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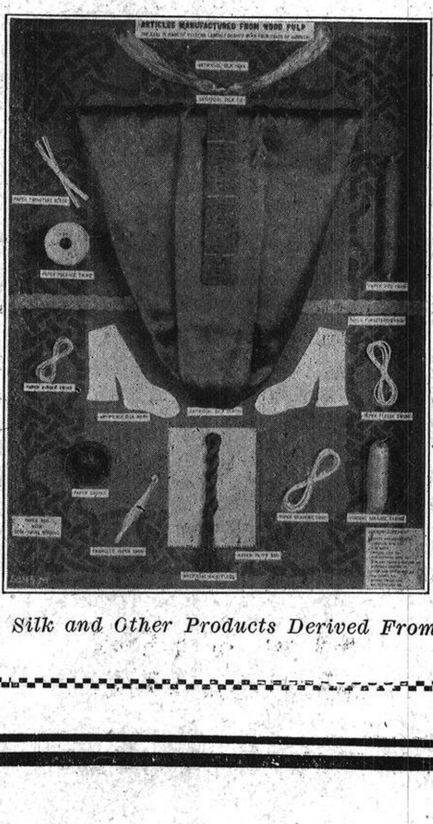

Artificial Silk and Other Products Derived From Wood

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The Wisconsin Engineer

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S. A. T. C. LYRICS

I

Poor little soldier boy! What shall he do?
Doesn't like his dinner 'cause its kidney stew.
If he leaves it on his plate, mess fatigue for him.
Put it in your pocket boy; surely that's no sin.

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The Wisconsin Engineer

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SOME USES OF WOOD WASTE

ARMIN ELMENDORF

Engineer, Forest Products Laboratory, Madison

Progress in the utilization of forest products is largely in the direction of the utilization of waste material. Methods are being developed for converting such material as cannot be used directly in building or manufacture, into products that are valuable for use in the industries. The purpose of this paper is to describe very briefly some of these products.

Probably no other material is converted into such an extensive array of useful articles as is wood. The paper upon which we write or print once existed in the form of fibre in the trunk of a tree, possibly a spruce tree in the forests of Maine. The varnish of the table top once flowed from a New Zealand tree as a resin. It hardened and was later dissolved by turpentine obtained from a Carolina pine. We may avoid board floors and fire hazard in our buildings by the use of concrete or of composition flooring; but we will cover the concrete with a linoleum which consists of a mixture of wood flour and linseed oil pressed upon a backing of fibre, which, in turn, may be spun paper. The composition flooring itself is nothing other than sawdust mixed with magnesium chloride and pulverised magnesia. The British Tommy fires his shells with cordite made by dissolving gun cotton in an acetone which is obtained from the destructive distillation of hardwoods. The shell wounds a German soldier who is taken to the base hospital where a surgeon dresses the wound with wood wool. In winter we may heat our living room with briquettes made from sawdust and keep out the cold by using fibre board insulation in the walls. In summer our food is kept fresh in refrigerators that are insulated with charcoal packing. Our shoes are made of leather tanned with an extract obtained from the bark of an oak or hemlock. Our hose of artificial silk may be of cellulose that once existed in the fibres of a tree trunk. Innumerable examples such as these could be given.

The following list of forest products does not aim at completeness, and the various processes of manufacture mentioned are only briefly outlined.

Sawdust

About 11 per cent of a tree that is cut into timber goes into sawdust. This need not be wasted, however, for it may be used for any of the following purposes: Heat insulation; sound deadening; polishing and drying metals which have been treated with acids; bedding in stables; floor covering in shops; sweeping compounds; steam distillation; extraction of turpentines and resins by means of solvents; drying of jewelry; packing of fragile articles for shipment; packing of perishables such as grapes; generation of producer gas; production of ethyl alcohol; manufacture of plastics; manufacture of porous clay bricks and tiles; manufacture of sawdust and plaster bricks; manufacture of artificial flooring, panels, and mouldings; the making of wood flour; the making of fuel briquettes; the making of briquettes for distillation purposes; as a substitute for sand in lime and cement mortars; for the smoking of meats; for the cementation of steel; for the production of oxalic acid; for the purification of power and illuminating gases; for fertilizer; for the manufacture of carborundum and calcium carbide; and for the production of fire lighters or kindling sticks.

Spun Paper

For the production of cord and rugs similar to those shown in Figures 1 and 2, kraft paper is used very extensively. Such paper is made by the combined action of caustic soda and sodium sulphide on softwood chips. Rolls of this paper are cut into long ribbons or strips which are passed through spinning machines which twist them into coarse strands. These strands are then woven into bagging material, carpets, matting, and cloth for upholstering furniture. In Europe, even belting is made of it.

At least 25 fibre-rug factories are in operation in the United States. Most of the rugs made by these firms are made entirely of paper, but several firms add some cotton or wool in making the paper threads. Patterns are either woven into the rugs by using colored yarns, or they are stenciled on the finished rug.

Paper twine, such as that shown in Figure 1, is made either entirely of paper, or of paper wound around a core of some fib-

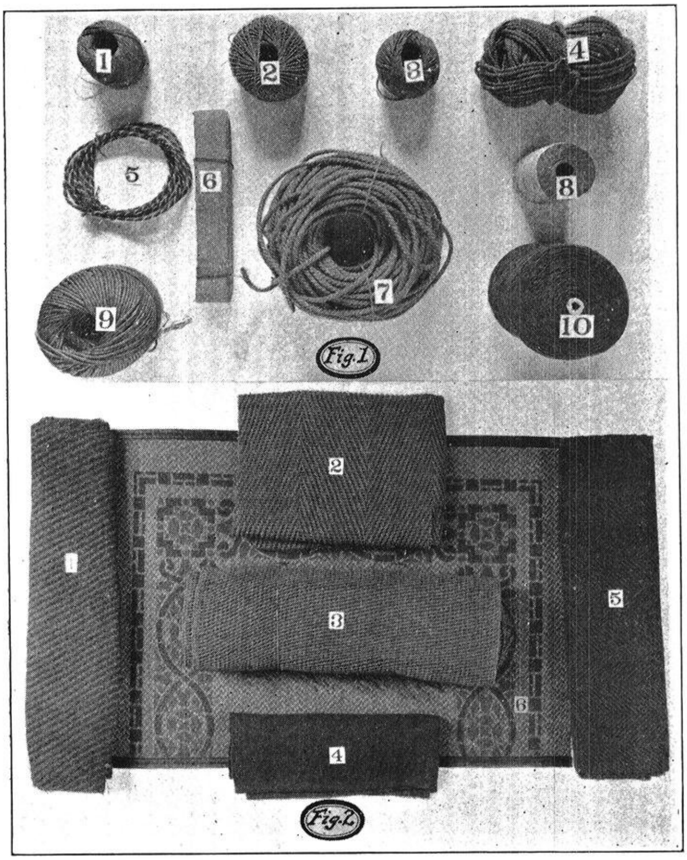


FIG. 1. *Twine Made of Spun Paper*
FIG. 2. *Matting Made of Spun Paper Yarn*

rous material such as hemp, manila, or sisal. Such cord is used extensively for tying packages.

Reeds made of spun paper are woven over a framework of wood in furniture manufacture. Such reeds are made of rather heavy paper suitably stiffened.

Underground electrical conduits and acid-resisting water pipes are made by winding kraft paper on a core and impregnating with a binder. It is said that such conduits may be turned and threaded.

Wood Pulp

Softwoods, such as spruce, cottonwood, yellow poplar, and basswood, are mechanically ground in great quantities for the production of wood pulp. A long-fibred wood, light in color, is most desired and spruce in particular is in favor. Wall board and all kinds of fibre-ware are made directly from ground wood pulp. Beaver board, used for insulating cold storage rooms and refrigerator cars, is familiar. Fibre-ware is represented by indurated pails and tubs, and pressed milk bottles impregnated with paraffin. Paper pie plates are made from sheets of pulp by cutting and pressing, or by moulding on forms.

The chemical pulps are too numerous to be considered in any detail, for it would be necessary to go into the technicalities of paper manufacture. The endless varieties of book paper, wrapping paper, paper for boxes, bags, posters, tissues, and wax paper are familiar enough. Imitation parchment, grease-proof papers, and vulcanized fibre are less common but quite important. The latter is a hard rubber substitute made by treating pulp with zinc chloride and mixing it with red ferric oxide. Felts and artificial silk are also made from wood pulps as the basic material.

Wood Flour

Wood chips, ground into a fine absorbent mass, are known as "wood flour." The chips are ground either between stones or steel rollers, enough water being added to prevent firing. The material from the grinder is sifted through gauze screens and yields a flour of a fineness that varies from 20 to 60 mesh. One American firm produces no less than 10,000 tons of wood flour a year. It is used chiefly as an absorbent, as filler for linoleum, for oatmeal wall paper, and for wood plastics.

Artificial Silk

In one of the important processes for producing artificial silk, known as the Viscose process, the basic material is wood. In chemical terminology, viscose is known as cellulose xanthate. The cellulose of the wood is treated with strong caustic soda solution and then with carbon disulphide. The final paste is pressed through dies to form the threads of the commercial artificial silk. Many thousand pounds per week are said to be produced at the American Viscose Co., at Marcus Hook, Penn. In contrast with silks made by other processes, it is claimed for this material that it has greater covering power and lustre, and a greater resistance to dyeing and finishing processes and to wear. Like some other artificial silks it loses half of its strength when wet. Figure 3 (see cover) shows cloth and various articles made of artificial silk.

Wood Alcohol

Wood alcohol and a number of other important industrial products are obtained through destructive distillation, which, in principle, consists merely in heating wood in a closed retort, and distilling all the products that lend themselves to distillation. Volatile compounds are in this way vaporized, while the non-volatile compounds are broken down, and finally vaporized with the water and other original volatile compounds. Charcoal is left as a residue.

The primary products obtained in the first distillation of raw material in retorts are gas, charcoal, and crude liquid distillate. The distillate is allowed to stand in tubs until the tar has settled. The watery distillate that remains after the tar is removed is called pyroligneous acid. This acid is distilled in copper stills to remove tar dissolved in it, and a colorless, tar-free, pyroligneous acid is produced. Lime is added to this product until it is neutral and the acetic acid is held in solution as calcium acetate. Distillation is again used to remove the crude alcohol, and a calcium acetate in solution, free from alcohol, is left in the still. Evaporating this liquor to dryness gives the commercial gray acetate of lime. The crude alcohol is further refined to give commercial wood alcohol.

Over 40 per cent of the 1,250,000 cords of hardwood distilled annually in the United States, is sawmill and logging waste. A large percentage of the remainder is cut from trees not suitable for the manufacture of lumber. A cord of beech, birch, and maple gives 180 to 200 pounds of acetate of lime, 8 to 10 gallons of refined alcohol, 48 to 52 bushels of charcoal, and 20 to 25 gallons of tar.

Wood alcohol is used chiefly as a solvent in the production of shellacs and varnishes. It is also used in hat making, soap making, in the coal-tar dye industry, in the manufacture of formaldehyde, photographic films, cellulose manufacture, cleaning, and burning. Another important use is as a denaturant for grain alcohol to produce "denatured" alcohol.

Ethyl Alcohol

Ethyl alcohol, or ordinary grain alcohol, is commonly made from such materials as corn, rye, molasses, or potatoes, but recent developments have made it possible to convert part of wood substances into sugars, which may be fermented by adding yeast, and subsequently distilled to recover the alcohol formed in fermentation.

If the wood is not already in a fine state, it is first shredded, and then dumped into vessels where it is treated with dilute sulphuric acid and steamed under pressure for a short time. In this process certain sugars are formed which are fermentable. The sugars are then washed out and the resulting weak sugar solution is run into neutralizing tanks where it is treated with lime to neutralize the acidity caused by the sulphuric acid used in digestion. The clear sugar solution is drawn off and yeast is added so that fermentation takes place and the sugars are converted into alcohol. Subsequent distillation brings the alcohol to the commercial form.

Two plants in the United States each consume several hundred tons of wood waste a day in the manufacture of ethyl alcohol. It is estimated that the cost can be reduced to from 15 to 20 cents per gallon. A ton of dry soft wood yields 20 gallons of 95 per cent alcohol.

Dyes

Yellow seems to be the only dye obtained on any commercial scale from woods. It is obtained from imported fustic wood and from the native osage orange. The latter is a tree common in the Red River valley of Texas, and in parts of Oklahoma. It is said that over a million dollars worth of this dye is now being made annually by American manufacturers.

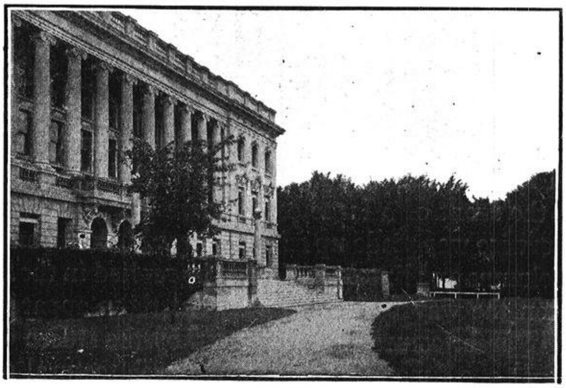
The bark of black oak is the source of a dyestuff used in the textile industry.

Turpentine

Turpentine is one of several products obtained in the so-called "Naval Stores Industry," one of the oldest industries in the utilization of forest products in this country. A manuscript kept in the Public Record Office, London, dated 1610, mentions both it and resin, the two leading naval stores.

The resins suitable for naval stores are found only in coniferous trees of which the longleaf pine is by far the most important. Upon wounding a tree of this species by slashing the bark, a flow of gum ensues which is collected by cutting pockets in the tree or by attaching special cups. The gum is taken from many trees, heated and condensed in a very simple "worm" condenser. The distillate consists of a mixture of water and turpentine, and the separation of the two takes place by gravity; the turpentine, being lighter, comes to the surface. The residue in the retort is tapped off and, after a number of hours, solidifies into commercial resin.

Turpentine is also one of the products of destructive distillation of yellow pine, but the quality of such turpentine is lower than that of the gum turpentine.



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OBTAINING IDEAS FOR TECHNICAL ARTICLES

By ALBERT M. WOLF, c '09, C. E. '13*
Assoc. M. Am. Soc. C. E.

To the engineer who has done little or no technical writing, it is a tedious task to find something to write about. With the great multitude of things going on all about us, one should have no trouble at all in finding good subjects to write about more often than once or twice a year. The trouble is, however, that the average engineer, untrained in this "scouting" work for suitable subjects for articles, pays too little attention to conditions, operations, and progress in his immediate sphere; in other words he is generally not a good observer. To illustrate this point, let me cite the following:

A few months ago, while doing some work in another city, I was entertained at dinner by a college classmate of mine, and after dinner the conversation drifted to the subject of technical writing. My host expressed some surprise as to how I kept supplied with material for articles. To this I replied: "Merely, by careful study of the technical journals and making notes of those subjects which are of interest to me, but regarding which little printed matter can be found, and by observing the results obtained by different methods and details of construction both in the work under my direction and that of others." Then I told him that on the way home to lunch with him, I had observed certain conditions which would easily form the basis of two articles. He was much surprised for he thought that nothing could be found worth writing about on that journey.

I asked if he remembered having noticed two common brick panels in the front of a large concrete building we had passed, which otherwise was made up of red-pressed brick spandrels and concrete columns and lintels. To this he replied in the negative; therefore on the way back I pointed out these apparent inconsistencies in architectural design caused by the stucco or plaster which had at one time been applied for architectural effect, becoming loose and peeling off because of the lack of bond between the two materials, and also the difference in expansion and con-

*Engineer and Secretary—Condron Company—Industrial Engineers—Chicago.

traction thereof. Here was an irrefutable argument against the plastering of common brickwork with cement stucco, which he had passed four times a day for several months without observing. A few photographs, with a detailed description of the actual conditions found, comments as to the causes, and perhaps a suggestion for remedying the difficulty, would have done much to stop the practice of applying cement stucco to surfaces that provide no key for it.

The other object noted was another bad feature of building design which, when I pointed it out to him, my host agreed was a fit subject for an article. What impressed him most, was how the practice of writing frequent technical articles improved the sense of observation, and the ability to deduce the causes of the defects.

An engineer often has to solve problems regarding which little direct information can be found. In such cases he must draw upon his technical and practical knowledge for the solution. If, after the work is completed, he will write a description of it, and the methods employed in design, with some comments as to whether the design has proven satisfactory in all respects or not, and send it to one of the technical papers for publication, other engineers looking for light on the same subject will be rewarded for their search. They will be able to profit by his contribution to the literature, and undoubtedly will make improvements in their design, suggested by his experience. Then, if they in turn would write up their experience along this particular line, we soon would have material enough at hand to allow some one to set forth clearly that which can be considered good practice.

Engineers who are not given to writing articles on technical and practical subjects, should bear in mind that today, experiences are not handed down from one generation to the next by tradition, but by written books and magazines; that they have received their own knowledge from this source and therefor are duty-bound to reciprocate.

MARINE POWER UNITS

By J. G. Callan

Professor of Steam and Gas Engineering

The total horse power of engines, and total fuel burned on the ships of the world are such as to place marine engineering among the most important of the power engineering branches. There are no really small plants on ocean-going ships. Our new, comparatively small, and slow cargo ships require 2,500 horse power,—a thousand more than was used on the "Great Eastern," and the sizes range from a little below this to the 62,000 horse power of the Mauretania, or the 180,000 horse power of the new American battle-cruisers.

Not so long ago every marine engineer was, like the hero of Kipling's verse, "a receeprocating mon," but the world has moved, and here, as in the generating of electric current, the steam turbine has become the standard power, leaving second honors to the venerable reciprocating steam engine and third to the youthful Diesel, which is just old enough to vote Most of us know more about the reciprocating steam engine than about the other and newer forms, and most of the limited space of this article will be devoted to the latter. We will not try to consider both small and large craft, but will confine our attention to ocean-going ships or their equivalent on the great lakes.

Reciprocating marine steam engines are either triple-expansion or quadruple-expansion—that is: the steam is delivered from the boiler to an initial high-pressure cylinder, does some work in that; is exhausted to another larger cylinder adapted to deal with lower-pressure steam, where it does some more work; thence to a third and still larger cylinder adapted to still lower pressures; and, if the engine be triple expansion, thence to the condenser, where it is cooled back into water—or, if it be a quadruple, to the condenser after still another and larger cylinder. All of the older ships, and not a few of the newer ones have such plants.

Turbines are either direct-coupled to the screw, as in the older types of fast turbine boats, and some recent ones as well; or they are geared down so that the turbine turns faster than the screw, as in all slow turbine boats and many of the newer fast ones.

The gears appear to be an added complexity and are large and expensive, and if electrical speed reduction is used, as it is on the U. S. S. California, the complexity is still more marked, so it may reasonably be asked why the drift of practice is toward the geared unit. The answer is found in the following facts:

The turbine in its simpler forms is a very high-speed machine; it is only by resorting to expedients of design which greatly increase cost, bulk, and weight that it can be tamed down to a speed at which a propeller can be run at all, and even then the propeller is usually operated at a rotational speed too high for best results as to efficiency and maneuvering. This high speed of the simpler turbines is due to the fact that a turbine is driven by a spouting jet of steam, somewhat as a windmill is driven by the wind. This steam spouting from boiler pressure to condenser pressure has a velocity equal to that of the projectile of the German 70 mile gun; and the wheel rim driven by the steam jet must keep up to a certain accurately calculable percentage of the speed of the jet that is driving it, or else it will not derive all possible advantage in the shape of power from the amazing velocity of the jet which enables it to follow and continue pushing on the moving blade even though the wheel be running away from it at a fair projectile speed itself.

To slow down the shaft without gearing, and without losing the velocity relation upon which economy depends, one of two things—or more usually both—must be done: A series of slower steam jets may be developed instead of one very fast one, by dropping the pressure a step at a time in a series of elementary turbines, or "stages" which may be compared to the successive falls of a cascade; or the high-speed jet may be dealt with by using a plural-rimmed wheel, and causing the steam to bound and rebound upon the successive rows of blades constituting the several wheel-rims until the high velocity is exhausted. Both expedients have their place and both are in general use, usually in combination; but it is found that if the shaft speed is slowed down to too small a fraction of that of the simple turbine, the cost, size and weight become so great that such a turbine, instead of being a smaller and simpler device than the corresponding engine, becomes in many ways a more complex and difficult design although a rather more efficient one for high powers. But even efficiency suffers, for, in direct connected marine units, it is customary to run the turbine a little slower and the screw considerably faster than best efficiency demands, in order to keep down size and weight.

This is particularly objectionable in Navy ships, which must be designed with battle speed a paramount consideration, but nevertheless spend most of their time cruising at fractional speed and still lower fractional power. The direct-coupled navy turbine at cruising speed is of course still further from best conditions than at full speed. The use of so-called "cruising turbines" temporarily thrown in series with the main turbine is a partial remedy, much used in the British Navy, but it involves rather too much complexity for use on any but high-powered ships.

Where reduction gears are used, or where the turbine operates an electric generator, driving electric motors on the screws as in the U. S. S. California, the turbine and screw can both be run at, or sufficiently near their own most advantageous speeds. A geared turbine in a merchant vessel is designed to run at its most economical speed at full power, or in a naval craft, to run a trifle above this at battle speeds, and a little below when cruising. The gain in efficiency from the correct speed and the simpler form are far more than the losses in the gearing, and the efficiency, weight, bulk, and cost are in favor of the geared form for everything, with the possible exception of the largest sizes and the highest speeds. For extreme conditions, the loading on the gears probably transcends safe limits, and electric drive seems to promise to be the solution despite its apparent complication. A turbine is like an automobile motor in that it can run in only one direction, and the electric drive has a slight offsetting simplification in the absence of the separate reversing turbines that the direct or geared sets require.

The gears for this service must be of highly intelligent design and, what is quite as important, of extremely precise construction or they will be inefficient, noisy, and short-lived. All the forms in use are of the "herring-bone" type; English construction inclines to single-reduction gearing, with no special features; in America, most of the gears have one or more unusual and interesting elements of design and many are double reduction. The floating pinion of the Melville-Mac Alpine gear, and the laminated structure of the Ahlquist are examples of unusual constructions, both for the same purpose—namely the even distribution of tooth pressure along the whole line of contact. The special features of the gearing on the "Eagle boats" built for the Navy by Ford, are of much interest, but cannot be discussed in print until the war is over.

A curious speed-reduction gear is found on one or more German mine-layers. This is the Fottinger hydraulic transmission in which the turbine drives a centrifugal pump, which delivers water to an hydraulic turbine that drives the screw at a slower shaft speed. It is not nearly so efficient as gearing, and has only the advantage of being directly reversible, like the electric drive.

As a general statement, the low-pressure end of a compound or of a triple or quadruple expansion engine is harder to design on an efficient basis than is the high pressure end, while the converse is true of a turbine. For this reason, and to avoid the reversing turbine, some marine designers have used reciprocating high pressure ends exhausting to low-pressure turbines. For example, on a triple-screw boat, the wing shafts may be run by reciprocating engines, both of which exhaust to a low-pressure turbine on the centre shaft; or there could be one engine on the centre shaft and turbines on the wing shafts, although this arrangement would not be so favorable in maneuvering.

By way of examples illustrating practice: the Lusitania and Mauretania were direct-drive turbine boats of 62,000 H. P. The Titanic had high-pressure engines and a low pressure turbine, direct connected. The new standardized cargo carriers and transports have geared turbines running at 3,300 r. p. m. and driving through double reduction gearing a screw at 90 r. p. m. (in cases where the turbines cannot be delivered in time reciprocating engines are used). The English standardized cargo ships have triple expansion engines in most cases—geared turbines in a few. In the Navy, the older destroyers are mostly direct-drive turbine boats; the newest ones have single-reduction geared turbines. Recent British battleships and battle cruisers have been direct-coupled turbine boats in all cases that I know of. Our Navy is not fully committed as to direct, geared, or electric drive for the first-line ships.

Since this article is purely a brief general review, there is not space to go into the design of recent marine turbines, nor even to consider the difference between impulse and reaction types. For the same reason marine boilers and auxiliaries, although very interesting, cannot be touched upon.

The Diesel engine, or motor, is an oil-engine working on a cycle different from that used in familiar gas engines. In the Diesel motor, the cylinder, instead of drawing in a charge of explosive mixture, compressing and exploding it, as in gasoline motors, draws in a charge of pure air, compresses it to so high a pressure that its temperature is raised by this alone to that of a red-hot body, and then sprays fuel oil into this air during the early part of the forward stroke of the piston. The oil takes fire spontaneously as soon as it comes into the "red-hot" air, and burns without explosion during the first part of the working stroke, thus generating power.

The Diesel engine was the invention of Herr Rudolph Diesel. It was announced about twenty-one years ago in a book called "The Rational Heat-Motor" and great things were expected from it. The efficiency, even in the early forms, was phenomenally high, and it may be assumed that a Diesel ship will not require more than from a third to a quarter as much fuel for a given voyage at a given speed as a steamer. The early engines were very expensive, heavy, bulky, hard to maneuver, and subject to many mechanical troubles. The early years of the development were fruitful of much improvement from an engineering point of view, but were not very profitable to anyone. Diesel himself became disastrously involved in debt, and committed suicide. It has been only within the last six years that reliable Diesel ships have been produced, but the need of all our available yard facilities for standard steam production during the war has delayed development, although work on these engines for merchant vessels is by no means at a standstill.

The most spectacular development of the Diesel engine has been in connection with the submarine. This service requires great power in small space and weight, high economy, and extreme reliability. The conditions thus imposed upon the Naval Diesel engine designer are much more severe than in the merchant marine; on the other hand he is not rigorously limited as to cost. The condition is somewhat like that confronting the designer of air-plane motors. The best forms of submarine motor have shown a very good performance indeed. None of the types that we know handle quite like a steam engine, nor are they quite as free from troubles as steam; but improvement in soundness of designing, and in mechanical details has been marked of late, and the experience gained under the severe conditions of submarine work should considerably advance the whole art after the war. If the Diesel can be made substantially as good in the matter of maneuvering and operation as steam, its low fuel consumption will undoubtedly insure an increasing field, particularly in ships of moderate power making long voyages. Much depends on the future course of the price of fuel oil compared to that of coal.

A type of engine called the semi-Diesel, in which there is some form of hot head to supplement a compression less than in the true Diesel, is rather largely used as a source of auxiliary power in sailing vessels, and also in small working craft. This engine generally works on a high-pressure explosion cycle, rather than a true Diesel cycle. Some of the best forms show excellent efficiencies at full load—almost as good as those of the true Diesel in some cases. Few of these semi-Diesels behave as well as the Diesel at partial load.

If we become a maritime nation again, after a lapse of fifty years, we may expect that the horse-power output of marine turbines and engines will reach large proportions. There seems to be some reason to believe that standardized units, built by a few large companies will supply a large part of the demand, but there will be a continual improvement in any case that will offer opportunity for American technical men in a field long closed to them.

Football Scrimmage

THE EMPLOYMENT MANAGER, A NEW FACTOR IN THE INDUSTRIAL RELATIONSHIP

By EDWARD D. JONES

Author of The Business Administrator, Director of Course Materials, Employment Manager Section, War Industries Board

The general executive is a correlator. He is a balancer of claim against claim. His business is to define the general aim and to harmonize all lesser or intermediate achievements with it. To do this work well, he must be supplemented by specialists who do not correlate or determine general aims or policies, but who concentrate upon some special phase, and upon demand furnish to him standards and reliable standardized agencies. The line executive in war determines where a battery shall go and what it shall do, but he depends upon staff men to breed a reliable artillery horse, and to design convenient gun carriages and to prepare service tables for sighting guns.

An Extension of the Division of Labor to Foremanizing

The distinction just drawn between line and staff is a case of the application of the principle of the division of labor to administration. This principle is being applied rather vigorously, just now, at a lower level in the hierarchy of industrial administration. It was one of the merits of the movement known as "Scientific Management" that it called attention to the absurdly wide range of functions which the average foreman was endeavoring to perform. This officer, until a short while ago, was attempting, in most establishments, to hire men and set their wages and discharge them, to find work for men and machines from hour to hour, to recommend equipment for the shop, and keep the equipment in repair, to give an off-hand opinion as to when future work would be completed, and what it would cost, to maintain a stock of raw materials, to preserve discipline, and to furnish the office with such records as it required.

It is needless to say that the degree of efficiency attained with such supervision was low. "The Jack of all Trades is master of none." This quotation found its proof in machinery operated at a low percentage of its possibility, in time lost in hunting tools, in waste of stock, in delayed deliveries, in unreliable quality, and in inefficient workmen, discontented, and frequently venting their grievances in strikes.

The remedy is functionalization. This means that groups of related functions should be put in the charge of service departments, such as the stock room, the planning room, the tool room, the designing department, the engineer in charge of repairs, and the estimates department. In conformity with this idea; there has come into existence, in thousands of businesses, a department (whether administratively distinct or called by any name suggesting it or not) in charge of the supervision of a considerable portion of the relations between employer and employee.

In this way the foreman is relieved. He no longer is a "bouncer." He no longer sells jobs, or practices nepotism, or holds his pets in soft jobs. He has not the easy device of covering his own incompetence by firing a man; but must suggest a transfer which may show his employee able to give satisfaction in another shop where the foremanship is different. He gets a more even and dependable run of workmen from the employment department than he could provide for himself. And he is free from other distractions, to become the teacher of the shop.

The Evolution of Wage Systems

The conviction is general among employers that the setting of a wage rate is perhaps the most vital matter in the relation of employer to employee. The employer needs to have such investigations made as will reveal the current market rates for different types of labor power. He needs an expert to supervise patiently the prolonged process of forming a wage scale, in which each job in the factory will find its proper relative place.

It is coming to be realized that wages can never be made wholly satisfactory until greater definiteness is attained in measuring the basic factors involved in it, namely, the worker's talent, the quality and quantity of effort required by the task, and the working conditions. Where low rates of pay are concerned, it is essential to obtain the local cost of living, by first-hand inquiries. Where excess performance is required, it becomes a problem for the expert to say what excess above standard wages is required.

The ideal wage system is that of the man in business for himself. For such a man, reward rises and falls in perfect accord with his performance. The endeavor of executives to approximate this wage, in the complexities of modern business, has lead to the devising of many kinds of production bonuses. Where these bonuses are sufficiently localized upon an individual shop, and pertain to a sufficiently definite and measurable aspect of performance, and where they are properly founded upon an hourly wage rate and a standard of performance, they have given satisfaction. To plan such bonuses in strict accord with the conditions of the individual business, the employer needs the services of a competent department.

The Democratic Shop

It is needless to refer to the steady drift of industry toward democratic control. This drift may make itself felt to an employer as the mandate of law, and it may come as the dictate of organized labor. On the other hand, if it is met with willing mind, it may come into an employer's business in the form of a welcome cooperation with his employees, as a getting together to settle questions of common interest, or as a process of taking from his shoulders a portion of the load of minor executive responsibilities. Through such a sharing the employer may give to his employees scope for suggestions and criticisms, and he may give them a voice in determining working conditions. If he makes these experiments tactfully and sincerely, he is altogether likely to find that production is improved, that the best employees seek his plant, and that discipline is largely self-enforced.

There is a wide field of activity, having to do with the efficiency of the worker, and including such matters as thrift, legal aid, insurance, pensions, housing, recreation, etcetera, in which the employer will desire that as large a portion of the initiative may come from his employees as possible. The employment manager's task is to guide these activities into fruitful channels in as natural a manner as possible. He may be a sort of power behind the throne, but he should be modest enough to give the credit to others for what has been done, whenever possible.

The Ideal of Service

The ideals of truth and service have, for many years, been prominent in the world of advertising and selling. Only short-sighted persons still believe that to make a sale terminates a business relation. It is much more in harmony with the best practice to say that a sale begins a mutually profitable relation. Mr. Henry Ford once asked his agents to remember that they were not selling machines but transportation.

This ideal of service has lead American business men to venture out constantly beyond what were once considered to be the boundaries of strict business. The surprise which has usually accompanied such ventures has been their profitableness. Where an employer has had faith, superior employees have gathered to him and built up a permanent and enthusiastic force around him.

The Great War

The coming of the Great War has intensified the strength of all these evolutionary movements above referred to. It has done so because the war has made efficiency seem more necessary; and because these movements are all calculated to construct a more firmly-knitted and economical social order.

The present shortage of skill commends to us a stricter labor accounting, both in the labor market at large, at the hands of a public employment service, and within the individual business, through the work of an employment department. The same necessity brings us to intensive methods of training skill, with careful vocational guidance, so that every man, young or old, may find his highest work. It implies, again, safety, sanitation, and medical aid in industry to maintain the working force at par.

Enthusiasm for the common cause of country is a great lesson in the psychology of mass action, for industrial leaders who have never learned the power of common cause with their workmen. Wages and prices have passed through such advances as to demand the closest attention to the wage-setting process.

The great slogan "To make the world safe for democracy" is certainly being carried over from politics into the field of industry. Democracy will not require less skill of economical leadership than one-man rule; it will require more. And this is true, because its aims are broader, and because it attains its aims, not by brutal coercion, but by a process which requires a finer man. The process is one of persuasion and due compromise; it requires purity of purpose. Business management now, more than ever before, needs a special class of executives, who shall be its tribunes with labor, and its statesman in framing labor policies.

It has already been pointed out that the United States Employment Service has undertaken to supply war plants with labor; clearly, it is incumbent upon the manufacturer to make the best possible use of that supply when it has been made available for him.

This the employer realizes; he sees that—if the maximum of efficiency is to be attained—the efforts of the United States Employment Service in his behalf outside the plant must be supplemented by his own within. This means the reduction of his labor turnover, which—in turn—will mean increased production. The question that he asks himself is: "How?" And under present conditions there is but one answer—improved working conditions for his employees. He must take the best possible care of his labor if he would keep it; and his production and his credit with the United States Employment Service suffer if he does not. With this problem before him in general terms the employer turns to his employment manager from whom he has the right to expect advice as to definite methods to be pursued and suggestions as to the specific application of well-established principles to the particular problems of his plant.

The Government has seen to it that, if his employment manager has had the advantage of instruction at one of the War Emergency Courses, the harassed executive need not turn in vain. These courses in Employment Management are offered to the representatives of manufacturers without charge, and at the express request and under the supervision of the Industrial Service Sections of the several departments at Washington, including the Emergency Fleet Corporation, the Ordnance Department, the Quartermaster's Department of Labor and the Navy. The organization and direction of the course has been undertaken by the Employment Management Division of the War Industries Board. This Division has placed the direction of course materials in the hands of the foremost authorities on Employment Management in the country; has arranged for the services of large numbers of special lecturers,—some of whom are the direct representatives of the cooperating Government departments; has provided for a first-hand study of typical employment departments in plants where a large variety of difficult problems has been solved by the application of principles explained in text and class room; and has seen to it that ample time for practical discussions and the interchange of ideas shall be allowed the students from day to day. The mature employment manager, coming to the course with a solid background of industrial experience and with the problems of his own plant constantly in mind, learns from his contacts there many new devices, finds his point of view broadening, and discovers new avenues of approach. At the conclusion of the course he returns to his own plant strengthened by an accumulation of expert advice which he could have secured from no other source, and stimulated by a vision of new ways in which he can prove himself of value to employer and to employee. He knows not only what ought to be done, but how to do it.

Emergency War Courses in Employment Management, for men and women are being conducted by the Government in Boston, where Harvard, Boston University and Mass. Institute of Technology are cooperating; in New York through the Bureau of Municipal Research; in Rochester at University of Rochester; in Pittsburgh, Carnegie Institute and University of Pittsburgh cooperating; in Berkeley, Cal., at the University of California; in Seattle at the University of Washington. Courses at the Universities of Cincinnati and Chicago are now being arranged for. Employers are invited to suggest men or women in their employ for these courses, which run from six weeks to two months. There are no tuition fees. Employers or individual applicants will be furnished complete information regarding the courses and entrance requirements by addressing Captain Boyd Fisher, Employment Management Division, War Industries Board, 717 Thirteenth St., N. W., Washington D. C.

EDITORIAL

THE NEW ENGINEER

During the war, and during the period of reconstruction which is to follow, the men who produce are going to grow in importance and influence. The engineer is by training and character suited to become a leader and a director of labor, and with the increasing importance of labor will come an increasing importance of the engineer. This opens up an entirely new field to the engineer, but with this new opportunity will come increasing obligations and responsibilities.

Formerly the rulers of the world were the bankers and financiers, the lawyers and the politicians. The producers were treated as mere machines, as cogs in the great wheels of industry. Today, however, they have come to be regarded as the prime movers. Capital and labor have assumed a new relationship. Formerly labor was thought to exist for capital, now it is realized that the two are interdependent. The engineer is the highest form of producer. His are the brains which direct the productive efforts of the toilers; why should he not direct their efforts to secure better working conditions and better wages, and to live more fully the life to which they are entitled?

The growth of this new opportunity for the engineer can be seen in the increasing number of engineers who are becoming managers and presidents of great industrial organizations, and in the increasing share that trained engineers such as Hoover, Coffin, Ryan, Vincent, and others are taking in the administrative departments of our government.

In order to meet this situation, however, we must have engineers with a broad training. They must know not only their mechanics, thermodynamics, and mathematics, which will serve to get them their place in the industrial organizations, but they must have a grasp of the industrial, social, economic, and political problems of the day. This, coupled with a good knowledge of the economic, social, and political laws which underlie these new problems and conditions, will enable the coming engineer to make a place for himself, and to render a service to society which the narrow-minded, strictly technical engineer could never hope to do. G. B. W.

ENGINEER-PHYSICIAN

The newspapers carry the story of how a Milwaukee-born engineer, Gordon Edwards, successfully invaded the field of medicine and perfected a treatment for wounds, the wonderful results of which have earned for him the title of "the man who conquered pain." The treatment is said to involve the application, by means of a spray, of an anaesthetic which deadens pain within ninety seconds and permits wounds to be dressed properly without shock to the patient. After overcoming many difficulties, including much governmental inertia, he has finally succeeded in making arrangements whereby the American Relief Society furnishes the instruments and solution free to hospitals that request it. There seems to be no element of personal gain in this achievement; his idea is to serve his fellow men in the way that happened to come to his hand.

Several morals might be drawn to adorn this news item; but they must be plain to all. One thing perhaps is worth saying: The curious linking of engineer and physician is not so curious after all. Both the engineer and the physician are animated by the spirit of service to mankind; both try to make the world a better place in which to live. Gordon Edwards was impelled along certain lines by that spirit; a path opened before him and, with simple faith, he took it although it was an unfamiliar path. He traversed it with determination and good judgment, and, at the end, brought relief to half a million suffering men. There is satisfaction in belonging to a profession that produces men of the type of Gordon Edwards. L. F. V.

FOREST PRODUCTS

The war with its drain upon our resources and our wealth has forced conservation upon us. Wood is one of our most essential materials, and it is becoming more imperative every year for us to conserve to the utmost this vital raw material. Such conservation concerns itself with the utilization of waste, rather than its elimination. Mr. Elmendorf's article in this issue gives a summary of some of the most important things which are being made from wood waste, and illustrates the efficiency with which modern industry is now utilizing raw materials.

A NEW FIELD

The war has opened up new fields for the engineer. He is no longer going to stick to strictly professional work, but is going to broaden out into the fields of industrial and governmental administration. The able article, by Mr. E. D. Jones, on the Employment Manager published in this issue illustrates but one of these new openings. The peculiar problems which will be presented in industry with the termination of the war are going to make it necessary to alter our entire industrial relationships. We are going to make a great many radical changes in the relation between employer and employee. Engineers should familiarize themselves with these new conditions, and the probable resultant changes so as to be able to meet the situation when it appears.

MARINE ENGINEERING

Whether the war has ended when this gets into print, or whether it lasts for ten more years, will make very little change in our ship building program, according to the best information. The United States is bound to become a great maritime nation. As such, the shipping industry, both from its engineering and its business side, is going to offer great opportunities to men with technical training. Prof. Callan's article, upon Marine Power Units, presents some of the technical details of this new industry that should be of great interest to engineers, and especially to those students who are in the navy. Prof. Callan is very well qualified to write on this subject, having just returned from Europe where he was studying marine engines for our Government.

WITH THE COLORS

By WILLARD A. KATES

ARTHUR M. ANDREWS, senior chemical 1917–18, has entered the West Point Military Academy.

BYRON BIRD, C. E. '15, since July has been commanding the 29th Co., Casual Detachment at the Signal Corps Cantonment, Vancouver, Wash. He is engaged in work for the Spruce Production Div., Bureau of Aircraft Production.

GUSTAVE E. BLOOMQUIST, adult special electrical 1916–17, is a 2nd Lt. in the Engineers.

ALEXANDER F. BODENSTEIN, soph civil 1916–17, was wounded in action July 24. He is reported to be recovering at a rest camp. He is a corporal in the 6th U. S. Engineers. Address, Class Co., A. P. O. 762, France.

ROBERT B. BOHMANN, freshman engineer 1917–18, is at the Great Lakes. Last year Bohmann did some editorial work for the Engineer and gave promise of developing into a strong member of the staff this year. D. t. k.'

H. A. CAMLIN, junior mechanical 1916–17, is in the infantry O. T. C. at Camp Pike.

W. J. CAMLIN, c '18, has been commissioned 2nd Lt. He is with the 1st Engineers Replacement regiment at Washington Barracks, D. C.

ROBERT M. CONNOLLY, c '17, completed a special pursuit course in flying at Brooks Field, Texas, early in September. He is now in France.

GEORGE F. DEQUINE, soph electrical 1916–17, is in the E. O. T. C. at Camp Humphrey.

ARTHUR FREDERICKSEN, m '18, chief machinists mate in the Naval Aviation Section, who has been acting as instructor in aviation engines at the Great Lakes, has been transferred to the officers training course. His address is Regiment 10, Pelham Bay Park, N. Y.

WALTER F. GRUBB, c '17, is in the aviation section.

ENSIGNS RAYMOND HARTUNG, CHARLES GOLDAMMER, and EVERETT COLE have been assigned to submarine duty.

CARL L. HADDORFF, junior mechanical 1917–18, is 2nd Lt. in the aviation section in France.

W. P. HIRSCHBERG, c '01, of Milwaukee has been commissioned captain of engineers.

HAROLD J. HOSLER, c '18, is a Petty Officer in the cost inspection department of the Naval Reserve on duty at the Fore River Shipbuilding plant. His address is 922 Massachusetts Ave., Cambridge, Mass. He was married during the summer.

LT. BOB JOHNSON, c '17, son of the former Dean, is reported to be with the allied forces at Archangel.

WILLIAM H. LANGE, soph civil 1916–17, is a 2nd Lt. in the 3rd Engineers Replacement regiment at Camp Humphrey.

ROBERT F. LIGHT, junior civil 1917–18, is a private in the Tank corps in training at Gettysburg.

CLAUDE N. (BUBBLES) MAURER, junior mechanical 1915–16, has been commissioned 1st Lt. E. O. R. C.

JOHN G. MERTON, junior civil 1915–16, is a 2nd Lt. in the Engineers at Camp Humphreys.

CHESTER J. MILLER, soph chemical 1917–18, is at Camp Custer.

MARSHALL B. NORDBY, soph electrical 1917–18, enlisted as a mechanic in the 124th Aero squadron. He went to San Antonio and from there to Eberts Field, Lonoke, Ark.

ROY W. REDIN, freshman engineer 1916–17, has been commissioned 1st Lt. in aviation.

LOUIS C. ROVE, m '18, is training as a flier at Lonoke, Ark.

E. EDWARD SABERHAGEN, junior mechanical 1917–18, is in the E. O. T. C. at Camp Humphreys.

CLAIRE SCHNEIDER, e '18, is in the radio school at Yale.

WILL R. STEELE, soph civil 1917–18, is at Camp Grant.

FREDERICK G. THWAITS, C '14, is in a training camp for artillery officers.

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*HYMAN TISHLER, freshman engineer 1916–17, died in France last October of wounds received in action.

LOUIS WELLINGTON VAN SLYCK, soph electrical 1917–18, is taking a course in the radio school at Yale. He instructed war classes in radio at the university last year and did similar work at Beloit last summer.

REX VERNON, c '18, is in the E. O. T. C. at Camp Humphreys.

CAMPUS NOTES

By Willard B. Bellack

It certainly is too bad. To think that after we had chased all the members of the fair sex out of the E. B. last spring the first thing one of them does this fall is to come back and take engineering. We might just as well bury the hatchet and get used to a co-educational course in engineering.

In tests recently conducted, radio telephone communication was established between the University radio station and the station of the University of Chicago. Lieut. Rinehardt, Signal Corps, U. S. A., had charge of the Chicago station. The University station was operated by Mr. Jansky. One of the new vacuum valves, made by Professor Terry and Mr. Jansky, was used in the test and the results are considered very good.

The fact that the new barracks at Camp Randall are now occupied has helped a certain portion of the population of Madison to endure the ennui caused by the closing of the movies and other places of amusement. Each night a select audience lines the walks on the opposite side of the street and through the glass side of the nearest building, watches the soldier boys climb into their nighty-nights. Ain't they the bold things?

S. A. T. C., means STICK AROUND 'TILL CHRISTMAS.

EMIL STERN, senior mechanical, is now an assistant in the Machine Design department.

G. B. WARREN and W. B. BELLACK, both senior mechanical engineers, are assisting in the Department of Mathematics.

We feel sorry for the junior engineers in the S. A. T. C. because they can't wear the conventional corduroy. Speaking of style, it certainly is surprising how quickly green head gear went out of fashion with the frosh. So far we haven't heard a single frosh bewailing the turn in affairs.

Oh! You'll Like It

Friday, October 25, was lucky day for PROF. LARSON; Miss Dorothy Alida Larson came to town and made him eligible for membership in the Amalgamated Order of War Dads. Gus is the proud dad and says: "Why, of course she has red hair."

After watching the effect of the supervised study system we have come to the conclusion that the old saying "You can lead a horse to water, etc." was started by a man who knew.

Things are becoming normal again. Now that the Naval Reserve has been put into barracks the M. P. force has less trouble keeping the right men in the right place at the right time.

The S. A. T. C. unit has been busy in a literary way during its brief sojourn at Wisconsin with the result THE REGIMENTAL EAGLE appeared on the campus during the past month. The first number was well edited and the paper should be a welcome arrival among university publications.

PREXY is back from Europe wearing a new silk hat. You'll like it; you've g. t. l. i.

The MINING CLUB is hard to put down for the count. It plans to continue its meetings this year and has requested the military authorities to permit the soldier students to attend. The meeting will be held on the first and third Friday in each month in room 210. The club is unique in other respects than mere vitality; it has a financial asset,—a genuine, paid-up Liberty Bond, which is tucked away in the club strong box to draw interest and hatch forth a whole covey of W. S. S.

It will soon be time to start coal conservation. Freshmen and others will save themselves trouble if they refrain from putting snow on the thermostat in the Machine Design room; Pat is wise.

In spite of the fact that over two-thirds of Prof. McCaffery's metallurgy classes are S. A. T. C. men, and that the steel mills of Gary and South Chicago are not open to visitors, Prof McCaffery managed to promote an inspection trip, during the last week in October, which was successful in every way. The Gary plant of the Illinois Steel Co., the South Works of the Illinois Steel Co., the Iroquois Iron Works, and the Wisconsin Steel Co., were visited. The success of the trip depended much upon the fact that Prof. McCaffery is so well acquainted in the mills visited, especially the Gary Works, and was, therefore, an excellent guide. Besides shaking hands with his many friends, Prof. McCaffery was kept busy handing out cigars. It is suggested that hereafter all men taking this trip stock up with Tom Palmers (not Little Toms), because Prof. McCaffery's pockets are not nearly large enough to hold a supply for all of the worthy gentlemen who so courteously show you around.

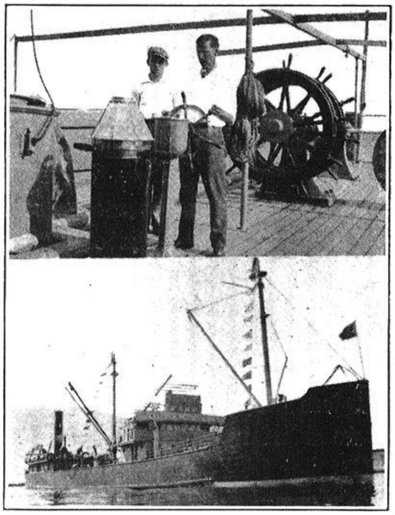
Football is still extant at Wisconsin, but it lacks most of the old time eclat. The military authorities wish to keep the game going, but limit the time to an hour and a half per day and do not allow much in the way of long trips. Coach RICHARDS left suddenly to enter war work and Coach LOWMAN, already overloaded, has had to take up the additional work in connection with the football team. Then, to complete the list of difficulties, the Flu came and remained with us; no civilians have been admitted to the games so far this fall. On October 26th, Camp Grant managed to clean us up 7 to 0, but on November 2, we defeated Beloit 21 to 0.

PROF. L. S. SMITH headed the joint committee of faculty and students that conducted the campaign in the university for the United War Work fund.

PROF. J. G. CALLAN made a hurried trip east early in the month in connection with a gas filter that he has devised to be used in gas masks.

ALUMNI NOTES

By Ethan W. Schmidt



Joe Schwada and the Faith

JOE SCHWADA looked in upon us recently. He looked somewhat peaked from the effects of an operation on his tonsils, but was able to describe the trip he took to South America on the new concrete ship Faith. Joe went along as an observer in the interest of the Concrete Ship Division of the U. S. Shipping Corporation. He left San Francisco on July 17 and voyaged as far south as Iquique, Chile. The return trip was via the Panama Canal to New Orleans, where he landed on October 12.

LEON A. SMITH, c '12 who has been superintendent of the Madison waterworks for several years, is working with E. E. Parker in San Diego on the construction of concrete ships. The City granted him leave of absence.

The 1918 alumni directory of the College of Engineering is just off the press.

ONWARD BATES has been made chairman of the Committee on Development of the American Society of Civil Engineers. This committee which has been created as a result of the changing order brought about by the war, is to investigate and make recommendations concerning "the purposes, field of work, scope of activity and usefulness, organization, and methods of work of the society," so that the society may face the reconstruction period with a definite program.

H. N. BRUE, 1st lieutenant of engineers, was in Madison in the latter part of October visiting his family after five months in France in active service. He was welcomed by a new daughter, Eleanor Louise, born Sept. 28. He has been at Camp Humphreys for the past two months, as instructor and expects to return there.

D. E. FOSTER, m '06, until recently professor of mechanical engineering at Washington State College, is now consulting engineer for Cosden & Co., oil refiners. His address is Box 203, West Tulsa, Okla.

S. C. HOLLISTER, c '17, is credited with having assisted Hool and Johnson in the preparation of the Concrete Engineers Handbook which was published last spring.

PATON MACGILVARY, who is flying in Italy, is the author of a set of letters which appeared in the September Atlantic Monthly under the title: An Italian Interlude.

J. E. NEWTON, E. E. '18, will be instructor in the radio course to be given soon at the University.

F. A. POTTS, c '05, left for Porto Rico in July. He will be with the Central Aguirre Co., at Central Aguirre.

JACK W. REID, c '06, has resigned as bridge engineer of the Chicago & Alton R. R. to enter the service of the Robins Conveying Belt Co., Chicago.

WALTER B. SCHULTE, ch '10, ch. e '11, who is connected with the Burgess Laboratories, has left for France where he will aid in the establishment of a plant for manufacturing signal apparatus. This plant represents a new venture on the part of the Signal Corps which will construct and operate it. Schulte goes as a civilian engineer and expects to return within a few months.

ART VAN HAGAN, who has been traffic engineer for the Michigan Telephone Co. with headquarters at Detroit for a couple of years, expects to be transferred back to the Chicago office about the first of the year.

SIDNEY J. WILLIAMS, g '08, C. E. '15, has been appointed chief engineer for the National Safety Council, with headquarters in Chicago.

From time to time, we must stand by, humble and contrite, while some critical friend explains wherein the Engineer is punk and void. More rarely, we hear a word of praise. Of course, that constructive criticism stuff is all to the mustard and we must have it to progress; but what we really enjoy are the rhapsodical utterances of the good old scouts who know that a kind word buttereth the parsnips. One such has written and we scatter his words afar:

"You will find enclosed my subscription for the "Engineer." There are magazines that are larger in size than the "Engineer" but the contents are worth their weight in gold. I remember especially in one of last season's issues the picture of Bill Kinne. That picture with the recollections that it brought back was worth a furlough any time. Made me think of the old structures class with Swede staggering in about 8:05 after a strenuous all night session, and Izzy Mendelsohn waxing eloquent. But we will all be back at the reunion and till that time the "Engineer" will keep me in touch with the changes so that I will not feel altogether like a stranger in a strange land."

S. A. T. C. LYRICS

II

Little Jack Horner came from Sauk Corner
Wearing his overalls blue.
You could tell by a glance that he hadn't no pants.
So he wore what he had till his "uni" came through.

S. A. T. C. LYRICS

III

Sing a song of study hour.
Students in a row.
"Where'd I leave that text-book?"
Hell! Its down below.