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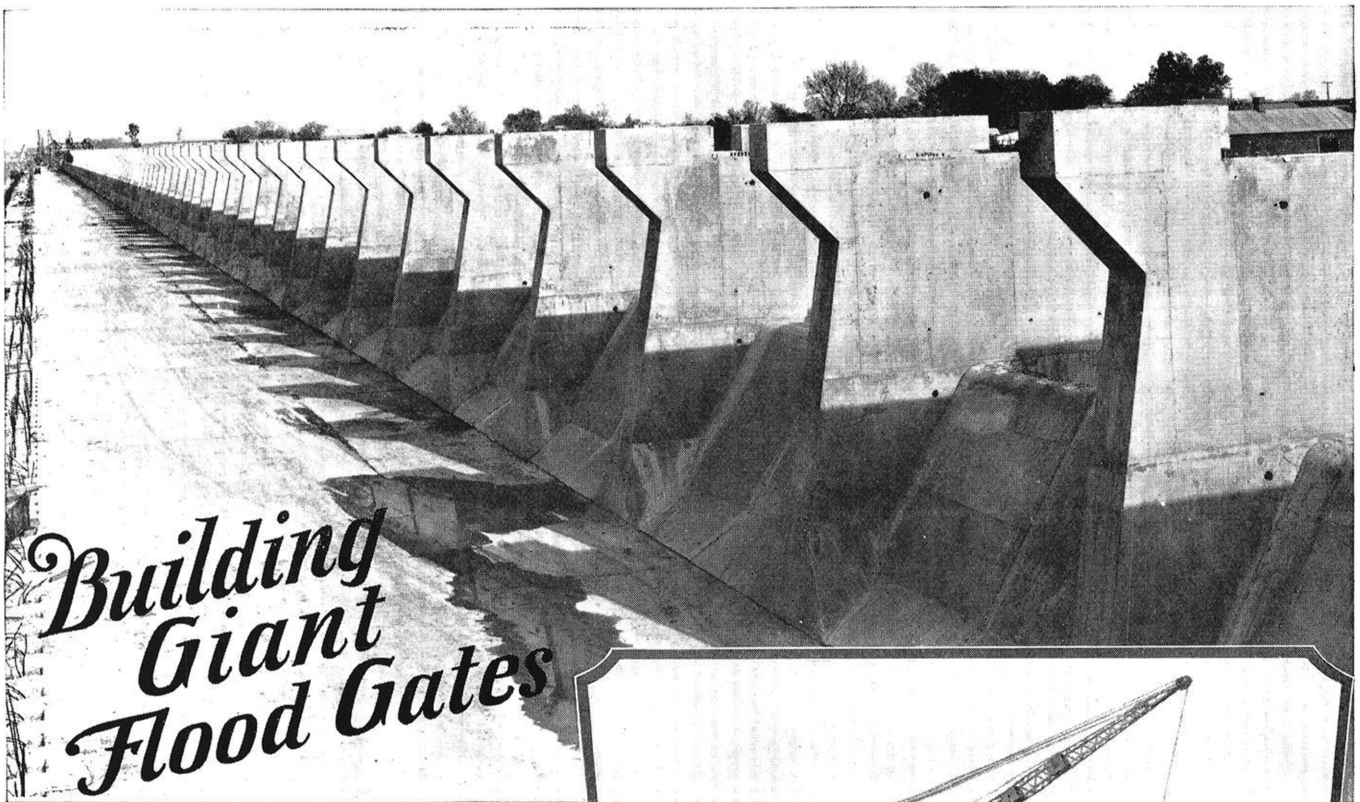
DECEMBER

MEMBER OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED

1930



TWENTY-EIGHT miles upstream from New Orleans a great flood gate known as the Bonnet Carre spillway is being completed. In times of high water this concrete dam on the east bank of the Mississippi will tap the flood before it reaches the city, diverting the dangerous excess into Lake Pontchartrain.

The Bonnet Carre spillway consists of a concrete dam and a pier-and-weir section about 7700 feet long. The weir sections, which are twenty feet wide between the piers, have timber needles on the crests at two levels — elevations 16′ and 18′. A traveling crane, on a bridge spanning the piers, removes the timber needles for discharge.

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VOLUME 35 — DECEMBER, 1930 — NO. 3

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The WISCONSIN ENGINEER

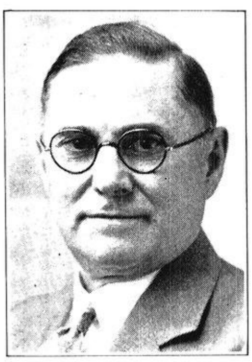
VOLUME 35, NO. 3 — DECEMBER, 1930

The Young Engineer and

Budgetary Control

By C. A. KELLER, e'99

"MONEY isn't everything," but, as the darkey said, "it am powerful handy." The farther the young engineer goes in his profession, the more he will realize that while his plans and projects may evolve from mathematical and materials, *money* is most "powerful handy." Indeed, when and if he sits atop his profession, he will likely pause to wonder what his detailed technical training and knowledge avails him when his job seems to concern primarily money—and men.



Mr. Carl A. Keller

Wilmette, Illinois

Mr. Keller, who is budget director of the Commonwealth Edison Company in Chicago, was formerly a business manager of the *Wisconsin Engineer,* and is a charter member of Tau Beta Pi. Concerning this paper he says: "It gives me great pleasure indeed to present this article, because I have a warm spot in my heart for the *Wisconsin Engineer,* having been on the publishing board when I was a Junior and a Senior at the University."

Somewhere in the archives of the College of Engineering of the University of Wisconsin is lodged a letter written some thirty years ago by a young engineer two years after graduation. This letter replied to an inquiry of Professor D. C. Jackson, then head of the electrical engineering course, as to what, in the young engineer's opinion, should be added to the curriculum of the engineering course to make it a more valuable preparation for the business world. The young graduate was then Assistant Engineer supervising the construction and initial operation of an interurban railway system. His previous experience had been along the same lines in minor capacities, when suddenly he found himself in charge of not only a construction crew, but also what little local office was maintained. He found himself confronted with, to him, a new aspect of the engineering profession. Not only was he responsible for the field engineering and supervision, but he was also required to supply the syndicate office with an estimate of his money requirements for each succeeding period, to disburse the moneys so drawn, and last but far from least, to balance these two functions so that the cash balance in the local bank appeared as a black instead of a red figure. So, without the slightest hesitation, the young engineer replied to his former professor that the great need in the engineering curriculum was an introduction into the methods and means of corporation finance and business in general.

Unquestionably, the past three decades have seen a broadening of engineering college curricula so that the young graduate of today is probably a better balanced business engineer than he was at that time. It is almost equally certain that few young engineers today would find themselves after such brief experience in the situation outlined above. Organization and big business have come into the picture so that now the getting, spending, and accounting of money are specialized activities most generally administered by specialists. But while today the young engineer may find himself remote from the purely financial functions of whatever enterprise he is engaged upon, he will soon discover that the responsibility still falls upon the man who incurs the expenditures, even though he may never actually see a dollar of the money he handles.

If the writer, who in his youthful exuberance was guilty of the above letter, were asked the same question today, he would, despite any liberalizing of curricula that has taken place, reply in the same tenor. As Mr. E. C. Stone, past chairman of the Engineering Section of the N.E.L.A., said to a graduating class, "The engineer's job starts with getting solutions to his physical problems, but by no means ends there—he should be a scientific business man if he is to fulfill his mission and achieve the greatest personal success." By "scientific business man," Mr. Stone explained that he meant a man of *science* and of *business*. The writer would append to this interpretation, "and a man of scientific business." For business itself has become a science, not as exact as engineering but certainly as fascinating—and quite as important.

To point these three definitions of the engineer, let us take an example in mechanical engineering. The problem is to convert coal into mechanical energy. The engineer, with an instinctive bent to get the most out of the process—which really amounts to conservation of material resources—passes over the simple compound engine to the triple-expansion, and finally to the turbine. He elaborates the simple boiler to include superheaters, economizers, pre-heaters, develops a regenerative cycle, goes to higher pressures, but at some point along the line the *man of business* puts his foot down and exclaims "Well, that's going to cost a lot of money!" If the engineer and the man of business are different men, the chances are the efficiency development will stop arbitrarily about halfway to some reasonable compromise point. The man of scientific business would insist that this point be determined by economy—efficiency curves, that maintenance, useful life, and all other costs be

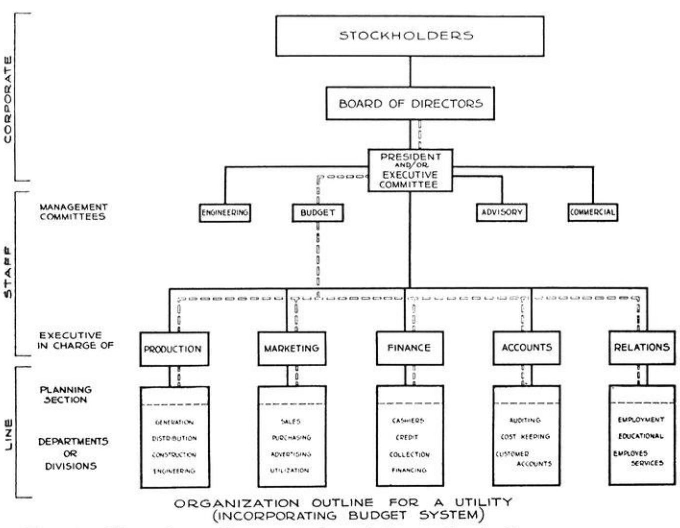


FIG. 1: *This chart shows in dotted lines the budgetary organization compared with the line organization of a private business such as an electric utility corporation. By substituting business names for the governmental agencies, both charts No. 1 and No. 2 are practical identical. The Electorate are stockholders, Congress is the Board of Directors, the Cabinet officers are the functional or divisional executives. The budget officers are the planning sections, coordinating with the Budget Director, who in turn reports to the President.*

considered. So the composite man embodying these three viewpoints would arrive at his solution after considering an overall picture of money, materials, methods, etc.

Engineering, too, has become highly specialized, and it is all too easy for the specialists working on their several individual portions of a project to fail to bring together *all* considerations that bear on the whole. It is for this very reason that "scientific business' has inserted into organization agencies, for correlating all considerations—both engineering and business, both internal and inter-related. The most successful of such agencies is budgetary control in some form. (Note accompanying charts) This is nothing

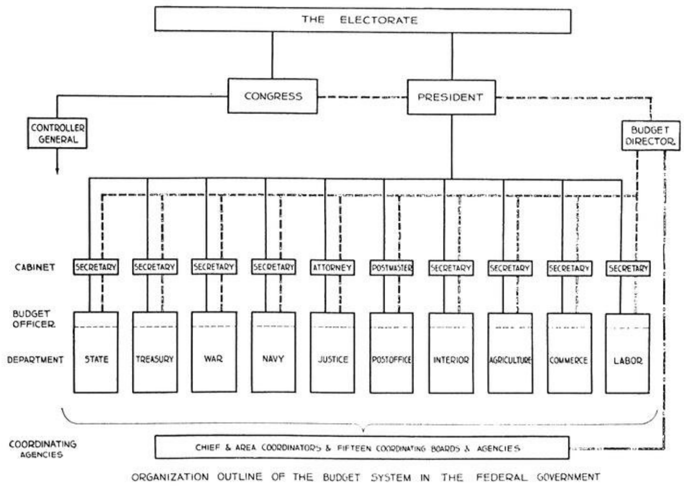


FIG. 2: *This chart shows in dotted lines the budgetary organization as compared with the line organization of the Government. Note that a special budget officer is designated in each department to compile the departmental budget. These budget officers coordinate with the Budget Director, who is nominally the Secretary of Treasury, but who in fact is responsible only to the President and so functions.*

more or less, as far as the engineer is concerned, than hitching up the $-sign to the plans and schedules he must prepare and follow through.

The principles and procedure of budgeting in their broader aspects are splendidly presented in an address by Mr. Louis F. Musil,* entitled "Budget Principles and Procedures in Their Broader Aspects," delivered before the International Budget Conference at Geneva, Switzerland, last July:

(a) Know what you are undertaking to do.
(b) Have the courage of your convictions.
(c) Know how far you have gotten toward your goal at all times.
(d) Individual opinion is not sufficient when you are spending money not your own.
(e) Cooperation requires tolerance of initiative of others in your responsibility.
(f) Whatever your official status, your coordination with the responsibilities of others is one of acquiescence and not of approval.
(g) Justify your confidence in your associates and their confidence in you.
(h) Reappraise the probabilities and possibilities of your undertaking in the light of all things that affect it at all times.

In actual application, there are a variety of budgets: operating, investment or construction, cash, stock, etc. Of these, the operating budget is perhaps most widely used in general industry, while the construction or plant addition budget is of prime importance in businesses where the ratio of investment to revenue is high and where almost constant extensions are required, as in the utilities. The operating budget comprises usually monthly estimates of all income, expense, and corporate items such as taxes, bond interest, etc., and culminates in an anticipated earnings statement, showing net earnings available for dividends and balance or deficit to surplus after dividends—the vital diagnosis of any enterprise.

The construction budget is a composite of all plant addition projects, new or old, to be undertaken or continued during a given period, frequently with monthly expenditures indicated. The sum of the year's expenditures for those projects minus the amount of property to be retired from active service is the increase in fixed capital which will show up in the next annual balance sheet. This capital must come mostly from the investing public and will require interest, taxes, depreciation, and maintenance as long as it is in use. Such outlays of money, of course, must have the authorization of the Board of Directors before work is started.

From the construction and operating budgets, the financial officer may compile a cash budget or summary of income and outgo, which will readily indicate when and in what amount new financing must be undertaken. This is the end-result of all budgetary control from the corporate financial viewpoint. Few businesses can earn all their money requirements, and for the others, the definite fore-knowledge of when and how much new money will be needed both for additional capital and for short time bank loans to tide over the scant periods, is a matter of considerable money in or out of pocket.

In general, a business budget is based primarily upon two factors: external business conditions and internal business requirements.

The value of budgeting is much broader in scope than the function of financing. Mr. Louis F. Musil points out that one great advantage of budgetary procedure in business and industry is the development of executives:

"The need for executives is always apparent; their unavailability is one of the limitations of industrial progress. More executives must be developed from the ranks of industry. Every man has some executive ability and its degree can only be determined by giving it an opportunity to show itself. To the extent that any man merely performs a task, he is only a workman; but, to the extent that he plans for himself or for or with others, he must call on his executive ability. Through this application he develops judgment, foresight, and conviction and starts up the executive ladder. Whatever executive recognition he may achieve, he, nevertheless, earns a better reward both in wages and satisfaction.

"Budgetary procedures invite this executive approach to every task. They are an aid to the executive, therefore, in selecting the men to whom he must subdivide his responsibility as his job grows beyond his own capacity.

"Budget procedures develop the yardsticks by which to gauge merit, and also the yardsticks by which the executive can determine to what extent responsibility is being suc-

(Continued on page 100)

THE DECEMBER COVER

Editor's Review

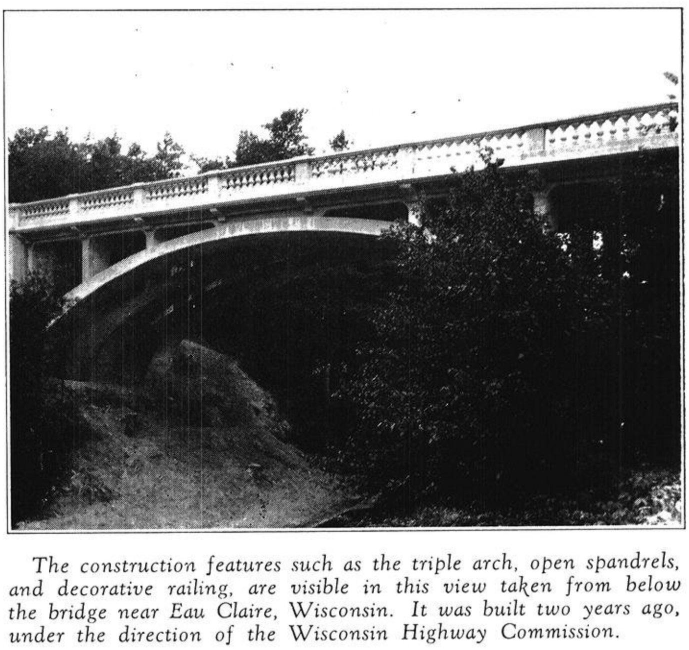
Bridges, constructed in the latter part of the nineteenth century, were for the most part ugly structures of wrought iron and steel. The advent of reinforced concrete into engineering, and the accurate analysis of the performance of this material has done away with many of these old trusses.

The majority of the older iron bridges were constructed by the railroads. In those days there were few people who actually saw the bridge. Deck structures cannot even be viewed by the people on the trains. The "eye-sores" were only apparent to the engineer and fireman, and possibly a few farmers who lived in the vicinity.

Mr. Cottingham

The automobile has brought the tourists into the country in large numbers. The improved appearance of bridges is the result of this city contact with the country, and the adaptability of concrete to arch construction. The structure on this month's cover picture was designed by Mr. Cottingham of the Structural Engineering Department, who graduated from the College of Engineering in 1925.

The main features of the design were the ninety feet clear span, the twenty-two foot rise, and the twenty-eight foot roadway. The roadway is supported by three arch rings. The open-spandrel type adds well to the appearance. The intricate railing is an indication of the movement toward artistic appearance. The parapet is divided into panels about twelve feet in length. The dado is filled with an English type of baluster, the monotony of which is broken at the panel points.



The construction features such as the triple arch, open spandrels, and decorative railing, are visible in this view taken from below the bridge near Eau Claire, Wisconsin. It was built two years ago, under the direction of the Wisconsin Highway Commission.

The Welland Canal

By George Washa, c'30*

THE history of the Welland Canal reflects both the industrial development which has taken place in North America, and the progress that has been made in canal engineering. The canal is one of the principal links in the great chain of navigation extending from the Straits of Belle Isle, up the St. Lawrence River, and through the Great Lakes to Duluth at the west end of Lake Superior, and Chicago at the south end of Lake Michigan. The approximate length of the waterway is 2,240 miles. The Welland Canal connects Lake Erie with Lake Ontario, with a difference in elevation of 325.5 feet, and crosses the Niagara Peninsula about ten miles west of Niagara Falls.

Early History of St. Lawrence System

The first actual excavation undertaken for canal purposes upon the St. Lawrence route was begun in 1700 by the Seminary of St. Sulpice, Montreal, which undertook to cut a channel without locks from Lachine to Montreal, but abandoned the work because of its great cost.

The first locks on the St. Lawrence route were the locks on the Haldimand Canal, built by the Royal Engineers for military purposes, 1779-1783, around the lower and upper rapids between Lakes St. Louis and St. Francis. These locks were 40 feet long, 6 feet wide, with 2.5 feet of water on the sills.

In 1798, at Sault Ste. Marie, the Northwest Fur Company built a small canal and lock which was destroyed by the Americans fourteen years later.

After the War of 1812, the Joint Commission of Upper and Lower Canada reported in favor of a canal system for the St. Lawrence River and in 1821 the government appointed commissioners to build the Lachine Canal with locks 110 feet long and 20 feet wide. This canal was completed in 1825. Twenty-three years after the opening of the Lachine Canal, the last of the St. Lawrence Canals for a 9-foot depth was completed and opened for traffic between Montreal and Prescott.

The First Welland Canal.

The first canal was built as a private enterprise by the Welland Canal Company formed by the late Hon. William Merritt and was completed in 1829. It was built via the Twelve-Mile Creek from Port Dalhousie, on Lake Ontario to Port Robinson on the Chippawa Creek.

The first canal had 40 wooden locks, each 110 feet long, 22 feet wide with 8 feet of water on the sills. This canal was connected by a feeder canal to the Grand River at Dunnville. The canal was later extended from Port Robinson to Port Colborne on Lake Erie, making the total length of the canal 27½ miles.

The Second Welland Canal

In 1841 the legislature of Upper Canada bought the canal and decided to enlarge it to 9-foot navigation and also to complete the St. Lawrence Canals which were necessary to avoid the various rapids between Lake Ontario and Montreal. The 40 wooden locks were reduced to 27 locks built of cut stone, by increasing the lifts. In 1853 the navigable depth of the canal was increased to ten feet by raising the banks and walls of the locks. The total cost of the canal prior to 1867 was $7,638,239.

The Third Canal

In 1870 the commission recommended a uniform scale of navigation for the St. Lawrence route and the enlargement of the locks to a length of 270 feet, a width of 45 feet, with 12 feet of water on the sills. The third canal, which was 26¾ miles long, was opened to traffic for 14-foot navigation instead of 12-foot as had been at first contemplated. The third canal up to March 31, 1925, had cost $25,375,347 for capital construction and $12,026,987 for repairs and maintenance. The tonnage passing through the Welland Canal from 1900 to 1925 was as follows:

1901	620,000
1914	3,860,000
1918	2,200,600
1925	5,640,298

The Fourth or Present New Welland Canal

The history of canal communication between Lakes Erie and Ontario is one of constant enlargement and reconstruction to meet the rapid growth of trade and commerce and consequent steady increase in size of vessels plying the Great Lakes. The shipping on the great Lakes has always exceeded the canal capacity so that at no time during its existence of about a century has the Welland Canal been able to accommodate the large vessels on the inland waters. In increasing the length of the locks from 270 feet to 859 feet for the ship canal it is confidentially expected that the capacity of the ship canal will be sufficient to provide for marine development for many years to come. During the

WELLAND CANAL IV

The New Welland Canal, which after seventeen years of construction will be fully opened next spring, is of interest to dwellers in the Lake States for it is an important link in the Great Lakes-St. Lawrence outlet to the sea. It will carry deep-draft vessels between Lakes Ontario and Erie around Niagara Falls. The canal is the fourth one to be built since the construction of the Lachine Canal, in an attempt to provide a waterway from the Lakes down the St. Lawrence. It lies wholly in Canada and is being built by the Canadian Government.

* Written for the course in senior Engineering English.

past quarter of a century exhaustive surveys have been made to determine the feasibility and cost of a 25-foot waterway.

Final Location

The Welland Ship Canal follows the valley of the Ten-Mile Creek between its mouth, about three miles east of Port Dalhousie, and Thorold, crossing the present canal below lock No. 11 where the water levels of both the old and new canals are at elevation 382.0 feet and below lock No. 25 where the levels of both are at elevation 568 feet. A new channel will be excavated between Thorold and Allanburg for the purpose of straightening the alignment of the canal. Between Allanburg and Port Robinson the present canal will be deepened and widened, and between Port Robinson and Welland the canal will follow the west slope of the Chippawa Creek Valley.

From Welland to Port Colborne the present canal will be widened and deepened with the exception of a section 2½ miles long just north of Lake Erie where the present canal follows a circuitous route. The new ship canal will follow a much straighter course in a deep rock cut east of the present canal through the villages of Humberstone and Port Colborne. This canal will for all practical purposes be a straight line and will have a total length of 25 miles. The time required to pass vessels through the canals from lake to lake is estimated at 3 hours in the canal reaches and 5 hours in the locks as against 15 to 18 hours now needed.

Contract Work

The Canadian practice in awarding contracts is to divide the work into blocks aggregating $1,000,000 or more, and requiring a 5 per cent bond on the total amount, by the contractor. The World War forced a cancellation of the original contracts and the government took over the work at a reasonable cost minus depreciation. In 1921 the work was again begun on unit price contracts and it has been completed on this basis.

Port Weller Harbor

At the Lake Ontario end of the canal, Port Weller Harbor is formed by 2 earth embankments extending 1½ miles out into the lake, where the depth at low water is 25 feet. The banks are parallel to each other and provide a channel 800 feet wide, one mile long which at the lake end is narrowed to 400 feet by two converging lines of reinforced concrete crib docking.

Port Colborne Harbor

This is an artificial harbor developed off the lake shore to protect the entrance to the present canal and to provide suitably sheltered facilities for the transfer of bulk cargoes of grain from the lake freighters to elevators and through the latter to canal-size boats, railway cars, and flour mills. The outer harbor is formed by two breakwaters placed 4,400 feet off shore. This arrangement provides 600 acres of enclosed harbor.

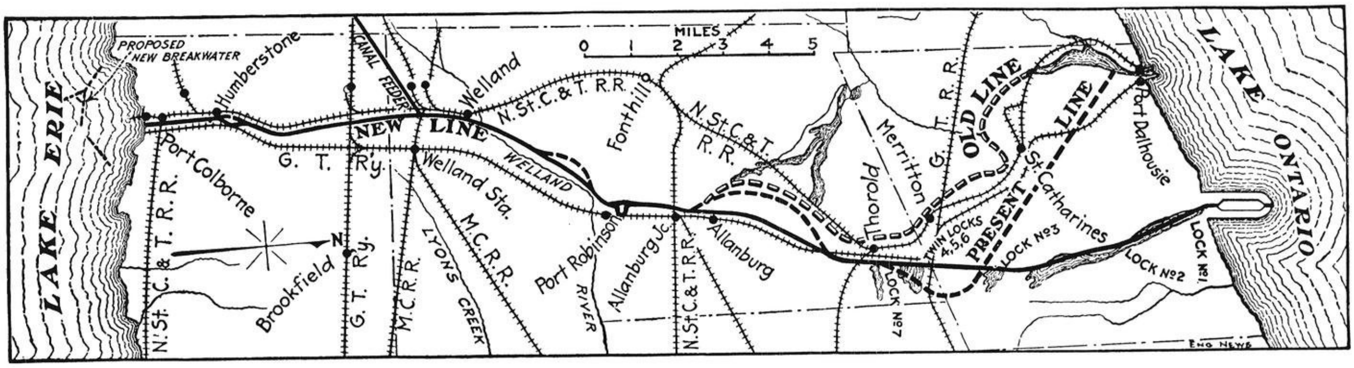


FIG. 1: *Map of the Welland Canal region. This shows the new course, the present course, and the old course. The improvement in the route is apparent.*

Locks

A fall of 325½ feet between the two lakes will be overcome by 7 locks of 46½ feet lift each. The direct line of the canal down the face of the escarpment, and the topography of the lower plateau permitted the adoption of these high lifts, which constitute a peculiar feature in the design of the canal and have no precedent in actual construction for locks of their size. The usable dimensions of the locks are: 820 feet long, 80 feet wide, and 30 feet of water on the sills.

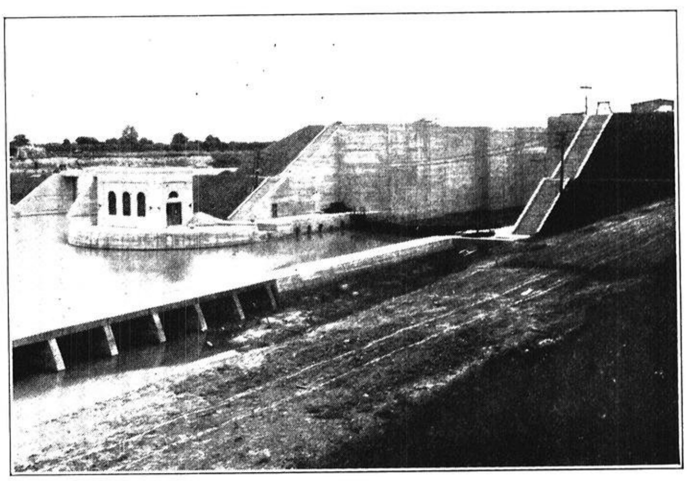


FIG. 2: *The difference of 325½ feet between the lakes is overcome by seven locks which are similar in design to this one. Its lift is 46½ feet.*

Locks 1, 2, and 3 are single locks and are located on the lower plateau between the lake shore and the Niagara Escarpment. As the lockage requires 70 acre feet, it is

(Continued on page 94)

Problems Confronting The

Student Societies

By C. M. Jansky
Professor of Electrical Engineering

WHEN the subject was first presented to me, I remarked, that is a poser; after several weeks of pondering and cogitation, I am still of the same opinion. Before making any suggestion relative to the specific contribution that the National Technical Societies can make through the branches, it may be well to briefly consider the situation from the standpoint of the branches.

The underlying purpose for organizing the Student Branches of the American Institute of Electrical Engineers was stated by President Scott in 1902 in the following words:

"The principal purpose for bringing the work of the Institute directly to the student is to enable him to keep in touch with actual things and to give him a definite idea of the kinds of worlds which lie before him, and for which he is preparing. Fortunate will it be if we can lead him to see that in the development of an electrical engineer there should be something besides technical training—that logical thinking and clear expression and general culture are indispensible in a profession that is closely related to so many departments of science and engineering as well as industrial, commercial and social activity, and that he must be a broad man with a broad educational foundation, who would aspire to the fullest usefulness and success."

Prof. Cyril M. Jansky

Madison, Wisconsin

Professor Jansky is connected with both the College of Engineering and the Extension Division. He maintains a close contact with the senior engineers through his course in Engineering Papers. This senior course is made up of the preparation and presentation of technical papers, many of which have and will be published in the *Wisconsin Engineer.*

Purpose and accomplishment in this, like in so many other human endeavors, have been quite disassociated and for no particular fault of the sponsors, organizers, or students themselves, but mainly because of conditions over which neither the parent body nor the members of the branches have absolute control. In order that keener appreciation may be had of The Problems of The Student Branches a brief review of some of these conditions will be apropos.

Some thirty or thirty-five years ago there were, in most if not in all institutions of higher education, flourishing forensic and debating societies which provided training in public speaking and in leadership such as it was hoped the Student Branches would furnish the young engineers. These societies flourished because they were the centers of the literary and social life of the students. They provided avenues of self expression, of which we hear so much today, in many different activities. Among the more significant may be mentioned dramatics, debates, declamations, reading of papers, and the social hour or two after the formal program.

To be an official of one of these societies was a distinction and honor much coveted. It was considered a mark of distinction to participate in the program, and even faculty members occasionally attended and participated in the proceedings.

Today most if not all of these literary societies are in a moribund state. No one seems to pay the slightest attention to their meetings; members are few and more or less inactive; it is no longer an honor to be an official of such an organization, and the apparent eccentricity of belonging to such a society is more a mark of distinction than any literary or forensic achievement.

Then, the student's extra curricular life was relatively simple while today the number of extra curricular activities, each under a separate organization, has so shifted the students' interests that even the academic training is suffering from inattention, and the question,—Should a student study—is not as paradoxical as it sounds. What are some of the demands of an engineering student's time?

First and most important are his scholastic duties. The engineering students are required to complete in eight semesters in the University of Wisconsin 146 credit hours of work exclusive of Freshmen Lectures, Physical Education, or Military Science. This means an average of 18 to 19 credit hours per semester. Assuming that each credit hour requires two hours for preparation and one for recitation, the student is expected to devote from 54 to 57 hours per week to his classroom work. This is one to one and one-half hours more per day than is required of union labor.

This, however, is not all of the demand on his time. The distinction and honor associated with the holding of office in a technical or literary society has been absorbed by the honorary and professional fraternities, Tau Beta Pi and Eta Kappa Nu. These also hold meetings which the student is expected to attend.

Then if he has any athletic ability he is importuned to try for a place on some athletic team. If he fails to make the varsity squad, the fraternity team demands that he uphold its prestige in inter-fraternity contests. Nearly every Saturday afternoon he is expected to show his school spirit by attending intercollegiate contests, for which he is supposed to have previously acquired enthusiasm at a "pep" meeting.

The social activities formerly associated with the literary society now center around the fraternities which, in addition to their weekly meetings hold regular formals and informals. For fear that after all of these activities the student might have a few minutes left to devote to the work of the Branch, the Union Board fosters weekly dances on Saturday evenings.

These are only a few of the activities that are demanding the spare time of the student. Decorations for homecoming; students' publications; preparations for St. Patrick's Day; the union vodvil; the band, and several other activities could be mentioned.

With so many enterprises competing for the student's time is it any wonder that an activity whose aim is to train leaders in engineering is dormant and lifeless? No distinction and honor attaches to the office of president or secretary, but there is attached much hard work in securing members, preparing programs and in keeping up the spirit of an organization almost unrecognized by the student body, most of the faculty, and the future employers of engineering students.

The position of the student societies in the College of Engineering is at present a precarious one. Many of them are hanging on only through the efforts of a few interested supporters among the faculty and the student body. It seems unfortunate that this type of extra-curricular activity which once flourished should be on the ragged edge now, and facing possible doom in the future years.

Although a member of the faculty who spends much of his time away from College of Engineering in the Extension Division, Prof. Jansky has shown that he has a keen insight into the situation.

In an early issue there will appear an article concerning the various activities in the engineering school, their scope and their membership.

Proficiency in athletics is rewarded by letter, and if combined with good scholarship a medal is sometimes awarded.

It is not the material reward, however, that animates students to activity in fraternities, athletics and the like, but the acclaim of their fellow students. Enthusiasm is a contagious emotion, and it is only natural for the individual student to participate in those activities in which he can secure the most renown. Ambition for the plaudits of the populace was not limited to Caesar or Anthony, but it is an affection common to the race.

In short, the ineffectiveness of the Branches is a result of the shifting of honor and acclaim from scholastic and literary achievement to athletic prowess and the transfer of the students social activities from the literary societies to the fraternities, unions, and other like organizations.

In brief, therefore, the problem of the Branches is to devise ways and means to restore literary activities to their proper place of eminence and distinction. Material prizes may serve as a stimulus, but unless some acclaim, some distinction, some public recognition is made of the winning of the prize, very few competitors will appear. Is it possible to make a literary activity so interesting and stimulating that it can compete with the many agencies mentioned? Perhaps not, but much can be done to arouse more interest in the Branches than is at present manifest.

What can the national societies do to assist in the solution of this problem?

In the first place, as the employers of the graduates of engineering schools are in most instances members of the national organizations they can very properly stimulate interest in the work of the student branches by recognizing as possible future leaders in engineering those students who are leaders in branch activities. It seems reasonable to insist that the management and promotion of the activities of the engineering societies requires ability of as much potential value as the ability to kick a goal. The placing of more emphasis on the students' participation in the work of the local branch as a qualification for employment is one contribution that the national societies can make. What else?

In my judgment the supreme need of the student body of today is not more mechanics, more differential equations, more thermodynamics and electrodynamics, but of inspiration and vision. They are surfeited with a continuous diet of such things for four years. As one disillusioned boy unburdened his soul to me:

"Four years ago I entered the University with the intention of making engineering my life work. Today I stand on the threshold of that work, bewildered and uncertain. I don't know whether I have chosen the wrong profession; I don't think I have, but the significant thing is that while at Wisconsin nothing has happened to stimulate or encourage my interest in engineering work; there has been nothing that inspired me; nothing but formulas, the substitution in an endless number of formulas."

Lest you say that is an isolated case, I want to say that I have read that boy's despondent cry to several seniors and they all confessed that such sentiments are more prevalent than we of the faculty imagine. To me it seems a great tragedy that a boy, who instead of "rejoicing as a young man to run a race," feels already defeated before life's race is begun.

If the youth of our colleges is to undertake life's problems with faith, courage and zeal, it must be conscious of the worth of the many human activities, and of the preparation necessary to successfully engage in them. Faith, Courage and Zeal are as much if not more the product of inspiration than of knowledge; for despite the bravado and assumed sophistication of our students they, like King Lear's fool,

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Some Freezing and Thawing Tests on

Concretes and Mortars

By Mr. L. O. Hanson, *Mechanics Department*

THIS article is a report on a series of tests performed by Mr. H. L. Turrittin to investigate the relative resistance to alternate freezing and thawing of concretes made from various aggregates, with differing water-cement ratios and with varying richnesses of mix. The specimens and tests described were made during the years of 1928 and 1929. The specimens were of four types: 6 x 12-in. concrete cylinders, 24 x 4 x 3½-in. concrete slabs, 3 x 6-in. mortar cylinders, and 1 x 1 x 6-in. mortar bars. In general, the concrete was of a fairly rich mix, and with the exception of one batch of cylinders, of a consistency which would give a slump of from 3 to 5 inches. All mortar of 1:2 proportion by weight.

A resume of tests is given in Table 3, "Summary of Test Results." Between a third and a fourth of all specimens were subjected to 200 cycles of alternate freezing and thawing. The greater part of the remaining specimens were placed in the moist closet and tested, half at 28 days and half at 1 year and 6 months. Still other specimens were used to determine absorption.

All specimens were eventually broken, the cylinders in compression and the slabs and bars under transverse loading. It was thought that the data from the strength test might establish some relationship between the strength of the concrete and its durability under alternate freezing and thawing.

Mr. H. L. Turrittin had direct charge of the experimental work described herein, carrying it out under the general supervision of Professor M. O. Withey. Mr. L. M. Basford, and Mr. R. E. Greiling assisted in the performance of the actual experimental work.

Batch	Sand	Mix	W/C Ratio	Compressive Strength Pounds per Square Inch		Tensile Strength Pounds per Square Inch	
				7 Days	28 Days	7 Days	28 Days
2	Janesville	1:3	0.64	2342	4508	303	464
3	Wissota	1:3	0.63	1915	3280	231	403
4	Ottawa	1:2	0.50	3340	5355	363	490
5	Janesville	1:2	0.51	3400	6450	463	650
6	Wissota	1:2	0.51	3163	6265	441	580
7	Ottawa	1:2	0.53	3108	5830	305	486
8	Janesville	1:2	0.53	3508	5663	393	568
9	Wissota	1:2	0.53	2915	5102	367	548

Table 1: *Results of tests to determine relative values of sands used.*

Materials

Universal Portland Cement was used throughout the series of experiments. This cement was tested prior to use and passed the A.S.T.M. specifications as to fineness, time of set, soundness, and tensile and compressive strengths at 7 and 28 days.

Janesville and Wissota sands were used in the making of the specimens. Janesville sand is a well graded fine aggregate containing approximately 65% of quartz by mineral analysis, with dolomite the other principal constituent. The Wissota sand, from the neighborhood of Winona, Minnesota, contains a larger percentage of quartz than the Janesville sand.

Aggregate	Weight, Pounds per Cubic Foot	Absorption, Percent by Weight	Fineness Modulus
Janesville Gravel	106.9	1.40	7.33
Lannon Dolomite	96.5	1.40	7.33
Elmwood Limestone	94.5	1.20	7.33
Wissota Gravel	106.3	0.80	7.33
Janesville Sand	111.0	0.78	2.74
Wissota Sand	108.4	0.70	3.10

Table 2: *Properties of aggregates showing physical properties of sands used in the tests.*

As outlined in Table 1, a number of tests were made to determine the relative values of these two sands. Three batches each of six 2 x 4-in. mortar cylinders and six briquettes were made from both Janesville and Wissota sands, and two batches from Ottawa Standard Sand. Half of the specimens were tested at 7 and half at 28 days.

In every test, the briquettes and cylinders made with the Janesville sand showed higher strengths than those made using the Wissota, giving values ranging from 3 to 38% larger in compression and from 4 to 31% larger in tension.

Physical properties of the two sands are listed in Table 2, "Properties of Aggregates." The absorption of both sand and rock was determined by immersing the materials in water at room temperature for 48 hours. The unit weights of all materials are based on dry rodded weights, the container having been filled in layers of one-third of its depth and rodded 25 times. The physical properties of the coarse aggregates used are also given in Table 2.

The gravels were artificially graded so as to consist of three parts passing a 1½-inch sieve and retained on a ¾-inch, two parts passing a ¾-inch and retained on a ⅜-inch, and one part passing a ⅜-inch and retained on a ¼-inch sieve.

Janesville gravel is a dolomitic rock of good quality, composed largely of rounded particles of smooth surface. Lannon dolomite is quite hard and tough, and is composed of angular particles with fairly rough surfaces. Elmwood limestone is a soft magnesian limestone. The particles are angular with rough surfaces. Wissota gravel from the neighborhood of Winona, Minnesota, is mostly igneous in origin. It is largely composed of smooth rounded particles.

Specimens and Tests

Two types of concrete specimens were made, 6 x 12-inch cylinders and 24 x 4 x 3½-inch slabs. The aggregates used in each batch, which consisted of either 20 cylinders or 12 slabs, are outlined in Table 3. For the most part, a fairly rich mix was used, a batch of 20 cylinders of Janesville sand and Janesville gravel with a mix of 1:3:6 having the smallest proportion of cement. With the exception of Batch No. 5, which was purposely made drier, a three-inch slump was used. The consistency of the material was rather closely controlled by the standard slump test and by the flow of the material upon a flow table as a further check. All concrete was mixed in a 6-cu. ft. No. O Smith mixer for a period of 1½ minutes. The forms for the cylinders and the slabs were then filled. After one day in the air the forms were taken off and the specimens placed in the moist closet. Three-fourths of the specimens remained in the moist closet until they were either tested or placed in the freezer. The remainder were used as absorption specimens.

Forty 3 x 6-in. cylinders and thirty 1 x 1 x 6-in. mortar bars were made from 1:2 mortar mixes, Janesville sand being used in half and Wissota sand in half. These mortars were of practically the same consistency as a 1:3 normal consistency mortar made using Ottawa Standard Sand, the consistencies being measured by flow on a flow table. The amount of water used in the mixes outlined in Table 1 was also determined in the same manner. Cylinder molds were filled in three equal layers, each being tamped five times with a tamper weighing 2.4 lbs. dropped from a height of three inches. The diameter of the tamper was one and one-half inches. Molds for the bars were filled in much the same manner as molds for briquettes. All specimens were placed in the moist closet after one day. They remained there until they were tested or placed in the freezer, with the exception of one-quarter of the specimens, used for absorption tests, which were removed from the moist closet at the end of four month.

Several specimens of each type were subjected to freezing and thawing. Such specimens were removed from the moist closet and placed in the freezer at the age of 28 days. The freezer, which was cooled by the expansion of ammonia, was kept at an average temperature of about 15° F. The lowest temperature was 10° F. Specimens were never removed from the freezer when its temperature was above 20° F. The specimens were alternately subjected to the low temperature of the freezer and thawing in a tank of water at 60°F. The average time for a cycle was two days, and the specimens were subjected to two hundred complete reversals. After the first hundred cycles the specimens were put in water at 70° F. for three months during the summer of 1928 and the reversals resumed again in the fall. At the end of the freezing and thawing tests the specimens were allowed to remain in the tank for two days and then for two days in the moist closet before being tested in compression or cross-bending as the case might be.

Batch No.	Fine Aggregate	Coarse Aggregate	Mix	Slump in Inches	W/C Ratio	Compressive Strength - Pounds per Square Inch				Ratio A/B	Absorption after 48 hr. in Water %	Remarks
						Absorption Specimens	After 28 Days in Moist Closet	After 200 Reversals of Freezing and Thawing (A)	After 1 yr. 6 mo. in Moist Closet (B)			
	6 x 12-in. Cylinders					*		**				
1	Janesville Sand	Janesville Gravel	1:2:3½	3	0.73	3962	4150	5996	6296	0.953	4.54	
2	Janesville Sand	Lannon Dolomite	1:2:3½	5	0.78	4116	4136	5872	6015	0.976	4.71	Each value represents the average of five test specimens.
3	Janesville Sand	Elmwood Limestone	1:2:3½	3	0.75	4435	4760	6242	6707	0.931	4.70	
4	Wissota Sand	Wissota Gravel	1:1.85:3½	3	0.71	3650	3630	5366	5193	1.034	4.55	
5	Janesville Sand	Janesville Gravel	1:2:3½	½	0.64	4975	5010	6850	6416	1.068	4.17	
6	Janesville Sand	Janesville Gravel	1:1½:3	2½	0.59	4680	4560	6478	6917	0.937	4.29	
7	Janesville Sand	Janesville Gravel	1:3:6	3	1.04	2394	2388	3652	3826	0.954	4.67	
	24 x 4 x 3½-in. Slabs					Modulus of Rupture - Pounds per Square Inch						
1a	Janesville Sand	Janesville Gravel	1:2:3½	3	0.73		688	1004	969	1.031		
2a	Janesville Sand	Lannon Dolomite	1:2:3½	3	0.78		870	1160	1101	1.053		Each value represents the average of four test specimens.
3a	Janesville Sand	Elmwood Limestone	1:2:3½	3	0.75		799	882	1074	0.821		
4a	Wissota Sand	Wissota Gravel	1:1.85:3½	3	0.71		717	796	851	0.935		
	3 x 6-in. Mortar Cylinders					Compressive Strength - Pounds per Square Inch						
1	Janesville Sand		1:2		0.53	5829	6010	8496	9230	0.921	6.35	Each value represents the average of five test specimens.
2	Wissota Sand		1:2		0.53	5750	5816	7984	7996	0.999	6.10	
	1 x 1 x 6-in. Mortar Bars					Modulus of Rupture - Pounds per Square Inch						
1	Janesville Sand		1:2		0.53		1000 (a)	1350 (b)	1400 (c)	0.969		(a) represents 3 specimens. (b) represents 4 specimens.
2	Wissota Sand		1:2		0.53		865 (a)	1100 (b)	1290 (c)	0.853		(c) represents 8 specimens.

TABLE 3: *A complete tabulation which shows the conclusive results of these tests. Ratio A/B shows the effects of alternate freezing and thawing. It is unusual that batches No. 4 and No. 5 of medium water-cement ratio had a higher compressive strength after freezing and thawing than after 1½ years in a moist closet.*

Some of the cylinders were allowed to remain in the moist closet for four months. They were then removed, allowed to become air dry, weighed, immersed in water for 48 hours and again weighed. In this way, the percentage of absorption was determined. These specimens were then allowed to remain in the air, except for a final period of seven days in the moist closet, after which they were tested in compression at the age of 260 days.

The remaining specimens were allowed to remain in the

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Editorials

"OVER A THOUSAND YEARS AGO AESOP SAID"

The old fable of the elephant and the blind men has been repeated millions of times since it first occurred. The story briefly is this: The blind men wished very much to understand what an elephant was like. They curiously examined the animal in an effort to imagine his true form. Each one, however, came in contact with a different part of its body; one in front of the elephant felt of his trunk, another its tusks, a third its side, and a fourth its leg. The argument that followed this was a lengthy and heated one. None of them had any conception of the beast's anatomy except that part which they had examined.

The engineer of today is not blind; but he is often very ignorant of all the factors of a problem. His analysis is local and restricted to the points with which he is familiar. A dozen engineers in consultation on a problem will give a dozen widely different reports all of which may not be correct. In the summer work at Devils Lake four maps (two of which were prepared by government employees) gave different interpretations of the local topography.

Know the facts is a familiar engineering slogan, yet it may be a worthless statement. The engineer must *know all of the facts* before he can render his opinion. Reputable consulting men are aware of this. Their reports are frequently very long, but they are nevertheless comprehensive. They do not, like the blind man, localize their scrutiny on a single feature. The entire situation is carefully examined. Many engineers do not trouble themselves overmuch. After feeling the "tusk" they report that the "elephant" is round, smooth, and hard; their reputation consequently enters oblivion.

There does not seem to be a fable about the wise blind man who examined the entire animal and reported the truth.

BUSINESS DEPRESSION

Next June the entire senior class will be ready to start on its career in the technical world. The first step in this journey is the selection of a good job.

A year of depression has left its indelible mark on industry. Getting positions last June was a serious task. Captains of industry are vociferous in their statements that "business is fundamentally sound." Yet annual and semi-annual reports have proved otherwise, and the optimistic statement has been widely ridiculed.

The law of supply and demand, and the saying that the "early bird gets the worm" are indications that next summer some graduates will be starting in good positions, some in bad positions, and the rest will join the ranks of the unemployed. Being without work is very bad on the morale of the young engineers.

Men who are going into medicine or food supply vocations do not have any worries. Undertakers are not concerned. These vocations supply a demand that is based on absolute necessity. The engineer, however, is in a different boat. Maintenance and construction can wait until the depression blows over. The senior engineers too will be waiting for jobs until the depression blows over.

The moral to this discussion is to get going on openings. There are always some good positions available. Those that are looking ahead, and making efforts toward getting jobs will be the fortunate ones in June.

THE INERTIA OF PUBLIC OPINION

One of the biggest barriers which engineers eventually run up against is public opinion. It is a problem which must be solved in nearly every public improvement project, and in many of the engineering programs which are not directly in the public eye.

The great mass of people in the nation are almost entirely ignorant of the factors which affect the construction of new roads, water treatment plants, sewage disposal plants, bridges, and public utility plants. They are acquainted with the general problems of financing which seems to be their only item of concern.

A city engineer, let us suppose, has conceived a splendid idea that will be of direct benefit to the community. He prepares a set of plans that are perfect in every engineering detail. He estimates the cost and proposes the proper measures of meeting the cost. And yet the plan is rejected by the citizens. And the engineer is thoroughly discouraged with his efforts.

His opponents are hard to defeat. Cigar store politicians are so self-centered that they will not accept any project unless they can see the direct benefit for themselves. Even good politicans are very careful not to spend too much money during their period of office. City councils, and city executives are thus one of the outstanding opponents. The consensus of public opinion is more directly shown by the ballot of the entire town. Townspeople are apt to be old-fashioned. They dislike the new developments, and are usually very incredulous of the benefits of public improvements. Public referendums are very likely to oppose the plans of the engineer.

Newspapers are beehives of very poor arguments which are well received by the gullible public. They are controlled by local capital and other interests who first decide which stand to take, and then scurry about to find arguments in support of their stand. Difficult as these situations are they must be met by the engineers with skill and ability. Many opportunities for the amelioration of city property and living conditions have been lost because of the technical man's inability to put his project over.

WHEN THE ULTIMATE? Fundamentally as human beings and members of our so-called "Golden age of civilization," and secondly as embryo engineers, we are all too apt to regard our tools and the products of our profession as being a close approach to the ultimate in engineering skill. Power plants, with their gigantic, silently humming turbines; towering buildings rising a quarter of a mile into the sky and built around a skeleton of steel; machines which perform millions of hum-drum tasks for us and even some of our thinking; — these are a few of the things upon which we found our vanity.

If, now, we could look five thousand, or eight thousand, or ten thousand years into the future, what do we see? With and upon what are the engineers of that age working? Gone are the inefficient power plants and everything built of soft and corrodable steel. In their place we find mighty power plants drawing pure energy directly from the sun and converting it to the multitudinous uses of that civilization, to which it is transmitted by wireless. Buildings, machines,—everything is fabricated of alloys and beryllium, magnesium, and aluminum—alloys many times lighter and stronger than steel and yet uncorrodable. The engineer's every whim is gratified by machines and robots that outperform him in any field of strength, agility, concentration, or ability to solve mathematical problems. Nevertheless, if we look closely we will see that daily he is learning to work better and more efficiently.

But why should we stop here? Let us look onward one hundred thousand years further and attempt to comprehend what we see. The power plants no longer draw energy from the sun—that method was too dangerous to the future of the sun; so now the atom is used and intra-atomic power supplies man's needs and wants. Transmission of this power by wireless and even by metallic conductors has gone the way of the kerosene lamp in our times; and now a completely resistanceless, "tight-beam" system is used, whereby the power is heterodyned upon a transmitting beam. Machines and robots composed of metallic parts have been succeeded by mechanisms of pure force in which unimaginable myriads of rays do all the work. With the unlimited sources of intra-atomic power at his command the engineer transmutes the elements and creates synthetic metals of any desired property—from a metal whose strength is the ultimate that any material of molecular structure may have, to metals of glasslike transparency that have been formed, not of protons and electrons, but of photons. These metals are not joined together by bolts or welds but by processes of molecular diffusion whereby the molecules of one part are "drifted" into the molecular structure of the other part, thus forming one piece in its entirety. And so on, but still the engineers are working and striving to create better tools and do mightier things.

As we go further and further into the future the changes that take place become so exceedingly complex that we can no longer comprehend what is going on—much less follow the progress of the engineer. He will be working at problems and using methods and tools which we cannot even imagine. But the ultimate in engineering progress will not have been reached until man ceases to be a physical entity and becomes a purely intellectual being.

THEY BLAME THE PRESIDENT Slim pickings, comparatively, awaited the seniors who finished their courses last June. They got jobs, but their choice was limited as compared with other years in the immediate past. Business was, and still is, in the dumps. Why? Of course, there are certain replies. The stock market crash of a year ago was spectacular and therefore receives a large share of the blame; prohibition is blamed by those who crave their booze; and the great engineer who is president, Mr. Hoover, is blamed for the depression by his political opponents. None of these causes, however, is sufficient to explain the depression, which is not confined to the United States, but is world wide.

The world has suffered many terrific natural catastrophies during the past five years; there have been great floods, hurricanes, and earthquakes. Furthermore, the people of the earth have been torn by incessant warfare. But, in spite of these handicaps, organized society has made substantial advance in providing those material things that make life possible and enjoyable. Food is abundant. Sanitation was never better, and mankind is being rapidly released from hard physical labor by the development of power and machines. Society has all the elements necessary for the creation of a Golden Age surpassing anything known in the past.

With our present means, it should be possible for everyone to live in comfort, even luxury. Instead we have a business depression, unemployment, hunger, and suffering. It doesn't make sense. A year ago business was booming; today the factory wheels turn slowly and men walk the streets out of work. The raw materials are still here, the machines are still here, the need for goods is still here.

Overproduction as an explanation of the depression does not satisfy the conditions. We are a long way from overproduction if we use actual human needs, instead of market demands, as a criterion. Eighty per cent of the individuals of this great and so-called wealthy nation are inadequately fed, clothed, and housed. Few of us are so abundantly supplied with the good things of life that we crave nothing further. There is plenty for our machines to do provided society can arrange for intelligent distribution of the things they produce.

The communists believe that they have a solution for this problem of distribution, and their Russian experiment is of great social importance. The communists may be wrong in their theories, but at least they have recognized the problem and are doing something to solve it. Our own capitalistic country must soon face the issue. The output of the machines must be fairly distributed.

Alumni Notes

WISCONSIN GRAD. NEW HEAD OF IOWA E. E. DEPARTMENT

Dr. F. Ellis Johnson, EE'09, has recently been appointed head of the department of Electrical Engineering

Dr. F. Ellis Johnson, Head of Electrical Engineering at Iowa State College.

at Iowa State College. He has spent the last ten years as an instructor at the University of Kansas. In 1920 he was ranked as an Associate Professor and later became a Professor of Electrical Engineering. During the academic year of 1927-28 he was appointed Head of the Department of Electrical Engineering at Kansas. Dr. Johnson held this position until he resigned to take the Professorship and Chairmanship of the Electrical Engineering Department at Iowa State College.

During his ten years at the University of Kansas he spent some time doing consulting work. He also conducted acceptance tests and placed a large amount of his efforts in the design and engineering of transmission lines and distribution systems including street lighting systems. He also valuated and reported upon numerous municipal electric systems.

At the time Dr. Johnson resigned from the University of Kansas to come to Ames, besides serving on the usual committees to which every faculty member is heir, he was secretary of the University Senate and a member of the Executive Committee of the board of Directors of the Physical Education Corporation and the University Athletic Board. He was also a member of the Board of Electors of Sigma Xi and the advisory board of the K. U. Chapters of Tau Beta Pi.

When Dr. Johnson went to Iowa State, he resigned as secretary of the Wesley Foundation Board of Trustees, and he also withdrew his nomination for president of the Kansas Section of the American Institute of Electrical Engineers.

HOLLISTER TAKES STRUCTUAL ENGINEERING CHAIR AT PURDUE

S. C. Hollister, c'16, has been appointed to the head of the structural engineering department of the School of Civil Engineering at Purdue University. Professor Hollister has had nearly twenty years of experience in private practice designing and supervising the construction of bridges, buildings, power development, and sewage disposal. He has also done

Prof. S. C. Hollister of Purdue University.

considerable research in the materials of construction. He has recently been occupied with the problems arising from the welding of steel bridges and buildings.

NATIONAL INSTITUTE HONORS JAMES ASTON

Dr. James Aston, e'98, Ch. E.'09, received the fifth Robert W. Hunt medal in recognation of his paper on "A New Development in Wrought Iron Manufacture," at the annual dinner of the American Institute of Mining and Metallurgical engineers.

Prof. James Aston of Carnegie Institute of Technology.

in the Hotel Commodore, New York, February 19. The presentation was made by George B. Waterhouse, professor of metallurgy and mining at Massachusetts Institute of Technology.

Dr. Aston is director of mining and metallurgy at the Carnegie Institute of Technology, and consulting metallurgist for the A. M. Byers Company, Pittsburgh.

He was born in England in 1876. His early education was received in the Milwaukee Public Schools and he graduated from the University of Wisconsin in 1898 with a B. S. degree in electrical engineering. In 1908 he returned to Wisconsin to do research and then served for several years as instructor in metallurgy.

In 1912 he went to the University of Cincinnati and later became a member of the staff of the U. S. Bureau of Mines, Pittsburgh. In 1915 Dr. Aston took the position of chief metallurgist of the A. M. Byers Company, and is now a consultant for this company as well as head of the mining and metallurgy department at Carnegie Institute of Technology.

CIVILS

Baillies, Sidney D., c'29, visited Madison on November 17. He has been draftsman with the Nantahala Power & Light Company at Bryston City, N. C. He is now with the same company at Minoqua, Wisconsin.

Brandenburg, William C., c'27, announces that he was married last August 9th. He has changed his address to 6136 Northwest Highway, Chicago, Ill. He is employed by the Telephone Company and is spending most of his time with the development of mechanical switchers which make dial telephone operation more practical.

Cutler, Joseph A., c'09, was recently elected to the board of directors of the Johnson Service Company. He is situated in Chicago and is very influential in the work of the American Society of Heating and Ventilating Engineers.

Potter, W. G., c'90, of Evanston, Illinois, has been recently elected president of the National Drainage, Conservation, and Flood Control Congress.

Ely, Alex W., c'12, is a consulting municipal engineer for small cities that do not keep a resident city engineer. He maintains offices in Janesville, Wisconsin. He is married and has three children, the oldest one being seventeen.

Homewood, Robert, c'27, is making a water survey for the State Board of Health of Virginia. He likes the work as it gives him a chance to drive around a lot and get out of doors to see the scenery.

Lane, E. Neil W., c'30, has a permanent position with Scott and Scott, civil engineers, of Lincoln, Nebraska. His address is 2818 J St., Lincoln.

Lindner, Clement P., c'25, visited the campus on October 29. He is on the engineering staff of the Corps of Engineers at the Washington office engaged in water power investigations of the Potomac and other rivers in that vicinity.

Matthews, Charles W., c'28, was married on November 12 to Janet Ruth Beckwith of Milwaukee. They will be at home after December 1 at 3273 South Kinnickinnic Ave.

Penn, W. C., c'07, CE'15, is secretary-treasurer of the Nantahala Power & Light Co. of Bryson City, N. C.

Poss, Robert J., c'30, is an inspector on the first unit of the harbor of refuge project at Frankfort, Michigan. He is employed by the United States Engineering Corps, and is very interested in his work. Other Wisconsin men on the job are **R. A. Heffernen**, c'22, in charge of construction, and **John E. Blanchar**, c'29, an inspector.

Shumann, Everett C., c'24, MS'26, was married to Eleanore Frances Moyer of Dubuque about a month ago. The wedding was announced to friends at a post-nuptial party at Milwaukee on November 1. Mr. Shumann is associate engineer at the Research Laboratories of the Portland Cement Association at Chicago. Miss Moyer has been employed in the same laboratories.

Stevens, Roger W., c'30, is employed by S. V. Praport, an engineer for the Russian Government. He is designing a rolling mill to be erected in Russia. At present he is in Pittsburgh but he may go to Russia at the beginning of the new year.

Velasquez, Bernardo Cock, c'30, passed through Madison on November 18 with his father who is governor of a state in Columbia, S. A. They were on their way to Rochester where the father was to undergo an operation.

CHEMICALS

Becker, Lloyd G., ch'23, has transferred to the Sales Department of the Trane Co., with headquarters in Milwaukee.

Casselman, Ralph T., ch.'30, has started work with the Bakelite Corporation as a research chemist. Address: 48 Spruce Street, Bloomfield, New Jersey.

Forrester, Jay H., ch'28, is now in the experimental department of the Standard Oil Co., Whiting, Indiana.

Fowle, M. J., ch'29, was transferred to the High Explosives Division of the du Pont Co., Gibbstown, Pa.

Geissman, T. A., ch'30, began as cadet engineer at the Whiting, Indiana, plant of the Standard Oil Co.

Hansen, R. E., ch'26, continues to sell Leeds & Northrup Company pyrometric equipment in the Chicago territory.

Kemnitz, H. C., ch'26, still holds his job with the Rubberoid Co., Joliet, Illinois.

McFarlane, R. W., ch'28, has moved to the Carrollville, Wisconsin, plant of the American Tar Products Co.

Menestrena, L. C., ch'28, received promotion to be Assistant to Head of Technical Dept., Roxana Petroleum Co., Wood River, Illinois.

Mitchell, M., ch'21, is design engineer for the Republic Creosoting Company, Indianapolis, Ind.

Quale, Irving; Popkin, H. R.; Kristof, F. J., ch'30, are cadet engineers for the Sinclair Refining Co., East Chicago, Indiana.

Rick, T. T., ch'29, changed from du Pont's to the metallurgical research division of A. O. Smith Corp., Milwaukee.

Schaefer, N. C., ch'28, still serves the Chicago By-Products Coke Company, Chicago.

Whelan, R. A., ch'24, has advanced to Superintendent of the Utica, N. Y., plant of the American Tar Products Co.

Zoerb, F. C., ch'28, was promoted to Superintendent of the New Orleans, La., plant of the Flintkote Company.

ELECTRICALS

De Merit, Merrill, e'14, is assistant to the president of the West Penn Power Company of Pittsburgh.

Fairweather, Robert W., e'30, is a member of the technical staff of the Bell Telephone Laboratories at New York. He is in the transmission research department working on "Voice operated echo suppressors and anti-singing devices."

Riebe, Clifford, e'30, is a student engineer of the Allen Bradley Company at Milwaukee. Address: 1726 S. 31st Street.

Watson, G. Stanley, e'30, is a student in the dial telephones training course of the Wisconsin Telephone Company at Milwaukee, Wis.

MECHANICALS

Bradford, Wm., e'04, is Director of Engineering at the Edgemore Iron Company, Wilmington, Delaware. He has a wife and one son who is a junior in the L. & S. College at Wisconsin.

Daniels, Chas. J., m'30, has started a training course in welding with the Chicago Bridge and Iron Works, at Chicago. He writes: "Immediately after graduating last June I took a train to San Diego, California. From there I helped sail a yacht to and back from the Hawaiian Islands." Address: 1305 W. 105th St., Chicago.

Pawlowski, John A., m'30, is in the production engineering department of the Cutler-Hammer Company at Milwaukee, Wis. Address: 1521 Kilbourn Ave.

Richtmann, William M., m'25, was married to Miss Marion V. Arnold, of Prentice, Wisconsin. They were married on October 25, 1930, in the First Congregational Church, Madison, Wisconsin. Mr. Richtmann was at one time business manager of the Wisconsin Engineer. He also held an instructorship in the college of engineering at Wisconsin after his graduation. Mr. and Mrs. Richtmann will make their home after November 10 at 2307 Melrose St., Rockford, Ill.

Rowley, Frank B., m'05, came down from Minneapolis on November 22 see the University of Minnesota go down to defeat before Wisconsin. He is Professor of Mechanical Engineering and Director of Engineering Research at the University of Minnesota.

Engineering Review

DROPPING A DAM INTO PLACE

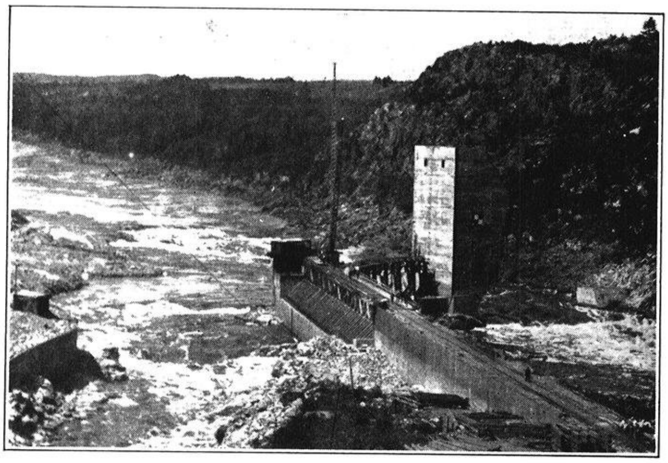
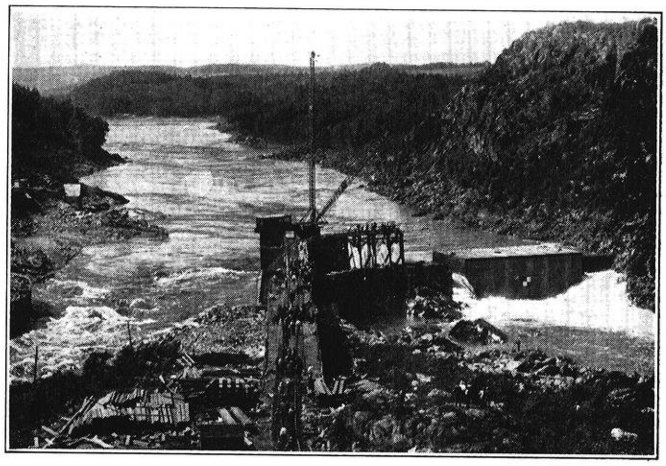
Inventions do not always lead to patents and quantity production. Many inventions are engineers' applications of scientific knowledge and of experience to individual problems. Achievement of a large enterprise, such as the diverting of the Saguenay River, is sometimes staked on an operation for which there can be no preliminary trials. Here is a story of such an adventure and its thrilling success.

A subsidiary power company of an American aluminum concern, has under construction a large hydroelectric power development at Chute-a-Caron on the Saguenay River about 140 miles north of the City of Quebec. The Saguenay River has a flow varying from 35,000 to 225,000 cubic feet per second. The site selected for the Chute-a-Caron power plant was naturally in a gorge located in a rocky section of the river. In order to complete the large masonry dam across this gorge, it was necessary to excavate a diverting channel and turn the river at a time of low flow through this new channel while masonry foundations were extended across the original channel which was the deepest part of the gorge.

The usual method of putting in timber cribs and weighting them down with stones, or large blocks of any heavy substance, was not quite practical due to the extreme depth and high velocity of this water. James W. Rickey, Hydraulic Engineer for this industrial concern suggested that a large, heavy, reinforced tower, or "obelisk," of the proper length, curved on one side so as to fit as nearly as possible the bottom of the river, be built on a concrete pier at the edge of the river, at a convenient place upstream from the power dam; then by blasting away a small portion of the pier tip the obelisk over into the river so that it would become a dam. This scheme was worked out very carefully by Mr. Rickey's staff, also his consulting engineering staff, and his construction engineers on the ground.

The channel was excavated, and tunnels were built in the permanent dam with large gates capable of carrying 40,000 to 50,000 cubic feet of water per second and passing it through the powerhouse where the first hydraulic turbine was to be installed. Extensive preparations were required. By means of a slow motion picture using a model of the project it was thoroughly studied by all the engineers working on it. So carefully was the whole scheme worked out that when this block of masonry 92 feet high, 45 feet wide and approximately 45 feet in the other dimension, containing 5,500 cubic yards of concrete, was dropped into the river, it landed almost perfectly in the place in which it was computed to land.

The sketch shows a cross-section of the Saguenay River a few hundred feet above the permanent dam, and the relative positions of the diversion channels and the permanent channel. The permanent channel was to be stopped by dropping the obleisk into it. The obelisk was built several months beforehand on the top of a pier composed of two parts. The right-hand part was arranged so it could be shot off by a large charge of dynamite, thus leaving the obelisk unsupported on the river side.

Construction photographs showing dam in uplifted position before being blasted into place, and after the blast effectivey damming the stream. The manner in which the bottom of the dam was moulded to fit the contour of the stream bed is shown in the right-hand photograph.

It was necessary to leave considerable water flowing down the old channel in order to form a cushion for the obelisk to fall in and therefore prevent breaking it. The quantity of water was regulated and this precaution worked perfectly.

On the day when everything was in readiness for dropping the obelisk, the holes in the front part of the pier were loaded with dynamite and it was blown away. When the large mass of the obelisk fell into the water, water was thrown two hundred to four hundred feet in all directions, but the obelisk, being of such great weight and moving at such high velocity, even the swift current in the river did not affect it and it settled into place as it was expected to do, thus becoming the dam.

The entire scheme was a bold one but was carried through successfully and accomplished complete, satisfactory coffer-damming of a most dangerous and difficult stream of great volume and swiftness of flow. If the reader had been the engineer responsible for the scheme, how would he have felt at the moment that dynamite was set off?

RECARBONATION OF WATER

Because of the rapid growth of the city, Bloomington, Illinois, a new water supply has been established, making use of a dam and reservoir. The water, although softer than well water, is not suitable for household uses; consequently, a method of softening the water, slightly different from the ordinary, is to be used in softening the water.

The process used is essentially the process of excess lime treatment, which process makes necessary, recarbonation by carbon dioxide. Carbon dioxide is forced through the water to prevent precipitation of calcium carbonate.

This carbon dioxide is produced by an oil burner which is installed in a low pressure steam boiler and which burns ordinary fuel oil. Tests have proven that only three quarts of oil per hour are necessary to produce sufficient CO_2; the heat generated being used to help heat the building in the winter and to produce hot water in the summer. The process is, therefore, very economical and also efficient; furthermore the process is entirely automatic. The CO_2 necessary seems surprisingly small, only a 4 per cent gaseous solution of CO_2, by volume, being required for recarbonation of the lime softened water. This method seems due to satisfy the citizens of Bloomington and marks another successful solution of the water softening problem which presents different angles in the various districts.

ODD CONDITION IMPOSED BY DONOR OF LAND PROVES DIFFICULT CONSIDERATION TO MEET

A peculiar incident arose in the process of widening the stretch of road near San Diego recently. The construction was held up for three weeks due to the eccentricity of a seemingly generous man who professed to "donate" the land to the state. However, he specified that a certain condition be satisfied before they could have the land. He asked that he be given a gold dollar in exchange for the parcel of land. At first thought this seemed like an easy thing to do but the highway commission of the State of California soon found out it was directly the opposite. Ransom, the engineer in charge, spent the next three weeks in pawn shops, banks and coin collectors. He found several coins minted in the '50's, but the owners wanted as much as fifty to a hundred dollars for them. Finally the engineer succeeded in purchasing a gold dollar for the sum of three dollars and fifty cents and even succeeding in persuading the state to O. K. this reckless extravagance. The deal was then closed and the construction got under way.

PAVING BRICK TO BE LAID ON IRON BASE IN ILLINOIS

Three different designs of brick paving with a sheet-iron base will receive their first test in 150 ft. of pavement on the Grand Avenue connection with the Rochester Road near Springfield, Ill., a contract for which has just been awarded. The iron base will be laid on a very carefully rolled and leveled subgrade. The following layer will be a layer of 2½ or 3 in. brick with asphaltic filler. Three 50-ft. sections will be laid with the iron base, one using blue annealed flat sheets and the two others galvanized corrugated sheets, in one case with corrugations parallel to the road and in the other transversely. The iron base is to be ¼-in. thick, while the corrugated iron will be 10 gage. Expansion and contraction in the flat iron section will be provided for by overlapping sheets along the center line. One transverse edge will be turned down to grip the roadway, while the other edge, lying transverse to the road, will be supported upon the adjoining plate section to provide free movement. The ends of the plates at the edge of the pavement will be turned up to form retaining walls for the paving material.

In the section where corrugated galvanized sheets run parallel to the highway, the outer edges will be turned up as in the flat iron section, while on edge of each other sheet will be turned down to grip the roadway. Sheets will be lapped one corrugation, with a T-bar used under each transverse joint. Where the corrupations run transversely, a 16-ft. 8-in. L-section will be welded along the outer edge to retain the brick, while the sheet ends along the center line will be laid on a T-bar. One transverse edge of each sheet will be turned down to grip the roadway, while the other edge will lap on the adjoining section.

STAR'S HEAT MEASURED BY NEW VACUUM TUBE

One hundredth of a millionth of a billionth of an ampere can be measured by means of a new type of vacuum tube perfected by eastern electrical engineers.

It is to be used with an "electric eye" or photo-electric cell, for determining the heat of stars so far away that the most powerful telescopes reveal them only as tiny points of light.

HIGHER BUT SAFER

The modern skyscraper has ushered in many important changes in the field of building construction. Steel construction has involved many new methods of erection, and safety measures of a new nature have had to be developed. Pedestrian traffic which must be carefully provided for, vehicular traffic, and the workers themselves must be provided for with new safety measures because of the new excessive heights to which the skyscrapers are being built. The worker has the hazard of high winds, menacing derrick guys, and the handling of steel members. Falling rivets, fitting-up pins and dolly bars are a danger that cannot be ignored. What is the record of the modern skyscraper? In the building of the Chrysler Building, the Manhattan Company Building, and the Empire State Building, only one fatality was reported. This was the result of new safety features on tools and equipment, education of workmen, and carefully considered changes in method of erection. The steel erectors are setting an example that should be followed in all lines of construction.

Campus Notes

SOPHOMORE HONORS AND HIGH HONORS ANNOUNCED

In order to receive sophomore honors a student must average at least 2.25 grade points per credit for his freshman and sophomore years at the university, and for high honors the average for the same period must be 2.75 grade points per credit.

The civils receiving high honors were the following: Harry Clem Dever of Beloit; Eldon Raymond Dodge of Antigo; Lawrence L. Krasin of Marshfield; and Aubrey Joseph Wagner of Madison.

Two mechanicals received high honors: Ralph Henry Kehl of Racine, and Karl Peters of Milwaukee.

Charles Churchill was the only chemical to receive high honors.

The civil engineers to receive sophomore honors were: Claude Albin Lynciss, Jr., of Fond du Lac; John Andrew Strand of Wauwatosa; and Robert Leslie Van Hagan of Madison.

Sophomore honors were earned by the following mechanicals: Henry Milton Haase of Beloit; Robert L. Hoyle of Lombard, Illinois; Carl Henry Ramien, Jr., of Milwaukee; and Kyle Carlin Whitefield of Madison.

Four electrical engineers received honors: Elwood Hugh Addison of Pelican Lake; Kenneth Joseph Rhodes of Watertown; Olaf Fritchoff Vea of Stoughton; and Philip H. Werner of Tomahawk.

The following chemicals received sophomore honors: Howard Helseth Darbo of Wauwatosa; Melvin Sterba of Elroy; and Lester George Zoelle of Watertown.

WADSWORTH RECEIVES TAU BETA PI FRESHMAN AWARD

Each year Tau Beta Pi gives a slide rule to the freshman making the highest grade-point-per-credit average. The award this year goes to Arthur L. Wadsworth, who finished his freshman year with an average of 2.73, having 93 grade points for the 34 credits carried during the last two semesters.

The highest average for the year before was 2.83, which was made by Karl Peters. The award is open to any engineering student who has just concluded his freshman work.

Wadsworth is also active in extra-curricular activities, being president this year of Chi Psi Fraternity, which is an unusually responsible job for a sophomore, and being active in Union Board work. Last year he was president of Phi Eta Sigma, freshman honorary scholastic fraternity, besides being chairman of the Freshman Frolic.

CHI EPSILON AWARDS SLIDE RULE

The Chi Epsilon slide rule, awarded annually to the civil engineering student making the best grade-point-per-credit average for his freshman year was given to Hyman Ginsberg at a civil engineering lecture on November 1. The slide rule was presented by John Drow, president of the organization.

During his freshman year Ginsberg earned 86 grade points for 34 credit hours, making his average for the year 2.529. The award is for the purpose of providing a near goal to the ambitious freshman civil engineers, spurring them to greater activity when the honor is not so far in the distance as Chi Epsilon and Tau Beta Pi.

Chi Epsilon is the national honorary civil engineering fraternity.

FACULTY RESEARCH MEETING

The first faculty research meeting of the year was held November 24 in the Main Dining Room of the University Club. This was one of the two meetings of the year in which experimental research is not discussed, but which consists of talks on matters of general interest to the faculty.

Prof. H. D. Orth, who represented Wisconsin in the Drawing Session of the Society for the Promotion of Engineering Education, spoke on "The 1930 S. P. E. E. Drawing Session." His talk was followed by one by Dean F. E. Turneaure, who described the Civil Engineering Session of the 1930 conference. The S. P. E. E. conference was held this summer in the East.

Prof. C. W. Thomas outlined the "Aims of Freshman English for Engineers." The talks were followed by a general discussion of the subjects, which in turn were followed by refreshments in the form of cider and doughnuts.

OUR FEMININE CONTEMPORARIES

Not so long ago the idea of a co-educational system at the university was frowned upon—just why is hard to tell. That this prejudice was a hangover from the Victorian period is about as good an explanation as any. The same thing which prompted the Victorian women to cover the legs of their grand pianos with tiny skirts most likely was behind all the opposition to co-education for women.

A somewhat similar attitude is sometimes expressed by engineering students toward women who choose engineering as their course. The reasons given are different, but they are generally just as foolish. Some students seem to have the idea that engineering is an extremely hard-boiled sort of a profession and that women are out of place in it, and that merely because they are women, they can never achieve success in this field. Perhaps girls are a bit out of place in the machine shop or foundry—perhaps they cannot carry a transit as far through brush and rocks—perhaps they are not capable of bolting a ten-thousand ampere bus bar in place—but is all this really engineering? There is some romance in roughing it in South American railway construction camps, but for the majority of graduates this never materializes outside of popular novels. Engineering is, after all, mostly mental work, and very little of the strong-arm stuff. The men are rapidly getting away from the idea of boots and breeches as a usual campus costume at the various schools, and are dressing as well as our friends the lawyers, except when in the field when a rough outfit is necessary.

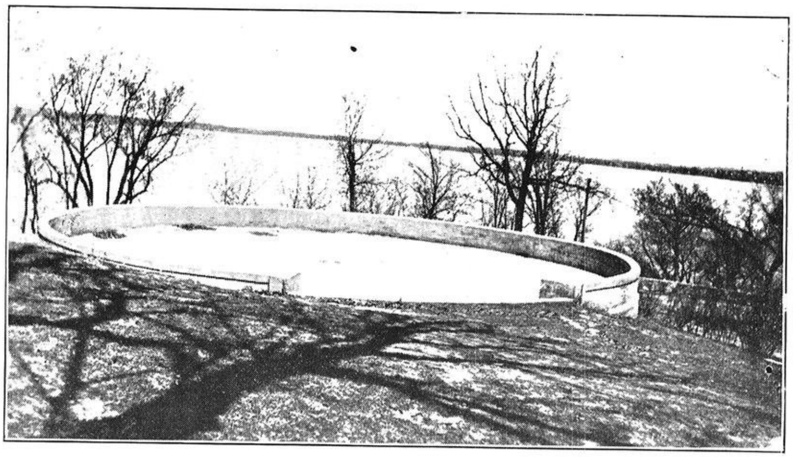
If a girl has an inclination toward engineering and has also the adequate mental equipment there is no reason why she should not study it. It is possible to think of a number of positions where a woman with an engineering education is better fit for the job than a man. As a woman's touch is said to brighten up a home, so it is possible that she has a better conceptios of what other women want in the home, and as a consequence she may be better suited for designing home equipment, both with regard to its appearance and its operation. Many a woman has offered suggestions which aided materially in the design of things which other women must use. Madame Curie is the outstanding proof that it is possible for a woman to have scientific ability.

At present there are five engineering students who also go by the name of co-ed. Most of these are daughters of successful engineers and aim to keep up the family reputation. Three are freshmen chemicals, one is pursuing an electrical course, and another expects to receive her degree of B. S. in civil engineering in two more years. M. Rosalind Moore, of Maplewood, N. J., hails from Bell Laboratories, and naturally is an electrical. Louise H. Bebb is another girl from the East, or more specifically, Chevy Chase, Md. Her preference is civil engineering. Margaret M. Donnelly, of Terre Haute, Indiana, M. Jeanne Glab, of Dubuque, Iowa, and Margaret Bardelson, of Balboa Heights, Canal Zone, are all on the threshold cf chemical engineering. There girls seem to come from all points of the compass and from quite a distance to study engineering, which is one good indication that they are since in their choice of a course.

Y. M. C. A. DRIVE

The annual finance drive of the student Y. M. C. A. began on November 24 and will continue until the quota is reached, which should be very soon. Some of our well-known engineers are officers of this organization, namely Franklin T. Matthias, versatile former editor, and present T. E. instructor, and E. J. Peterson, president of the student A. S. C. E. and senior civil. Franklin Matthias heads the "Y" as president, and Peterson is the secretary-treasurer.

The Y. M. C. A. student organization has a good deal more to do than is ordinarily known. The organization sponsors the Christmas Festival, takes care of class commissions, holds conferences on motives and ideals, sees that students in the infirmary are visited when they otherwise may be pretty lonesome, puts on a program at the Old Soldiers Home at Mendota, and holds freshman discussion groups. Student employment is handled by the "Y", which alone should justify the drive. Besides this, student counselling, international student relations, faculty-student discussions, and the publication of the "Wisconsin Men" bulletin are activities of the group.



Fall scene on Lake Mendota from the University Reservoir, memorable site from which generations of civils have observed on Polaris and found North to occupy new and unexplored points of the compass.

NEW STEPS

Those who noticed the worn-down condition of the steps to the engineering building will be pleased to hear that they have been resurfaced, and thus the work done by engineer feet in scuffing off three inches of stone in as many decades is all for naught.

Some of the math sharks should enjoy caluculating how much shoe leather is used up per annum in accomplishing all this destruction of public property. It certainly takes more leather than stone—but even that may be cpen to argument.

TAU BETA PI INITIATES

The first semester group of Tau Beta Pi initiates received the privilege of wearing the much-coveted key at the initiation banquet held at the Park Hotel on December 2. Full justice was done to the steak dinner served, after which Professor W. S. Kinne gave a very interesting summary of the past history of the organization. Prof. Kinne also acted as toastmaster, introducing as the first speaker Ted Perry, the president of Tau Beta Pi, who welcomed the new initiates into the fraternity. Lester Bartsch responded on behalf of the initiates.

The speaker of the evening was C. W. Thomas, assistant professor in the English department, who outlined the aims the newly organized Engineering department, and described what was being accomplished in it.

The initiates were as follows: Lester Bartsch, Milwaukee; A. LeRoy Bell, Racine; Donald Charles Bengs, Milwaukee; Clarence Buending, Fort Atkinson; James D. Cobine, Madison; Pierce G. Ellis, Milwaukee; G. Willard Gibson, Janesville; Martin Joos, Albert Center; Donald J. Miller, Stanley; Martin F. Mortenson, South Milwaukee; Oliver L. Parsons, Wauwatosa; Charles C. Watson, Madison; Gordon C. Williams, Rumford, Maine; Richard E. Wolff, Shorewood; and Harold H. Zabel, Montello.

All of the men are seniors, since the fraternity makes a practice of selecting seniors the first semester of the school year, with the exception of one junior, Charles H. Watson, who succeeded in earning 209 grade points out of a possible 210 for his first two years of university work. He is the son of James W. Watson, professor of electrical engineering.

Tau Beta Pi holds another initiation in the latter part of the school year when more juniors will be initiated.

Nature is wonderful! A million years ago she didn't know we were going to wear glasses, yet look at the way she has placed our ears!

SOME PROBLEMS CONFRONTING THE STUDENT SOCIETIES

(Continued from page 75)

must cling to the hand of some Kent to give them courage to face the unknown.

While the giving of guidance and inspiration to the students is the prime function, and major part of the work of the members of the faculty, the National Societies can be of material assistance.

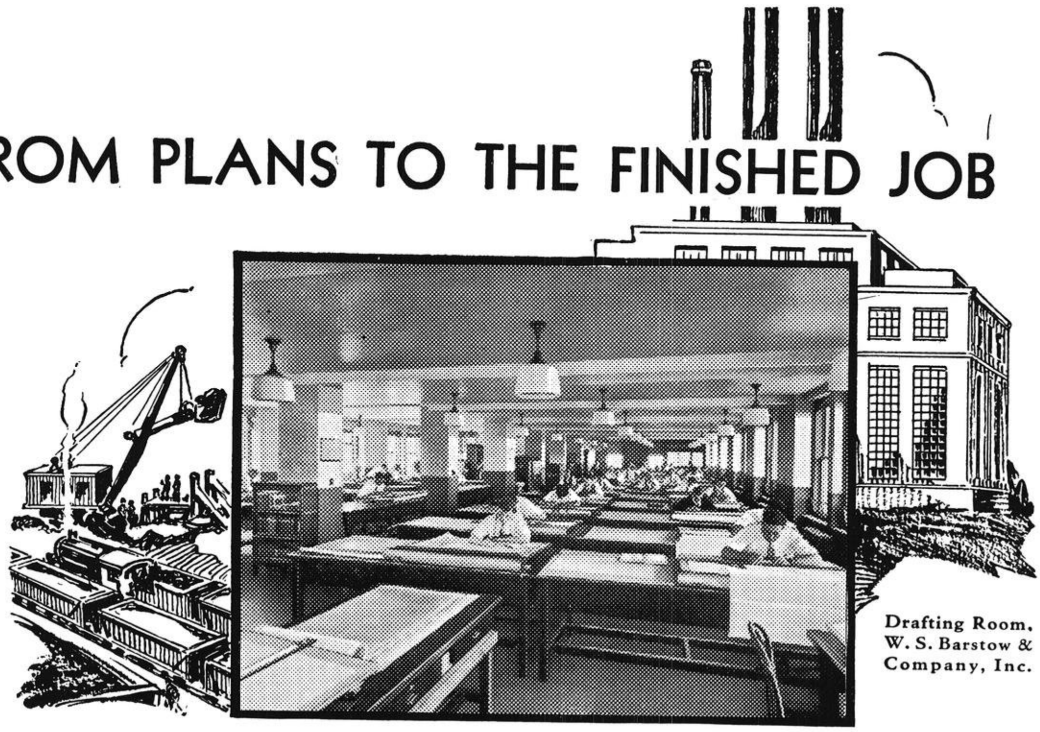
How? By carrying out the ideals of the profession as expressed in the Christmas Greetings to the members of the American Institute of Electrical Engineers, which reads as follows: "The Institute enters its forty-fifth year conscious of an outstanding position as an organization for service, for holding high the ideals of the profession, for furthering the advance of engineers and engineering, and, *mark this,* for giving *guidance* and *inspiration* to the embryo engineers in our schools and colleges."

These are not mere idle words of a man with a fluent pen, for President Schuchardt has been most active during the past years in giving vitality to the sentiments quoted. He has done this by actively participating in some of the Branch and Section meetings and by monthly messages in the Journal of the Institute. The message in the May issue is directed to the Members of our Student Branches and reads in part as follows:

"Your education has aimed to prepare you to add to the richness of life, — your life and your fellows'. If you have become technicians only you are in danger of continuing along narrow lines with a limited outlook. If, on the other hand, you have broadened your viewpoint and your contacts with the humanities without sacrificing the acquirement of the necessary technical foundation, if you have familiarized yourselves with the ideals that have inspired mankind through the ages, if you have developed an appreciation of the beautiful and take an interest in history and art as well as in engineering and economics, then you are indeed well started on the road leading to a balanced and well rounded life. We do not live by bread alone, and a life wrapped up in materialism misses the rich enjoyment that comes from the finer, the cultural and the spiritual contacts."

This message has significance, not so much by what it says, as by its source. It comes from one who employs college graduates and the sentiments expressed show that his interest in the young men is not stimulated, nor is it aroused by the mere desire for more efficient production units. It is not to interest young men as robots, but as sentient human beings. Such interest gives faith, courage and zeal.

FROM PLANS TO THE FINISHED JOB



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FREEZING AND THAWING TESTS OF CONCRETES AND MORTARS

(Continued from page 77)

moist closet all of the time until they were tested in compression or cross-bending. Part were tested at 28 days and part at one year and six month.

Results of Tests

Table 3 contains a complete summary of the results of this series of tests. These will now be considered in the order in which they appear in this table.

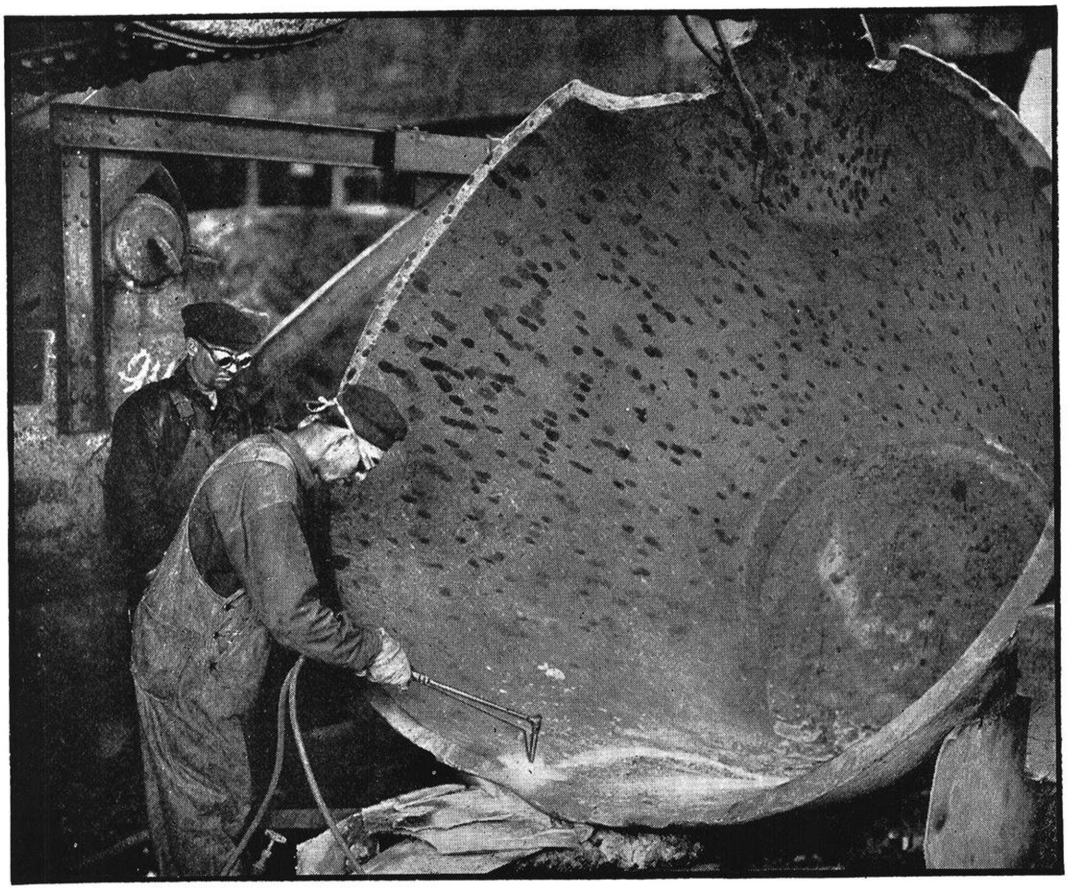
The first of the columns dealing with the compressive strengths of the mortar and concrete cylinders show that concrete and mortar specimens, tested at the age of 260 days after a curing period of 4 months in the moist closet and then in air except for a final seasoning period of one week in the moist closet immediately before testing, possessed approximately the same strength as similar specimens tested after a period of 28 days in the moist closet. These particular specimens were made primarily to determine absorption.

The second column gives the compressive strength of the concrete and mortar cylinders, and the modulus of rupture of the concrete slabs and mortar bars after a curing period of 28 days in the moist closet. The values given here show the concrete and mortar to have been of very good quality.

The third column (marked A) gives the strength of the various specimens after 200 reversals of freezing and thawing. The fourth column (marked B) gives the strength of an equal number of specimens held in the moist closet while the first group was being alternately frozen and thawed, and then broken at the same time as the latter which was at an age of one year and six months. Column five gives the ratio of A to B. Concrete and mortar cylinders were tested in compression and concrete slabs and mortar bars in cross-bending.

The two most noticeable things about columns A and B are the very high strength values possessed by the specimens, and the comparatively small differences between the strengths of the same type of specimen when subjected to the different treatments. Column five, giving the ratio of the frozen and thawed specimens to those held in the moist closet for an equal length of time, brings this out very well. If the concrete cylinders are considered, it is found that the value of this ratio varies from .931 to 1.068. Inasmuch as each value represents only five test specimens, considerable variation might reasonably have been expected if there had been no difference in the treatment of the two sets of specimens. Two of these values are also greater than unity, representing cases where the concrete cylinders subjected to the freezing and thawing actually tested higher in compressive strength than those kept in the moist closet. The concrete was of very good strength, all but one of the mixes testing around six thousand pounds to the square inch in compression.

The mortar cylinders tested in compression do not show any considerable lowering of strength due to freezing and thawing. It will be remembered that preliminary to these




EVERYTHING
FOR OXWELDING
AND CUTTING
LINDE OXYGEN
Prest-O-Lite
DISSOLVED ACETYLENE
Oxweld
APPARATUS AND SUPPLIES
UNION CARBIDE
UCC

freezing and thawing tests, a number of mortar tests were made using Janesville and Wissota sands as outlined in Table 1, and it was found that mortars made using the Wissota sand were not as strong as the others. Similarly, in the specimens made for the freezing and thawing tests, specimens made using Wissota sand gave somewhat lower strength values. These latter specimens appeared to resist the effect of freezing and thawing quite as well as any, however. The A/B ratio for mortar cylinders using Wissota sand was .999, while that for the mortar using Janesville sand was .921.

The concrete and mortar specimens broken in cross-bending show the greatest variation in the ratio of A to B. Although in two cases the above ratio is greater than unity, in two others it falls to values of .821 and .853, suggesting that in these instances the freezing and thawing might have had some destructive effect. Possibly the effects of freezing and thawing are more easily noticeable when the material is afterward subjected to tension, as happens when it is broken in cross-bending.

Conclusions

1. The principal conclusion that can be drawn from the results embodied in this article may be stated as follows: The compressive strengths of well made concrete and mortar specimens, in which good sound aggregates and a fairly rich mix are used, are affected to a negligible degree by alternate freezing and thawing when the maximum range between the freezing temperature and the thawing temperature is not over sixty degrees and the thawing is carried out in water.

2. The cross-bending test, which throws a portion of the specimen into tension, is possibly a somewhat more sensitive measure of the weakening of concrete or mortar due to freezing and thawing than is the compression test.

THE WELLAND CANAL

(Continued from page 73)

essential that there be a large pondage area above each lock in order to draw down the levels as little as possible when filling the locks.

Locks 4, 5, and 6 are double locks in flight. The flight is double so that the ships may be passed in both directions simultaneously in order to save long delays to vessel passing through these locks. A pondage area of 84 acre feet will be formed above lock No. 6 by an earth dam 3,300 feet long with a maximum height of 75 feet. Lock No. 7 is a single lock and will be fed from the summit level of the canal. About three-quarters of a mile above lock No. 7 are a pair of guard gates provided for safety purposes only, as the water level on each side of them will be the same. In operation there will always be at least three pairs of gates closed against the summit level, two at lock No. 7 and the guard gate. The service flow through the canal will be regulated by weirs at the sides of the locks and guard gate. To protect the 16-mile summit level and to maintain a constant level in the canal, a guard gate will be built at

Humberstone with a usable length of 1,340 feet, 80 feet width, and 30 feet of water on the sills.

The section of the present canal that will be abandoned for navigation between Humberstone and Port Colborne will be used as a runway for supplying the ship canal with water and the flow through it will be regulated by a large supply weir that will be built at Humberstone.

Between the guard gate at Thorold and Humberstone the water level in the summit reach will be maintained at elevation 569. The walls of the guard lock and guard gates and the canal banks between Thorold and Port Colborne will be built to elevation 582 feet or 3 feet higher than the highest water level of the lake, so that should an accident happen to the guard lock permitting the lake waters to flow freely into the canal even at the highest stages no damage will occur to adjacent property nor will the water be able to find its way over the escarpment.

Syphon Culvert at Welland

At Welland the canal crosses Chippawa Creek, and the latter will be carried under the canal by means of a syphon culvert consisting of six tubes 22 feet in diameter. The bottom of the culvert will be 65 feet below the surface of the canal and will operate under one-foot head during high water in the creek. It will be carried on a timber pile foundation and an extensive sheet steel pile cofferdam will be necessary to permit construction of the culvert in the dry. A stage is to be built at the ground level upon which are to operate both electric and steam locomotives and hauling trucks to take away the material which will be raised to the surface by means of cranes.

Costs

It is estimated that the completed canal will cost about $122,000,000, and it is expected that the canal will be completed in 1930.

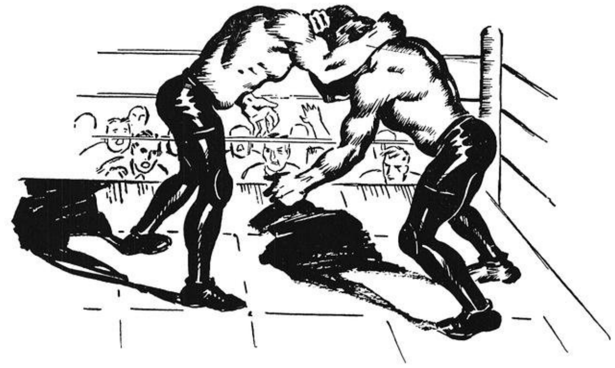
The wage rates varied greatly during the period of construction due to the general increase of prices brought about by the World War. The average wage rate for laborers was 35 cents per hour and for shovel runners $1.00 per hour. The maximum number of men employed at one time was in August, 1926, when 3728 men were on the job.

There were 50,000,000 cubic yards of earth excavated at an average cost of 45 cents per cubic yard. There were 9,000,000 cubc yards of rock excavated at an average cost of $1.89 per cubic yard. About 3,500,000 cubic yards of concrete were poured at an average cost of $5 per cubic yard. Central mixing plants were used in lock construction because of the large quantities needed at the locks and the short hauling distances that were necessary.

Summary

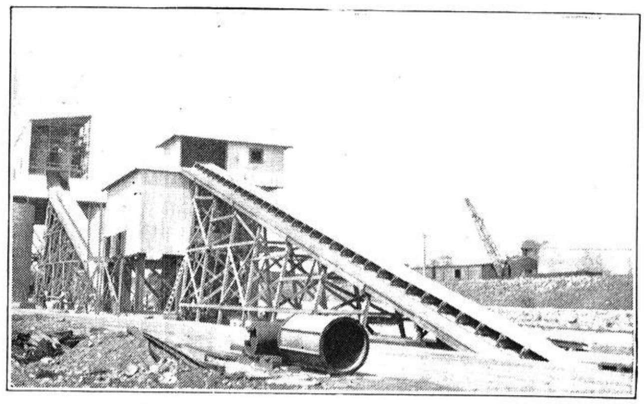
1. Number of lift locks including guard locks; 8.
2. Usable length of locks No. 1-7, inclusive; 820 ft.
3. Usable length of lock No. 8, guard lock; 1335 ft.
4. Usable width of locks; 80 ft.
5. Depth of water on sills; 30 ft.
6. Lift of locks No. 1-7, inclusive; 46½ ft.

BULK MATERIAL

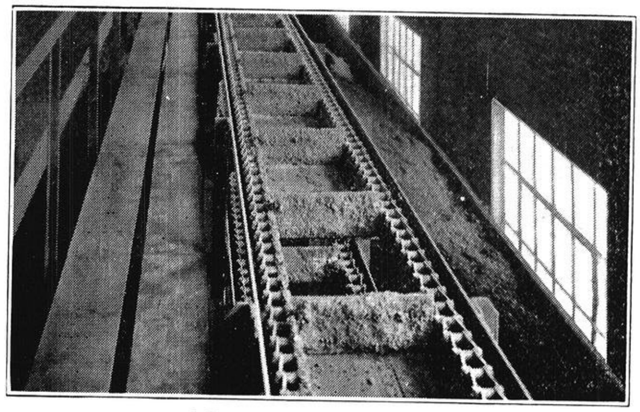


Penny-saving is the order of the day in modern industry. Manufacturers are cutting their costs —cutting them from the very beginning—and the savings come on down to the consumer.

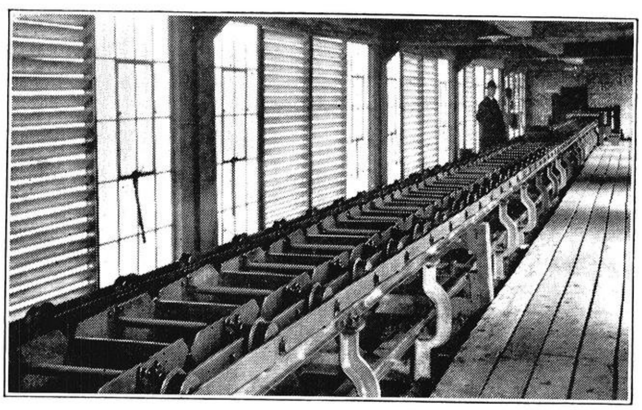
Much of the saving is in the handling of bulk material. Right at the mine, the cost of iron and steel is reduced by mechanical handling of the iron ore. Loading and unloading of cars and even boats is now done by machinery instead of



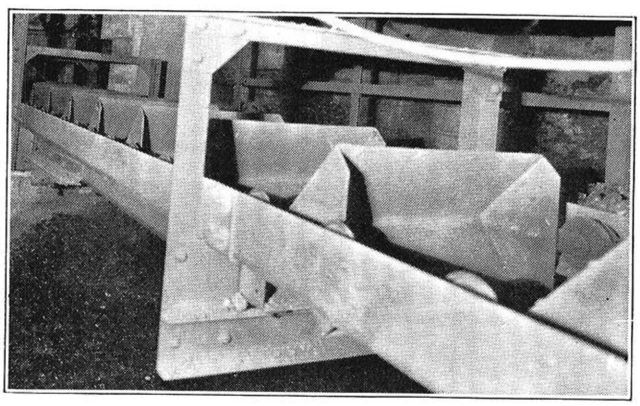
A Rex Belt Conveyor for handling rock



A Rex Scraper Conveyor



A Rex Pivoted Bucket Carrier for handling coal



A Rex V-Bucket Conveyor

by slow and costly human labor. A fraction of a cent a ton saved in the cost of handling the coal burned in the factory may mean thousands of dollars by the end of the year—and a radical difference in the price which the consumer pays for the finished product or for light and heat.

Rex Bulk Handling Equipment is doing its share in reducing costs. In every part of the country, in mine, mill and factory, Rex Equipment is at work, handling cement, stone, sand, phosphate rock, coal, ore, and other materials more quickly, more cheaply.

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7. Lift of lock No. 8 at summer level of Lake Erie; 3 ft.
8. Height of lower mitre gates; 82 ft.
9. Greatest height of lock wall, between No. 4 and 5; 130.5 ft.
10. Width on bottom of prism; 200 ft.
11. Width at water line; 310 ft.
12. Minimum navigable depth; 25 ft.
13. Approximate weight of metal in each leaf lower gate; 454 T.
14. Total weight of metal in lock gates with their fixed parts and machinery; 23,000 T.
15. Total weight of metal in valves of locks and weirs and their machinery; 3,800 T.
16. Estimated connected motor load for operating canal and Port Colborne elevator; 15,300 h.p.
17. Time required to fill lock; 8 min.
18. Estimated time for vessel to pass through canal; 8 hrs.
19. Total lift; 352½ ft.
20. Length; 25 miles.
21. Number of bridges across canal; 21.
22. Syphon culvert under canal at Welland.
23. Estimated cost; $122,000,000.
24. Time of completion; 1930.

"He says that he is in close touch with the heads of the Engineering faculty."

"Yes, he's a barber."

BUDGETARY CONTROL

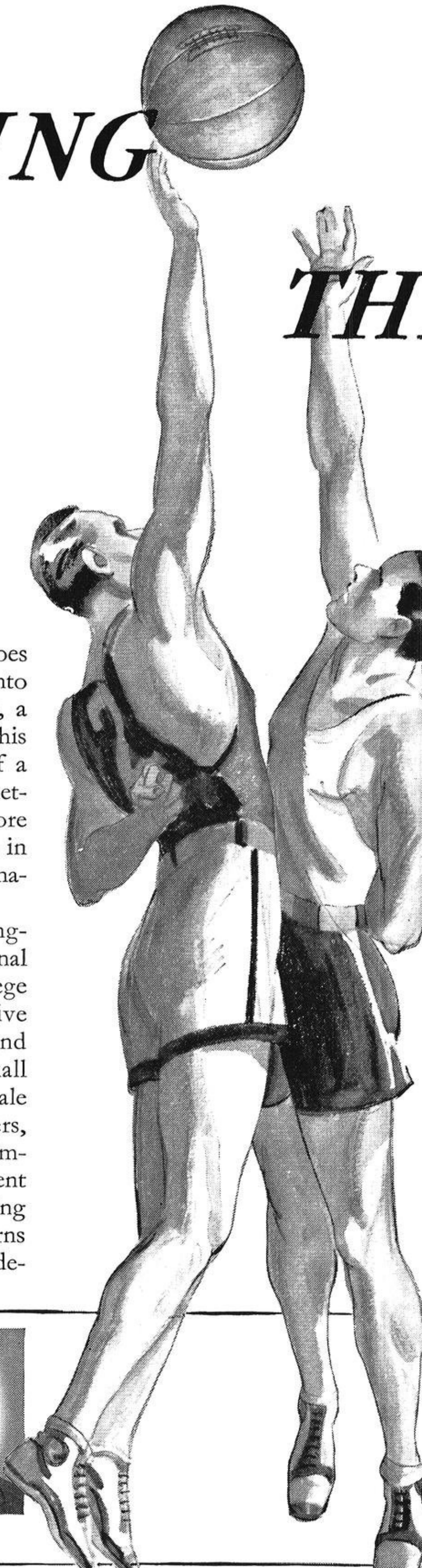
(Continued from page 71)

cessfully and continuously assumed. This is most important if full justice is to be done in judging the relative ability of individuals who are trying to assume responsibility and are entitled to know to what extent they have or have not succeeded."

Executives who use the budget in the administration of their business realize the importance and necessity of a carefully planned budget. They realize that there is more to budgeting than the mere coordination of all of the activities of the business into a well-balanced plan of affairs for a given period. They realize that there are by-products of budgeting which will help the men who prepare the estimates to become better executives. These by-products, all of which are necessary for the success of any undertaking, are: elimination of guessing, development of foresight, ability to think a thing through, and habit of saving.

It has been estimated that more than one million horsepower can be taken from the tides of the British Channel in the form of Electrical Energy, according to experiments now being carried on at Avonmouth Docks, near Bristol, England. The system is based upon the fluctuation of the tides at that point and if found practical it may be applied to various other similar conditions along the coast of North America.

GETTING THE JUMP



The referee's whistle blows. Up goes the ball. The opposing centers leap into the air and one, a little more alert, a little better endowed by Nature than his adversary, tips it into the hands of a waiting team-mate. So it is in basketball — and so it is in the vastly more important game of life which starts in earnest after text-books and examination papers are finally laid aside.

In the sales departments of Westinghouse, as with other great national organizations, are many younger college men — graduated within the past five or ten years — whose alertness and ability are winning them no small measure of reward. Not only in the sale of electrical goods to dealers, jobbers, and power company stores, but in important negotiations for equipment with central stations, railroads, shipping lines, governments, industrial concerns and building contractors, success depends on the extending of contacts and the ability to "get the jump" on competition. And because of their exceptional engineering training and background, Westinghouse representatives are regarded less as salesmen than as expert consultants in electrification.

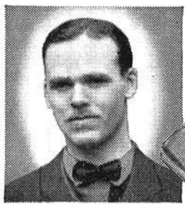
The men whose photographs appear on this page are but a few of many who, with college memories still fresh in their minds, are helping Westinghouse to maintain the contacts which keep it busy doing so generous a portion of the world's electrical work.

• • •

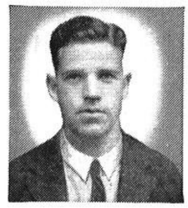
The following are but a few of the more outstanding examples of recent Westinghouse jobs, in the negotiation of which younger college men have played a part:

Turbine-Electric Drive, New Dollar Line Passenger Ship ⸰ *Electrification, New York, New Haven and Hartford* R. R. ⸰ *Steam Turbine-Generators, Duke Power Company.*

F. E. UHL
Cornell '24
Transportation Div.
New York Sales



R. D. LAWLOR
Tufts College '23
Industrial Salesman
Springfield, Mass.

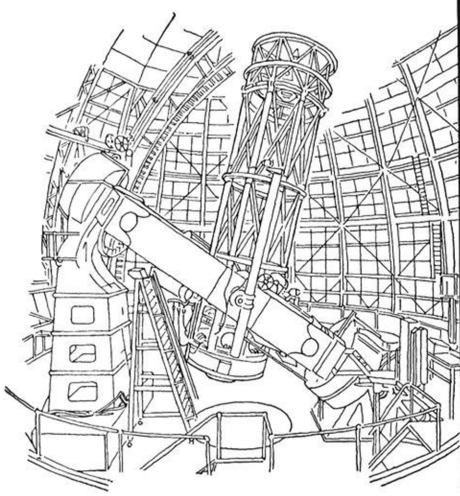


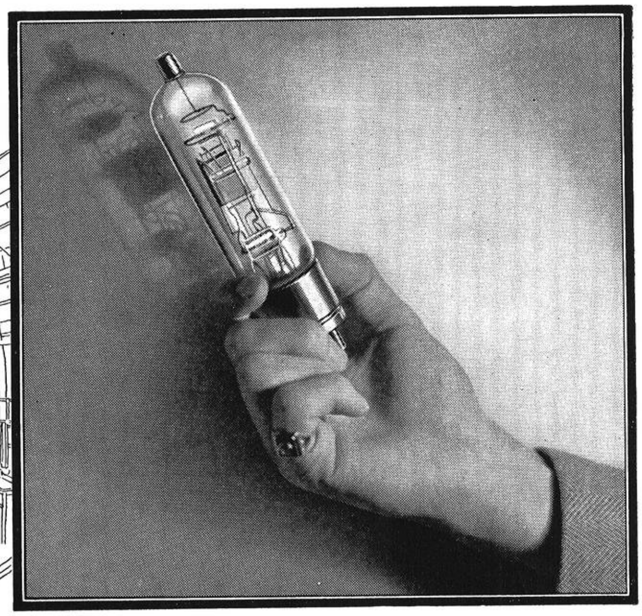
J. C. FRINK
Syracuse '27
Marine Salesman
New York

M. S. ANGIER
Univ. of Ill. '24
Sales Manager
Johnstown, Pa.

Westinghouse

Please mention The Wisconsin Engineer when you write





The new G-E low-grid-current Pliotron tube capable of measuring a current as small as 10^{-17} ampere

This Little Tube Measures Stars Centuries of Light Years Distant

By MEANS of a new vacuum tube called a low-grid-current Pliotron tube, astronomers can gather the facts of stellar news with greater speed and accuracy. In conjunction with a photoelectric tube, it will help render information on the amount of light radiation and position of stars centuries of light years away. It is further applicable to such laboratory uses as demand the most delicate measurement of electric current.

So sensitive is this tube, that it can measure 0.000,000,000,000,000,01 of an ampere, or, one-hundredth of a millionth of a billionth of an ampere. This amount of current, compared with that of a 50-watt incandescent lamp, is as two drops of water compared with the entire volume of water spilled over Niagara Falls in a year.

General Electric leadership in the development of vacuum tubes has largely been maintained by college-trained men, just as college-trained men are largely responsible for the impressive progress made by General Electric in other fields of research and engineering.

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