The M.S.C. RECORD

Published by and for

The Alumni and Former Students
of the
Michigan State College

EAST LANSING

ENGINEERING NUMBER

Vol. XXXI APRIL 19, 1926 Number 26

THE M. S. C. RECORD

Established 1896

Published for the alumni and former students of the Michigan State College by the M. S. C. Association.

Published weekly during the college year and monthly during July, August and September; thirty-five issues annually.

Membership in the M. S. C. Association, including subscription to THE RECORD, $2.50 per year.

Unless members request a discontinuance before expiration of their memberships it will be assumed a renewal is desired.

Checks, drafts and money orders should be made payable to the M. S. C. Association.

Entered as second class matter at the postoffice at East Lansing, Michigan.

ROBERT J. McCARTHY, '14, Editor

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Vol. XXXI. No. 26 EAST LANSING, MICHIGAN April 19, 1926

ELECTRICITY APPLIED TO MARINE WORK

L. C. Brooks, '92, Formerly Electrical Engineer for Bethlehem Shipbuilding Corporation Discusses Progress In Development of Power and Light Units During Past Twenty-five Years.

The application of electricity to marine work may be considered to have followed the application in other industrial lines except, of course, in not so marked a degree, and perhaps not so early in the development of new theories, due to the fact that ships have depended for their operation upon trained engine men, and they did not so readily accept the transition as did their fellow workers on land.

The following few comments may not be considered as expressing anything new, but anyone who is interested in any specific line may obtain full detailed information from the leading manufacturers of specific equipment (power, communication, etc.) in the country. The "Transactions" of the A. I. E. E., the American Society of Naval Engineers, and the Society of Naval Architects and Marine Engineers have published, somewhat intermittently, very complete articles on the developments of specific applications. In applying electricity to marine work there were several features of design which at first were not given complete detailed attention, such as anti-corrosion, resistance to shock, resistance to high temperature in the operating spaces, ability to withstand rough usage and operation by inexperienced personnel, but all these points were successfully covered several years ago.

It is recorded that the German government preceded the United States by about two years in applying electricity to marine work, but the United States preceded England by about three years.

The first application for interior communication was in 1873, which installation consisted of call bells only, mechanical gongs having been used previously to this date. Electric telegraphs were first used about 1899, and loud speaking telephones were applied in 1895. These simple installations, of course, developed into the present-day fire control systems, which systems are of a confidential nature, available only to the Navy department and well covered by patent, the main principles being for the so-called "director gun firing," whereby the firing of all the guns simultaneously with the aim, range and deflection rightly corrected for various atmospheric and ordnance conditions.

Electric lighting was first installed by Thomas A. Edison about 1880. The average life of lamps was 400 hours, there being 110 lamps on the first ship. Lighting has developed from that day until the present time where, on the airplane carriers now being built for the United States navy, there are 4500 lights.

The use of electricity for power purposes on shipboard was very limited until 1897 when the U. S. navy contracted for the battleships Kearsarge and Kentucky, to be built at Newport News, Va. These ships were completely powered electrically and full description of the same is given in the "Transactions" of the Society of Naval Architects and Marine Engineers for 1899 and 1900. These ships were an entire success, and since then practically all naval ships have been completely powered electrically for auxiliary machinery, and there has been considerable advance in merchant work.

Voltages used in marine work have been slow to develop. The voltage of the first lights used by Mr. Edison was 50 volts. This was later increased to 80 volts which was the lighting voltage on the Kearsarge and Kentucky. These ships were wired on the 3-wire system using 160 volts for power. In 1902 the navy increased the standard to 125 volts, which is the present-day standard for lighting, the power having been increased to 230 volts about 1915.

The electrical requirements on shipboard may be summarized in the transition from the Kearsarge and Kentucky, whose auxiliary power plant consisted of seven 50-KW sets, whereas on the airplane carriers Lexington and Saratoga now being completed, the auxiliary plants consist of six 750 KW sets, the increase in power being accounted for by the increase in size of ships, which accordingly increased the size and number of the various auxiliary machines, and the later ships requiring excitation current for their propelling machinery.

The electrical drive of ships received considerable impetus during and just after the war. The first electrically driven ship, the U. S. S. New Mexico, was completed and put into commission during the summer of 1918, and the operation was so successful that all subsequent navy ships were contracted for with electric drive. However, the Hughes disarmament conference resulted in withdrawing many of these ships from construction. Considerable progress and development may be recorded in connection with Diesel electric propulsion, the units of course being D. C. motors. This application has found considerable favor on ships of smaller horse power (3000 and less) and with the present prices of fuel and the simplicity of machinery, the application bids well for considerable extension.

Probably the most important feature of the electrically propelled ship is the control equipment whereby the operator can get various power desired by a combination of generators and motors with the control mechanisms so interlocked that the operator cannot make a mistake. When it is realized that the propulsion power plant of the airplane carriers is 180,000 H.P. (4 turbo generators and 8 driving motors), the importance of safety in operation and the simplicity of control gear is better realized.

In conclusion I would say that there are a number of very interesting engineering problems that have entered into the development of the application of electricity to marine work during the author's 25 years' experience in connection with this development, and only regrets that it would be impossible to cover any of the details of this development in the limitations of this article, and it is hoped that the reader may have gained some idea of the importance of this branch of the industry, which at this time is in a very comatose state, due to the inactivities in foreign commerce, and the various left-overs from the war, the more momentous act of the same being the Hughes disarmament treaty, which prevents any new construction of importance until 1932, at which time, no doubt, an entirely new generation of engineers and constructionists will be at the helm.

STATION INVESTIGATES TOWNSHIP HIGHWAYS

By H. C. Woods,
Assistant Professor Civil Engineering

A project now under way is the investigation of one of the troubles with which the state highway department has had to contend. There are in this state several thousand miles of concrete pavements. Of this, 224 miles were laid in 1925 and 471 miles in 1924. In laying such pavement it is necessary to build in them numerous joints. These joints must be filled with some subtance which has a high degree of stability, yet is elastic and will remain so at all temperatures. Furthermore, it must have chemically stable constituents, so that it will retain the desired qualities throughout the life of the pavement. Numerous materials are on the market and are extensively used. None however has yet been found which entirely fulfills the requirements. The ultimate result is the same whatever fault there may be in the joint filler. The cracks become filled with "dead" inelastic material, which will not yield when the pavement slab expands under the influence of a summer sun and breaks in the pavement occur.

To examine all of the available materials, analyze them in the laboratory and try them out in actual pavements is a painstaking job, but it has now been under way for over a year. Over 30 different kinds of joint fillers are under observation on about three miles of pavements. In time it will be possible to say which of these 30 odd fillers is the best for pavements in this region and it may be possible to give the analysis of an ideal joint filler. The importance of the subject will be appreciated when it is known that $15,000 is spent annually for joint filler in this state alone. It is hoped that the results of this project will enable highway officials to save annually many times that amount in maintenance charges.

Another project also connected with the highways is research and extension work on township roads. In Michigan, the township roads are in the hands of the township officials. Many of these officials are good, practical road men. It is presumed that all of them are interested in their roads and conscientiously try to keep them in the best condition possible. The condition of the vast majority of the township roads though, is susceptible of improvement. About $13,000,000 is spent annually by 1400 townships on roads. That amount is more than the state and counties combined spend on their road systems and shows the great field into which the second project has entered.

It is recognized that the mileage of township roads is great, that local needs may possibly be best looked after by local people. Such local people have their regular business which they quite generally cannot leave even for a short time to go and take some training which would better fit them for their road work. Therefore the College is going to take the training to them. One-day institutes in road building and maintenance together with lectures and lantern-slide illustrations are to be made in as many counties as possible. Dates are now made up for 20 counties this spring. Contact has been made with the road officials of 400 townships and great interest is manifested. If by this means the College can help township road officials to do their work more efficiently, which will mean better roads at less expense, the College authorities will feel that it has in another very material way again justified the esteem in which it is held by the people of the state.

The teaching staff of the civil engineering department have undertaken studies of other problems. Stucco, snow-fences, setting temperatures of Lumnite cement, pollution of wells and cisterns and yield of well are some of the subjects now under investigation.

All of the members of the civil engineering department are thoroughly alive to the opportunities for service that the department can give. Their chief business is to produce broad-guage capable civil engineers after which any possible service will be renderd to the state.

One of the problems discussed at a recent meeting of the State Board of Agriculture was that of moving the college barns across the Red Cedar. It is planned that the farm equipment will all be located south of the river as soon as funds are available, the present site lacking proper drainage and room for expansion.

Carl H. Boehringer, '25, Bay City, a reporter for a Lansing newspaper, and R. H. Powers, '26, Hartford, who will complete his course at the close of the winter term have mapped out a program of travel which will take them around the world. They will start by April 1 and intend to complete their journey within fourteen months. Both were prominent in student publication work, Powers succeeded Boehringer as editor of the State News.

VIEWS AND COMMENT

The same reasons, or nearly the same reasons, that brought into being the Agricultural Experiment station apply to the Engineering Experiment station. I qualify a little because the only institutions of investigation in agriculture until very recently, have been the agricultural experiment stations; whereas many universities and lately many large corporations, have spent money in industrial research; but the general argument is as good in one case as in the other.

Of course it may be said, with reference to the development of investigational work in our own engineering division, that the University of Michigan is doing a great deal of this; but I am sure the authorities there would be the first to agree that there is so much to be done that, if a little care is used in the way of cooperation, not only will there be no danger of duplication but the combined efforts of both institutions will be inadequate to solve the problems that are pressing upon us in the field of applied engineering.

Personally I have the feeling that M. S. C. will find it wise to take for itself a few rather distinct lines of investigation without widening its scope unduly. Just what these will be the engineers must decide, but already suggestions have been made and work has been done looking toward rural engineering, domestic engineering, communication and so on.

I hope we shall have increasing funds from the legislature so that there can be increasing development in our Engineering Experiment station.

KENYON L. BUTTERFIELD

On Jan. 16, 1924, the state board of agriculture established the Michigan Engineering Experiment station.

The station is organized and maintained to carry on investigations and research in the field of engineering and the allied branches of applied science and to publish the results thereof, in order to stimulate scientific ideals among the students and teachers of engineering at the college; to promote co-operation in research work between engineering and other departments of the college; to make contributions to engineering knowledge and science and to increase the contact of the college with the people of the state engaged in engineering industries, in agriculture and in other industries and activities dependent to a greater or less extent upon engineering.

The station at Michigan State College is one of 25 similar organizations in land grant colleges and universities of the United States. These 25 stations expend annually nearly one million dollars in engineering research and in the publication of the results for distribution. Since the establishment of the first station in 1903, 490 bulletins have appeared and the present total personnel of the stations numbers 110 full-time, 140 half-time men and 220 cooperating members of teaching staffs of the institutions.

The engineering section of the Land Grant College association serves as a clearing house for the correlation of the energies of the stations through a standing committee on engineering experiment stations consisting of Dean Bissell of Michigan, Dean Hitchcock of Ohio, Dean Jones of West Virginia and Dean Seaton of Kansas. The committee has published a summary and index of station projects and bulletins up to July 1, 1923, and publishes a quarterly bulletin containing lists and abstracts of new projects, reports of progress and titles of publications.

The Michigan station had an appropriation of $3,000 for the year 1923-24, $8,000 for the year 1924-25, and for the current year has a budget of $10,000.

There are now ten active projects engaging the attention and resources of the station, as follows: 1 Mixed Fuels for Domestic Heating; 2 Defects in Abnormal Steels; 3 Protection of Iron and Steel from Corrosion; 4 Bituminous Fillers for Cracks in Concrete Pavement; 5 Study of Rural Electrification; 6 Study of Dirt Road Construction and Maintenance; 7 Disposal of Creamery Waste; 8 Metallographic Study of Electric Welding in Structural Steel; 9 Vibrations in Machinery; 10 Study of Grain Growth in the Heat Treatment of Steel.

Four projects have already been published in bulletin form: Bulletin No. 1, Heat of Combination of Copper-Zinc Alloys; No. 2, The Impact Test for Chrome-Nickel Steels; No. 3, Modulation in Radio Transmission; No. 4, Some Properties of Lumnite Cement.

In carrying on the work of the station one full-time research assistant is employed and several half-time graduate assistants work under the direction of members of the engineering staff of the College or in other departments having facilities for the problems involved.

G. W. Bissell, Dean.

RESEARCH IN ALLOYS IMPORTANT TO STATE

By F. G. Sefring.
Department of Michigan Engineering

"The Heat of Combination of the Constituents of Brass" covers some of the pure science phase in non-fermrou metallurgy and shows the practical application of these results. Bulletin No. 2, "Impact Tests of Nickel-Chronium Steels," is a compilation of data to show that fracture tests are significant in the inspection of the quality of nickel chromium steels. Some of the problems which are in progress at the present time are as follows:

Much work has been done on the study of the testing and inspection of plain carbon steels. A progress report on this problem is ready for the press. Much work is still to be done however, to complete this work and we regret not to be able to work more intensely on it. The results thus far are very interesting and indicate high practical values. It will undoubtedly take a long time to gather enough results to draw definite conclusions and also to determine the causes of the phenomena underlying the methods of testing and inspection.

Another very interesting problem is the study of electroplating cadmium and chromium and the study of protective coatings for metals. Much valuable data has been gathered in work carried on for over two years.

Metallographic studies in steel welds are being conducted in collaboration with several industrial plants. These results are being gathered in order to study the real welding power of different types of welds.

Michigan State College is very well adapted to carry on work in metallurgical research because its equipment is especially good to study problems both in practice and in pure science. We have a foundry with two cupolas, an electric steel melting furnace, a very complete variety of steel heat-treating pots and furnaces, and the best and latest devices for testing metals. The facilities for metallography and all kinds of microscopic work in metals are quite complete and of the latest design.

All the work is being done with state funds and of course the results are public property. Therefore the College station offers a splendid opportunity by which the industries of the state of Michigan can find solutions to their common metallurgical problems. This kind of cooperation between the industries and the College station will create a greater demand for better and more research work in metallurgy. With more and more research in metallurgy industrial progress will be stimulated.

Your subscription to The Record must be paid up to July 1 if you are to take part in the election of officers of the Association.

FARM PROBLEMS PHASE OF ACTIVITY

Musselman, '08, Professor of Agricultural Engineering, Discusses Importance of Work On Agricultural Machinery and Appliances; Problems Small Individually But Aggregate Greater Than Many Other Lines.

Agricultural engineering is coming to be recognized as a distinct field. The qualifications of the agricultural engineer are much the same as in other lines of engineering, basically chemistry, physics, mathematics and mechanics with the additional requirement that he should have a background of agricultural training and experience to give a sympathetic viewpoint and understanding of agricultural problems.

Agricultural engineering problems do not, perhaps, appeal to the imagination of the youth who visions engineering undertakings such as great bridges, power houses, buildings or the Panama Canal. Agricultural engineering problems are, for the most part, small in their individual applications. They are large in the aggregate, however, when the number of applications are considered. This is well illustrated by the power problem on the farm. The power requirements of a single farm are generally not such as to excite the interest of the engineer. Considering the use of primary power on the farm in the aggregate, it is somewhat staggering to learn that it is practically as much as all the manufacturing and central station plants combined.

The problem of the application of power to the farm is one which involves a great many factors in addition to those included in industry, and should be a challenge to the young man who wishes to be of service.

Farm machinery has gone through a great cycle of development until it may seem to the layman that it must have reached the end of development. But as machinery is developed to meet certain practices, it is also possible for these practices to change so that entirely new impetus may be given to the development of machinery. It does not seem beyond the bounds of probability that the further application of power to agriculture will change many practices. The possibilities of electricity as a form of power applicable to the farm are tremendous.

It is apparent also that the further development which must come in power and machinery, as related to the farm, can be brought about with the least loss to both agriculture and industry by the man who understands the problems to be met and has the knowledge and skill of the engineer to meet them.

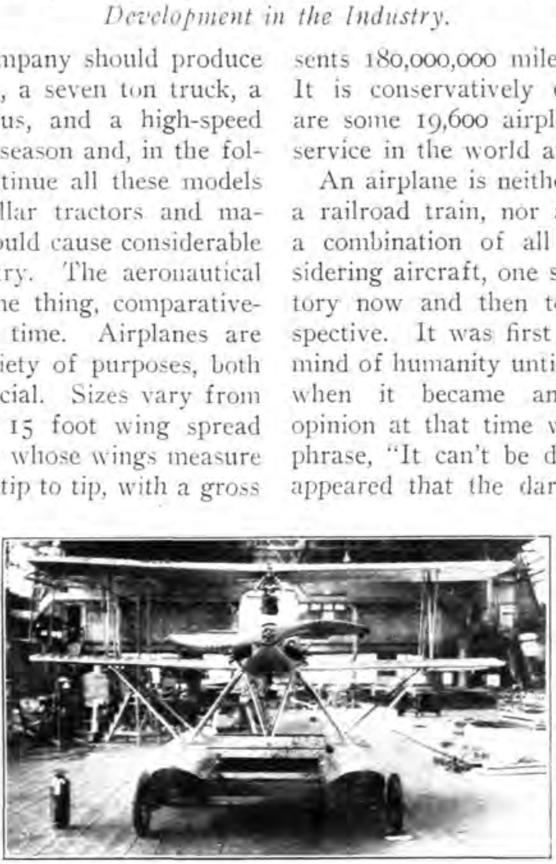
The American Society of Agricultural Engineers has attempted to state the aims and objectives in agricultural engineering education. A partial report of the committee which follows seems to state these quite clearly;

"The primary aim and objective of agricultural engineering education is to make the individual in the industry of agriculture more efficient and a larger producer and thus provide a higher standard of living for our rural population. A study of general standards of living prevailing in various agricultural regions both in the United States and foreign countries reveals with a certainty that the evidence of a prosperous agriculture are identified with high individual efficiency and large productive capacity. It is out of the surplus of production that those things which make for a high standard of living are provided. This statement refers not only to those conveniences and comforts which surround the individual but also to efficient schools, active churches and community spirit, which are indicative of a good social condition."

THE NEW FIELD FOR THE ENGINEER

L. C. Milburn, '14, Chief Aeronautical Engineer for the Glen L. Martin Company, Tells Some of the Qualifications for Work and the Outlook for Development in the Industry.

If the Packard company should produce a 10 H. P. cycle-car, a seven ton truck, a 40 passenger road-bus, and a high-speed racing car all in one season and, in the following season discontinue all these models and produce caterpillar tractors and machine gun tanks it would cause considerable uproar in the industry. The aeronautical factory does the same thing, comparatively speaking, all the time. Airplanes are used for a large variety of purposes, both military and commercial. Sizes vary from midget airplanes of 15 foot wing spread to Goliaths of the air whose wings measure nearly 150 feet from tip to tip, with a gross weight of nearly 50,000 pounds. Some airplanes land on land, some on water and a few are capable of alighting on either land or water as occasion may require.



A Miniature of 18-foot Span

Some airplanes are intended to develop great speed, at the present time in excess of two hundred fifty miles per hour. Others are designed for carrying huge loads, some as great as 7,500 pounds over and above crew and fuel. Some are intended as flying demons of destruction, carrying .50 caliber rapid fire guns while others carry bombs large enough to do tremendous damage. Fortunately the present time finds us spending more and more attention upon aircraft of more useful service. It is estimated that nearly 3,000 planes will be built and sold for commercial purposes during 1926. This quantity is but a small beginning and yet if each airplane flies only three hours per day, and but 200 days per year, it represents 180,000,000 miles of flying annually. It is conservatively estimated that there are some 19,600 airplanes in active flying service in the world at the present time.

An airplane is neither an automobile nor a railroad train, nor a steamship and yet a combination of all three. When considering aircraft, one should review its history now and then to keep a good perspective. It was first an obsession on the mind of humanity until December 17, 1903, when it became an invention. Public opinion at that time was expressed in the phrase, "It can't be done". Eventually it appeared that the darn things really flew as advertised and popular comment changed to "What of it? About this time came the war and aeronautical engineers simultaneously took up aviation and the whole problem was opened out and developed a hundred-fold. Airplanes have become quite stable, well-behaved affairs proceeding about business of various kinds with regularity and dispatch.

Due to the many ramifications which have developed to date, an aeronautical engineer should (for the benefit of those who have inclinations in this direction) be well acquainted with physics, hydrodynamics, meteorology, algebra, geometry, trigonometry, calculus, air-dynamics, air-navigation, fire and accident prevention, legal rights of aviation, patents, aerial warfare, altimeters, turn-indicators, compasses, radio, oxygen apparatus, night landing equipment, parachutes, ventilation, signal lights, bombs, machine guns, photo apparatus, metallurgy and wood technology, paints, varnishes and cellulose lacquers, specification writing, thermodynamics and gas engines, air-propellers, cooling systems, superchargers, reduction gears, eccentricity, vibration, redundancy, and least work, as well as all known branches of structural design. A knowledge of salesmanship—a good command of English and for field work, a stout pair of rubber boots will also come in handy.

After the war, the great wave of expectancy for aviation passed away and the many wild plans were succeeded by a period of slow, steady progress. A great fund of research data gathered between 1912 and 1918 was available but several factors held back progress. The greatest, I suppose, was that no one knew just where the proper sphere of usefulness for airplanes was. As a result there were designed and built in the years between 1919 and 1925 all over the world some 5,000 new and different airplanes. Fifty of one kind is a rare quantity even today, and in many cases, only one or two of each kind were built. Without opportunity for standardizing or duplication the cost has remained high.

Another factor which has made progress slow is the absence of any background of operation upon which reliable cost data could be based and the attending difficulty of interesting substantial quantities of capital.

This transition period is passing and aircraft operation is rapidly becoming a stable business, as evidenced by the formation, during the last year, of several large companies for the purpose of giving the public aerial service of all kinds. The business of constructing aircraft has been on a firm basis for a number of years, due chiefly to the constant need for military airplanes. In the meantime, aeronautical engineering has been steadily progressing and modern airplane design is an exact science. Gathering knowledge from every art, science and industry, the air-engineer is gradually building up a new science and technic which is reaching farther and farther ahead toward the day when surface travel will be as obsolete as the "buggy-ride".

CLASS NOTES

'83

Frank Rogers writes: "When I left the College in August, 1883 I began work as a surveyor in the swamps of Sanilac county. Since that time I have followed engineering directly. My work as highway commissioner is interesting, both on account of its engineering work and its administrative features. The work never gets monotonous If there is any danger of that one can easily stir up enough trouble to make it lively."

'86

C. H. Judson is office engineer in the office of the chief engineer of the New York Central.

"Work is very interesting and along constructional lines. Live at Berea, about 14 miles from Buffalo. Have a little bungalow set among some fine trees. Have two children. Plenty of fresh air and country life with all city conveniences. A covey of quail frequent the rear of my little farm. Am hoping to be able to run over to the Campus for the reunions. Occasionally listen in to your broadcasting programs."

'91

V. S. Hillyer, 3302 Central avenue, Indianapolis, is with the Central Indiana Power company, a public utility. Hillyer adds: "Since leaving the College in '91 I have been engaged in various kinds of engineering design and construction. I graduated from the Michigan College of Mines at Houghton in '99. My construction work has been in connection with the mining industry, road building, hydro-electric construction and electrical distribution construction."

'94

"I live at 92 East Iroquois Road, Pontiac", writes M. F. Loomis, production manager of the Jewett Radio corporation. "We make receiving sets and loud speakers. Some time when you are at leisure listen in on WJR, 517 meters, 5000 watts. I tune in on WKAR often. You are doing good work and the quality of your station is good. I wish that you might put on one regular engineering night each month, not too technical but of general interest to engineers. Dog fleas, worms, pruning grape vines and household tasks are interesting but a regular date on engineering topics would also be worth while".

'99

T. C. Lewis writes: "I am employed by the Southern Pacific as instructor to apprentice draftsmen and paymaster, headquarters at Portland, Oregon. My hobbies are radio, photography and the cornet. The enclosed picture is of my drafting school"

'08

E. S. Martin of James A. Wickett, Ltd., con-

tracting engineers of Toronto, Canada, has just completed the construction of a filter plant for St. Catherines near Niagara Falls, Ontario, capacity ten million gallons.

'16

Ivan Driggs, according to the Dayton Daily News of April 7, has perfected a light airplane which has been sold to the government and will be used in making pilot-less or "radio" flying tests. The new plane is known as the Driggs-Dort. It is the first light plane that the army air service has ever purchased and represents a new avenue of aeronautical activity. Driggs is vice president and chief engineer of the Johnson Airplane and Supply company of Dayton, Ohio. Driggs writes: "We have two children, Lois Jean and Dorothy Ellen. Address 37 Glenbeck boulevard.

'18

W. E. Dobson, 58 Fairview avenue, Yonkers, N. Y., is a salesman with the Mack Truck company. "Enjoying life fine."

FURTHER MATERIAL ON ENGINEERING WILL BE PRINTED IN THE SUCCEEDING ISSUES OF THE RECORD.