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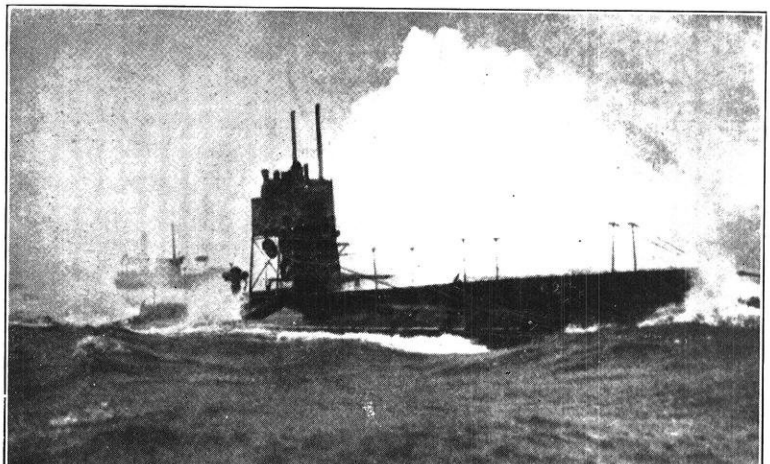

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SUBMARINES

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In the art of submarine navigation, as in that of flying, history is in the making, and since there is but little available information concerning the development since the beginning of the war, nothing of much value as to recent practice can be presented. It is thought, however, that even a very general outline may possess some interest.

The submarine, and its weapon the torpedo, in their effective forms are essentially twentieth century developments. Both require engineering and manufacturing precision of a very high order, and a considerable basis of directly relevant experimental data. These things in the necessary degree have not been long available. The questions of displacement, longitudinal and lateral stability, control apparatus, motive power for surface and submerged running, maintenance of living conditions, and armament, present a series of interdependent problems of great complexity and exacting requirements. The torpedo, which is in fact the sole reason for the existence of the fighting submarine, is an equally highly organized and delicate apparatus.

The history of the submarine is interesting to the student of military and naval antiquities. In the absence of a highly developed means of driving and of a precise knowledge of the engineering elements involved, early efforts had little chance of attaining a marked success. Even had these efforts accomplished all that their inventors hoped, the submarine, without the self-propelled torpedo, would have achieved little.

The essential advantages of the submarine lie in its invisibility and in the extreme deadliness of the torpedo. Its limiting factors are inferior speed, particularly when submerged, small submerged cruising radius, extreme vulnerability when on the surface, and in a lesser degree, cramped space and discomfort when cruising. Much trouble has been encountered on account of imperfect machinery, but this may be assumed to mark the developmental phase and not to be permanent.

In so far as a division may be made, submarines can conveniently be grouped into three classes, harbor-defense, coast-defense, and fleet submarines. The first two names are sufficiently explanatory. The last type is a comparatively large unit, one whose purpose is to accompany the fleet at sea, and, of course, to have a speed and cruising radius that will permit this. There is no sharp line of demarcation between the various modern units, since progressive improvement has postponed standardization. A table prepared by Mr. Lake giving some important figures regarding our type "A" submarines of 1,900 and type "B" of 1914, serve to show the progress in fourteen years (see

TABLE I	1900 *Type "A"*	1914 *Type "B"*
Length	53′ 10″	230′ 6″
Beam	10′ 3″	21′ 6″
Surface displacement—Tons	67	663
Submerged displacement—Tons	75	912
Horsepower, surface	50	2,000
Speed, surface,—knots	6	17
Horsepower, submerged	50	980
Speed, submerged,—knots	5½	10¾
Radius of action, surface,—knots	200	3,000
Number torpedo tubes	1	8
Pounds per H. P., main engines	78	48
Fuel consumption, lbs. per H. P. H	0.74	0.50
Pounds per H. P., electric motors	57	48
Pounds per H. P., storage batteries	909	216

table I). The one-man "baby" submarine is still in the cradle, and its present effectiveness is in doubt. All of our larger units now in commission are of the coast-defense type. The figures in the "B" column of the table apply to this type. The authoritative plans for the sea-going or fleet submarines have not been made public so far and none of them are yet in commission. They are said to be about 300 feet in length, and the single unit that the writer has seen on the stocks seemed to be about that size. A section of a proposed seagoing "Lake" submarine is shown.

In this country there are two general makes of submarines—the Holland and the Lake. These originally differed from each other to a marked degree, but development and government requirements have progressively eliminated radical features and brought the designs closer together, so that at present the larger vessels from the two makers are not strikingly different in appearance or performance. The common features of the two

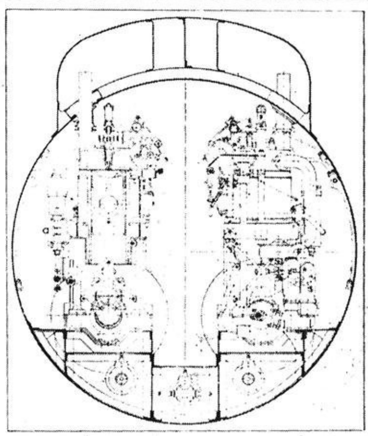

Fig. 35. End Elevation and Sectional View Through a 200-Horsepower, Four-Cylinder, Four-Cycle Submarine Engine of Krupp Design, Installed in a Submarine Boat

types will first be described and the differences noted in their proper connections. The Lake company prefers to call their boats submersibles.

The true hull of any modern submarine is somewhat cigar shaped, with a circular cross-section at all frames except those very near to the bow and stern. Such a section, however, is not well adapted to surface cruising and a more or less ship-shaped false hull is superposed to add better weatherly qualities. This false hull fills with water when submerged so that the external water pressure bears upon a structure of circular section, which is able to withstand it better than one of irregular section on account of its more advantageous distribution of material for resistance to collapse. In this country, the depth to which these hulls are required to be able to submerge is 200 feet, while abroad fifty meters has been named as the usual test of submersion. A small stream-line superstructure including a conning tower with means of entrance, a removable bridge, and a narrow deck protected by a detachable railing, are found on practically all these boats. By means of hatches located in the superstructure and the deck, and closed from the inside, access is gained to the interior. Other features are referred to in subsequent paragraphs.

The usual primary motive power is a pair of Diesel heavy-oil engines of the general type indicated in the illustration. The secondary units, for submerged operation, are direct-current electric motors mounted on the same shafts. On the surface the vessel is directly driven by the oil motors; while at the same

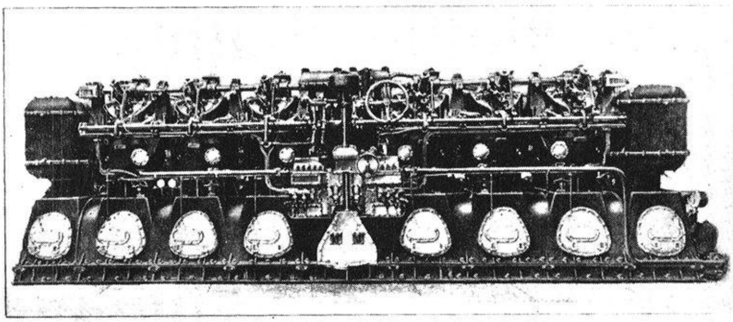

Fig. 33.—Latest Model of Krupp, Six-Cylinder, Two-Cycle, Diesel Engine

Scavenging cylinders are arranged at each end, [illegible] as the control gear, is located at the center of the [illegible] struction.

time or at a time when the boat is not under way, the electric motors, serving as generators, charge the batteries which operate the boat when submerged. In case of emergency these motors can be used to assist the oil engines in surface operation, adding an extra knot or so to the speed.

The Diesel Engine has undergone great and rapid improvement in the course of development for this service and a considerable number of makes, of rather widely different design, have been developed abroad, and in much lesser degree here. Both the two-stroke cycle and the four-stroke cycle are used in the German U-boats, the principal makers being Krupp and the Machinenfabrik-Augsburg-Nuernberg. The British navy is said to use the four-stroke cycle type almost exclusively, and so far as is known to the writer our fleet is similarly equipped.

These motors weigh about forty-eight pounds per horse power, a weight which is much lighter than the practice for surface ships. A good deal of trouble was experienced during the development period, cracked cylinder-heads being the most common single item. The situation at present, with units of standard size, is improving; but the increased requirements of the larger fleet submarines will place a new development burden upon our designers. When submerged the Diesel Engines are free and the propelling screws are operated by the electric motors which draw current from the batteries. Lead cells are generally used, for the balance of advantage seems so far to rest with that type.

Various other forms of power have been tried in the past, both for surface and for submerged operations, though most of these are only of historical interest. However, several boats using steam equipment have been built recently to take part in the war. The power plants of these boats, according to an oral description given to the writer, contain several novel features. A flash boiler is used, with highly efficient lagging adapted to reduce the very high temperature which had previously made steam propelled vessels uninhabitable. A system of automatic fuel control, operated by the pressure and temperature of the steam, maintains a constant steam supply similar to that used in the old "White" steam automobile. A steam turbine geared to the shaft, and the usual electric motors, furnish power for surface and for submerged operation respectively. Another boat, still more radical in design is reported to have been built by the French some time ago. This was to be driven by steam at all times, the energy necessary for submerged operation being stored by chemical means and returned as heat to the boiler, when operating under water. Little information is obtainable regarding the success of this effort.

The formidableness of the submarine may be ascribed to its armament, the torpedo. The first self-propelled torpedo was the invention of Whitehead, an Englishman, and the subsequent improvements that have survived have been indicated. The torpedo in use in our navy is known as the Bliss-Leavitt. Like the Whitehead our type is propelled by compressed air, but the motive power in our design is furnished by high-speed Curtis turbine geared down, instead of the radial-cylinder engine used in the original Whitehead.

The torpedo, as will be seen from the illustrations, is a cylindrical shell with a hemispherical head or bow and a tapered stern; the stern section carries rudders for vertical and horizontal steering, and a pair of propellers concentric with the axis of the torpedo and rotating in opposite directions. The front end or "war-head" is detachable and contains from 200 to possibly 400 pounds of wet gun cotton, a small firing charge of dry gun cotton, which is detonated by a primer carried in a small detachable "primer head." The primer is exploded by the impact of a firing pin projecting forward. This is protected against acci-

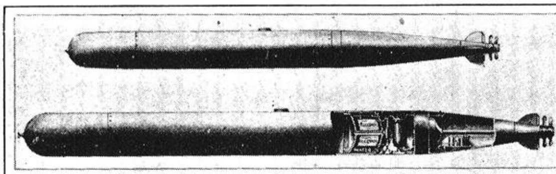

Fig. [illegible] The 18-inch torpedo compared with the late [illegible] 21-inch, 21 foot torpedo. In the new torpedo the alcohol fuel for the superheater is contained in an annular flask as shown.

dental firing by a retaining nut having wings of propeller form and adapted to be unscrewed by the action of the water as the torpedo moves forward.

Directly astern of the war-head is a cylindrical section filled with high-pressure compressed air which furnishes the power for the engine or turbine. The stern section is occupied by the alcohol fired reheater, the driving machinery and the controlling apparatus. The latter apparatus is exceedingly ingenious, and precise in operation. The device for establishing horizontal direction consists of a gyroscope which is spun at the time the torpedo is launched. This controls a relay apparatus which so actuates the horizontal rudders as to keep the torpedo directed toward the point at which it was aimed. The torpedo maintains its own initial direction, being so mounted as to permit this, and any departure from a proper relation to this direction operates a compressed-air valve which admits air to the horizontal steering cylinder in corrective direction.

The depth is maintained through indirect or relay control of the vertical rudders by the external water pressure, obtained by a diaphragm adjustable to initial response and therefore to the pre-determined running depth. A pendulum works in conjunction with this diaphragm in such manner as to prevent violent plunging. The usual submersion is eight to fifteen feet, but this can be increased or, waves permitting, decreased. The torpedo cannot ordinarily be seen but the bubbles of air from the exhaust mark its position by a characteristic wake.

These torpedoes are of two types, eighteen inches in diameter by eighteen feet in length and twenty-one inches in diameter by twenty-one feet in length. One of either size is sufficient to sink an unarmored or lightly armored ship and it is unlikely that the most heavily armored superdreadnought could remain in line of battle after a single impact, even though she were not absolutely destroyed. The maximum range is 10,000 yards at reduced speed, though the chance of a hit at this distance is rather remote. Where the range is about a mile the speed is in the neighborhood of forty knots or about forty-eight miles per hour.

The control of the submarine itself is naturally more complicated than that of a surface vessel. Submergence to the condition known as "running awash" is determined by ballast tanks, to which water may be admitted directly, or from which it may be discharged, either by pumps or by compressed air. Steering in horizontal and vertical directions is accomplished by means of rudders at the stern; vertical steering is directed by rudders or "hydroplanes" near the bow. Submersion from the "awash" condition may be accomplished either by turning the bow downward, as in Holland boats, or by the pulling of the controlling rudders downward at bow and stern, as in Lake boats. Usually the boat is operated with a little residual buoyancy unless it is desired to lie on the bottom.

When under way the function of steering includes the maintenance of the exact depth required, the helmsman working by a gauge actuated by the water pressure. The writer has been told that certain boats are equipped with a pressure-controlled, electrically-driven ballast pump capable of holding the boat stationary at a predetermined submergence; this would be of no small advantage to a submarine lying in wait in smooth water since the wake of the moving periscope under such conditions may be seen at some distance. The periscope is an optical instrument projecting above the surface when the boat is otherwise submerged, and affording vision in any direction in which its upper end is pointed. It is of the general character of a divided and offset telescope of very slight magnification with reflecting prisms at the top and the bottom of the vertical tube. There is a type of periscope which reflects upon a table extending entirely around the horizon.

The larger units carry wireless and mount a folding mast. Recent crafts have been fitted with apparatus for audible signalling and for recognizing sounds under water—presumably the Fessenden Oscillator. This enables the lookout to listen for the sound of a propeller and to determine its approximate direction even when the periscope is submerged. Surface patrols similarly equipped can hear the Diesel motors of a submarine at a considerable distance.

The early designs had trouble with their magnetic compasses on account of the steel hull. The gyroscopic compass affords one satisfactory solution of the problem.

The living conditions on board are rather trying. The noise of the motors is unpleasant when running on the surface and the atmosphere becomes stuffy after long submersions, since the compressed air supply must be used economically. Living quarters are cramped and there is little deck room. These conditions will be much improved on the fleet submarines should the proposal to inhabit the false hull, when on the surface, prove possible.

As a means of defense against submarines, the conditions are in so active a state of development as to make it hazardous to venture more than a generalization. The great difficulty of finding the boat when submerged is the main problem. Probably the most effective all around weapon is a fair sized quick-firing gun; if an under water craft comes to the surface within easy range of such a gun for more than a momentary "porpoise" she is very likely to be destroyed. The matter is quite otherwise should the submarine remain submerged. The periscope is hard to see and harder to hit, and the water is an effective protection to the hull. The principal further recourse of a ship of adequate speed is flight in a zig-zag path.

Steel nets and mine fields are used to protect harbors, important short routes, and naval bases against the submarines themselves, and finer-mesh steel nets to guard naval ships at anchor against torpedoes. High speed motor boats, with either gasoline or steam power and with one or more guns are effective because they can be numerous, and their light draft, which is less than the depth at which a torpedo should be run in seaway, is a source of protection. Aeroplanes can sometimes detect the submarines by wave formation or by oil "slick" or, if the water is clear and the light good, by direct observation. These methods represent the best that are publically known, but despite all of them, the submarine is exceedingly hard to catch.

We pass next to the present and future importance of the submarine. The restricted operations of hostile fleets may in part be traced to their activities, and the campaign against merchant ships is too conspicuous to require comment.

For our own service it would appear that as a weapon of defense to prevent the landing of troops from transports, the shelling of coast cities or public works, or other demonstrations off an unprotected coast, the submarine would be absolutely essential and very effective. It would seem most desirable that our appropriation for vessels of this type should be largely increased, and that facilities for construction of adequate numbers at one time should be provided; an outlay equal to that for even one superdreadnought would build some twenty coast-defense boats, with an aggregate defensive power rather difficult to appreciate.

RECOVERY OF WOOL GREASE IN THE UNITED STATES

W. C. Helmle

Wool grease is a term applied to the natural fat occurring in the fleece of sheep. In order to understand the problem of wool grease recovery it may be desirable to state some facts about wool and the woolen industries.

Wool is the product of a lymph-like gland in the middle layer of the skin, which besides producing wool, secretes an oil to lubricate it. Other glands secrete the wool fat, which forms a protective coating and prevents matting. The length and character of the hair are different for different breeds of sheep, for different individuals of the same breed, and even for different parts of the same individual. The hair is from one to eight inches long, and from 0.0018 to 0.0040 inches in diameter. A good average sample of Merino wool, dry at 100 degrees, has the following constituents:

Earthy matter	26.06 per cent.
Suint and yolk, soluble in cold water	32.74 per cent.
Neutral fats, soluble in ether	8.57 per cent.
Earthy matter, adhering to fat	1.40 per cent.
Wool fiber	31.23 per cent.

The moisture content in air-dried wool is from twelve to fourteen per cent. The suint is dried perspiration, consisting largely of potassium salts of fatty acids, together with three to four per cent of sodium salts. The yolk is composed of ethereal salts, cholesterol, iso-cholesterol and salts of oleic, steric, and palmitic acids. The clean wool fiber:

Carbon	50 per cent.
Hydrogen	7 per cent.
Oxygen	26–22 per cent.
Nitrogen	15–17 per cent.
Sulphur	2–4 per cent.

The preliminary steps in the preparation of wool are as follows: sorting, dusting, picking, carbonizing, and scouring. The sorting is done on tables with screen tops through which the loose dirt falls and which are provided with heating coils for use in cold weather to prevent matting. A dusting machine, provided with a fan, carries away the remainder of the loose dirt. Carbonizing is treatment which dilute sulphuric acid to disintegrate the vegetable matter, which is removed by passage through drying apparatus, rolls, and a duster. The wool is then ready for scouring. This is the first stage at which a waste liquor with possibilities for recovery is produced. Later in the process another scouring is given, but the oil removed here is that used for lubrication, and is not wool grease. This second scouring will therefore not be further considered.

In the scouring process all the potassium salts and practically all the grease are removed, and both are recoverable to an extent depending on the process used. Until the supply from the continent of Europe was cut off by the war, the price of the products of recovery was so low that few American mills found the recovery profitable; most of them wasted the scouring liquor. Similar conditions obtained in England, save that labor was cheaper. Since these pre-war conditions will return in a more or less modified form after peace is established, it is well to consider them. Prior to 1914 the wool grease in England was recovered solely to comply with the laws against public nuisances. In the United States conditions were not generally such as to make it a sanitary necessity, and few plants were in the recovery business. Even the best of these plants probably did not do more than pay for labor and material, and did not pay interest on the investment. When a large scale method of disposing of scouring liquor was demanded, the proposal was made to use it with an admixture of molasses, as road dressing. Crude wool grease sold for from two to three and a half cents a pound. The price is now around eight cents. As an indication of the possible profits, the Sharples Specialty Co., manufacturers of centrifuges, claims that all recent installations of their equipment have paid for themselves in one year.

As the result of an extended investigation by the Massachusetts Department of Health, the scouring liquors have been shown to contain from 105 to 220 pounds of fat and from 57 to 78 pounds of potash per thousand gallons. The total scouring liquors for different mills varies from 24,000 to 56,000 gallons per day.

The usual standard practice of scouring wool will first be described, and afterwards the variations will be taken up. The modern method is largely mechanical. There are four bowls containing liquor and rinsing water. The bowls are from sixteen to thirty-seven feet long, and two to four feet wide. The first two, for scouring, are longer than the last two, which are for rinsing. The wool passes through the bowls in a sort of mat, propelled by rakes, and through squeezing rolls between the bowls. On coming out from the bowls the wool is dried by hot air or by a centrifuge. Previous to carding and spinning, the wool must be oiled. In this process olive oil, lard oil, red oil, or mineral oil is applied in an emulsion state.

The passage through the scouring tanks is made in about eight minutes. The cleansing agents are alkali and soap, used at a temperature of 100° to 120° F. The soap used consists of twenty-five pounds of caustic potash in 300 gallons of water, to which 100 pounds of red oil are added, to produce a jelly-like mass. The red oil is a by-product of candle making, and contains about 90 per cent oleic acid. One pound of the soft soap is used for each two gallons of water, to make suds.

The first bowl contains eighty pounds of soda ash, thirty-six gallons of suds, and water enough to make 800 gallons. The second bowl contains the same quantity of liquid as the first, but of half the strength. The third bowl contains twelve gallons of suds, but no soda ash. The fourth bowl contains running water. The suds are renewed every hour, and the soda ash three times a day. When the contents of the first bowl becomes muddy, it is thrown out, and the liquor in the third and second bowls is run into the second and first bowls, respectively, and the strength made up. The discharge from the fourth bowl is continuous, and contains somewhat more solid matter than does domestic sewage. The discharge from the other bowls is a dirty brown liquor, of high power for pollution if run into a stream.

When the price of the grease is such that there is no profit in its recovery, it may be treated by sewage disposal methods. If settling basins are used, thirty per cent of the organic matter, in addition to sand and sediment, may be settled out in a reasonable time. Chemical precipitation methods have also been tried. Lime, ferric sulphate, lime and ferric sulphate, iron alum, aluminum alum, ferrous sulphate, ferric chloride, and calcium chloride have been tried at the Lawrence Experiment

Station of the Massachusetts Department of Health. Excessive amounts of any one of the above reagents were necessary. Of all those tried, calcium chloride proved the best, and the application of 10,000 to 20,000 pounds per million gallons resulted in a nearly odorless discharge. Filtrations through sand or coke beds gave considerable clarification, but the beds became clogged rapidly. It was recommended by the director of the Lawrence station that the weak discharge only, from the rinsing bowl, be treated by sewage disposal methods.

The present high price of the grease, and the insufficiency of other sanitary measures, therefore, justify the recovery of the solid matter in the scouring liquor. The most usual method of doing this is cracking with acid. The wastes are run into large settling tanks for cooling, and for the removal of sand and mud. The liquor passes to the treatment tank, where it is agitated by compressed air. At the same time sulphuric acid is added until cracking, or the separation of the fats, takes place. Loam may be added to assist later in the settling. The agitation is continued for a number of hours, and the settling for a similar period. Part of the fat rises, and part settles. The clarified acid is drawn off in between, and treated by filtration beds, either with or without neutralization. The sludge is run onto sawdust on the sludge drying beds, where the grease is absorbed as it solidifies. The water is allowed to drain off. The sawdust remaining behind is shoveled into bags, and pressed in heated presses, whereupon the grease is released. This crude grease may be purified by one of a number of methods to be discussed later. The remaining sludge may may in some cases be extracted by solvents for the remaining grease, but it is usually sold for fertilizer, or thrown on the dump. This system has been used by the Lorraine Manufacturing Company at Pawtucket, R. I.

The Turner–Akeroyd process is a patented modification of the foregoing. It involves dilution of the liquor to such a specific gravity that none of the fat rises, but all settles out. It was demonstrated at the Pontoosac Mill at Pittsfield, Mass., from 1906 to 1911. Two settling tanks, three sludge beds, filter, press, and necessary air compressor and piping comprised the plant. The settling tanks were twenty feet in diameter and ten feet deep, with 20,000 gallons capacity. The sludge beds were one-one hundred sixtieth of an acre in area each, made of three to four inches of fine cinders laid over broken stone and tile drains. The filter area was one thirty-sixth of an acre, covered with cinders. The steam heated hydraulic sludge press had a capacity of thirty-five to forty cubic feet. In operation, one-third barrel of loam and twelve to fifteen gallons of sulphuric acid were added to each tank of liquor, and allowed to settle over night after agitation. The sludge was run onto one of the sludge beds previously covered with three or four inches of sawdust. The draining and drying lasted one or two days. The fat recovery was 98 per cent. With no allowance for interest, a slight profit was made. The relative cost of labor and material (acid) was about two and one-half to one. At the expiration of the demonstration period the operation was not continued.

The Hudson Worsted Company of Hudson, Mass., since 1909 has been operating a plant designed by R. S. Weston of the Massachusetts Institute of Technology. The daily waste of 24,000 gallons is collected in a sump. It is thence pumped into a cooling and settling tank of 15,000 gallons capacity. From this tank it is pumped to the treating tanks, of which there are three, of 20,000 gallons capacity each, covered to prevent the spread of odors. All fumes are exhausted to the stack by fans. After the application of acid, and agitation, the settling period is twelve hours. The supernatent liquid is drawn off through a floating arm, passed through the settling tank, and then filtered. The filter beds are four in number, with an area of 0.023 acre, covered with two inches of cinders, and underdrained. The sludge is run onto eleven filter beds of 147 square feet area. It is dried for one week, bagged, and pressed. Five steam jacketed presses are used. The grease is pumped into settling tanks, clarified and barreled. The remaining sludge is sold for fertilizer. The cost of the plant was $15,000. If the grease is sold for two and one-half cents a pound, there is a loss; if sold for three and one-half cents, a profit.

In England a process patented by John Smith and Son, and Leach, has been in operation for a number of years at the plant of the Field Head Mills, Bradford. Here the liquor is first settled, and then run into a Yaryan quadruple effect evaporator, and evaporated to one-tenth to one-fifteenth of its original volume, to a specific gravity of 1.23. This would be solid if allowed to become cold. It is run through a centrifuge, which gives a concentrated potash liquor, a grease, and a sediment, which is removed from the machine by hand. The grease recovered is only the unsaponifiable part, which is the most valuable. The saponifiable greases, such as the oleates, are acted on by the alkali present, and run off in the potash liquor, which is evaporated further, and finally calcined in a revolving furnace. About one-third of the total fat is here burned up. From 1,000 gallons of the raw liquor there may be recovered: 125 pounds of crude grease containing seven pounds of water and 94 pounds of crude potash containing twenty-eight pounds of insoluble matter. The plant cost $21,900, and has a full capacity of about 130,000 pounds of wool per week.

The Battage process is in use in France. A foam or froth is formed on the surface of the liquor by an air or superheated steam agitator, or a mechanical stirrer. The foam, which contains most of the fats, is skimmed off, and the fats recovered.

In France and Belgium, and to a lesser extent in Germany, Russia, and England, a steeping process has been used preliminary to the actual scouring. By this method, forty per cent of the impurities are removed from the wool by a continuous current of warm water, and the resulting solution is, after concentrating, incinerated for the recovery of potash. This is said to make easier the subsequent scouring with soap.

Volatile solvents have often been tried for the recovery of fatty matter from the wool, but their use has never become general. The solvent is used after the water-soluble matter has been removed by a steeping bath, and the solvent is recovered from the wool by blowing with air or carbon dioxide. The opponents of the system argue that the use of solvents, owing to excessive decreasing, produces an inferior wool of a very dry and brittle fiber. The users of the method argue, on the other hand, that the solvent process is more easily controlled; that the wool is left lustrous and in an ideal condition for manufacturing; that the wool is more elastic and stronger, and will take dyestuffs more readily. Being free from felted parts, it cards and combs freely without breakage of fiber. Evidently the control of the process is a most important point. Arlington Mills, at Lawrence, Mass., have used a solvent process for a number of years with great success. The solvents proposed are numerous, including benzol, carbon bisulphide, carbon tetrachloride, ether, chloroform, ethyl acetate, toluol, and acetone. All of these have the objectionable property of dissolving from the raw wool the coloring matter and odor of sheep-dung. This, of course, spoils the wool fat, and necessitates complicated purification processes. The lighter petroleum distillates do not present this disadvantage and do not dissolve the potassium soaps from the wool, but get all the desirable wool fat. Carbon tetrachloride is sometimes preferred, however, because of the lack of risk from fire. Carbon bisulphide gives the scoured wool an objectionable yellow color, attributed to deposited sulphur. If an attempt is made to use solvents for the extraction of fats from the soapy scouring solutions, emulsions are produced which render the process almost impossible.

The use of centrifuges for the removal of fats from the scouring liquor is a recent American development. The centrifugal method is applicable only to the emulsion method of scouring. Some of the cleansing agents used on the wool aid in the process of emulsification, others are indifferent or hinder it. The various soaps are all good emulsifying agents; the carbonates and hydroxides are as good or better. Ammonia is probably the best of all. There are various secret formulas used in the New England mills, all of which are aimed at the production of a better grade of wool. A certain amount of alcohol is often added, as it aids in giving a good emulsion. The proper emulsion could not be produced without the fatty acids and alkali salts naturally present in the wool.

The procedure recommended by the Sharples Specialty Company is as follows: The weak rinsing liquor is added to the strong discharge from the first bowl until the fat content is about two per cent. This mixture is held at 140° F. in large shallow settling basins, or run through a long settling trough, until the dirt has settled out. If the temperature is allowed to fall, bacteria will act, and break the emulsion and also injure the quality of the fat. A higher temperature would permit more rapid settling, but would also fix a sheep odor in the fat. If the liquor is too strong, the fat will adhere to the dirt, retard settling, and finally cause a loss of fat in the dirt. Some fat will settle out in any case, and with a one per cent liquor, the best practice is to omit the settling. Next the liquor is run through the centrifuge. This machine is preferably steam turbine driven, and handles up to 28,000 pounds per day. The only part of the process requiring special skill is the determination of the rate of introduction of the liquor. The lower the rate the better the separation, and the greater the difficulty of holding the temperature at the right point. The wool fat is discharged with a moisture content of from two to fifteen per cent. It is washed with fresh water, and rerun through the machine whence it comes with a moisture content of less than one per cent. It must of course be heated for this second run. The product contains about the same amount of fatty acid, and is translucent when cold. All natural and artificial emulsifying agents are dissolved in the wash water. Any chemical reaction tending to break the emulsion will throw these into the grease. The water discharge from the centrifuge should be acidified with sulphuric acid and rapidly passed through the machine again. From this acid run is obtained the remaining neutral fats (one per cent) and also a large part of the fatty acids. The product is said to be superior to the ordinary crude grease. The final discharge may be treated for the recovery of the potash, or it may be run into the river, as it has all the objectionable greasy constituents removed. It is claimed that this is the only process which can make money in the United States at pre-war prices, and that it may be profitably operated with all wools except carpet stock. That part of the dirt which does not settle out in the tanks causes no trouble in the centrifuge, as it sticks to the inside of the tube, and may be removed by hand at intervals.

The wool fat recovered by any of the processes mentioned is in a more or less crude form. It is known in the United States under the name of "degras," a term which is applied in Europe to another product used in leather making. Depending on the nature of the process used for the recovery, the degras contains various amounts of the fatty acids used in the scouring soaps. The purified product is not saponifiable in the ordinary sense of the word, but may be saponified by boiling alcoholic potash. It has a complex composition, about which little is known. It consists largely of cholesterol and isocholesterol, the former being probably a cyclic alcohol, a white crystalline solid melting at 146° to 151° C., of composition $C_{26}H_{43}OH$. The purified wool grease melts at 40° C., and is formed into emulsions with water, taking up 105 per cent of its own weight. It is sold in both the anhydrous and the hydorus condition under the names lanolin and adeps lanae, and other names. The name lanolin was originally a German patent, and applied to a product containing thirty per cent water. It is a very good base for ointments, as it is absorbed directly into the skin. The lanolin, specific gravity 0.973, is nearly insoluble in alcohol, but soluble in most other solvents.

The crude grease is used for various purposes. It is used as a lubricant for wool in the process of spinning, either with or without the addition of other oils. It is also used as a stuffing grease in the dressing of bark and chrome tanned leather. Along with the magnesium salts of the fatty acids recovered in the cracking process, and zinc resinate, it is used in paints. By distillation with superheated steam, various oils and pitch may be obtained. The oil is used for wool lubrication, and the pitch for waterproofing and insulation purposes.

If it is desired to prepare lanolin, the decomposition products of proteid bodies must be removed. One method is to dissolve in benzine or other solvent, and treat with syrupy phosphoric acid, but acetic and tannic acids may also be used. About two per cent addition of phosphoric acid will be necessary, but the amount should be determined by test of a small sample. A precipitate will form, which must be removed. Then the solution may be evaporated, leaving the nearly pure fat; or an aqueous alkali may be added with agitation and heating, when the watery layer will separate out. Alcohol will aid in the separation. The lanolin will be in the benzine layer, and may be further purified by the addition of calcium chloride. On evaporation of the solvent, the pure fat remains. The separation of the proteid matter is not so complete or so easy in case the fat has been heated much in the recovery. Hot acetone may be used in this process to advantage. In case the fat is in solution in benzine, the addition of acetone will throw out the soaps. A centrifuge may be used to separate the hot liquids. If the fat is made into an emulsion with ammonia, the addition of alcohol will throw out the lanolin as insoluble. A very old process, known to the ancients, was to knead the fat repeatedly with sea water. It has been suggested that the fat may be kneaded with alkaline solutions of permanganate, bleaching powder, or of hydrogen peroxide, to get rid of the odors and colors of objectionable impurities. What may be considered a standard method is that used by the Norddeutsche Woll-kaemmerei u. Kammgarn-spinnerei, as follows: To crude wool fat is added benzine or carbon tetrachloride and alkali, as well as common salt, sodium sulphate, or magnesium chloride. The soaps are precipitated, and the solvent then evaporated. This concern recommends the use of sulphurous acid in place of sulphuric acid in the cracking process to prevent subsequent decomposition of the grease.

The recovery of crude wool grease is obviously a side line for woolen mills. The situation of the mill decides whether or not the recovery is a sanitary necessity, and market conditions determine the financial possibilities of the process. It is only the high prices of the last two years that have caused the industry to be exploited in the United States, and the uses and market for the product are not so definite and well defined as to warrant a statement regarding the future of the business. Wool fat is one of the few non-saponifiable natural greases, and this fact should cause expansions of those uses to which it is now applied, and perhaps the development of new applications.

A NEW INTEGRATING MACHINE AND ITS PRACTICAL USES

ARMIN ELMENDORF
Instructor in Mechanics, University of Wisconsin

In order to explain the function and operation of an integraph, which as its name suggests, is simply a machine to give a graphical record of the operation of calculus called integration, it will be necessary to cite a few of its uses in engineering practice. Of these its applications in the mechanics of traction for developing curves of work, distance and velocity, in structural engineering for determining stresses and deflections in beams or girders, for finding centers of gravity, and moments of inertia of irregular surfaces demand first place.

To illustrate, let us imagine two stations on a railroad passing through mountainous country. The consumption of fuel may be excessive for the small stretch between the two towns, and it is desired to make a study of the work required of the locomotive to pull a train over various sections of the road. This is more than a matter of drawing a train up and down grade, since much work is lost in friction around curves; it is necessary therefore to obtain a graphical record of the draw-bar pull. Such a record may be made by noting the readings of a dynamometer attached to the locomotive, and it will be assumed that this has been done. From it we are to analyze the work done by the locomotive in pulling the train.

Figure 1 (a) represents a chart showing the relation between tractive effort and distance. By definition, work is the product of force and distance, so that the elementary area shaded in the figure, which is equal to Pds, is the work done by the locomotive on the car in pulling it through the small distance ds. The work done in pulling the car from A to any point C is the area shown, bounded by the co-ordinate axes, the curve and the ordinate erected at C. When the force is in pounds and the distance in feet then work is, of course, expressed in foot-pounds. If the tracing point of a planimeter be guided around the boundary of the shaded area then the planimeter reading would indicate this work to some scale. The ordinate $P\ q$ could be obtained by means of the planimeter in the same way. It measures the total work done by the locomotive in pulling the car to a position D and is equal to the area bounded by the force curve, the co-ordinate axes and the ordinate erected at D. Similarly the end ordinate *rt* measures the total work done in pulling the car from A to B. The curve *nqt* is then the work curve. In the notation of calculus it is called the integral curve of the given force-distance curve. In railway engineering distance-time curves are often

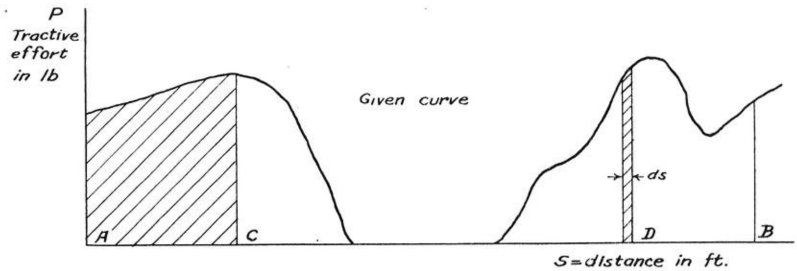

Fig 1(a)

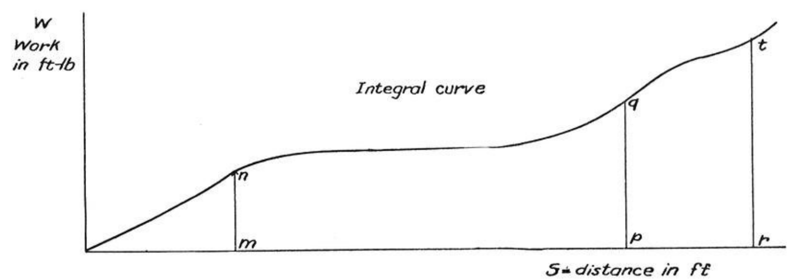

Fig. 1(b)

desired. Dynamics gives us the familiar definition of velocity as the rate of change of distance with respect to time. Mathematically, in the notation of calculus, this relation is expressed by the equation $s = \int v dt$, in which s is the distance, v the velocity, and t the time. When the velocity-time curve is given it is possible by successive integrations with the planimeter to develop the distance-time curve.

Another problem of considerable importance lies in the determination of stresses in beams which are non-uniformly loaded. A girder may carry a distributed load whose magnitude per foot varies with the position of a point on the girder. The integral curve of the load-length curve represents total vertical shear. If V stands for the shear and x for the distance from the origin, then the equation $M = \int V dx$ gives the curve for the moment at any section; that is by first integrating upon the load curve to obtain the shear diagram, and then integrating the latter, the moment curve is obtained. From the moment curve the stresses at any section in a beam are readily determined from the flexture formula $S = \frac{Mc}{I}$ where S stands for stress in lb. per sq. in., M the bending moment at the section under consideration and $\frac{I}{c}$ the section modulus of the beam, usually constant.

The science of mechanics of materials also gives us a relation between external or bending moment and the deflection at any point in a beam as follows: $EI\frac{d^2y}{dx^2} = M$ where E is the modulus elasticity of the material of which the beam is made, I the moment of inertia of any section about the neutral axis, y the deflection at any point and M the bending moment, varying with the distance from the origin. Since E and I are usually constant and M is a function of x, this relation may be written

$$\frac{dy^2}{dx^2} = F(x).$$

Integrating gives

$$\frac{dy}{dx} = \int F(x)\, dx^2 + C_1:$$

A second integration yields in turn

$$y = \int\int F(x)\, dx^2 + C_1x + C_2$$

where the constants of integration are determined by conditions such as the kind of beam and the nature of the loading. It is thus seen that two successive integrations of the moment curve or four successive integrations of the load curve yield the deflection curve.

Space limitation does not permit a further explanation of the use of graphical integration in the solution of other engineering problems. Among those of considerable importance are the determination of centers of gravity, of the center of pressure on a dam, of moments of inertia, and radii of gyration, of the exact division of irregular tracts of land into proportionate parts, and the determination of all the real roots of an n^{th} degree equation.

Mechanical integration, consisting in tracing the planimeter thru increasingly large areas and progressively plotting the values of the area determinations, and so developing the integral curve, is a very laborious process; and the perfection of an instrument for performing the operation continuously has long engaged the attention of scientists. The earliest workers were Coriolis in 1836, Zmurko in 1861, and J. Thomson and Cayley in 1876. About forty years ago the first model of the Abdank - Abakanowicz instrument was built. It seems to be the only device ever perfected and, as manufactured at present by G. Coradi of Zurich, Switzerland, is one of the most remarkable instruments of precision made. Each part has passed through an evolution until mechanical perfection has been practically attained. The "integraph," as the Coradi instrument is named, depends for its operation upon a small sharp-edged steel roller which turns upon the paper and makes a variable angle Θ with the X — axis, so controlled that tan Θ is measured by the perpendicular distance of the tracing point from the X — axis, that is, the ordinate of the curve. The integral curve is drawn by a pen in such a way that the tangent to the curve as it is drawn is always parallel to the disc.

The sharp roller seems to be essential to every integraph so far built. In the machine the author proposes this roller is discarded and a principle is adopted which makes possible more than one integration. By simply duplicating a sphere n times, such a process as the following may be performed at one tracing of the given curve.

$$y = \int\int F(x)\, dx^n$$

If, for example, the moment curve had been drawn, and the elastic curve of the beam were wanted, then by the use of two spheres, a single tracing of the moment curve would yield the desired deflection curve.

The "movable center" sphere device, upon which the design of the machine is based, was discovered by Professor Hele-Shaw in 1884, and used by him in an instrument which had the same

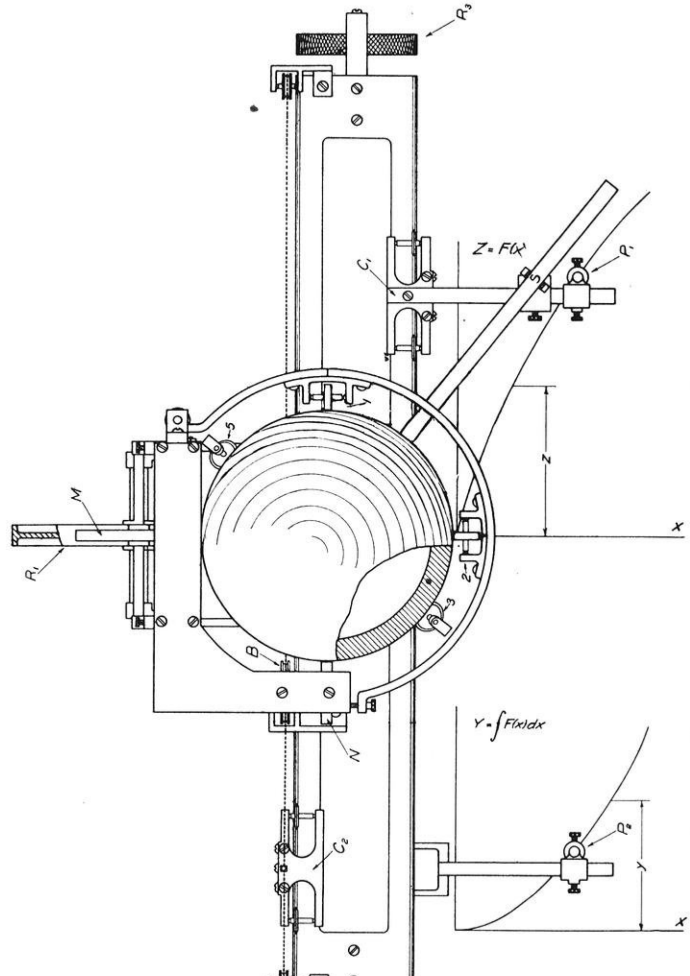

FIG. 5.—Plan of the Proposed Integrating Machine.

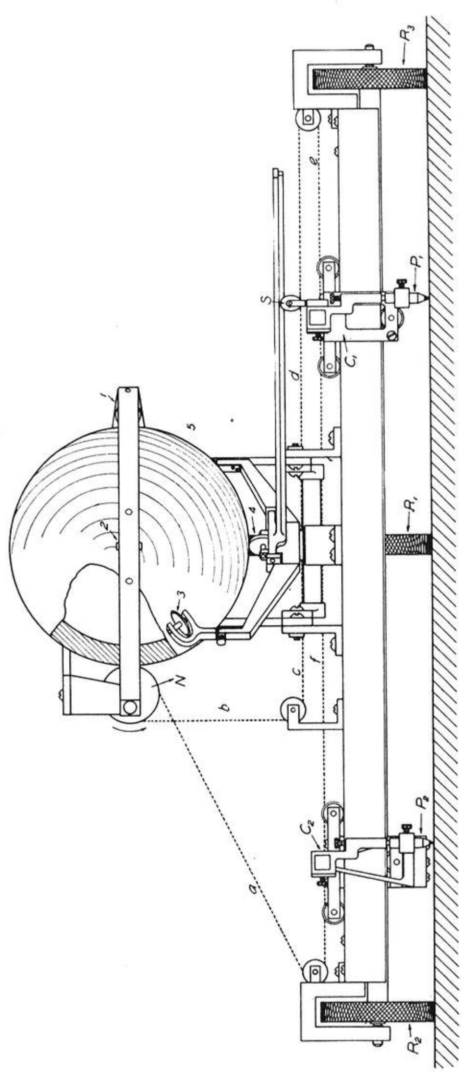

FIG. 6.—Elevation of the Proposed Integrating Machine.

function as a planimeter, namely, area determination. Figure 2 shows a sphere mounted upon two pivots, A and B. The discs scattered around the sphere are all tangent to a horizontal great circle and their axes lie in the horizontal plane. The axis of ro-

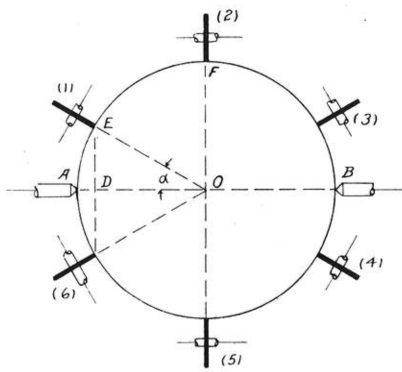

Fig. 2

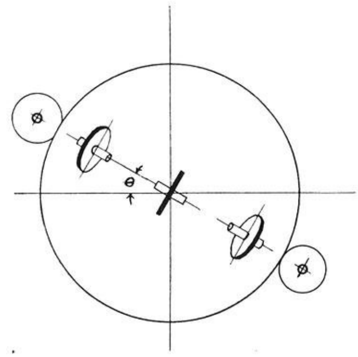

Fig. 3

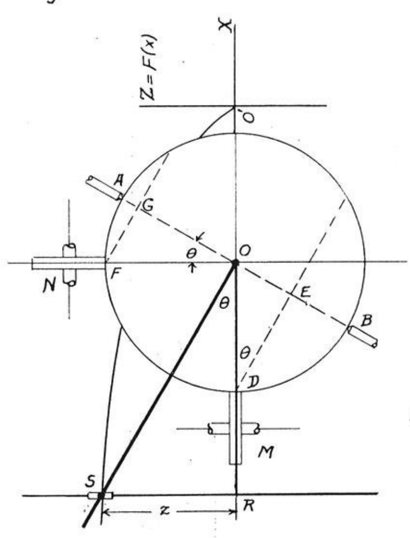

Fig. 4

tation when the pivots are in place is, of course, AB. Upon rotating the sphere, the discs (1) and (6) roll upon a circle whose radius is DE, and (2) and (5) roll upon the circle with radius OF. It is obvious that the speed of a point on the surface of the sphere is directly proportional to this radius; and so if W_1 represents the angular speed of (1) and W_2, the angular speed of (2) then

$$\frac{W_1}{W_2} = \frac{ED}{OF} = \frac{\sin \alpha}{\sin 90}$$

Upon removing the pivots the sphere is no longer constrained to rotate about any particular axis, but is free to rotate about any axis in the *horizontal* plane. Now we will suppose the horizontal discs removed, and a set of discs whose axes all lie in a vertical plane as shown by Figure 3, to be set in position. The sphere is then free to rotate about any axis in this *vertical* plane, and as before, the axis of rotation is independent of the position of the discs around the great circle, the only condition imposed upon them being that their axes must all lie in the same plane. If both sets of discs be present simultaneously then, of course, there is only one axis about which the sphere can possibly rotate, and that is the intersection of the horizontal and vertical planes. Turning the vertical plane with its discs about a vertical axis through the center of the sphere shifts the axis of rotation.

In Figure 4, the axis of rotation must be imagined determined by the intersection of the horizontal and vertical plane and not by the pivots shown in the figure, which in reality are not present. To avoid confusion all the discs, except the two in the horizontal plane, have been omitted. The rollers M and N are of the same size and their planes are at right angles. The rate of rotation, W_1, of the roller M is determined by the radius DE; and W_2, the rate of rotation of N, is fixed by the radius FG. But $DE = r \cos \Theta$ and $FG = n \sin \Theta$, where r is the radius of the sphere, so that the following relations holds

$$\frac{W_2}{W_1} = \frac{FG}{ED} = \frac{FG}{ED} = \frac{\sin \Theta}{\cos \Theta} = \frac{\text{sine}}{\cos \Theta} = \tan \Theta$$

We will next imagine an arm, OS, extending out perpendicular to the vertical frame carrying the discs, and suppose that the runner S is free to slide along the line SR, the distance OR being fixed. Then

$$\frac{SR}{OR} = \tan \Theta = \frac{z}{OR}, \text{ or}$$

$$z = K \tan \Theta = K \frac{W_2}{W_1}$$

If the sphere be placed upon a carriage constrained to move in the X-direction and M be driven by this motion, then $W_1 = \frac{dx}{dt}$, and denoting the rate of rotation W_2 by $\frac{dy}{dt}$, we have

$$z = K \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = K \frac{dy}{dx}$$

Letting s_1, and S_2 be the distances passed through by points on the circumferences, β_1 and β_2, the angles swept through by a radius of M and N, respectively, then

$$\frac{W_2}{W_1} = \frac{\frac{d\beta_2}{dt}}{\frac{d\beta_1}{dt}} = \frac{rd\beta_2}{rd\beta_1} = \frac{ds_2}{ds_1}.$$

Since $\frac{W_2}{W_1} = \frac{dy}{dx}$, we see that the distances passed through by a point on the circumference of N, namely, S_2, is equal to y, and it follows that

$$S_2 = y = \frac{1}{K}\int zdx = \frac{1}{K}\int F(x)\,dx$$

That is, y measures the integral or area bounded by the X-axis, the curve O'S, and the ordinate under R, and to obtain an integraph or recording machine it is only necessary to work out a device that will record this circumferential distance as an ordinate on the paper over which the machine rolls.

The mechanical principles involved in the diagramatic machine of Figure 4 also lie at the basis of the completely designed machine shown in Figures 5 and 6. The integral curve of the curve drawn as $z = F(x)$ is desired. The battery of rollers whose axes all lie in a horizontal plane will be readily recognized in M, N, 1, and 2. The rollers with their axes in the vertical plane which determines the axis of rotation are indicated by 3, 4, and 5, the latter being hidden by the sphere in Figure 6. The bar O S, whose angle with the X-axis determines the rate of rotation of N rests at an end upon the roller pivot S, the roller and the tracing point P_1 being fastened to a bar, which in turn is a part of the carriage C_1. The machine rests upon the three wheels R_1, R_2, and R_3, of which the former, besides serving as a support, imparts rotation to M.

Since the machine moves in the X direction, the direction of rotation of N as shown in Figure 6 may be traced. M is fastened to the same shaft with B; the latter in turn imparts motion to the integrating carriage C_2 by means of a continuous cord, or fine wire. In this way the pencil point P_2, traces the desired integral curve. Were the second integral curve of F (x) desired, that is $\int\int F(x)\,dx$, it could be obtained by an extension of the same principles to a machine with two spheres. The integrating carriage C_2 would then have to serve also as the carrier for the new pivot S for the bar of the second sphere and such a machine would require a third carriage. It obviously would draw the first and second integral curves simultaneously. While the machine described has not yet been actually built, its design has been carried out in detail. As a piece of scientific apparatus its cost should not be excessive.

ALUMNI LETTERS

TEN YEARS OUT

A. J. SOREM, e '06
Electrical Engineer, Ft. Wayne Electric Works, Ft. Wayne, Ind.

FACTORS OF SUCCESS

A well known engineer once stated that "Education may be defined as a means of gradual emancipation from the thralldom of incompetence." Everyone is desirous of escaping from a state of bondage, and the degree of competency attained is, in the final analysis, a measure of that person's education.

Education may be obtained by unaided individual effort. In the large majority of cases, the opportunities for this "emancipation" are furnished in our grade schools, colleges and universities.

A man seeking an engineering education does so, unless he is of independent means, with the primary object in view of obtaining a financial compensation for his service. In rendering this service he has the satisfaction of knowing that he is a self supporting member of society, instead of a burden on it. And this utilitarian education does not preclude his ability to serve society in channels other than those for which he has peculiarly fitted himself. A prominent business man once remarked that for accuracy of judgment, keenness for detail, ability carefully to estimate limitations and advantages, the engineer, because of his training accurately to gauge, weigh and test a proposition, was, in his opinion, the best mentally equipped professional man.

In the mental makeup of an engineer there are certain qualities which are absolutely essential, and others which it is desirable to acquire in order to obtain even a modicum of success in life. Time and space will not permit a lengthy discussion of this subject, so a brief mention only will be made of some of the factors of success, the foundations for which are laid in the classroom. The first of these is character. Character is what one is. Reputation is what one is thought to be. A man's character, being himself, must be moulded by himself alone. It enables him to resist temptation, to achieve, to endure. It begets determination, forcefulness, foresight, reason, and a mastery of self. The second is personality. It "is that which constitutes distinction of person." A man of high character possesses a strong personality. The essentials of a pleasing and engaging personality are self-sacrifice, prudence, judgment, diplomacy, and tact. Personality is an attribute worth cultivating for it brings big percentage of return on the investment. The third is knowledge. "A little learning is a dangerous thing," and is nowhere more dangerous than in the engineering profession. The mistakes of an engineer proclaim his incompetence. To an engineering student a thorough knowledge of fundamentals is essential, and with a few years of practical application of theory, he should become a good engineer. The fourth is thoroughness. Emphasis should be placed on the manner in which an assigned duty is performed. Results are measured in dollars and cents, and the successful completion of an engineering design is what an employer expects, demands, and should receive. A proposition should be carefully analyzed from all angles, so that the engineer *knows* that he is right. Precision is usually possible since the engineer is dealing with fixed laws and forces. Conscientious application and devotion to duty make for thoroughness. The fifth is an effective use of speech. The ability to express one's self clearly, concisely and comprehensively is a valuable asset. Mere verbiage is a handicap. A good working knowledge of syntax, and a well stocked vocabulary, together with ease of presentation usually commands ready attention. The last is integrity. An engineer is always and everywhere a truth-seeker and truth tester. Men in other professions may play false with more or less impunity. The engineer must be thoroughly honest, both with himself and his employers or clients. "The evil (or poor work) that men do lives after them," is particularly applicable to an engineer. The honest student does not write on his cuff, borrow data which should have been obtained in the laboratory, or shirks the work of an assignment in the classroom. The honest engineer does not guess at results, does not misrepresent facts for personal gain, does not shirk responsibility. He is always square in his undertakings, loyal, upright and honorable.

To the above can be added reliability, punctuality and perseverance. Success in life in the true sense is entirely of one's own making, depends upon one's individual effort and can be obtained by a conscientious striving to reach the ultimate goal which is the personification of all the above qualities.

NINE YEARS OUT

CARL ZAPFFE, g '07, m s '08
Geologist, North-Western Improvement Co., Brainerd, Minn.

BUSINESS PREPARATION FOR THE ENGINEER

Your letter requests a statement from me as to experience, advice, and observations. Experiences are easy to relate and may prove interesting to a group of readers; advice is less interesting, for it can hardly be other than a statement how these experiences might have resulted more beneficially and how the benefits might have been obtained more easily had my preparation been different; the value, to the reader (of my observations) will necessarily be limited by the maxim "if the shoe fits, wear it."

Ever since my graduation my official title with my employers has been geologist. Most of the time I have been obliged to perform duties entirely foreign to geology, and I have also engaged in some equally foreign enterprises. Some of these duties or enterprises were related to engineering and some were not. I have concluded that engineering and geology together make a strong and valuable combination. Professionally considered, the title geological engineer would be more descriptive of my work.

My experiences proved to me the value of my pre-college training in business, a training impossible for a student in engineering to obtain in my college days. Engineering skill alone will not lead to success, if good business methods are not also applied along with it. I believe every student in engineering should receive, or have previously obtained, some training in business administration, for he will then be enabled more easily and properly to surmount the many and usual obstacles which invariably confront the youthful graduate. I also believe in longer courses and broader education because the graduate will then be better enabled to determine whether or not he is about to pursue labors in a field to which he is adapted, or enable him to adapt himself more easily to whatever task or employment is presented, whether immediately upon graduation or later in life.

Every man owes a duty to his community, and every community needs an engineer. Engineers, and geologists as well, are well qualified by their training to serve their community by taking active part as active citizens as well as professional advisers. I do not mean that the engineer should or need meddle as a politician, but he can prove very valuable as a member of school boards or public utility boards.

I have taken active part in the affairs of my city, a city of 10,000 people, first, in inducing and in helping the building of a strong commercial organization, later, as a member of our city charter commission, in introducing and arranging for a new charter providing for the city-manager plan of government. It devolved upon me to lead the fight for this new charter against much opposition (and suspicion); twice have the voters of the city rejected that charter, but the campaigns were not without some compensation for they have enlightened the public and I daily see things shaping themselves that indicate that such a form of government will soon be adopted here. Engineers will find in the present rapid adoption of this form of government a splendid field for employment. The city manager is and must be an engineer, and a successful one. Some universities already have courses of training for engineers desiring to enter that field. It is a practical demonstration of the necessity of a broad education and of business training for engineers.

Recently I became a member and chairman of our Water and Light Board. Our city controls its own electric power plant and water supply. Just now the board is preparing for a new water supply by drilling and testing a series of wells, and is planning a new distribution system. This work is being done under my guidance. I find the subject of water-supply a very interesting one, and my training in chemistry and in geology has proved useful and valuable.

In geological work I have studied the mysteries of the mineral deposits in many places along the Northern Pacific Railway system, from Lake Superior to the Pacific ocean, but my principal work has been the development and mining of iron ore near Brainerd, in the Cuyuna district of central Minnesota. When I first came here in 1906 just a few drills were in operation and no mines opened; this year twenty-five mines will ship ore. The railway company, which I, as geologist, represent in the Cuyuna district, is the largest owner of ore deposits and has spent several million dollars in the development of the district and several more millions acquiring equipment. The supervision of this work keeps me very busy and compels me to perform the greatest variety of work, which if to perform had required special courses at school would still have me in attendance there. The other ventures mentioned are merely incidental to my work for the railway company.

EIGHT YEARS OUT

J. H. THICKENS, ch. '08, ch e '12
General Superintendent, Pulp and Paper Division, Bathurst Lumber Co., Bathurst, N. B., Canada

ESSENTIALS OF COMMERCIAL SUCCESS

The request which has come to me to write something of my observations and experience during the eight years which have passed since graduation, gives me a great deal of pleasure.

I am anxious to let the undergraduates know what in my experience goes to make for the success or failure of the men going into commercial work.

One of the first things which I noted in myself was the lack of initiative and confidence in my own ability, and this has since been brought to my attention many times in watching the college men who have been in my employ. There seems to be a lack of initiative among young engineers, which I have not noted in men who have obtained their knowledge in the school of practical experience. I believe this to be one of the first causes of failure, and one which should be most carefully guarded against at all times.

The college men who have worked under me in different capacities, I have found lacked, in almost every instance, the ability to write good reports, and they very seldom had any knowledge whatsoever of costs and business practices. In my opinion engineers would be worth a great deal more if they would take more interest in courses in English, Economics, and Commercial Law, than they do.

Another thing which I would advise undergraduates to do is to take more interest in experimental work. I have found that the training I secured in carrying on research after leaving the university has been of far more value to me than any other one thing in my experience. No matter what line of experimental research is undertaken, the training can be applied later to commercial problems. The careful analysis of a problem is usually about sixty per cent of its correct solution. Learning how to attack a difficult piece of work is almost identical with carrying the work to a satisfactory conclusion.

My experience has been almost entirely in the application of engineering to manufacturing and sales problems, and I firmly believe that any graduate engineer is sure of success in this branch of engineering if he is willing to start at the bottom, to develop initiative, and analytical mind and support these with a careful and painstaking study of the economics of the business in which he is engaged.

Our company employs in its pulp and paper work approximately four hundred men. We do all of our own engineering work and during the past year have completed a new 2500 horse power boiler house, a 1500 foot wharf, a chemical recovery plant, a diffuser plant, and a coal storage and handling equipment to the value of approximately six hundred thousand dollars.

We have had a number of engineers on this work, all young men and recent graduates, but I am sorry to say they all seemed to believe that "distant pastures are greener" and left for ten or twenty dollars per month more salary.

This is another failing which I would advise all young men to guard against.

SEVEN YEARS OUT

P. H. Johnson, e '09
Sales Engineer, Cutler–Hammer Mfg. Co., Boston, Mass.

MOTOR CONTROL EDUCATION

The past few years have seen a wider and wider application of motors for industrial use and it is little understood that a great variety of applications have been made possible only by an equal development in the motor-controller. The earlier forms of controllers had their limitations as to horse power capacity which could be safely and conveniently handled and it was not until the magnet switch was brought out that motors of large horse power were common in the industrial field. The efficiency of the magnet switch is responsible for the efficiency we have today in automatic motor control and in the now commonly used "clapper" type, including the "lockout" switch for accelerating purpcses. We have the most reliable and satisfactory form for motor control. Magnet switch control has demonstrated also that it is in many cases the most efficient method of controlling motors of comparatively small horse power. These unit switches are assembled into different forms of controllers depending upon the motor application and provide means for starting, stopping, controlling the speed of motors, to protect the motors and supply lines against heavy currents and also to protect the operators and machinery driven against mechanical and electrical injury.

The controller engineer comes in contact with all forms of machinery and practically every field of industry and probably requires a more general knowledge of the sciences than any other man. He must know the characteristics of such machines as fans, compressors, pumps, machine tools, printing presses, elevators, cranes, textile, rubber and paper machinery, etcetera, and as well the characteristics of the various motors applicable whether they be series, shunt, compound, squirrel cage, slip-ring or synchronous. He must understand also the operation and characteristics of generators, storage batteries, transformers, transmission lines and meters. A thorough working knowledge of all these elements is necessary for the successful application of a motor controller.

The successful operation of any electrically driven machine depends upon the proper combining of all its component parts. The behavior and service will be largely dependent on the form of control used. The motor controller is one of the devices which should receive more attention in the technical schools and as one who has been in the motor control field since graduation. I wish to make the appeal here that this branch of electrical engineering be given increased consideration.

SIX YEARS OUT

G. O. PLAMONDON, c '10
Designer, Trussed Concrete Steel Co., Youngstown, Ohio

ONE VIEW OF GOVERNMENT POSITIONS

Many a young man starting out in life views the engineer in government service with envy because the latter appears to enjoy a particularly easy life. It seems to be a view quite generally held. Even though the position is under civil service, it is regarded as something "soft" and the salary received in the nature of a pension.

Announcements of government positions are brought before the public in the form of large bulletins which announce the examinations in a carefully worded form to attract qualified men. At this state of the matter the probable advantages of a certain position overshadow the disadvantages. The latter phase of the matter does not forcibly appear to the individual until the matter has progressed to such a state that other means of success seem to be closed. Examinations are repeated twice each year to secure the necessary number of eligibles. The men occupy these positions temporarily as eligibles, but wave appointment when they discover that the positions are not as they were represented in the bulletins.

If successful in examination, one's name is placed on the eligible list and when a vacancy occurs, the three highest men are submitted for the appointment. If one accepts the salary offered he is then sworn in and given a probationary period of six months. In the book of rules and regulations of the department one will find certain rights accorded to the outside employee are denied to the government employee. One cannot take part in politics or discuss, in public, subjects which the government may be concerned with, even in a remote way.

Officials often conceive it to be their duty to issue many orders and surround themselves with intricate systems of procedure. Trivialities are unduly emphasized. The work may be highly specialized without allowing the use of discretion; one is compelled to act according to precedent and within the narrow limits given him. No matter how bright a man may get into a rut by being assigned to uninteresting or uncongenial work. There are many departments that are blind alleys.

The government service likewise has its advantages, which I have not attempted to touch upon, believing that they are much better understood by the average reader. If anything, I believe that they are over-emphasized as the drawbacks seldom appear side-by-side with the advantages.

FIVE YEARS OUT

JOHN A. HOEVELER, e '11
Wisconsin Industrial Commission, Madison, Wis.

SELECTION OF LIFE WORK

It is difficult for a man only five years out to advise younger men because he hardly has had time to gain prestige enough to make his words carry weight in the minds of others, but he can give the plan he has started to pursue to arrive at a realization of his ambition.

Every student of engineering takes a fancy to some special branch of engineering practice. Some particular subject appeals to him more than others. In my opinion he should by all means indulge his fancy and go to work with a company specializing in that branch of engineering. If a man can make his work his hobby, he is sure of a great measure of success.

Personally, I was bitten by the "lightning bug", and as a result I took up illuminating engineering work and stuck to it. Illuminating engineering today offers big opportunity for the technical man. There are all too few practicing illuminating engineers. Manufacturers and business men are waking up to a realization of the value of proper lighting in reducing accidents and increasing plant efficiency. Because of the lack of the services of an illuminating engineer to guide them in the choice of proper lighting equipment, a great deal of money and effort toward securing better lighting is misdirected.

FOUR YEARS OUT

C. T. Wiskosil, c '12, c e '13
Instructor in Civil Engineering, University of California. Berkeley, Cal.

ENGLISH AND THE ENGINEER

The relation of English to the engineer has been mentioned in a few of the alumni letters, but I might lose an excellent opportunity to help someone realize his own possibilities in this matter if I failed to emphasize the subject of English in my letter.

The engineer will be a leader in this new age. He must direct the labors of other men and to do it effectively he must express himself in terms that they will understand. But to attain his purpose he must first be keenly aware of the importance of the ability to write well. An accurate knowledge of language is essential in every part of the engineer's work. In technical writing, which is the precise expression of technical knowledge, it is worth his while to use words with exactness and develop ideas logically. And it is necessary to write, for until an engineer accomplishes some great work he is known only by his reports and technical papers.

While the engineer is, presumably, an educated man he shows no regard for his most useful tool—good English. He bungles language badly. Some engineers cannot write enough good English to keep an accurate daily record. Today the man of science, particularly the engineer, is among the few who has something to say and do not know how to say it. He makes a fetich of efficiency and writes articles on the subject in ineffective language. And notwithstanding the importance of clearness, it is not uncommon to see articles so badly and awkwardly expressed that they fail to carry conviction and often defeat their purpose.

It has been said that little culture characterizes the engineer. There is a reason for it. His taste is spoiled by reading the daily newspapers and his contact with uneducated men produces careless speech and slovenly writing. The use of slang beggars his vocabulary and slovenly habits corrode the very substance of his thought. Is it any wonder that he cannot write well?

The engineer himself is largely to blame for his lack of knowledge of the use of English. A comprehension of grammar is within the range of hsi learning, while his proficiency in the use of language, by which he will always be judged, depends upon the persistence of his own efforts and study. He should stimulate his thoughts by reading classic literature daily and to attain clearness in writing he should write carefully and systematically. He should use words that must, not can be understood.

THREE YEARS OUT

L. L. Lowry, c '14
City Engineer, Cresco, Iowa

COUNTY SURVEYING WORK

With the temperature staying around 20 to 30 degrees below "nothing," I have "nothing to do" until Spring.

There is not a great amount of engineering work in a city the size of Cresco, Iowa (population about 3,300), so, in order to keep busy, I mix into all the engineering work around this county.

During the last season we laid a good deal of two-course concrete paving in Cresco, and prospects are good for more next season.

As deputy county engineer I have been on considerable road and bridge work. Last summer we built 110 concrete culverts, six concrete bridges with spans from sixteen to fifty feet, and rebuilt about fifty wood pile bridges, all by day labor. That's pretty tough on the bridge contractors. Paved country roads are a long way ahead of us at present; gravel road construction is the best we can aspire to for a few years.

In private surveying I rather enjoy acting as judge, jury and all, in attempting to settle property line disputes among the farmers.

A short time ago this county let the contracts for a drainage job for which I prepared the reports and estimates, and which I will have charge of next season. This job consists of draining about 3000 acres of very wet land, the main drain will consist of about 17,000 feet of tile from eight to twenty-six inches in diameter. As this is Howard County Drainage District No. 2, you can see that we are young in the drainage business.

TWO YEARS OUT

H. A. Cobaugh, c '14
Engineer, Field Mining and Milling Co., Scales Mound, Ill.

A COLLEGE MAN IN THE FIELD

After three years in the engineering field, I have received certain impressions which I believe will be of value to men who are about to leave school. The thought that has most impressed itself on me is this, a man is a man, not because of his education, but of the manner in which he applies that education. You will find that many of the studies which are given you in school will never find an application in the field. On the other hand, however, you will find that the training you received in them will be beneficial in that they give you the foundation to solve many other problems and study in an intelligent manner. You will find, as I have found, that your study and your efforts may not have an immediate outlet, but it is well to remember that nothing is lost, so long as one is applying himself in the right direction.

As a general point of advice, I might say, a man who will study, apply himself in his work in a whole hearted manner and make the proper friends is bound to go ahead in this competition of the engineering field.

ONE YEAR OUT

W. C. Raube, e '15
General Electric Co., Schenectady, N. Y.

INITIATIVE

Some time about the last of July, 1915, "Jack" Reed and myself sallied forth from Milwaukee in high spirits to seek our livelihood in the East. Everything was great until Jack left me in Schenectady and continued his journey to Elizabeth, N. J.

My troubles began the minute I landed in this place. I had been accustomed to certain standards of living which I soon found were quite a little in advance of my salary. Consequently, my first great task was to readjust myself to standards within my means. As soon as I had successfully solved this mystery by locating the lunches where I could get the most for two bits, or get a $2.20 meal ticket for $2.00, I turned more attention to my work.

I started here as a testman with the General Electric Company and found that I still had a lot to learn about electricity. Each day brought up new points, and the longer I stayed the less I thought I knew about my subject. I did not even have enough brains to be discouraged, so I stuck at it until I became able to persuade a couple of the engineers that I was good enough to be taken into the engineering department.

In getting to the position that I now hold, I have been convinced of one thing. A person, in getting ahead, especially in a large corporation such as this company, should not be too modest about his ability. Competition is too keen, and unless one exerts himself a little to advance he is very apt to be lost in the organization and greatly hampered in his advancement.

I take this opportunity to send greetings to all of my old time associates.

JUST OUT

H. W. Tabor, c '16

United States Reclamation Service, St. Ignatius, Mont.

EARLY IMPRESSIONS

While many of the readers of the Wisconsin Engineer are digging in their books I am working on ditch location, making it possible for others to dig in the ground next spring. Our work is of an irrigating nature and we lay out a main ditch and a lateral system to reach the different farm units below the main canal.

Much of the work is different from that given at the university. The only definite relation between the two is the calculations of the capacity of the canal. The main canals are put on economic location, so called, because the excavation will equal the fill. In lateral location there are other points to consider. Laterals must deliver the water to the highest possible point of the farm unit. We place the ditch as near the property line as possible to save cutting up the unit. Often we must calculate whether it is worth while to run a canal to a certain spot; in this the cost of construction is balanced against the number of acres that will be benefited.

Tact is most useful in this work. We often come to a place where the farmer wants water delivered on his place but raises a row if we cross his land to reach the man below him. Sometimes he would place the canal in some impossible location and must be persuaded out of this determination to keep peace in the community.

We get some amusement along with our work. The other morning we found a coyote asleep in a straw stack and sent our dog after him. Bill caught him after the coyote had collided with a fence. Then we decided that we should be on hand and took out across the fields to the scene of action. It was of no avail for when near enough we were so winded that we were unable to throw ourselves upon the beast. The dog and the coyote were also winded but the coyote got his wind first.

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CO-OPERATE WITH THE ENGINEERING FACULTY

There is always a certain percentage of students, who like a certain percentage of all other classes, are always grumbling about something. This type of fellow is always telling how this Professor failed to give him the square deal, or how that Professor had it in for him.

If one will just stop to think of his acquaintances among the students, he will have to admit that those who complain most are the very ones who get their assignments in late, or not at all, and do the least to deserve a square deal.

The fellow who complains most, and does the least on the job, is always the first to be fired, and the first to be laid off in a dull time. Better get over the habit of finding fault; it is sure to bring disaster upon you if continued after college days are over because the world is less lenient than are the faculty members. Do your own part and you won't have occasion to complain.

—J. M. W.

* * *

LOYALTY

With the closing of the 1917 Intercollege basketball season, one very prominent fact was evident. There is a decided lack of interest on the part of the engineering students as a whole as to the position occupied by the Engineering College in athletics. It is time for the majority of us to realize that a few men can not do all there is to be done to uphold the College in athletics. But such appears to be the state of affairs at present. In the fall, a call for football candidates was issued. What was the result? Just enough men responded to compose a team to represent the school. There was little competition for a position on the team. Yet in this College are men of good football reputation who, when this call was issued, failed to answer. The basketball season just closing added further evidence to the fact that there is a lack of loyalty for the College. How can the engineers ever expect to win Intercollegiate events when so few show an interest in the matter. Of what good is the participation in these games to the representative of his college? Probably one of the first questions asked regarding a prospective employe is ,"What has he done?" The man who can show a fair grade in scholastic work along with record of an athletic nature stands a much better chance for the position than he who confines his attentions to his studies alone. All of us are not of an athletic tendency but we can help by arousing the interest of those who are, and by encouraging them to answer the call to represent the College. The track and baseball seasons are still before us and it is the duty of each and every one of us to see that our College is represented to the best advantage in both of these events. Let us give a little more evidence of that "pep" for which the Engineers have always been noted.

* * *

THE TECHNICAL MAN IN THE PRESENT CRISIS

There comes a time in the life of every individual when a second thought is absolutely necessary. Such a time appears to be crowding down upon many of us at the present and we do not know when or how we may be called upon to render our best services to our country. Are we, who have had the privilege of the benefits of a technical education, to rush forward at the first call for men for the firing line? Can we serve our country to the best of our ability and is there no place that we might better serve, than on the firing line? A few moments' reflection as to the probable results of such action on the part of the technical men of the country, is far from pleasing. Should such a general action on the part of the mechanics and technical men take place, we, in the United States would find ourselves in a short period of time in a similar position to that occupied by Great Britain at the present time. However, it is to be earnestly hoped that such an action, which would result in the loss of the technical men to the country, shall never occur. Can not the man who has not been able to have the benefits of a technical training, shoulder the gun as well as he who has had a technical training? Without a question they both have the same chance. Could the untrained man hope to compete with the trained one when it comes to a question where a technical knowledge is essential to a successful solution of the problem? We speak of our army and navy and the increase in both branches of the service, but do we stop to consider what the cost is going to be to keep this vast number of men in the field? Our industries will have to be managed as never before, our resources will be taxed to the utmost and to best meet these demands, we will have to be able to call upon those, who are best fitted to handle the various undertakings. In this manner a technical man may find his place at the head of a munitions factory supplying the man in the field with the necessary punch for the "mailed fist." And he would be serving his country to the best of his ability.

LORA WALTER MILLER

April 27, 1883–January 27, 1917

Injuries received in a fall from an overhead bridge resulted in the death of L. W. Miller, c '10, on January 27, 1917. The deceased was born at Plevona, Indiana, on April 27, 1883, and lived in that community during most of his childhood. He graduated from the Anderson, Indiana, high school in 1902 and from Indiana University with an A. B. degree in 1907. During the following year he worked with James Stewart and Co. of New Orleans, Louisiana, and the C. L. Gray Construction Co. of Memphis, Tennessee. In September, 1908, he entered the University of Wisconsin and received the B. S. degree in 1910. Except for six months of work with the National Bridge Co. of Indianapolis, he worked continuously for the Chicago and Western Indiana Railroad from the summer of 1910 until his death. After a year of work for the railroad he became assistant engineer in charge of the company forces on the South Chicago track elevation. The construction of the one hundred and seventy miles of track of the Clearing gravity switching yard was under his direct supervision from March, 1913, until August, 1915. His work included much field and office engineering. After completing this undertaking he was put in charge of the 83rd Street track elevation. Both passenger and freight traffic continued uninterrupted during the progress of the work, making its accomplishment especially difficult. He held this position until he met with the accident leading to his death.

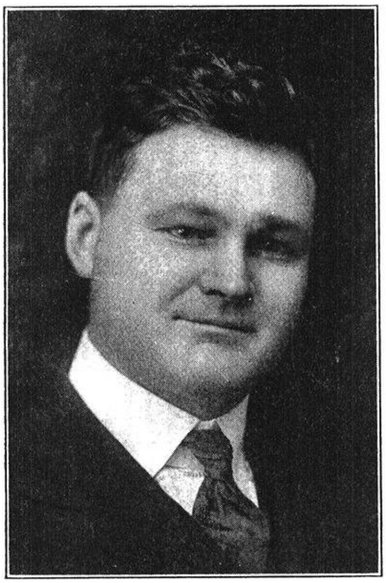
Less than five months before his death he married Miss Flora Traylor of Jaspar, Indiana.

The words of one of his chief engineers illustrate his character: "Mr. Miller was absolutely honest in all his business transactions. He had a genius for handling a large amount of detail and his personality, together with the high grade of his work, influenced and inspired the men under him."

SUCCESSFUL WISCONSIN ENGINEERS

C. M. LARSON, c '05, c e '09

A natural aptitude for engineering, together with a thorough university training, have made of C. M. Larson, c '05, Chief Engineer for the Joint Engineering Staff of the Wisconsin Tax Commission and Railroad Commission, an engineer of national importance.



Mr. Larson was born near Prairie du Chien, Wisconsin, on April 10, 1874. When he was but three years of age, his parents moved to Bridgewater, South Dakota, where he lived until he graduated from the public schools in 1892. After a year of preparatory work at Dakota University, he entered the University of Washington, Seattle. He graduated with an A. B. degree in 1899 but took a year of post-graduate work. His interest in engineering led him to enter the University of Wisconsin in the fall of 1900. After completing three years of work he dropped the course from 1903 to 1904 to accept the position of assistant inspector involving the original valuation of all steam railroads in Wisconsin. When this work was finished he re-entered the University, receiving the degree of B. S. in civil engineering in February, 1905.

Mr. Larson's experiences have been many and varied. From February, 1905, to August of the same year, he was engaged in laying out a narrow gauge railroad at Mexico City, Mexico.

During the next few months he acted as chief engineer for the Cordoba and Huatusco Railroad, but as Mexican methods were not to his liking, he returned to the United States and commenced his work for the Wisconsin Tax and Railroad Commission as assistant chief engineer. Except for a period of two years (1909–1911) during which he was Real Estate engineer for the Chicago and Alton, and Toledo, St. Louis, and Western Railroad, Mr. Larson has been with the Commission continuously. In April, 1913, he received his promotion to chief engineer.

The department, of which he has charge, has a variety of duties, chief among which are:

Valuation and revaluation each year of all steam and electric railways in the state.

Inspection of service rendered by steam and electric railways, and by gas, water, telephone, and electric plants.

Inspection of tracks, bridges, block signals, interlocking plants, equipment, etc., relating to the safety of operation of trains, both steam and electric.

Investigation of dangerous highway crossings and approval of plans for their protection.

BOOK REVIEWS.

Bridge Engineering, by J. A. L. Waddell, C. E., LL. D., Consulting Bridge Engineer. Two volumes, $8.00, pp. 2177, New York. John Wiley & Sons.

One of the most important works on engineering which has appeared during the past year is the two-volume treatise on bridge engineering by Dr. J. A. L. Waddell, the well-known consulting bridge engineer. This work represents the long professional practice of Dr. Waddell and several years of the author's spare time in the preparation of material for the book. It is not intended as a text book for students; neither is it a mere compilation of data from the results of the author's experience. It is a thoroughly scientific and rational treatise on the broad subject of bridge engineering, based on the author's extensive study and practice. Dr. Waddell has always been very active in the promotion of study and experimental research in his line of work, and has in the past made many valuable contributions to the literature of bridge engineering. In the present work he has presented in a revised form the most valuable material heretofore published, and added a great amount of new matter, so that, as the author states in the preface, it may be considered as "the greatest and most important work of his entire professional career."

Not the least interesting feature of the work, especially to the engineering student, is the entertaining and informal style of the author. Dr. Waddell has always taken a great interest in the work of engineering students, and it is evident that in the preparation of this book he has had in mind very largely the needs of the student and the young engineer in practice. To the latter the work will be of especial value, although it will also be a very valuable addition to the library of the engineer of experience.

Among the general topics discussed are the following: History of Bridge Engineering; Materials Used in Bridge Construction; Theory of Stresses; Fundamental Principles of Designing; Details of Design of Various Kinds of Bridges, including Elevated Railroads, Trestles, Arches, etc.; Movable Bridges of Various Kinds; Reinforced Concrete Bridges; Foundations; Aesthetics of Design; Weights and Quantities; Office Practice; Contracts and Specifications; and Engineering Ethics. It is seen, from this list, that many subjects are treated which ordinarily are not included in works on bridge engineering, which fact makes the work of much more general value than would otherwise be the case.

The work is profusely illustrated with cuts of details, diagrams of quantities, and other illustrations. It is a work which the young engineer who expects to devote himself to structural engineering should purchase at his first opportunity.

CAMPUS NOTES

The University of Wisconsin Standards Laboratory exhibited, at a recent meeting of the Wisconsin Electrical Association, a complete set of meter testing and standardizing apparatus, and the mode of operation of which was demonstrated by members of the staff. The service meters were compared with a secondary portable standard watthour meter, which in turn was compared with a primary standard meter, which in turn was checked against a potentiometer and standard cell.

The Laboratory also exhibited a number of current transformers; a discussion of their merits in regard to ratio and phase angle were taken up with the operating men.

The Standards Laboratory in addition to standardizing electrical measuring instruments is in position to make precise photometric tests and to conduct a certain amount of special testing.

Mr. H. J. Ludden is conducting an investigation of the effect of stray fields upon the performance of watt-hour meters. Very little work has been done upon this problem so that the work of Mr. Ludden will be watched with great interest.

Mr. A. W. Gower is making a study of the dialectric strength, the permittivity, the resistance and dialectric loss of a number of oils which have been developed by the Forest Products Laboratory, Madison.

Mr. H. F. Weiss, who has been Director of the Forest Products Laboratory for a number of years, recently resigned to become associated with the C. F. Burgess Laboratories, where he will have charge of a department devoted to research in the field of Forest Products.

The present great industrial activity has created an active demand for engineering graduates. Representatives of the companies listed below have recently called to confer with men of the Senior Class in regard to employment upon graduation: General Electric Company, Fort Wayne and Schenectady Works, The Mechanical Appliance Company, Milwaukee; The National Lamp Work, Cleveland; Western Electric Company, Chicago; American Telephone and Telegraph Company; Northwestern Group of Bell Telephone System; Commonwealth–Edison Company, Chicago.

The Committee on "Relations with Educational Institutions" of the National Electric Light Association has made arrangements whereby undergraduate engineering students may obtain profitable summer employment with a number of Public Utilities Companies, such as The Milwaukee Electric Railway and Light Company, Commonwealth–Edison Company, Chicago. This summer work will no doubt prove very beneficial to the student by giving to him broader viewpoint and a sound practical knowledge of operating conditions.

The disturbances produced in a telephone by a paralleling transmission line are often very serious, the magnitude of the interference depends upon a number of factors, one of the more important of these being the wave form of the transmission line current. A device for determining the noise making ability of a current of a given wave form has been constructed here by Messrs. Dodge and Goff, a modification of a device for a similar purpose developed by the American Telephone and Telegraph Co. The instrument consists essentially of a micro-ammeter and a number of oscillatory circuits, the constants of which are so adjusted that the harmonic components of the supplied potential are weighted in accordance with the sensibility of the ear for them.

To determine the noise making ability of a given alternator, it is merely necessary to connect the "noise meter" to the machine, through a suitable transformer, the micro-ammeter of the "noise meter" will then read directly in noise units, upon an arbitrary scale.

The Standards Laboratory has recently constructed a very accurate timing device for use in precise watt-hour meter testing. This is a modification of a somewhat similar device developed by the Bureau of Standards. The apparatus consists of a very carefully constructed, electrically driven tuning fork, which vibrates at a frequency of twenty per second, and controls an electrically operated counting device.

The two large engines and generators which have so long occupied a position on the first floor of the Dynamo Laboratory are to be removed and a fifty K. W. three phase motor-generator set installed to supply the Laboratory with direct current. A sixty K. W. transformer will be installed to supply the Laboratory with alternating current. The electric furnaces in the Thermal-Chemistry Laboratory will be supplied from a separate 75 K. W. transformer. The removal of the engines and generators will increase the available floor space of the Dynamo Laboratory by about thirty per cent.

Mr. Francis A. Vaughn delivered a lecture to the engineering students, March 4, on "Illuminating Engineering." Mr. Vaughn showed some of the beautiful effects obtainable in installations where the size, position and type of each lighting unit had been carefully predetermined. The beautiful, even illumination resulting offered a striking contrast to the glaring, garish effect so commonly seen.

The first annual banquet of the student section of the American Society of Mechanical Engineers took place at the University Club, March 26th. Mr. Calvin W. Rice, national secretary of the A. S. M. E., was the guest of honor. Mr. Rice, at one time the occupant of an important position in the engineering department of the General Electric Co., is a graduate of the Massachusetts Institute of Technology, '90. His message was very timely and enjoyed by all present. Dean Turneaure, Professor Callan, Professor Larson and President Ashur Kelty, of the student section, were also on the program. The famous A. S. M. E. "jass" orchestra was also much there.

Another fraternity makes its bow to the Greek letter circle. A chapter of Theta Xi, national fraternity, has been granted to the Engineer's Lodge. This chapter comprises men enrolled in the College of Engineering, in the electrical, mechanical, civil and chemical courses.

Rho Alpha Chi, an 'cnorary fraternity, has several prominent men of the College of Engineering among its members. "Cub" Buck, of football fame; "Jim" Wall, manager of the University Circus, and several others of note from our college. Students enrolled in the Colleges of Medicine, Letters and Science, Agriculture, Commerce and Law are also "brothers."

The Theta chapter of Eta Kappa Nu gave their annual dance at Lathrop parlors March 9, 1917. Many old "grads" attended the dance and enjoyed the evening.

The Wisconsin chapter of the A. S. M. E. held one of their famous meetings at "Crcnin's" on March 11, 1917. After the banquet Professor Larson, of the Steam and Gas Department, and Professor Corp, of the Hydraulics Department, spoke to those present.

The Engineers Club have adopted the plan of having a ten minute argument on some question of technical interest by two members of the club before the regular program.

Chi Gamma Rho, the Civil Engineers' fraternity, gave a smoker and mixer to the Junior and Senior Civils at the Woman's Building, February 23, 1917. Later in the evening Professor D. W. Mead spoke to those assembled.

Great interest has been aroused in Commercial Mechanical Engineering 103, as it is offered this semester. Professor Callan, who is conducting the course, has adopted the plan of having men, prominent in their respective lines of work, address the section. This plan has proven very satisfactory. Since the beginning of the semester Professor W. H. Kiekhcefer has lectured on the "Advantages of Eccnomics to Engineers." Professor Trumbower has lectured on "The Difficulties of Launching an Industrial Organization." Professor Kinne of the Structural Engineering department: Professor D. W. Meaa of the Hydraulic Engineering department and Mr. Jackson of the Wisccnsin Commission have also addressed the section.

Mr. E. A. Barnard, who succeeds Mr. Kennedy, instructor in mining and metallurgy, is a graduate of the University of Idaho, class of '11. Since graduation Mr. Barnard has been connected with the Anaconda Iron Mining Company located at Anaconda, Idaho. He has been active in the Testing Department of the "Washoe" smelter, the largest copper smelter in the world. He is on a temporary leave of absence and is here to act as instructor of mining and metallurgy.

Mr. L. B. McMillan, formerly instructor in Steam and Gas Engineering, was recently accorded honors in the junior membership of the A. S. M. E. His paper entitled "Heat Insulating Properties of Commercial Steam Pipe Coverings," won the junior prize for the year 1916. This prize is given each year by the society to the best paper submitted during the year, the prize consisting of fifty dollars and an engraved certificate. Mr. McMillan is now in the employ of the Johns-Manville Company and is located at the New York office.

A. B. Foeste and M. L. Margenau, Senior Electricals, are performing a series of interesting experiments on the wave forms of rotar currents. They are to redesign a wound rotar induction motor and provide a squirrel type rotar.

The Alpha chapter of Tau Beta Pi gave their annual dance at Lathrop parlors February 16. Mr. Walter Alexander, now a member of the Railroad Commission, and Mr. and Mrs. Kinney acted as chaperones.

S. C. Lawson and L. V. Nelson, Senior Engineers, are conducting a study of Wisconsin Zinc Ore. "Stew" has charge of the sulphuric acid leaching and "Les" has undertaken the electrilytic precipitation of the ore.

At a meeting of the Engineers Club, March 23, C. A. Pottinger, W. S. Wilder and S. Wise were elected to membership in the club. At the annual election of officers held on March 30, Charles R. Poe takes the place of Raymond E. Porter as President. Parry H. Paul and J. E. Newton were elected to the offices of Vice-President and Secretary, respectively.

A. S. Loevenhart, Professor of Pharmcology and Toxicology, gave an interesting talk to the Chemical Engineers Club, March 27, on the subject of "Poisons and Antidotes."

At the meeting of the Mining Club, April 2, A. F. Peterson gave a talk on the subject, "Surveying on the Gegobic," and C. A. Bachhuber spoke about "Experiences on the Border."

March 30, Mr. W. A. Rogers, Civil Engineer and Contractor of Chicago, spoke before the members of the Engineering College on the subject, "The Contractors' Superintendent." Mr. Rogers is President of the Bates and Rogers Construction Company of Chicago. He has been actively engaged in engineering work for a number of years. The approaches to the Chicago and Northwestern Railway terminals in Chicago and four of the Chicago, Milwaukee and Puget Sound Railway division terminals were built by this firm. They have also been engaged with engineering work in the Northwest, Idaho, Wisconsin and for the Government on the Ohio River. The lecture was illustrated and dealt quite largely with the training given to young engineers to fit them for the position of a superintendent. Mr. Rogers is an alumnus of Wisconsin, having graduated from this College in 1888 from the Civil Engineering Course.

Eta Kappa Nu, honorary electrical engineers' fraternity, announced the following elections at their last meeting: H. R. Hientzen, C. F. Kottler, C. A. Pottinger, C. Kalveledge, L. L. Call, J. M. Connolly and C. L. Schneider.

ALUMNI NOTES

Lloyd E. Davis, c '13, is doing general drafting work for the Morgan Engineering Company of Memphis, Tennessee. His business address is 610 Goodwin Street.

R. P. Decker, e '13, has left the General Electric Company of Schenectady, New York, and is now working as power engineer in the equipment engineering department of the Western Electric Company, 3939 North Paulina Street, Chicago, Illinois.

J. E. Dixon, m '00, has recently been made vice president of the Lima Locomotive Works, Inc., of New York City.

Announcement is made of the marriage on December 2, 1916, of Ann Josephine Magee and E. H. Omara, c '04. Mr. and Mrs. Omara will be at home after May first at 5839 Washington Blvd., Chicago.

J. W. Dohm, c '11, is doing private engineering work at Duluth. Mail addressed to either the Commercial Club Building or 400 West First Street will reach him.

H. S. Drew, e '14, has left the strictly engineering field and is now a traveling salesman for the George M. Clark Company of Chicago. When in Chicago his address is 179 N. Michigan Ave.

W. F. Duffy, c '84, is a civil engineer for the Pardee Company of Philadelphia. Until a short time ago he was the U. S. deputy surveyor for Colfax, Louisiana.

E. A. Ekern, e '03, is a hydro-electrical engineer for the Vaughan Engineering Company, 185 Devonshire Street, Boston, Massachusetts.

F. C. Ellis, e '15, is working for the Idaho Power Company of Boise, Idaho, as their commercial agent.

Work is progressing rapidly on the new alumni directory that is to be published this spring. Answers have been received from a majority of the letters sent out by Dean Turneaure and all those who have not sent in their replies are urged to do so at once.

Within the past year E. E. Engsbeerg, e '09, has been pro moted from telephone engineer to general superintendent of the Interurban Telephone Company of Waterloo, Wisconsin.

The last directory gives no information concerning E. M. Evans, '94, but we have recently learned that he is superintendent of the Holabird and Roche Company of Chicago. His business address is 104 S. Michigan Avenue.

R. C. Falconer, c '95, holds the responsible position of assistant chief engineer for the Erie Railroad.

R. N. Falge, e '16, has charge of the photometric laboratory of the National Lamp Works at Nela Park, East Cleveland, Ohio.

P. T. Fess, c '14, and C. B. Shafer, c '14, have gone into partnership under the name "Fess & Shaper." Their business home is at 123 East Doty Street, Madison, Wisconsin. They intend to do general contracting and engineering work.

E. A. Fretz, c '10, is doing civil engineering and estimating work for Horton and Horton, contractors. His address is box 916, Houston, Texas.

H. B. Gates, c '05, is the assistant engineer in charge of the subway construction work done by the Public Service Commission of New York City. His address is 143 West 40th Street.

O. F. Gayton, c '09, is a member of the firm of the Utilities Engineering Company, 1247 Webster Bldg., Chicago, Illinois.

G. H. Gray, E. E. '16, is an instructor in electrical engineering here at the university.

S. H. Gregory, m '13, has left the Illinois Maintenance Company and is now with the Commonwealth Edison Company of Chicago. His business address is 72 West Adams Street.

F. W. Greve, Jr., m '08, has been made assistant professor of hydraulic engineering at Purdue University.

E. W. Grimmer, c '14, is a U. S. drainage engineer at Jackson, Tennessee.

H. H. Scott, e '96, was president of the National Electric Light Association for the year of 1914–1915. He was recently elected president of the New York Alumni Association of Wisconsin University.

R. M. Connolly, c '16, is at present in the employ of the firm of Sloan, Huddle, Feustel and Freeman, consulting engineers, Madison.