incised and sea level was, no doubt, greatly lowered) would inspire even more wonderment and awe than the Grand Canyon of the Colorado does at this time. It would indeed be a show place to all, and a veritable mecca for Geologists. Its head is located approximately 100 miles southeast of the mouth of the Atchafalaya, 48 miles south of the mouth of Bayou Lafourche, and 59 miles southwest of the mouth of the Mississippi.

¹See The Field Engineers Bulletin (No. 10, December, 1936) of the U. S. Coast and Geodetic Survey, which contains on pages 156 and 157 maps showing the character of the topography on the Coastal Slope off our Eastern Coast.

This canyon is covered by 50 fathoms of water at its head, and by 530 fathoms at its outer limits (so far sounded) and extends generally in a southeasterly direction. Its length is over 45 miles and its maximum top width is more than 26 miles, while its greatest depth is more than 3180 feet. In his brief remarks concerning it, Dr. Veatch called attention to its great virtually flat bottom width which he, in the absence of other proof, interprets to mean that subsequent to being incised, or perhaps being created by faulting or folding, it has "graded

Figure 1



up" greatly with deposit. He called attention to the "pimple" or hump a little off its eastern edge, surmising that it would probably be found to be the crest of a coastal salt dome. I believe you will concur with me in my speculation that three other such "domes" are apparently indicated, as follows:

One at $28^{\circ}-37'$, $89^{\circ}-52'$, covered by about 120 fathoms.

Another at $28^{\circ}-33'$, $89^{\circ}-56'$, covered by about 80 fathoms.

The third at $28^{\circ}-28'$, $89^{\circ}-52'$, covered by about 100 fathoms.

Dr. Veatch unhesitatingly averred that the submerged canyons along our eastern continental shelf were stream eroded through clearly undisturbed coastal plains, of Tertiary and Cretaceous Age, when this area manifestly stood about the level of the sea. He is not certain of this being true, however, in the case of the canyon off the mouth of the Mississippi, where he finds indications that the topography might owe its form to deep seated disturbances, but, that even so, its sides were, in his opinion, manifestly etched by stream erosion.

The location of the head of this canyon might lead to the assumption by some that it could not have been incised by the Mississippi River; but, when we recall that during the flood of 1927 (when a stage was reached that was only a few feet higher than any previously experienced) water from the Mississippi escaped as far west as the Vermilion River, 150 miles from the present mouth of the Mississippi River, it is not difficult to understand how the location of its ancient sub-aerial canyon might be expected to be found at any place between Pearl River and the Vermilion. The course of the 10 fathom contour on a location chart, also sent me by Dr. Veatch, seems to indicate that the mouth of the Atchafalaya may have been the place where the Mississippi debouched into the sea, probably being deflected there via Bayou Plaquemines.

Item (i) A supplementary item of apparently equally convincing physical proof is said to be the presence, along the Atlantic coast line of the United States—and elsewhere—of terraces or tiers of both submerged and elevated scarps or faces of banks that are interpreted by certain of the scientists as being respectively, ancient submerged or elevated beach for-

mations, one above the other.² The lowest of these are found nearly two miles below present sea level. It is claimed that the existence of such of these formations as are submarine is indicated on some of the more recent charts of the U. S. Coast and Geodetic Survey. These charts were declared to be based on careful routine soundings taken in the same scientific way that also revealed the presence of the submerged "river cut valleys" above described. The method employed is known as echo sounding and is a recently developed accurate and rapid way³ of ascertaining ocean depths and charting coastal "isobaths" or submarine contours. This method consists of supersonic frequencies electrically emitted from the bottom of the boat. These sounds travel to the bottom of the ocean and are echoed back through the water at an easily established rate of travel (approximately 4,800 feet per second under usual sea water conditions). The computation of both depth and position of closely spaced soundings along continental coast lines is quite simple and almost absolutely accurate.

Item (j) Some of us may be inclined to treat the ancient accounts of the sinking of Atlantis into the sea as purely legendary, and to look askance even at the biblical story of the "Deluge"; but is it not passing strange that all the peoples of the earth—even the isolated South Sea Islanders—have handed down to posterity the story of the Deluge in one form or another? In January, 1930, issue of the *National Geographic Magazine*, appeared an unusually interesting illustrated article⁴ by Mr. E. L. Malloway, concerning the archaeological excavations conducted at the site of Ur, the City of Abraham, in the land of Sumer (now a part of Persia), north of the Persian Gulf. In 1929, the expedition decided to excavate beneath the ancient cemetery site which had been found to contain burials that had been laid down as far back as 3,500 B. C., and that had

²Accounts of which were broadcast over the radio recently, and mention made in *Time Magazine* shortly prior thereto.

³Capt. R. S. Patton "A Profile of Shoal Water Depths by Echo Soundings." (Echo method used by U. S. Coast and Geodetic Survey, for deep sounding for over 10 years, and, for shallow water soundings only during the last year or two) *Science*, November 6, 1934, p. 421.

⁴"New Light on Ancient Ur." (Photographs by the British Museum and University of Pennsylvania).

already yielded the oldest and most magnificent treasures. The excavators were astonished to discover that the cemetery itself laid over a very ancient rubbish heap that had accumulated at the foot of one of the highest mounds in the city, and that this rubbish heap was obviously older than the cemetery, else the Sumerians would not have knowingly buried their royalty in or over such a heap which necessarily must have been completed before the interments could have been made. The scientists concerned claimed that the trial pits, excavated in 1929, furnished indisputable geological evidence of the biblical story of the Flood—in the form of merely a clean water-laid stratum of clay eight feet thick, beneath which, in turn, was found the remains of the most primitive civilization of Ur. The question immediately arose among the archaeologists as to whether or not this stratum or bank of clay was laid down by the great flood of Genesis, and was therefore not local, but definitely pre-Sumerian. It so happens, that among the treasures recovered at Ur was a graphic (stylus) record of the fact that the Sumerians had produced a "Noah" whose dairy-like account related the story of the "Deluge" as having been witnessed by him while aboard the "Ark"; and, it is indeed a coincidence that this evidently very ancient stratum—"that only a World flood could have deposited"—was found beneath the chief city of his land. The city of Ur was situated on or near the banks of the Euphrates River, and it has long been claimed by the scientists that the valley of the Tigris and Euphrates, north of the Persian Gulf, emerged from the flood (of Genesis) about 8,000 years ago and has since been gradually elevated, progressing successively through conditions first of marshy, then of arable fertile valley loamy land, and finally of the arid sandy desert land of today.

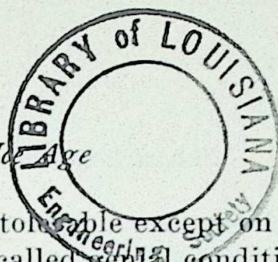
Item (k) A great number of estimates of the age of the earth—many of them unscientifically estimated—have been made but the most reliable are now said to be based on measurements of radioactive contents of the oldest rocks, and indicate an age for the earth of . . . "between one and two thousand million years. Nearly half this time had run its course before plants or animals had developed structures sufficiently resistant to permit fossilization. The duration of man's existence is but one-tenth of one per cent, or less, of the earth's history.

The idea of continental glaciation was developed by Louis Agassiz in the middle of the 19th Century, in the face of much opposition. If the occurrence of continental glaciation alternating at intervals with genial ages—is taken into consideration, the method of computing the age of the earth by such things as the rate of recession of waterfalls (like that at Niagara) must be revised accordingly, since the stream would be frozen and not be running over the falls for long periods of time, and since the concurrent elevation of sea level would tend to lessen the fall even though the river should not be solidly frozen during any less rigorous portion of the Glacial Age. On the other hand, when a genial age prevailed and the sea level was very greatly lowered, the height of the fall would be much increased and its kinetic energy greatly intensified.

Item (1) Physical evidences of genial conditions in the Arctic region, where coal outcroppings were found in Greenland, Spitsbergen and Iceland, have been known for some years; but, it was only very recently that the geologists who accompanied Admiral Richard E. Byrd on his 1928-30 and 1933-35 Antarctic expeditions discovered the fact that, within 182 miles of the South Pole, there are not only many outcroppings of coal seams, interbedded with sandstone formations, but fossils of leaves, branches and even trees (petrified) indisputably establishing the fact that this great polar continent was covered with vegetation for at least a part of the time during the past. The fossils gathered by Admiral Byrd's geologists are now being studied and classified at various universities in the United States. We must wait until their reports are made and properly oriented before we can learn the facts revealed by the presence of these fossils 'mid the surroundings in which they were found in Antarctica. It is my expectation that these revelations will be found to be compatible with the theories expounded by Sir Robert S. Ball, and to confirm my own convictions concerning the tremendous changes in climate, sea level, etc., that must have attended such cycles of the precessional movement of the earth as happened to synchronize with the phases of the other astronomical factors necessary to produce glacial ages.

**SIGNIFICANCE OF THE RECURRING PHENOMENA
OF GLACIATION**

If, in the light of the foregoing presentation of my topic, the occurrence of the alternating Genial and Glacial Ages,—including the attendant changes postulated, either in cycles of 2100 years or at much greater periods of time—can be accepted as having been established in fact as well as in theory, what then would be its significance? Would it not mean that a better understanding will be had in future of many of the happenings in nature that have heretofore been considered puzzling? Could we not then plausibly explain the repeated submergence and emergence of whole continents and of innumerable islands and archipelagos, whose relative forms and stability must have remained virtually unchanged for perhaps one or two billion years; yet, at the same time, be able to reconcile the fact that relatively minor cataclysmic changes do occur locally, now and then, along the coast lines and even in the interior of the continents, as well as far out in the oceans? Would not the probable underlying reason for the great prehistoric migrations of both men and beasts be better understood? Would not the transplantations of flora from continent to continent and the extinction of ancient forms of both fauna and flora and the appearance, later on, of different forms on the same continent be more easily explained? Would not the elevation or the depression of sea level, by a mile or more above or below present sea level convert estuaries and marshes into raised plateaus, hills into mountains, and vice versa? Would not the emergence of continents to heights above the usual cloud levels produce constant cold peak (local glacial) conditions that might be expected to wring the last atom of moisture from the humid atmosphere rising from the surrounding oceans and moving overland, before the inland basins were reached, thus rendering the interior lands barren deserts? Would not the increasing relative inclination of continents tend to intensify the rate of seepage towards the equatorial seas, lowering the water-tables in the upper terrain at increasing rates—especially where man has drilled deep wells further down the slope in search of artesian water-supply as other sources failed? And would not the heat and aridity, even in



the temperate zones of today, become intolerable except on the high mountain slopes at such time as so-called glacial conditions were shifted to the very poles of the earth, first on one hemisphere then on the other? Would it not be easy to explain first, why the continents in the northern hemisphere now appear to be relatively tilted towards the south compared to the time when the great raised beaches were active beaches; second, why for that reason the rivers, for the most part, now run southward, yet some of these same rivers—like Red River of the North—at times reversed their direction of flow; and, third, why the water and oil in the permeable sand strata also tend to move southward in the northern hemisphere at this time, and furthermore tend to accumulate where obstructed by faults in the earth? Could not these faults themselves be explained as having transpired either because of relief from pressure against the shore of the continent when the sea level is reduced, or, perhaps in some instances, because of the re-application of this pressure during glacial periods? Could not the forcing up of igneous rock, salt domes⁵ and other older structures through the less ancient formations be accounted for especially when it is remembered that the earth as a whole cannot be considered as being absolutely rigid? Under the circumstances, would it not seem natural for various and sundry readjustments to transpire—some of them perhaps being cumulative under widely separated recurrent stresses? And last, but not least, would not the belief⁶—largely accepted, up to the present by scientists—that the Ice Ages, or so-called Glacial stages, are coincident with maximum continental emergence prove to have been a most confusing illusion? (Note—Concerning this last query, the writer submits the thought (1st) that the glacial evidence identified with depressed sea level conditions, originated with local high peak glaciers during periods when emergence was sufficiently great to create them; and (2nd) that the melting of the ice at the foot of such

⁵Geological Bulletin No. 1, Department of Conservation, "Geology of Iberia Parish," pp. 107-108, Quotation from De Golier's "Discovery of Potash Salts and Fossil Algae in Texas Salt Dome," 1926.

⁶Paul McClintock & Horace G. Richards, Bull. Geological Soc. of Am. Vol. 47, No. 3, (March 31, 1936), p. 293.

local glaciers, plus copious coastal rains would, in spite of the absence of major rivers, supply the volume of tumbling water and the kinetic energy required to incise the Georges Bank and other "submarine canyons" about the origin of which there is so much conjecture.⁷

EVOLUTION OF COAL DEPOSITS

Pearson, who seemed chiefly interested in the location of coal deposits, went so far as to estimate and to chart the changes that would occur in the location of the Ocean Currents due to the momentous changes in both climate and sea-level postulating that in the past they would have involved various places (some of which have since emerged from the sea) where areas corresponding to the Sargasso Sea, would have accumulated and deposited sufficient vegetable matter to bring about the formation of coal seams. (Note.—Perhaps the coal seams in the polar regions were created in this manner and in this connection it is interesting to know that, as a result of the discoveries made by Byrd's Antarctic expeditions, it has been "estimated that the second largest coal reserve in the world lies buried in Antarctica.")

MENACING CHANGES

Man is already endeavoring to conserve both water and power supply by constructing enormous engineering works in the semi-arid areas, and to make life more certain and bearable in many ways through scientific developments including water purification and air conditioning but, more than likely, his ingenuity will ultimately be taxed to the limit to meet the changes in vast basin areas and other places, which changes now seem so far away. But, none the less, they appear under the hypothesis considered to be ultimately inevitable.

STUDY NO. 1

(Transitory Datum Planes)

For one thing, we civil engineers who are accustomed to referring elevations to sea level may not have to be specially concerned for the immediate present, when the center of gravity of the earth appears to be not very far removed from its

⁷Henry C. Stetson, "Geology and Paleontology of the Georges Bank Canyons." *Bull. Geological Soc. of Am.*, Vol. 47, No. 3; p. 353.

quiescent or normal position, but, in order to keep the record straight under the hypothesis in mind, we will, in time to come, have to adopt a more stable and reliable datum plane than the fluctuating surface of the sea.

With the changing conditions that might be expected to prevail, under the hypothesis being discussed, it would appear that at such periods as the earth's center of gravity is being shifted by ice accumulations, we would have to make allowances for certain discrepancies that would enter the picture whenever precise levels were run first, at *one* time, from recognized and well established datum planes, in one latitude, to locally used well placed bench marks situated in another latitude—such, for instance, as the levels run, by the Corps of Engineers, U. S. A., from Cairo, Ill., to Biloxi, Miss.—then were rerun between these same termini at a materially later time.⁸

In the light of all the evidence that seemingly supports the general hypothesis in mind, and, under the conditions assumed to govern, in a case like this, it would certainly not seem to be amiss, during the periods of most rapid shifting of the center of gravity of the earth, to expect discrepancies to appear that would be directly due to the relative amount of change in sea level that would occur in the interim at the termini concerned. If the changes that would be involved can be compared to what occurs with respect to the elevation of two points in a flat inclined plane (for convenience a flat plane was employed in place of a curvilinear plane) when the plane is further inclined by raising its upper end relatively more than its lower end, let us see just what might be expected to occur in the assumed case.

Figure No. 2 is a sketch designed to graphically illustrate what would occur:

Along the solid line in Fig. No. 2, let A represent the location of the latitude of the Amazon, at the Equator; B, Biloxi; C, Cairo, and D, Duluth. Now, increase the slope by additional tilting (to correspond with the dotted line shown—a, b, c, d.).

⁸See Historical report (in 3 volumes) entitled "The Improvement of the Lower Mississippi River for Flood Control and Navigation," U. S. Waterways, Experiment Station, May 1, 1932, pages 146-147. See also, Appendix "C." Statement of Mississippi River Commission, on Relation of Datum Planes—Cairo, Memphis and Mean Gulf—Proceedings, La. Engineering Society, Vol. 5, December, 1919, Issue, pages 310-311.

It is obvious that B, C and D have changed elevations in proportion to their distance from A, and that C has changed more than B—the difference probably being sufficient to account for discrepancies that could not otherwise be accounted for—and, of course, matters would be further complicated if the precise levels were run in sections, at appreciably different times, and these sections were connected up, one with the others, some years later on, as happens to have been the case with the Cairo to Biloxi levels.

Let us now see whether, under the assumed governing circumstances, there would be anything remarkable in finding the degree of change that would apparently take place in such a comparatively short length of time. Remember, it requires 21,000 years for the precessional movement of the earth and nutation to complete one cycle. This is a very long time compared to man's term of life; but, you must also remember that Pearson informed us, in 1904, that the raised beach at Duluth, Minn., had an elevation of about 1075 feet, and that he claimed it had been 11,000 years since the sea began to subside from its maximum flood stage, at the latitude concerned. Accordingly, if we assume that the subsidence of the sea (or the equivalent so-called emergence of the land), at the latitude of Boulevard Beach, has been continuous and at uniform rate of 1075

—or 0.09773) of a foot per annum, it would mean that this 11,000

ancient beach is emerging at the rate of a little over one foot in eleven years. Such a rate of subsidence of the sea could not very well be ignored for any great length of time. Here, on the shore of the Gulf, the rate of our emergence, under the conditions assumed to govern this study, would, of course, be proportionately less; but, even so, would perhaps amount to enough to command consideration, on our part. If submergence were occurring at this same rate, it would certainly be a matter of real concern to New Orleanians. The computed proportionate annual rate of rise at Cairo would be 0.076+ feet, and at Biloxi 0.063. Which would mean that Cairo would emerge at rate of 1 foot in 13.7 years, and Biloxi 1 foot in 16 years; and, that on this basis, precise levels rerun between

Cairo and Biloxi, would show a discrepancy of about one foot every 74.6+ years.

The question arises here, however, as to whether or not, under this 21,000 year cycle hypothesis, the rate at which the sea level is assumed to be subsiding, in the northern hemisphere, has been uniform. If we assume a uniform rate throughout the intervening period, then at the end of the next 10,000 years, when the lowest stage of sea level during the cycle should be reached at the latitude of Duluth, sea level will have subsided only 977 additional feet, or a total of 2052 feet. This figure falls so very far short of the mile, or perhaps nearly two miles, indicated by the physical evidences cited by some of the scientists hereinbefore mentioned, that, unless our premises are erroneous in some respects, we are forced to adopt the thought that the rate under a 21,000 year assumed cycle, must be progressive, presumably reaching its next peak, in the northern hemisphere, ten thousand years hence, when the greatest possible mass of ice might be expected to have accumulated at the South Pole and might also have been expected to have then been prodigiously augmented by the vast mass of sea water perforce attracted there. The first portion of this mass of water—small as it may have been—was irresistibly pulled by the gravitational force of the very first ice formed there, in excess of that existing in the North Polar region, and this certainly caused only a very small movement, during the succeeding one or two thousand years, that must, however, have subsequently grown apace, at a progressively self-accelerated rate, as the masses of both ice and water grew and compounded their combined influence at the expense of the waning masses at the other pole.

Eleven thousand years ago, as the rate neared its peak, under reversed conditions, and it was in the northern hemisphere that the sea was assumed to have approached maximum flood stage, such an accelerated rate of rising flood—plus “forty days and forty nights” of rain, and, perhaps, plus such great storm tides of hurricane proportions as might be expected at such a climaxial period, may have furnished the setting for both the Deluge of Genesis, in what is now Mesopotamia, and the ob-

viously somewhat earlier cataclysm that was reputed to have "suddenly" submerged Atlantis, the "Lost Continent." Who knows but that these assumed conditions might have prevailed and that, under them, the motivating reason for the Atlantians embarking on an expedition of conquest along the Mediterranean may have been the realization that their native continent was in a rapidly submerging condition and plainly doomed as a place of further abode?

STUDY NO. 2

Another explanation of why, under Study No. 1, my computation of the prospective additional subsidence of sea level, during the next 10,000 years, turned out to be so very much short of that indicated by the physical evidences previously cited herein is that it was no doubt a false assumption on the part of Herbert W. Pearson that the Boulevard Beach represented the maximum stage of the oft' repeated floods in the northern hemisphere. In reality, as I now see it, the maximum stage resulting from an Ice Age in the northern hemisphere could never contact land at that latitude for the reason that there the land would have been completely covered by the ice cap that extended as far south as the latitude of the Ohio River, where the lower limit of the ice barrier was said to be located at the time of maximum floods; and no beach formation north of the Ohio could therefore represent anything more than a sub-stage reached only at such times as the receding or advancing ice blanket crossed the latitude concerned. At these times the surface of the sea must have been far below its maximum flood stage. Thus it transpires that the maximum stage, north of the Ohio, was always "written on ice" and, of course, always vanished completely as evidence, in spite of its repeated recurrence.⁹ For the purpose of this study, Pearson's elevation curve should therefore be materially revised and, for the northern hemisphere, must be based on authentic elevations of only such raised beaches as are north of the equator and south of the latitude of the Ohio. In the absence of any knowl-

⁹In Alfred Wegener's "The Origin of Continents and Oceans," mention is made (pp. 96) of evidence that land ice extended to not quite 10 degrees of latitude in Brazil, India and Eastern Australia. (Copy in Tilton Library).

edge on my part of any such elevations, I will have to resort to the best information available to me. Since the Bright Angle quadrangle of the U. S. Geological Survey, in Arizona (that includes the Grand Canyon of the Colorado) shows the elevation of the topmost deposits—of submarine origin—as being about 8500 feet above sea level at that latitude, and, since it is apparently safe to assume that flood stage of the sea must have reached at least this height during Ice Ages in the northern hemisphere (whether the cycles were 21,000 years or longer), let us, for the sake of convenience, assume this elevation to represent maximum sea level reached 11,000 years ago, and revise our drawing accordingly, again employing the constant rate of change hypothesis, as follows:

Figure 3. Where A represents the Amazon; B, Biloxi; and G, Grand Canyon. Then $\frac{8,500}{11,000}$ gives 0.77272 feet per year as the rate of emergence (rise) at latitude of Grand Canyon. This would mean that in 44 years the further elevation at Grand Canyon would be about 33.84 feet, while the proportionate rise at Cairo was 35.5 feet, and at Biloxi, was only about 29.125 feet—a difference, between the two latter points, of 6.375 feet in 44 years, or of 0.145 feet each year—which difference in rate of rise would produce a discrepancy in precise levels, between said points, of a little over 1 foot (1.015') in seven years. Emergence at Cairo would be at the rate of .8 feet per year and at Biloxi .662.

It is obvious that if, in the northern hemisphere, under this set up (namely Ice Ages assumed to recur every 21,000 years), the physical evidences of maximum submergence and of maximum emergence¹⁰ are, respectively, nearly equally above and below the sea level of today in just a little more than half the period of a complete 21,000 year cycle, the rate of the subsidence of the sea might *seem* to have been constant, and not subject to either acceleration or deceleration. As previously mentioned, we must remember that Sir Robert Ball claimed that Ice

¹⁰The submarine deposits being 8,500 feet above, and the sub-aerially incised Atlantic coastal slope canyons being from 8,500 to 9,000 feet below present sea level.

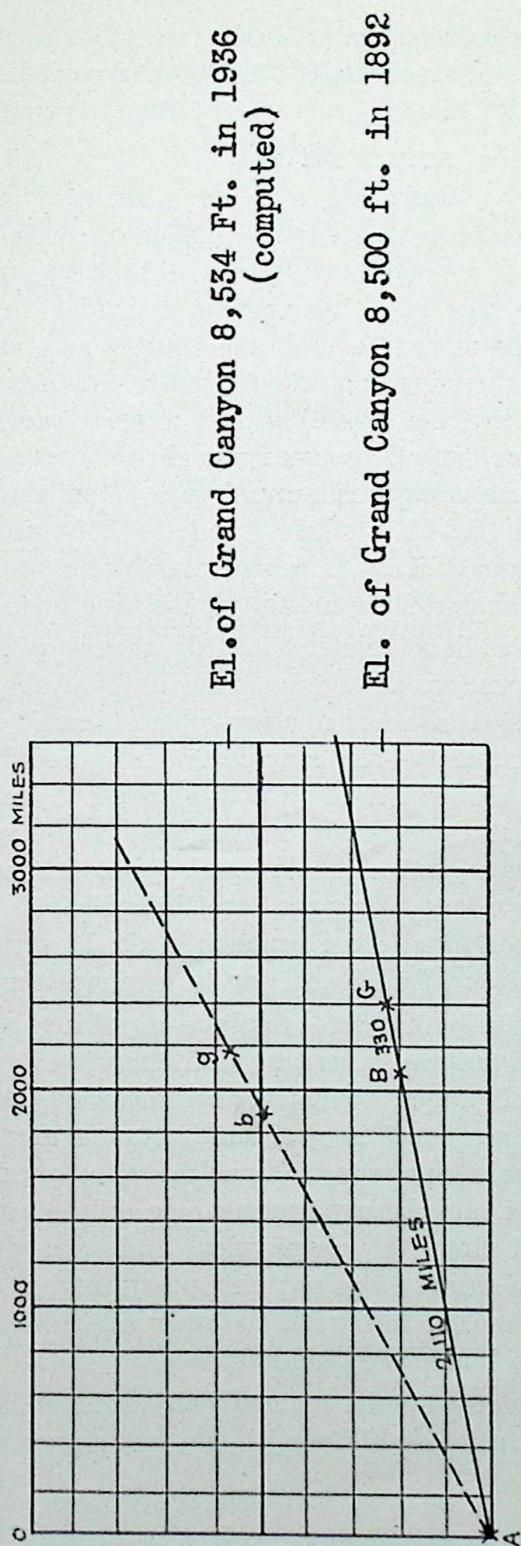


Fig. 3 Scale: Horizontal 1 in. = 1000 mi. Vertical 1 in. = 50 ft.

Ages might not have occurred every 21,000 years, but might have occurred in each of several successive 21,000 year periods during much longer periods of time.

STUDY NO. 3

Due to the relatively small rate of change involved in Study No. 1, it may be necessary to resort to official records, 1st, of actual surveys (consisting of precise levels) that were employed in establishing stable tide gages at various latitudes, and 2nd, of reliable observations or readings on such gages, as a means of determining whether the elevation of sea level is now measurably changing; and, if so, in what direction and at what rate? However, it is obviously not at all necessary to do so in the case of Study No. 2, where the computed annual rate of subsidence involved, is so material (0.8 ft. at Cairo, and 0.662 ft. at Biloxi) that it would not be at all likely to escape even the casual notice of almost everybody, should it be actually subsiding at that rate.

However, when the data relative to tide gages—placed for the purpose of observation at the latitude of New York and Biloxi, respectively, and at several other places among the Atlantic and Pacific seaboard—are considered, it is definitely established that sea level is relatively stable at present; and, as a matter of fact, does not appear to be noticeably subsiding during the present phase of the earth's precessional cycle. If anything, a slight tendency towards a rising sea level is indicated by both the New York and the Biloxi observations. This, however, is so slight as to be virtually negligible and can be so considered.

Since it is unlikely that there could be anything radically wrong either in the technique of setting and checking the gages, or in the readings of stages observed and recorded, we must accept the fact that sea level is practically stable at present; and, accordingly, limit our speculations to the question of whether this condition may be a permanent or only a relatively temporary one. And since the geophysical and geological evidences are so overwhelmingly against any possibility of a truly permanent sea level, we are left with the only alternate conclusion, namely, that sea level does fluctuate.

Under this conclusion we must reconcile the undoubted occurrence of periods of relative stability with the occurrence of other

periods during which extensive fluctuations are positively indicated to have occurred, at times in the past, and that may confidently be expected to recur in the future.

While it is true that none of the geologists and oceanographers are apparently willing to accept any of the hypotheses so far advanced as being complete and infallible explanations of either the enigmas of the old raised beaches in the vicinity of the Great Lakes and elsewhere, or of the veritable canyons beneath the seven seas of the earth, they all seem agreed upon at least some general emergence and submergence having occurred at times; and most of them are disposed to concede sea level fluctuations of as much as 250 or 300 feet. Even R. A. Daly, who, according to some scientists, has advanced a seemingly possible (though highly improbable) hypothesis for the cutting of the submarine canyons—other than Ice Ages as the cause—postulates two or three hundred feet fluctuation as an essential feature of his “density” theory. So, after all, it would seem that the only important difference of opinion as to material long range fluctuations of sea level is largely one of degree and of frequency of occurrence, with the rate apparently never having been seriously speculated upon. Furthermore, it would seem safe to assume that the establishment of stable tide gages and the keeping of records of the annual average readings of sea level thereon was not attempted prior to say 2000 years ago, and that during all the years that have intervened since that time, the center of gravity of the earth has probably remained so comparatively near to its natural or normal location as to have neither caused much change in sea level nor attracted any attention that may have been considered worth recording.¹¹

It would, therefore, seem that practically all of the great fluctuations above and below present sea level must have transpired during the phases of the precessional movement of the earth, when the mass of polar ice was in course of being shifting from one hemisphere to the other, and was not nearly so evenly divided between the hemispheres as it is at present; and, that the most unequal division must occur when the earth's orbit is

¹¹Alfred Wegener in his “The Origin of Continents and Oceans,” p. 23, says, “Indeed Scandinavia is still rising, as leveling shows, at rate of about 1 m. in 100 years.”

experiencing its maximum ellipticity; at which time there is probably greatest disparity between both the length and intensity of the earth's winters and summers. The problem, as I see it, is whether the maximum variation in the elliptic eccentricity of the earth's orbit coincides with certain co-operative phases of each and every precessional cycle of 21,000 years, or—as Sir Robert Ball surmised—is perhaps subject to such material, yet very gradual elongation and contraction, as to co-operate with said phases in producing maximum changes only on the extremely rare occasions (estimated to be once in every thirty-six to eighty million years) when the sun's relative position is at one of the foci of the ellipse and the separation of the foci has reached, or very nearly reached, its maximum.

Discussion

BY DR. J. F. THOMSON *

Precession alone could not cause an Ice Age for the reason that precession does not change the inclination of the earth's axis toward the sun. This inclination is the cause of seasons, but seasons in the northern and southern hemisphere are of equal intensities, regardless of precession. Nor would an increase in the numerical value of this angle of inclination cause an Ice Age. This would make the winters colder, but likewise, the summers correspondingly warmer.

The geological evidences which you have presented would certainly indicate an Ice Age, but the above astronomical facts alone are not sufficient to explain it. There is, however, a third fact,—the shape of the earth's orbit, which taken into consideration along with those first mentioned, might throw more light on the subject.

If the earth's orbit about the sun were circular (with sun at center of circle) it is agreed that even with precession and changes in precession, there could be no Ice Age. We know that the earth's orbit is elliptical, with the sun at one of the foci and not at the center of the ellipse. This means that the earth is not at a constant distance from the sun, but at some time during the year gets closest to the sun, and of course, six

*Department of Astronomy, Tulane University.

months later gets farthest from the sun. This time of closest approach occurs at present in January, when the southern hemisphere has its summer, so we might expect the southern hemisphere to have a warmer summer than the northern hemisphere. (Even so the northern winter would be less severe than the southern winter).

But the eccentricity of the earth's orbit (its variation from circular to elliptical shape) is too small at present to produce this condition. That is to say, the difference between perihelion (closest distance from earth to sun) and aphelion (farthest distance from earth to sun) is not enough to cause any unbalancing of the seasons.

Another compensating factor is that at perihelion the earth is moving fastest in its orbit and at aphelion it is moving slowest. However, the earth's eccentricity is not constant, nor is the time of perihelion passage constant. Changes are brought about due to the gravitational influences of the nearby planets. In other periods of our history, this eccentricity may have been large enough to affect the length and severity of our seasons and this fact, taken in conjunction with precession, might unbalance the intensity of the seasons in the northern and southern hemispheres sufficiently to cause an Ice Age. The problem is quite a complicated one.

MR. LOMBARD: Thank you very much, Dr. Thomson. I am glad you brought those facts out so clearly.

ERRATA, PART I

(August 1937 Issue of Proceedings)

Page 154, 10th line from bottom, last word should be *are* instead of *have*.

Page 156, 9th line from bottom, the figure should be $0.4'$ and not $4.4'$.

Page 159, 12th line from bottom, the last word *moon* should be omitted.

Page 162, 3rd line from top, the letter *r* was omitted from the word *Archeozoic*.

Pages 162, the numbers 533 in the footnote should be 532.

Page 164, in first line of Item (d) the word *record* should be *record 24a*, and a corresponding footnote should be introduced immediately following the number 68 in the first line of footnote No. 24.

BUT HE FORGOT

He brushed his teeth twice a day with a nationally advertised tooth brush.

The doctor examined him twice a year.

He wore rubbers when it rained.

He slept with the windows open.

He stuck to a diet with plenty of fresh vegetables.

He relinquished his tonsils and traded in several worn-out glands.

He golfed, but never more than eighteen holes.

He never smoked, drank or lost his temper.

He did his daily dozen daily.

He got at least eight hours' sleep each night.

The funeral will be held next Wednesday.

He is survived by eighteen specialists, four health institutes, six gymnasiums and numerous manufacturers of health foods and antiseptics.

HE HAD FORGOTTEN ABOUT TRAINS AT GRADE CROSSINGS.—Traffic Tidings.

Little Boy: "How come you have three daddies while I have only one?"

Playmate: "Well, I don't know, unless maybe your daddy hasn't any trade-in value."

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meetings Held on September 13, 1937.

The meeting was called to order in the Hunt Room of the St. Charles Hotel by First Vice-President Grehan in the absence of President Williamson. Seventy members and guests were present.

It was voted that the reading of the minutes be dispensed with. Reports of the Employment Committee were read.

The technical program consisted of a short talk, and motion pictures showing the manufacture and uses of "Non-Metallic Pressure Pipe." Mr. R. F. Orth of the Johns-Manville Company presented the material and showed samples of the finished product.

Colonel Shaw made a few remarks about the splendid report on the Soil and Foundation Survey which had recently been published. He pointed out that this work had been suggested by members of the Society.

Col. Shaw asked that a committee be appointed to draw up resolutions in connection with the report. Vice-President Grehan appointed Col. Shaw as Chairman, asking Mr. D. W. Godat and Mr. C. J. Peirce, Jr., to serve with him.

There being no further business the meeting adjourned to the usual collation.

A. M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Board of Direction held on October 6, 1937.

The meeting was called to order by President Williamson with Grehan, Hackett, Newman, Peirce and Hill present.

The following nominating committee was selected by the President, and approved by the Board: F. N. Billingsley, A. T. Dusenbury, J. M. Todd, with Mr. Dusenbury as Chairman.

It was voted to fix student fees at \$1.00 for period of October 1937 to June, 1938. Proceedings will not be sent; only notices of the meeting.

In view of the nature of one of the papers to be given on October 11 it was voted to invite members of the various cotton firms in New Orleans. Prof. Zervigon's paper is "The Determination of Properties of Cotton Fibers as an Engineering Problem."

It was with regret that the resignations of Bruno Stolley, H. B. Cooley, and P. E. Seepe were accepted.

The Secretary was authorized to place an order for a rebuilt addressograph at a cost of \$45.00.

The Secretary was directed to obtain prices on the cost of reprinting the booklet containing the Constitution and By-Laws.

It was suggested that the House Committee investigate the advisability of disposing of a number of vacant bookcases in the library, these being of the sectional variety.

The report of the Committee on Awards was read and accepted, Mr. Zimmerman of L. S. U. being the recipient of the scholarship this year.

A. M. HILL, Secretary-Treasurer.

Minutes of the Regular Meeting of the Society, October 11, 1937.

The meeting was called to order about 8 P. M. in the Hunt Room of the St. Charles Hotel by President Williamson. About one hundred members and guests were present.

Prof. Brosman made a short address on behalf of the Community Chest.

The minutes of the last meeting were read and approved.

The report of the Chairman of the Employment Committee was read; Col. Shaw presented a resolution in connection with the Soil and Foundation Survey Report.

Mr. C. J. Peirce, Jr., made a few announcements concerning plans of the coming Annual Meeting.

The Nominating Committee was announced, Mr. A. T. Dusenbury, F. N. Billingsley and James M. Todd, Chairman.

An announcement was made concerning the coming A. I. E. E. meeting.

The first paper of the evening was presented by Mr. Leal McLean of Jones & Laughlin Steel Corporation. The title of his talk was "The Fabrications of Structural Steel." In a very graphic manner he traced the steps in filling an order, from start to finish.

The second paper or address was by Prof. M. G. Zervigon, of Tulane. His subject was "The Determination of the Properties of Cotton Fibers as an Engineering Problem." A number of lantern slides were shown illustrating his points.

A list of new members was read; announcements concerning an arc welding contest and a problem in elevated highway construction by A. I. S. C. were read.

The announcement was also made that Mr. E. Zimmerman had been selected to receive the scholarship at L. S. U. this year; A. C. Porter is the recipient at Tulane.

The meeting adjourned to the usual collation, after extending a rising vote of thanks to the speakers.

A. M. HILL, Secretary-Treasurer.

ACTIVITIES OF LOCAL SECTIONS

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STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Special Meetings at
call of President

On September 28th a meeting was held at The St. Charles Hotel in New Orleans of the American Society of Civil Engineers Committee on Flood Control, of which John F. Coleman of New Orleans is Chairman. The following members were present: John F. Coleman, New Orleans; Harrison P. Eddy, Jr., Boston, Mass.; E. W. Lane, Iowa City, Iowa; J. B. Lippincott, Los Angeles, Cal.; Gerard H. Matthes, Vicksburg, Miss.

The committee appointed by President H. A. Sawyer of the Louisiana Section to review a report of the Committee on Salaries of the Parent Society has completed its review and forwarded its report to New York. This committee was composed of Mr. A. J. Negrotto, Chairman; Mr. J. A. McNiven and Mr. John O'Neill.

A committee of the Louisiana Section A. S. C. E. has been appointed to review the new New Orleans City Building Code which will shortly be presented to the Council for adoption. This committee is composed of Col. E. S. Bres, Chairman; Mr. Geo. P. Rice, John O'Neill, John Reiss, and Prof. Donald Derickson.

The Louisiana Chapter Associated General Contractors of America, composed largely of members of this Section, has recently awarded a scholarship to Tulane University in recognition of the high standing of its School of Civil Engineering.

The Student Chapter of the A. S. C. E. at Louisiana State University has held two meetings since the opening of the fall term and committees have been appointed to work out details and supervise various functions of the Chapter. Charles Beadles is the Chapter Secretary.

The W. P. A. has recently published a book on Foundation Data in New Orleans and Vicinity that has met with high commendation. This project was proposed by Prof. Donald Derickson, member of the Louisiana Section and carried through under the direction of Mr. F. P. Hamilton, member of the Louisiana Section.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

OCTOBER, 1937

“PATRONIZE OUR ADVERTISERS”

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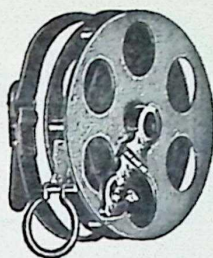
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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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No. 6

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EDITORIAL NOTES AND COMMENT

Let's Call a Spade a Spade. Why is it that engineers will persistently neglect the development of proficiency in the use of the English language? Frequently careless in diction, halting in delivery, and faulty in grammar, such engineer presents a sorry sight when he rises to address an audience. Why must it be so? All too frequently we see an engineer who can think brilliantly and act with logical sureness, but who seems acutely uncomfortable, if not hopelessly lost, when it comes to communicating his ideas to others.

Even in ordinary conversation the faulty grammar of many engineers is striking. A large proportion of engineers finally land in administrative positions—twenty-five years after graduation about fifty per cent of the technically trained men become executives. As an executive, a fine command of

the English language, and the ability to use it in a forceful, pleasing and attractive manner, becomes a necessary and valuable asset. In general it is certainly true that success in life depends not alone upon ability, but also, and quite largely, on impressions made upon others.

A faulty use of the English language, either spoken or written, is a handicap that operates to the immediate and certain prejudice against the user. In these days education is cheap and widespread. No longer can lack of availability of education be given as an excuse for the use of careless English. The old day of the "diamond in the rough" is fast disappearing.

To our younger members, then, goes this message: take part in the meetings of the Society. Learn to speak on your feet with grace and ease. Most of us think of the clever things we should have said *after* we have sat down. Of course you will not be successful at the first or second trial. It is only after earnest perseverance that a measure of success is attained. The same is true of the written language. Make opportunities to write papers or reports. The Society offers you these opportunities; take advantage of them. Above all, learn to speak and write clearly and correctly.

The use of faultless English is always the mark of a cultured gentleman. All too frequently we engineers have been criticized as uncultured.

The Union Station Survey. To the thousands of drivers who have wasted time at blocked railroad crossings, and to the hundreds of businesses which have had their busses and trucks similarly delayed, the Union Station Survey offers some glimmer of hope. Whatever else may be said about the citizens of this city, they certainly possess the virtue of patience to a superlative degree. For a city of the size and dignity of New Orleans to permit the continuance of such traffic delays without an earnest effort at abatement is not only a civic disgrace, but is extremely costly in dollars and cents. Fortunately the effort at abatement has been initiated. Under the able leadership of Mayor Maestri, a complete survey of the Union Station question has been made.

At the December meeting, papers were read by Messrs. Barnard and Ernst giving the highlights of this survey. These papers are published elsewhere in this issue. They make interesting reading for all those who have any civic interest.

The full report of the Union Station Survey is a volume of 163 pages. It contains numerous discussions, diagrams and maps. A copy of this report is in the Library of the Society. It will repay careful study.

Welding of Mechanical Equipment. One of the great advances of recent engineering is the development of welding. Starting in repair work as a makeshift substitute for older and reliable methods, it received scant attention and less confidence because of the unreliability of results obtained. When the engineering profession awoke to the fact that here was an opportunity of almost unlimited possibilities, real development started. There is now a great distance between the old, unreliable, spongy repair weld and the present day fabrication processes in which reliable welding is used with great advantage and economy. Mr. Gibson's paper on the welding of mechanical equipment is both informative and interesting. It is printed elsewhere in this issue.

PAPERS AND DISCUSSIONS

PROPOSED UNION STATION AND GRADE CROSSING ELIMINATION IN THE CITY OF NEW ORLEANS

BY CHARLES C. BARNARD* AND T. E. ERNST**

Read before the Society December 8, 1937.

The city, through Mayor Robert S. Maestri, is planning within the next year to inaugurate a large street paving program. Knowing this, Mayor Maestri was certain that a satisfactory solution concerning Union Passenger Terminal and grade crossing elimination must be reached before this paving program could be properly planned. He has, therefore, gone into this proposition with the idea in mind of getting some definite results in the immediate future. Hence, in April, 1937, Mayor Robert S. Maestri and Commissioner Fred A. Earhart of the Department of Public Utilities called to a conference representatives from all the railroads entering the City of New Orleans to discuss the formation of plans relative to Union Passenger Terminal for the City of New Orleans and to devise ways and means to eliminate, as many as possible, the extremely dangerous grade crossings which now exist in the city.

An agreement was reached at this meeting wherein a study of the situation could be made and a report rendered at the earliest possible date. The responsibility of this report was placed in the hands of Commissioner Earhart by the Commission Council. The engineering direction of this survey was handled by Mr. V. J. Bedell, General Manager and Chief Engineer of the Public Belt Railroad. Mr. Hampton Reynolds, Chairman of the City Planning Commission, gave his time and efforts unsparingly in assisting us with our problems. Therefore, on May 1, 1937, we started work on this survey.

*Engineer in Charge, Union Station Survey..

**Assistant Engineer, Union Station Survey; Secretary and Engineer to the Commissioner of Public Utilities.

In order to determine the extent of the grade crossing situation which would effect our survey, it was necessary to have some definite information as to the time lost by the motoring public at present grade crossings. Fortunately, a traffic survey was being conducted through the Department of Public Safety and Works Progress Administration and the co-operation of this survey group was secured. I will now ask Mr. T. E. Ernst to give a report covering results determined in this survey.

TRAFFIC SURVEY REPORT OF MR. ERNST

The delays to vehicular traffic at grade crossings in the City of New Orleans have been and are continuing to be a nuisance and a hazard, which represents an economic loss to the motoring public. I can venture to say that there is probably no one here tonight who has not at one time or another been delayed by the shifting of box cars or passenger coaches across one of our major traffic arteries. The vehicular traffic situation and safety at our grade crossings was one of the major factors in making our recommendations for outer stations. The past three City Administrations have been harassed with complaints pouring in from citizens who have been consistently delayed at crossings. Commissioner Fred A. Earhart has been more or less in constant contact with the offending railroads ever since he has been in office and has had little or no success in eliminating the evil, due to the fact that the local representatives of the roads either could not, or would not, take steps to curtail their operations to such time when delays would be at a minimum or to so regulate the operations of train crews that a crossing would not be closed more than five minutes. The Department of Public Utilities has endeavored by persuasion and threat to have the railroads minimize these delays and at one time threatened to have the engineer and foreman of train crews subpoenaed into court for violation of the City Traffic Code by blocking a crossing for more than five minutes.

This, of course, was not the solution to the problem. Traffic is becoming more and more congested and the classification and making up of trains within the inner city more

numerous. The only economic solution was the removal of all classification yards to points remote from the city's traffic lanes to locations where they may be free to operate without disturbance for many years to come. The elimination of the delays to the railroads caused by vehicular traffic by moving out of the congested areas, together with classification of freight at points where interchange and routing can be made without any backhaul, will decrease the operating cost of these roads sufficiently to pay for the cost of the removals over a period of years.

A more expensive and less desirable solution was the separation of grade at all main present day crossings with the ever increasing cost of additional grade separation structures becoming necessary at adjacent streets, which will be opened to traffic as the city expands.

The freight lines by their nature have to remain at grade in order to serve the many industries located on or adjacent to them which would require bulky and expensive overpasses in order to separate grade. The property damage incidental to the construction of an overpass would increase the cost of these structures to such an extent that their construction would be prohibitive. In removing these yards to the suburbs of the city, very large areas may be opened to residential and commercial development.

The disposal of land now owned by some of the railroads would offset to a great extent the cost of the project, as there are 156 city squares comprising over 11½ million square feet. This land is valued at over \$2,500,000.00 as vacant land after the removal of the tracks without the streets being cut through.

Commissioner Earhart, being familiar with the situations as they presently exist and realizing the underlying factors involved in arriving at a solution of the problem, was desirous of obtaining an accurate and authentic check of the delays to vehicular traffic. With this in mind, just prior to the establishment of the present Union Station Survey, he induced the Works Progress Administration to include such a check of traffic in their Traffic Survey of the City of New Orleans,

which has proven to be of great value, not only to them, but also to us in our study.

Accordingly, the Traffic Survey of New Orleans, under the direction of Mr. Paul L. Ristroph, checked the flow of traffic at forty-two major grade crossings within the city. The check included such pertinent data as: The number of vehicles that passed over the crossings, the time during which the streets were blocked by train movements, number of vehicles delayed by such movements, the number of railroad cars passing the intersection, the name of the railroad operating the train and other detailed information, recorded by half-hour periods at each observation point.

The most important railroad crossing, with respect to both the volume of vehicular traffic and the frequency of vehicular delays, were observed for six days a week, 18 hours a day, from 6:00 A. M. to 12:00 o'clock midnight. One such crossing was selected for each road as an average with two crossings being observed in some cases. A varying number of other less important crossings on each line were observed for three different days in the week, 12 hours a day, from 7:00 A. M. to 7:00 P. M. It was necessary to adjust these 12-hour counts to the 18-hour basis, in order to have all data accurately comparable.

This was done by assuming that the number of vehicles delayed for 18 hours bears a constant ratio to the number delayed for 12 hours for the same railroad line. Therefore, it was only necessary to divide the total number of vehicles delayed on any one railroad line as counted at all 18-hour stations by the total number of vehicles delayed at these 18-hour stations during the 12-hour period from 7:00 A. M. to 7:00 P. M. It was then only necessary to multiply the number of delays at the 12-hour stations by this ratio factor to convert them to the 18-hour basis.

In order to obtain an accurate picture and complete the count of delays at all railroad crossings, it was necessary to include in the count all lesser crossings at side streets which were not observed. The vehicular volume count on these side streets had previously been made; therefore, it was a simple

matter to determine the number of delays at these crossings on a strictly proportioned basis.

The number of delays for each crossing was reduced to the value for an average day and the sum of delays for all crossing multiplied by 365 days to give the number of delays for the year per railroad line.

In order to determine the vehicular minute delay, the length of time the vehicles were delayed was multiplied by the number delayed and then divided by two. The delay factor was obtained by taking the sum of the average minute delay for each line and dividing it by the total number of delays for the same line. The delay factor, then multiplied by the number of delays for the year, gave the vehicular minute delay.

The cost of these delays to the motorist was calculated on the basis of only 0.14 of a cent per vehicle as the cost of stopping and starting and 1.05 cents per vehicle as the cost per minute delay. These values were based upon the average of such values for the whole country and were obtained by reference to such books as "Highway Economics" by Sigvald Johannesson, "Routing Through Traffic" by Harold M. Lewis, "Protection of Railroad Grade Crossings" by Philip X. Rice, and by correspondence with Nathan Cherniack, Analyst, The Port of New York Authority and with Maxwell Halsey, Assistant Director, Bureau of Street Traffic Research of Cambridge, Mass.

In order to estimate the cost of delays in future years, it was assumed that the number of vehicles delayed per year for all lines is a constant percentage of the number of vehicles crossing all lines per year and it was further assumed that the number crossing all lines per year is a constant percentage of the vehicular registrations.

The count shows that there will be 7,371,540 vehicles delayed during the year 1937 at all crossings to be eliminated or operated on a restricted basis. It is estimated that the total vehicular minute delays will mount to approximately 6,349,219. This will, undoubtedly, increase in proportion to the increase in vehicular registration during future years. It is estimated that over 288 million cars would be delayed for the 30-year period between 1937 and 1966.

VEHICULAR REGISTRATION CHART TRAFFIC FLOW MAP

I. C.-Y. & M. V.-S. P., G. C.....	97,000
L. & A.....	56,000
Southern and G. M. & N.....	102,000
L. & N.....	41,000
TOTAL.....	296,000

**ESTIMATE YEARLY COST OF VEHICULAR DELAYS AT
EXISTING RAILROAD CROSSINGS**

Since the motorists of New Orleans will sustain an economic loss of approximately \$77,000 during 1937 through delays at railroad crossings, it would justify an expenditure of \$1,900,000.00 to eliminate this loss.

**ACCUMULATED COSTS OF DELAYS TO VEHICULAR TRAFFIC AT
RAILROAD GRADE CROSSINGS TO BE ELIMINATED
IN THE CITY OF NEW ORLEANS**

If compounded annually at 4% through 1966, it would amount to \$5,630,000.00.

Commissioner Earhart expresses his regrets at being unable to attend this meeting as he was called to Chicago to represent the Mayor on some important city business, and Mr. Barnard will now give you the details as outlined in our report.

[End of Traffic Survey Report]

The location of the site for a Union Station was a very befuddled affair at the start of this report because of the many surveys previously rendered which did not agree in many cases in whole, or in all cases in part. The advent of the new Mississippi River Bridge had completely changed the picture in so far as the North and Western roads were concerned. Since most previous surveys were made before the construction of the bridge, they naturally could not incorporate this feature in the plans.

Several extremely important primary facts had to be kept in mind in all recommendations made by our group in this report.

The first of these being a location that would be within reasonable traveling time from any part of the city and that would adequately serve the public need.

Secondly, a location wherein the lead tracks to the station could either be elevated above the street levels of our city or through proper location not cross a great many of the thoroughfares.

Thirdly, a location which could be within the cost range that the railroads and the City of New Orleans could afford to expend.

Fourthly, a passenger terminal layout which would tend to blend in with the purpose of eliminating freight tracks from out of the heart of the city.

The first of these four features would allow us to locate a station anywhere from the foot of Canal Street to any point in the city within twelve or fourteen minutes driving time from the central business area. As the center of population of the city is continually moving outward, it was our opinion that a location a little farther back from the river at points near the dividing line, between the strictly commercial and the residential sections, would fit present and future needs to the best advantage.

The second feature was not nearly so general in scope as there are only two ways to reduce grade crossings; one being to locate the tracks where grade crossings will not occur and the other to locate tracks across thoroughfares and separate the grade by either elevating the tracks or elevating or depressing the streets. It was immediately found that the cost to elevate tracks into the heart of the city would be so high that the project would immediately be abandoned because of the financial conditions of the railroads, and secondly, that even if the tracks were elevated, this would not take care of the freight situation, particularly to serve industries, as an additional track at grade would be necessary to serve these in-

dustries, since the construction of ramps off an elevated to each industry would be a highly impractical solution. Hence, the elevated line would evolve into simply a grade separation unit for passenger service alone, which service does not in any sense justify the extreme cost. The elevation or depression of every cross street would also be expensive and would place a heavy burden on the city as well as the railroads; in addition, due to the topography of this city, underpasses are impossible in many sections. The construction of overpasses which would start at street level and rise to a 22-foot clearance over the tracks would be very impractical in most locations due to the length of the structures which would block out side streets and probably cause more traffic interference than a rail grade crossing.

After considering these points, it was our effort to locate the station leads where few crossings would be encountered.

The third feature also tended to locate stations out of the central business district, as the cost of real estate and damages to surrounding property in the central business area would practically equal the expenditures involved in the actual improvement. So here again the outer station solution more nearly fitted into the picture.

The fourth feature is undoubtedly one of the most important to be considered. As shown in our report, and heretofore explained by Mr. Ernst, the cost to the motoring public in grade crossing delays is an enormous figure. This amount has to come out of every individual's pocket as the majority of people now have some kind of vehicle, or ride busses or street cars which are also delayed at railroad crossings. Such tracks and yards as those located in the Poydras and Government yard areas, the Bernadotte Street area and the Press Street area, are strangling the growth of our city and until such barriers are removed, New Orleans will not be able to expand and take its place among the greater cities of this country. As long as the railroad passenger business is allowed to come into the central business district, it will be practically impossible to force the railroads to remove their freight lines as they give their passenger business as justification for the

lines remaining. There is no reason or justification for the continuance of interchange and classification yards in the central business district and with this fact in mind, we have selected the two locations where the railroads converge into a bottle-neck at the outskirts of the city and recommend that classification and interchange yards be set up at these points. These outer yards will not only remove the tremendous amount of rail traffic from within the central business areas, but will also simplify and reduce the movements along the river front and decrease the present delays at ferry and dock road crossings.

The freight situation, due to grade crossings, has become extremely acute in the City of New Orleans, because of the fact that railroad switching yards are in the same locality and with practically the same conditions existing as fifty years ago. Since the city has expanded in all directions and has gradually surrounded these yards, it is evident that the city has become completely separated by these dissevering yards. It is now nearly impossible to go anywhere in the city without crossing numerous yard tracks and in many cases be delayed, due to switching movements. As before mentioned, the removal of these yards to the outskirts of the city should decrease this traffic interference to a minimum. By consolidating the tracks in these close-in areas, large strips of real estate which are now covered with classification and interchange yards can be released for other purposes. This will be to the advantage of the City of New Orleans. The present day value of property that it is possible to release when these yards are abandoned amounts to over \$2,000,000.00. After improvements such as streets, sewerage, etc., this property will have an actual value many times its present day valuation.

After coming to a tentative decision that the outer stations were the most practical, our work progressed to the more detailed features of this study; such as, proper station leads, location and design of station, coach yards and engine terminal facilities and the consequent cost data involved. It was also necessary to go over fully the previous findings and develop charts and graphs, time and mileage studies, interchange data,

etc., to check our previous judgment on these outer locations. In addition, it was necessary to determine the amount and time of all railroad freight service on those lines running into the city to justify our plan of outer yard location. It was found in this check from all of the lines entering the central business district that 85% of the industries are now served at a time when vehicular traffic is light. It was, therefore, even more evident to us that the greatest delay to vehicular traffic is caused by switching of cars in interchange and classification work rather than industry service.

Before locating the proposed outer station there was one other location which we felt should be given thorough consideration, this being a station site at the foot of Canal Street. However, we found several features concerning this location so detrimental that we could not propose this site. The objectionable features are as follows:

- (a) Increased mileage and time for all carriers over outer station and for all North and Western roads over present locations.
- (b) High cost of real estate which would be at least ten times as great as that for locations as proposed.
- (c) Overcrowding of present freight facilities which cannot be expanded due to restricted areas.
- (d) Doubtful levee conditions near Dumaine Street, due to impending set-back in levee. This set-back would prevent the construction of necessary tracks to carry passenger traffic.
- (e) Room for future expansion could be obtained only by destruction of French Market, United States Prison and other highly valuable and historic improvements.
- (f) Hinderances to dock and levee vehicular transportation by the addition of fast rail traffic. Since grade separation is impossible, this would necessitate the installation of crossing gates or signal protection.

Coming directly in along the present lines to locations in the city which are just outside of the first major traffic arteries; viz, Carrollton Avenue on the west and Elysian Fields and Florida Avenue on the east, we have selected two sites which will require only one grade separation unit each for a complete elimination of grade crossings in so far as passenger trains are concerned.

The Carrollton Avenue Station, located on the west side of Carrollton Avenue, between Palm Street and Palmetto Canal, facing the intersection of Washington and Carrollton Avenues, is proposed to accommodate the Illinois Central, Yazoo and Mississippi Valley, Southern Pacific, Texas and Pacific, Missouri Pacific, Gulf Coast Lines and the Louisiana and Arkansas. This consolidation will group seven out of the ten roads entering the city in the one place. This location which is twelve and one-half minutes driving time from Canal and Baronne Streets, is also at the hub of one of the largest residential areas in the city. It is served by numerous street railway and bus lines with good connections to any part of the city. It was found after many checks that a passenger arriving at this station could by taxi or car reach the central business district or nearly any other location in town in much less time than from the present Union Station, due to the time consumed by train travel from Carrollton Avenue to the present station.

The location at Elysian Fields and Florida Avenue, while not so well known to the average citizen in New Orleans, is even closer to the central business district than the Carrollton Avenue location and can be reached from the business district by car or taxi in from nine to ten minutes. We have proposed in our report the widening of Elysian Fields Avenue, St. Claude Avenue and Rampart Street, which will give ideal street connections to the central business district, and have also proposed the opening and paving of a street between Elysian Fields and Broad Street, making the station accessible from that area of the city and in addition, creating a good interchange line between stations by way of Broad and Tulane to Carrollton Avenue. As it is proposed to pave Elysian Fields Avenue from Florida Avenue to the Lake, this will make

this station location convenient for the entire Gentilly and Lake Shore section. We have been assured by the New Orleans Public Service that adequate transportation will be furnished at this station. It is our recommendation that the commuter traffic handled through this station be transported into the city by bus furnished by the railroad company. It has been definitely determined that this procedure will save the average commuter time, even though his business is now close enough so that he can walk from the present L. & N. station. This, of course, is due to the fact that bus time from the outer station compares very favorably with the train time from this location to the present L. & N. Station and to the fact that the bus will transport the average passenger much closer to his place of business. This idea of a railroad furnishing bus transportation from their station is not at all new and is at present in operation in many of our large cities; namely, New York, Cincinnati and St. Louis. Here the railroads furnish bus transportation along with the railroad fare to hotels and interchange points. Passengers from the Southern Railway System or G. M. & N. Railroad will, of course, save considerable time, due to the thirty minutes now required to reach Canal Street station from site of proposed station.

In addition to the moving of yards to reduce traffic delays in those areas, the matter of grade separation on the New Orleans Terminal Company (outer belt) had to be considered. This line, being a very necessary link in our rail transportation system, has to be left open for unrestricted service. Hence, in order to reduce the dangers and delays due to grade crossings along this line, grade separation units consisting of underpasses have been proposed at Pontchartrain Boulevard, Canal Boulevard, Orleans Avenue, Hospital Street, Beauregard Avenue and Gentilly Road and overpasses at Elysian Fields Avenue and Franklin Avenue, all over or under the tracks of the New Orleans Terminal Company. In addition, an underpass is planned at Gentilly Road and Peoples Avenue, under the Southern main line tracks and also an underpass at Monroe Street near Palm Street, under the Carrollton Station lead tracks. These proposals as listed will entirely eliminate grade

crossings on all major streets in the City of New Orleans, except on the lines used for industry service only and along the river front.

The cost of this entire program which includes stations, station yards, engine terminal, etc., the two outer railroad yards; namely, the Illinois Central and Southern, and removal of the inside yards and construction of all grade separation units and the street improvement on Elysian Fields Avenue, St. Claude Avenue and Rampart Street, the cross pavement between Elysian Fields Avenue and Broad Street and a new street along the Palmetto Canal, from Carrollton Avenue to intersection with the proposed Airline Highway, amounts to approximately seven and one-half million dollars. This sum divided between ten carriers and the City of New Orleans does not place a heavy financial burden on any of the participants of this plan.

For your information then is given below the more detailed estimate of cost relative to individual features:

Carrollton Avenue Station and Station Yards, including real estate.....	\$1,849,000.00
Carrollton Avenue Coach Yards and Engine Terminal, including real estate.....	1,280,000.00
Elysian Fields Station, Station Yards and Coach Yards	1,455,000.00
Estimated cost of new outer yard and Engine Terminal—Illinois Central.....	659,000.00
Estimated cost Southern Railway outer yard and Engine Terminal	1,178,000.00
Estimated cost grade separation—New Orleans Terminal Company, including the raising of tracks and grade separation units.....	414,000.00
Estimated cost—Other grade separation units on the Southern	129,000.00
Estimated cost for the widening and paving of above mentioned streets.....	201,000.00

WELDING OF MECHANICAL EQUIPMENT

By A. E. GIBSON*

Read before the Society November 15, 1937.

It would be much more enjoyable for me to talk to you of the charm and romanticism of your quaint yet progressive city than to discuss welding. There is no city in America with a more thrilling background than New Orleans, nor one which has retained so intact the purity of its physical charms of days long past. My few visits here have been pleasant ones, and I shall always return knowing I will re-experience the joy of my first visit to your old French Quarter.

However, tonight we are to talk on another subject—"The Building of Welded Mechanical Equipment." This too is filled with romance, because with welding we have ventured into new fields—have pioneered—and the rewards have been as great as those which your French and Spanish forebears found in this new world.

Some industries such as the electrical, automotive, shipbuilding, and oil, have been outstanding in the pioneering spirit shown in the adoption of welding to the building of their equipment. What has been the result? Electrical generating equipment revolutionized in design, efficiency and cost. It would be a revelation for you to visit the Schenectady plant of General Electric and see the construction of the world's largest generators from rolled steel, so perfectly aligned as to eliminate hundreds of hours of machine labor, and the resulting structure much lighter in weight, stronger, and lower in cost than the older cast designs. The same story could be told of many other industries.

In the fabrication of mechanical equipment, what can we hope to gain from welding? First and foremost, welding must be competitive with castings. We can never hope to replace castings 100%, nor do we wish to. However, there are thousands of instances where we have redesigned details for welding which were previously made of castings, and have effected

*President, Wellman Engineering Co., Cleveland, Ohio.

savings of 25% or more in the overall cost. In many instances we combine plate and steel castings which produce superior products at much lower cost than all welded or all cast designs.

There is one essential for success in welding, and unfortunately too few of us realize it—that is the necessity for clear constructive thought in design, unprejudiced by our past experience with cast or riveted construction. If we start out with the thought of designing a part to look like a casting, we will find little success. There are certain limitations to foundry practice: the question of shrinkage, the necessity of long sweeping curves, large fillets and gradual reduction from thick to thin sections. In welding, we can make a perfect bond between a $\frac{1}{8}$ " and a 2" plate, and we have unlimited latitude in making a distribution of metal to withstand maximum stress in tension, bending, fatigue, impact, and to provide desired rigidity. From a design standpoint, this is of utmost importance. Too little use is made of such inherently strong sections as the beam, the box and the cylinder. In many structures such rolled sections as angles, channels and I-Beams offer opportunities for strength and rigidity with a minimum of labor cost in the preparation of material and welding.

Another fundamental one should keep in mind is that welding labor is expensive, and our cost will be in proportion to the amount of welding we are able to eliminate. No design should be made which requires two pieces of steel to be welded to form an angle, if one piece can be bent to form that shape. Outstanding reductions in cost can result from the wide use of the bending brake in a welding plant.

The day when a properly constituted welding plant consisted of purchasing welding equipment and hiring welding operators is past. We have not yet lived down the mistakes our faulty welding practice and supervision produced ten years ago. No welding operator should be employed without qualifying tests to determine his ability. Time prevents more than mention of this subject, except to state that quality welding may be judged from simple nick-break tests. These tests cost the company practically nothing and are made by the

applicant on his own time. They rule out about four out of five men who come to our plant seeking work, and who actually believe themselves to be first class welders, but who fail to pass this test.

Next in importance to design is supervision. Welding is as exact a science as any other method of making steel. One who supervises welding operations should have a fairly good working knowledge of metallurgy. This is of great importance when using high strength or alloy steels of considerable air hardening quality. Then too such aids as positioning machines and welding fixtures are not only time savers but assist greatly in making quality welds and in maintaining correct alignment of the parts to be welded.

During the last few years there has come onto the market a wide range of so-called low alloy, high strength steels which are revolutionizing welded construction. Many of these steels have yield points above 60,000 p. s. i., ultimate strength above 90,000 p. s. i., together with satisfactory ductility. Many of them possess fine qualities of resistance to corrosion or abrasion. The developments made in building welded Diesel engines, light weight trains, railway rolling stock, clam shell and drag line buckets, and many types of moving mechanisms, has firmly established these high strength steels in welded equipment. Savings in weight in the nature of 25%—30% and even 50% have been realized. We are more conscious today than ever before that to accelerate mass consumes power. The potential savings in power with light weight equipment is a matter deserving careful consideration. No better example can be cited than the developments in the type of earth moving equipment used to build the extensive levees along the Mississippi River and its tributaries. Today, drag line buckets probably average 30% or more lighter than those in use five years ago.

We, as hundreds of others, are convinced that welding is here to stay, solely because with welding we can build stronger, lighter equipment and build it at a cost lower than with any other method of fabrication.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board of Direction, November 29, 1937.

The meeting was called to order at 8 P. M. with the following present: President Williamson, Godat, Grehan, Lassalle, Hill.

The minutes of the last meeting were read and approved, with one correction.

A notice concerning the meeting of the geologists was read, and it was voted to give guest cards to those attending the session.

The Board voted to underwrite the Annual Meeting, January 7 and 8, 1938, in the sum of \$350.00.

The Secretary asked that certain members of the Society be transferred from Junior to full membership, in accordance with the Constitution and By-Laws. This action was approved by the Board.

The names of applicants to membership in the Society were approved.

There being no further business, the meeting adjourned.

ARTHUR M. HILL, Secretary-Treasurer.

Minutes of the Meeting of the Society, November 15, 1937.

The meeting was called to order about 8 P. M. by President Williamson in the Convention Hall of the St. Charles Hotel. About 135 members and guests were present.

The reading of the minutes of the last meeting were dispensed with. An announcement concerning the Annual Meeting was made.

Mr. A. E. Gibson, President of the Wellman Engineering Company, Cleveland, Ohio, spoke on "Welding of Mechanical Equipment." His very interesting address was illustrated with a number of slides.

An interesting discussion followed, after which a rising vote of thanks was extended to the speaker.

The meeting then adjourned to the usual collation.

ARTHUR M. HILL, Secretary-Treasurer.

Minutes of the Regular Meeting of the Society, December 13, 1937.

The meeting was called to order in the Convention Hall by President Williamson with 125 members and guests present.

The minutes of the last meeting were read and approved.

The report of the Employment Committee was presented.

The Nominating Committee reported the following:

B. H. GREHAN, President.

D. W. GODAT, 1st Vice-President.

B. W. PEGUES, 2nd Vice-President.

B. S. NELSON, Director.

W. H. RHODES, Director.

D. W. Stewart, Director.

A. M. HILL, Secretary-Treasurer.

An announcement was made concerning the coming Annual Meeting.

The paper of the evening was entitled "Proposed Union Station and Grade Crossing Elimination," by Mr. Charles C. Barnard, Engineer in Charge of Union Station Survey, and Mr. T. E. Ernst, Assistant Engineer of the Survey, Secretary and Engineer to the Commissioner of Public Utilities.

Numerous colored charts and diagrams served to illustrate traffic flow and points of traffic delay.

An interesting discussion followed, with a rising vote of thanks to the speaker. The meeting adjourned to the usual collation.

ARTHUR M. HILL, Secretary-Treasurer.

ACTIVITIES OF LOCAL SECTIONS

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1st Vice-President,
A. J. NEGROTTA
2nd Vice-President,
N. E. LANT
Secretary-Treasurer,
J. A. McNIVEN



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Baton Rouge
Tulane University
New Orleans

Special Meetings at
call of President

The annual meeting of the Section was held at the home of Mr. Ole K. Olsen, 508 Millaudon Street, New Orleans. After the business meeting and reading of a paper on "Charity Hospital Main Building Foundations, Design and Construction" by Mr. George P. Rice, Consulting Engineer of New Orleans and Member of the Section, a smoker was held in the Rathskeller of Mr. Olsen's home.

Officers elected for the coming year are: Mr. William H. Rhodes, President; Mr. A. J. Negrotto, 1st Vice-President; Norman E. Lant, 2nd Vice-President, and J. A. McNiven, Secretary-Treasurer.

Mr. Allen T. Dusenbury, Past Director of the Parent Society, presented life membership certificates to George G. Earl, J. Frank Coleman, and George Derby for completion of 35 years' membership in the Society.

Chairman E. S. Bres of the Section Scholarship Committee announced that the recipients of this year's award are: Mr. Volney F. Landry, of Baton Rouge, to Louisiana State University, and Mr. Clement B. Binnings, of New Orleans, to Tulane University.

Mr. Jack Burk, President of the Tulane Student Chapter, read a paper on the New Tulane Stadium at the annual meeting of the Louisiana Engineering Society. This paper has received much favorable comment.

The Tulane Student Chapter has again received commendation by the Parent Society for the excellence of its work. They recently visited the construction site of the Charity Hospital, and also saw a motion picture depicting construction of the Golden Gate Bridge.

The Louisiana State University Student Chapter made an inspection trip to the Baton Rouge Bridge, to view the construction activities on the foundation for the bridge.

PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

DECEMBER, 1937

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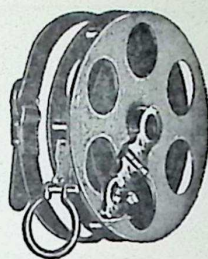
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