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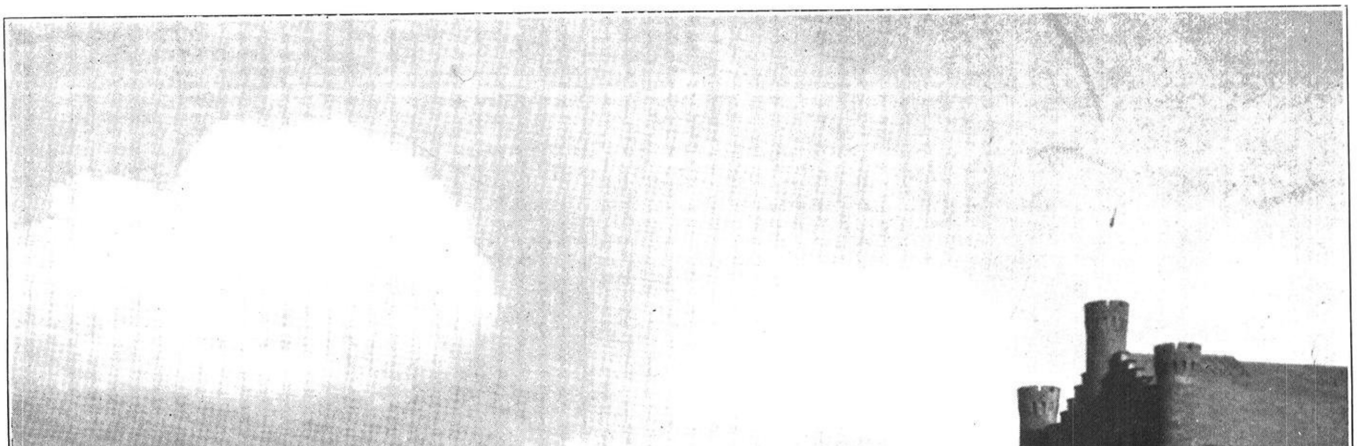

sting, and according to Eric Miller,

(Continued from Page 5)

3/20/23

Engineer Mag Presents Article on Chemistry

"The Importance of Colloid Chemistry to Industry" is the subject of an article found in the March issue of the Wisconsin Engineer, out today.

It was written especially for the Engineering College Magazines, Associated, of which the Wisconsin publication is a member, and is on a subject which is growing in interest at Wisconsin because of the presence at the university of Professor Theodore Svedberg, of the University of Upsala, who is an international authority on colloid chemistry.

This number also features an article by Charles H. Schwab on "How to Succeed in Business," written for the E. M. C. A. Clarence F. Rasmussen, '23 is the author of an article on papermaking which also appears in this issue.

2/6/23

ENGINEERING MAG TO FEATURE SCHWAB STORY

The Wisconsin Engineer for March will feature an article by Charles M. Schwab written especially for the magazines making up the group known as Engineering College Magazines, Associated.

This group, acting through one of the member publications, prevailed upon the famous engineer, executive, and financier to prepare for their thirty thousand readers. The article, it is stated, was written personally by Mr. Schwab.

"If you have any influence in the world to get you a start in life, don't use it," is the advice of Schwab to young men about to go to work.

First Page

The

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VOL. 27 MARCH, 1923 NO. 6

The Wisconsin Engineer

UNIVERSITY OF WISCONSIN

VOL XXVII, No. 6 MADISON, WIS. MARCH, 1923

SECTIONAL PAPER MACHINE DRIVE

By Clarence F. Rasmussen

Senior Electrical

One of the most interesting of our many manufacturing industries is paper making. No matter in what direction we turn, we behold paper of some description, of which, probably the most familiar grade is that used in our daily papers,—News Print Paper.

This article is intended to show some of the features and difficulties of paper manufacture and to give some methods used in overcoming these difficulties. Because news print paper is most familiar to us, I have chosen to deal only with that machine which makes this particular grade of paper.

News print paper is made on what is called a Fourdrinier machine, so named after the man who developed it. A Fourdrinier machine is diagramatically shown in Figure 1. It consists essentially of a device for allowing screened pulp of constant consistency to flow uniformly into a horizontal or slightly pitched wire screen, known as the "wire." This "wire" is an endless wire cloth belt supported on a frame in a horizontal position by rolls which keep it taut and level. It travels constantly away from the point where the pulp flows upon it. As the water drains through the wire assisted by suction boxes under it, a thin sheet of pulp is formed. A sidewise shaking motion of the frame helps the sheet carries it between two or more press rolls which squeeze out more water. Three such rolls are shown in Figure 1. From the third press the sheet passes over a series of steam heated cylinder rolls which dry out most of the remaining moisture. The number of these dryer rolls varies with different machines, depending upon the thickness of the paper made, and upon the speed of the machine. After leaving the dryers the sheet passes through the calendar stack where the paper is given a finish. The calendar stack is merely a number of heavy rolls one on top of the other which press the sheet between them.

The weight or thickness of the paper produced is determined by the rate at which the stock is admitted to the wire, and also the speed of the wire. A machine which is used continuously for one class and weight of paper may require but a small speed adjustment, such as 10 per cent. Ordinarily, however, machines are used for making papers of different thicknesses in consequence of which they commonly require a speed range of three to one or four to one and even as high as ten to one.

Paper machines comprise a number of elements. Several pumps and screens are required for the paper

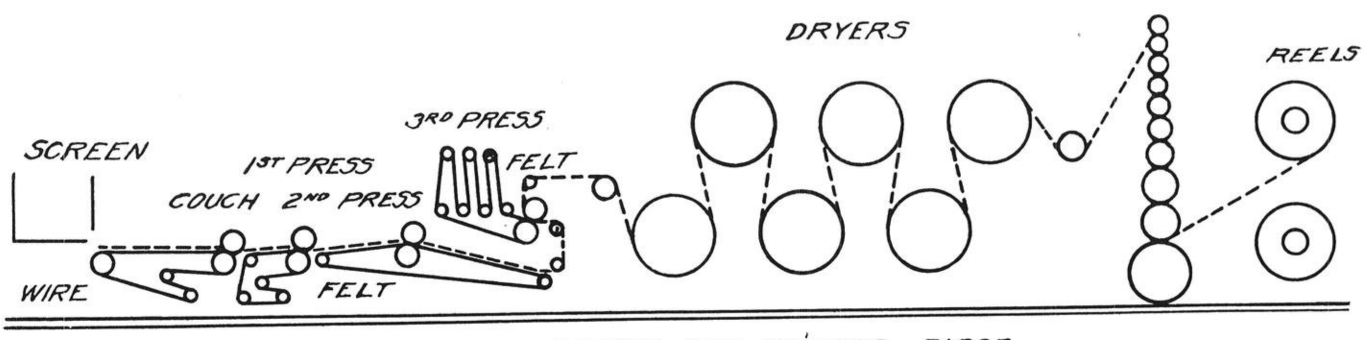


Fig. 1. Diagram of the Fourdriner Machine. *The dotted line shows the path taken by the paper as it is changed from pulp into News Print Paper.*

to form evenly and interweaves the pulp fibers. At the far end, the wire passes around a large roll on top of which turns another large roll called the "couch," which is covered with a felt jacket. The sheet then passes onto an endless felt belt which

stuff. By stuff is meant the wood fibre held in suspension in water in the ratio of about 5 per cent wood fibre and 95 per cent water. These pumps and screens operate at a constant speed and are designated as the constant speed section. The so-called "variable speed" section comprises the wire, couch, presses, dryers, calendars, and reel. The speed of all these units must be varied in unison, as the paper forms a continuous and (see Figure 1) delicate connection between them. Moreover it is necessary that the relative speeds of the component parts be slightly adjusted from time to time as the paper "stretches" in the press rolls and shrinks in the dryers. It is further necessary that the speed regulation of the entire variable speed end of the machine be very good as it is evident that, with constant flow of paper stuff, any speed variation will result in non-uniform thickness of paper.

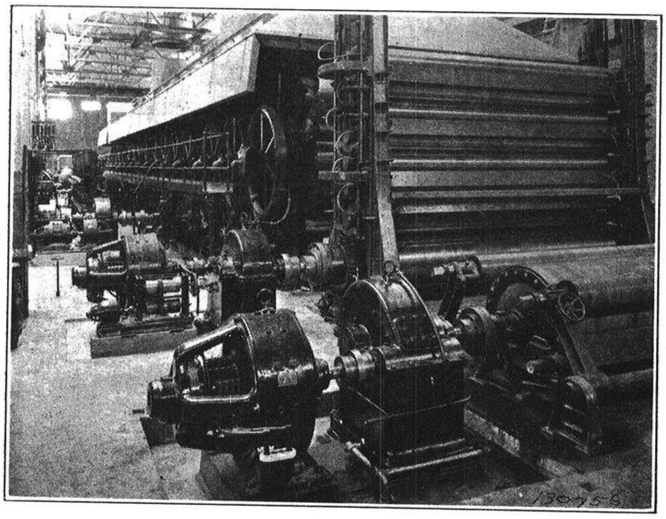


FIG. 2. THE FOURDRINIER MACHINE. *This picture shows the arrangement of the machine itself, driving motors, and control apparatus.*

Figure 1 shows clearly the different sections of the Fourdrinier machine. The constant speed end is shown by the outline of the box screen. No drive has been indicated for this section as it involves no problems worth mentioning in this paper. In the variable speed sections are shown the wire and couch, the first press, second press, and third press, dryers, calendars, and reels, with the sheet of paper running through from the screen to the roll of paper on the upper reel.

In the early history of paper mills it was common practice to drive the entire machine from one line shaft which was usually driven from one large engine by means of a rope drive. This engine usually furnished power for the entire plant. Variations in speed of the paper machine were made by means of tapered pulleys and belt shifters. Later it became common practice to use separate engines for the constant and variable sections, driving the variable end by means of a variable speed engine. Tapered pulleys and belt shifting devices were used to permit adjustment of the relative sectional speeds. Motors have largely superceded the variable speed engine, but are applied in a similar manner, the motor being either directly connected or belted to the variable speed shaft. For the few machines having specialized production and requiring not to exceed 25 per cent speed range, wound rotor induction motors have been used, with secondary resistance control. This method although cheap does not provide the adequate speed regulation. Direct current shunt motors with speed adjustment by field control are adopted where a speed range of two to one or three to one is all that is required. This arrangement when taking current from the same line used by other machines is subject to speed variations due to variations in line voltage. To overcome this a separate engine driven generator or synchronous motor driven generator is used to furnish power for the paper machine alone. Such equipment is usually controlled by automatic type controllers with push buttons for stop, and start, fast and slow operation.

No little trouble has been experienced with drives as above described because of troubles in the mechanical transmission gear, notably belts on the cone pulleys, unequal slips due to varying tension, or other difficulties which caused breaks in the paper. As a result of necessity two ingenious systems of sectionalized drive for paper machines have been developed. In each of the systems separate direct current motors are supplied for driving the individual elements of the paper machine and an individual generator with variable voltage control supplies the direct current for all of these motors in common.

Direct current motors are used on account of their adjustable speed characteristics. Such motors, when properly designed and controlled by a suitable regulator can be satisfactorily operated at any speed desired within the range of the paper machine and very fine increments of speed change can be obtained between sections when necessary. As it is not necessary for all of the motors to operate at the same speed, due to stretching in some sections and shrinking others, they can be directly or rigidly connected

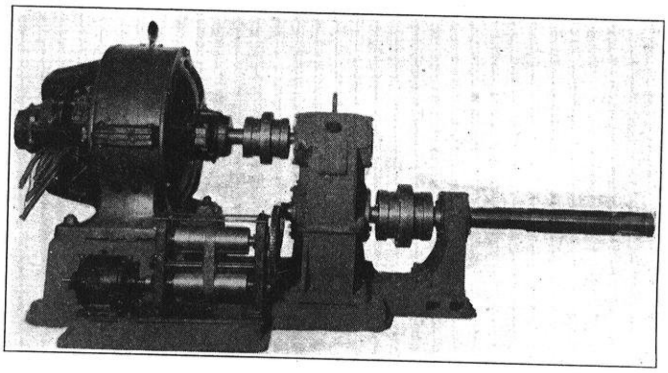


FIG. 3. A DRIVING UNIT. *This is one of the driving units described in the article assembled and ready for action.*

to the machine section shafts, thereby doing away with any possibility of belt slippage. Likewise, by very simple means, the speed of the entire machine may be adjusted over the entire or any part of the

(Continued on page 114)

April 19, 1923.

ROY BARNHILL INC.,
23 East 26th Street,
New York City, N. Y.

Attention: Mr. W. B. Littell.

My dear Littell:

The WISCONSIN ENGINEER is willing, and as director, I am willing, that Mr. Schwab's article should be reprinted by J. G. White Engineering Corporation. I think it is good business for the group that it should be recognized and circulated even farther than it has already gone. The matter of any advertising from that corporation should be treated as a separate matter and upon its own merits rather than as part of a bargain.

Yours truly

Van Hagan

Copy to W. E. Pride.

HOW TO SUCCEED IN BUSINESS

By Charles H. Schwab

As time goes on I find it more difficult to speak of retiring from my forty-three years of business life. In fact instead of retiring I find myself drawn more and more into concerns, each of which involves new responsibilities. But the greater the responsibilities, the less I find of the element of personal supervision and the less I enjoy my new work. The thing that has given me the most pleasure and that I am the most proud of is that I keep finding friends, and friends,—and yet more friends on every hand.

You want me to tell you how you can succeed in life. I know that it is very difficult to convince the great majority of people that men who are in active pursuits of life have any other object in view than the making of money. That is a great mistake. The real leaders of industry and the real men in life, and the real successes in life, are not always the men who have lots of money or a great fortune.

Believing that a successful man's philosophy of success cannot but interest young men who have the future before them, the Engineering College Magazines, Associated, acting through Tech Engineering News (Mass. Inst. of Tech.), has prevailed upon Mr. Charles M. Schwab, engineer, executive, and financier, to prepare this message for the 30,000 readers of these college journals. It is a sane, courageouss, and optimistic message that offers tangible suggestions.

My idea of the successful life is the man who has successfully accomplished the objects for which he set out, to do something that is worthy of a real American man. Money is often a matter of chance or good fortune, and is not the mark of a successful life. It is not the thing that brings a throb of pleasure or a thrill into my life. And I would not pose as a successful man if that was to be the measure. But when I look about me and see the multitude of friends that I have after forty years of business association with men, when I see the great lines of smoking stacks and blazing furnaces that have come into being because of my interests and activity in life, and when I see a work that I set out to do successfully accomplished and meeting the approval of my fellow men, then a real thrill comes into my heart and I feel that I have done something worth while. The money you do not think about as long as you have enough to pay your bills and keep your business going. The captains of industry do not keep on working for the sake of making money, but for the love of completing a job successfully. Men who typify the ideal business man in my mind are Mr. Carnegie, the elder Mr. Rockefeller, Mr. Baker, the younger Mr. Rockefeller, and Judge Gary.

One of the dearest friends that I ever had in life, Andrew Carnegie, used to say to me when I went to him with my balance sheet and showed him how many hundred thousand dollars we had made that month or year, "That's interesting, but show me your cost sheet." That is the mark of successful manufacturing,—how economically and how well you do a thing, not how much money you make in the doing of it. So, his mark—and he was a wise man—his mark of successful industry is my mark of a successful life. Set out with some definite purpose in life and accomplish that purpose. There is little that the human mind can conceive that is not possible of accomplishment. The thing to do is to make up your mind what you are going to drive for, and let nothing stand in the way of its ultimate accomplishment.

Now, in my long experience in business life and association with men, there are some fundamental things that must not be overlooked. If I were asked to say the most important things that lead to a successful life I should say that, first of all, was integrity,—unimpeachable integrity. No man can ever do anything of any great value in life and have the confidence and approval of his fellow men, or be successful in his undertakings with other business men, if he doesn't have the reputation of being a man of honor and integrity.

I am going to speak of a young man that I regard as the most successful young man I have ever known. And if I did not regard him as the most successful young man that I know, he would not be President of the Bethlehem Steel Company. I am going to speak of a young man that I have known since he was a man your age—I refer to Eugene Grace. You may have heard of him. He came from Lehigh University. When I first knew him he was a shoveler of coal with an electric crane. I followed his career on and on and on. And whatever may have been said of Mr. Grace you could always depend upon it absolutely that when Mr. Grace said a thing you would know the absolute facts, good, bad, or indifferent. And, today, Mr. Grace stands among the great business men of New York and this country, with the reputation of being a man of absolute integrity and a man in whom everybody can place the greatest possible confidence.

A man must also be a true democrat, and not an aristocrat who condescends to talk with anyone. The educated man must not get the idea that education necessarily makes him superior to any other skilled man who has devoted his life to mastering one business.

When I first entered the business world in 1879, the United States was producing only one million tons of steel a year; now we produce fifty million. Never was the opportunity and the reward so great as it now is in this reconstruction era. The hardest struggle of all is to be something different from what the average man is. I don't believe in "super-men," for the world is full of capable men, but it's the fellow with determination that wins out.

Bet on the United States if you must bet at all, for any good enterprise in this country is worth more than six or seven per cent. Put your all into any business which depends for its success on your own brains and determination to win. Be not fearful in borrowing money; I have borrowed more money than any other man in the United States, and on less collateral.

Be sure to go into a business that will keep your interest, for you can't handle working men successfully if you only pretend to be interested in them.

If I were able to give you whatever I wanted, I would wish that you might have a rugged constitution, a desire to work, and the great American characteristic of driving onward.

Any man who goes into anything in life and does it better than the average will have a successful life. If he does it worse than the average his life will not be successful. And no business can exist in which success cannot be won on that basis.

Another important thing is loyalty. Be loyal. What measure of success I may have won in life I attribute to the loyalty I had for a dear old friend who was my first steel master, whom you perhaps have never heard of, Captain Bill Jones.

Captain Jones was a great mechanic, just a natural genius at mechanical things. No education at all. He knew nothing of engineering or chemistry or the sciences. Now I was thrown in, fortunately, with him. I made up my mind that I could be very useful to that man by learning things that he could not learn, and, above all, by being loyal to him and never letting the world know that the things for which he received credit were not his own creation. Did you ever stop to think that a great man in life who has won great acclaim and great reputation is the very man who is willing to share and give the honor to others in the doing of the things that made him great? The man that will selfishly stand alone and proclaim that he is the man who has done these things never is the man who really did them. My own experience is that there is no real effort in life that is not done better under encouragement and approval of your fellow men. A man goes along with greater confidence. You must learn to let others share with you in that which you are doing, and honor and credit will be reflected upon you for so doing.

Marshall Foch, the great commander, once said to me, "This great military staff is like an orchestra, and each one fills his place. Each is equally important in the functioning of the whole. If the baton is in my hands it is merely a matter of chance, but we shall see to it that each man in this staff gets recognition for that which is due." You never heard a great man say, "I did this," or "I will do that."

In the management of my great enterprise I have yet to find fault with any man. If a man is such that you must find fault with him to get the best out of him he is not a man to be desired in an organization. Show me the man that will do his best under approval, and I will show you the man that has within him the elements for successful going ahead.

Now, to come back to loyalty. Be loyal to the people with whom you associate at the start. When this good Captain Jones came to the end of his life's work, do you not suppose it was worth more to me than anything else to have him say: "That is the man that helped me do those things?" Remember always that it will but attract attention and credit to yourself to share it with those who help you. Be loyal when you start life, wherever you start. Make your employer feel truthfully that you are sincere with him; that you are going to promote his interests; that you are going to stand for the things he represents; that you are proud of being a member of his staff, and there is nothing that will reap you a richer reward. Loyalty above all!

There are other things in life than mere work. I believe an appreciation of the finer things in life, the learning to know the beauties of literature and art and music, will help any man in his career. A man to carry on a successful business must have imagination. He must see things as in a vision, a dream of the whole thing. You can cultivate this faculty only by an appreciation of the finer things in life. No active business life, whether it is manufacturing or something else, should prevent you from enjoying the beauties of life. These finer things will contribute to your success.

Be friendly. When you have friends you will know there is somebody who will stand by you. You know the old saying that if you have a single enemy you will find him everywhere. It doesn't pay to make enemies. Lead the life that will make you kindly and friendly to everyone about you, and you will be surprised at what a happy life you will live.

I want to tell you a little more about this man Grace, because one often sees the points in a successful life best by analyzing a single individual. I told you of his great faculty of making good, no matter in what position he was placed. This boy went on and on. Above all, he worked hard with the brain that had been trained in the university to think and concentrate upon the subject that he was thinking about until he had reached a satisfactory conclusion. Now, that is the great point, to concentrate and think upon the problem in mind until you have reached a satisfactory conclusion in your own mind, and then finally go ahead. If you have made a mistake, all right. Never find fault with a man because he has made a mistake. It is only a fool that makes the same mistake the second time. I tell a story of my own experience with Mr. Carnegie, as showing what this might mean.

As chief engineer of the works I had just built a converting mill. I went to him and said to him: "If

(Continued on page 110)

THE IMPORTANCE OF COLLOID CHEMISTRY TO INDUSTRY

By Harry N. Holmes

Chairman Colloid Committee of the National Research Council.

There is nothing mysterious about colloids. They are not new substances but merely ordinary substances with particles of special dimensions, ranging from approximately one to one hundred millionths of a millimeter. Such particles are a little larger than the largest molecules and yet just too small to be seen with definite diameter by the microscope.

Colloidal particles, then, are simply aggregates of a few hundred (more or less) molecules. With a somewhat greater degree of dispersion colloidal suspensions become true solutions. On the other hand when these colloidal units or aggregates coalesce into still larger aggregates, they may be precipitated from suspension. Unless such coagulated material becomes distinctly crystalline on standing, we are in the habit of calling it colloidal, as in the case of cheese for example.

The subject of Colloid Chemistry is a particularly live one this semester at the University of Wisconsin.

Professor The Svedberg, of the University of Upsala, international authority on Colloid Chemistry, will be in residence at the University from February 1st to August 5th. He has been brought here to stimulate interest in research in colloid chemistry and to assist in the solution of scientific problems having a colloidal bearing. His activities are not to be limited to any one department.

From June 12th to 15th inclusive a National Symposium on Colloid Chemisitry will be held at this University. This Symposium will consist of the presentation and discussion of about twenty-five original papers. These papers will be presented in person by the leading colloid chemists of the United States and Canada.

From the theoretical standpoint, the chemist is interested in such topics as the preparation of colloids, their electric charge, coagulation, peptization, protective action, dialysis and diffusion, gel structure, surface tension, emulsions, viscosity, adsorption of gases, adsorption from solution and many others.

All the sciences, even astronomy, dealing with the colloidal dust of comet's tails, are dependent upon colloid chemistry for their full development. Physics with its surface energy problems, geology with diffusion through gelatinous silicic acid and fine powders, biology with hydrated plant and animal tissues, medicine with the study of hydration and diffusion in body tissues and peptization by digestive juices, engineering with countless colloid problems to solve—all eagerly watch the rapid growth of the young sciences of colloid chemistry.

The applications to the industries are almost universal, although all manufacturers are not yet familiar with this fact. When research chemists demonstrate convincingly to their employers the basic connection between colloid chemistry and industry, our manufacturers will finally come to a proper appreciation of the financial importance of this growing science.

Colloid chemistry is closely related to the problems of lubrication, agriculture, de-watering oils, purifying clays, catching offensive or wasted fumes, drying peat, de-inking old newspapers, concentrating ores, tanning, baking, cooking, washing, dyeing, roadmaking, photography, water purification, sewage disposal; and one should know a good deal about colloid chemistry if he is to manufacture rubber goods, glass, porcelain, enamels, cements, alloys, fungicides and insecticides, dairy products, any cellulose ester materials, colloidal fuel, gelatine, glues, gas masks, adsorbent gels, paints, varnishes, soap, inks, oils, pencils, and crayons.

Theory and practice must go hand in hand. For example, wetting power—the ability of a liquid to wet a solid—is a property made use of in many technical processes, and one may blunder along in the application without adequate theory as a foundation. Nuttall (J. Soc. Chem. Ind. 39, 7-73 1920) discusses this subject very clearly. For a liquid to spread easily in a thin film on a solid the liquid must have a low surface tension, a low interfacial tension, and perhaps a high surface viscocity. Solutions of alkali soaps, with their low surface tension, have high wetting powers. But a solution of saponin with a comparatively high surface tension has excellent wetting powers due to its high surface viscosity. A 1% solution of saponin wets a sheet of paraffin although a 5% solution of soap does not.

Substances that lower surface tension, concentrate at surfaces or interfaces, sometimes in a film with the properties of a plastic solid as in the case of saponin. These films tend to prevent mixture and running together to form drops.

Thus saponin is a good emulsifying agent, as in an alkali soap, but for a different reason. The plastic film formed at the oil water interface interferes with the coalescence of drops. In milk the globules of fat are surrounded by a tenacious coating of adsorbed protein.

Foaming usually, but not always, parallels high wetting power. Saponin foams are merely plastic films resembling the "armor-plated" flotation froths.

In flotation of ores we depend upon the fact that a little added oil wets the small particles of the valuable metallic sulfide better than does water, while the reverse is true for the particles of "gangue" or waste rock. Thus, when finely ground ore is beaten with water carrying a very little of some special oil, the films of oil in the froth wet and float the copper sulfide (or other valuable sulfide). The froth is stabilized and stiffened by presence of this plastic film of sulfide particles. Removal of the froth gives a concentrate far richer than the original ore. Of course the gangue, being preferentially wet by water, sinks to the bottom of the tank. Quartz particles may be wetted even more readily by water if a little acid or base be added. This may be due to adsorption of hydrogen ion or of hydroxi ion. Since 60,000,000 tons of low grade ores are "floated" annually, it is evident that the topic of "preferential wetting" is worthy of study. Now it is proposed that fine particles of coal be separated from ash, or waste rock waste, by the use of a solution wetting the two materials in different degree.

Emulsions are dispersions of one liquid in another and are simply made by suitable mechanical agitation of the two liquids. However, the tendency of the two liquids to form two drops or layers thus presenting the minimum of surface is so great that to prevent coalescence of minute drops a third substance called an "emulsifying agent" must be present. As a rule the emulsifying agent is colloidally dispersed in one of the liquids; for example, an alkali soap in water. Such alkali soaps aid emulsification by lowering the surface tension of the water as well as by forming concentration films around the oil globules. Saponin, on the other hand, is a good emulsifying agent, in spite of the comparatively high surface tension of its aqueous solutions, because it concentrates at the oil-water interface to form a plastic film.

With alkaline earth soaps the oil is not dispersed in drops in water (the usual type of emulsions), but water is dispersed in drops throughout the oil (the unusual type, a water-in-oil emulsion). This is because alkaline earth soaps are more soluble in oil than water. A rule applicable here is that if the emulsifying agent is more readily peptized by liquid A than by liquid B, it will be B that is dispersed in drops. This is even true in the case of insoluble fine powders which are more readily wet by A than by B.

Industry needs emulsions and makes them, but industry is also concerned with breaking certain annoying emulsions. To attack such a problem one must first learn what the emulsifying agent is. It may be a soap, a glue, a gum, a fine-grained sludge or a sulfonated oil. It any event it must be removed or converted into some other substance. Addition of acid to a soap is effective because this liberates the fatty acid, a poor emulsifying agent. A dehydrating agent may ruin the effectiveness of a highly hydrated emulsifying agent. Since oil particles carry a negative charge of electricity, they may coalesce if this charge is neutralized by ions of high positive charge such as Al*** or Fe***. Also, if the droplet charge is almost neutralized by addition of a suitable salt, the emulsion may become so unstable that filtration through proper material will completely separate oil from water.

Lubricating greases are emulsions of 3-5% water in a soap oil system. The soap, usually a calcium soap, although aluminum soaps are also in use, is dissolved in the hot oil, a heavy petroleum fraction. The mixture is stirred while cooling, and the water added below 100°. Separation of oil from soap on long standing is checked by the presence of water droplets. It is probable that some alkali soap is added to increase the viscosity of the water droplets. Cheaper greases are made by the use of soaps of the resin acids.

Nuttal, in his fine paper already referred to, points out that a disinfectant must wet the surface it is intended to disinfect. Chick and Martin (J. Hygiene, 8, 698-703) believe that with coal tar disinfectants the bacteria are adsorbed on the emulsified particles of the tar acid, thus being brought into contact with disinfectant in a most concentrated form. Sprays must wet green leaves. "By incorporating an oil emulsion with the dip, and thus ensuring high wetting power, Cooper showed that it was possible materially to reduce the sodium arsenite content of the dip and yet ensure the destruction alone of the tick without injury to the cattle. This application alone of wetting power has been instrumental in clearing large tracts of tick-infested country in various parts of the world."

Wetting power has been discussed here in some detail as an illustration of what any chapter in colloid chemistry may lead to if applied as carefully. Space lacks for an adequate discussion of the enormously important topic of adsorpotion.

Adsorption of toxic gases by cocoanut charcoal is familiar to all after the experiences of the great war. Yet the application of the principles of gas adsorption by activated carbon, silica gel, etc., is now a peace time matter of great commercial importance. Silicic acid, formed as a gel, washed and dried to a content of 18% or less, is a glassy material shot through with innumerable capillary pores of diameter not much greater than that of molecules. In these capillary pores gases are brought well within the range of molecular attractive forces and so are held or "adsorbed." This adsorption is preferential for various gases but it may be mentioned that such a "gel" is a powerful dryer, that it removes gasoline from casing head gas, and that it removes obnoxious sulfur compounds from crude petroleum, thus suggesting the possibility of dispensing with the costly sulfuric acid treatment in refining petroleum.

The power of silica gel to adsorb sulfur dioxide and the oxides of nitrogen suggests its use in connection with the Gay-Lussac tower of a sulfuric acid plant.

The use of fuller's earth in oil refining is an application of adsorption, as is the use of bone char in decolorizing the syrups in sugar refining.

The physical condition of the soil—its colloid content—have everything to do with its power to retain water—to hold, and adsorb the fertilizing salts so vital to plant growth.

According to W. B. Hardy, a good lubricating film must be powerfully adsorbed by the bearing surfaces. Otherwise the film will tear away in spots and seizure of the metal surfaces may result. It is an interesting fact that Southcombe and Wells found the addition of 1% of the free fatty acids of rape oil, for example, to a petroleum lubricant added as much to the effective lubrication as addition of more than 10% of neutral rape oil itself. This must mean a superior lowering of the interfacial tension between oil and metal. Of course a very low interfacial tension is necessary to film formation and penetration to all parts of the lubricated surfaces.

Many wheats (as California wheat, for example) yield weak gluten flours. Such gluten in the bread dough does not stretch well enough for a good loaf, and admixture with a strong gluten flour is necessary. The protein of corn, rye, and other grains is "weak" in the sense that it does not permit the manufacture of a satisfactory light, porous loaf. The colloid chemist who can so change the physical condition of corn or rye or oat protein that it will stretch like the best wheat gluten will add untold wealth to the world and have much to do with checking famines.

The de-inking of old newspapers is a conservation measure of first importance. S. D. Wells reports that this may be done successfully and the pulp worked over into paper. It is easy to loosen the carbon by dissolving the varnish with alkali but unfortunately the paper fibers enmesh the loosened carbon. However, by adding to wet pulp some Wyoming bentonite, a highly colloidal "transported, volcanic ash", the carbon will be adsorbed by the clay rather than by the paper. This bentonite is so finely divided that a water suspension of it passes thru a filter paper even though it carry the carbon with it. Over 7,000 tons of newspaper are printed daily.

Sheppard and Bates have invented a process for peptizing (subdividing colloidal size of particle) powdered coal in fuel oil. The coal, even the worst grades, is pulverized until 95% will go through a 100 mesh sieve and 85% through a 200 mesh sieve. Stirred with fuel oil carrying less than 1% of the peptizing agent, a remarkably stable liquid suspension is obtained. As much as 40% of it may be coal and yet it is so fluid that it can be sprayed like fuel oil and burned under boilers. This "colloidal fuel" would be excellent for ships, partly because the fire hazard is less than that of oil. As the fuel is heavier than water a sprayed liquid is so good that the lowest grade coals, even lignite, can be utilized.

All glues are hydrated colloids; hence, when dry they tend to take up water from moist air and thus weaken. So to change these glues so that they will not rehydrate after drying and yet will retain their adhesive power is a problem of vast importance. Large timbers are becoming scarcer and we are being forced to the use of timbers built up from smaller pieces. Present-day glues greatly limit the period of usefulness of glued woods; they weaken too soon.

Metals and alloys at a certain stage of their existence are in a colloidal state, and, although this stage may be brief, a portion of the metal or alloy tends to remain in the colloidal state and exert a powerful influence upon the physical properties of the final solid mass. (Alexander).

These few applications of colloid chemistry may serve as an incentive to further reading. For such reading I urge the purchase (at a small price, fortunately) of the "First, Second, and Third Reports on Colloid Chemistry and its General and Industrial Applications." These are issued by the British Association for the Advancement of Science. A fourth report is in press and a fifth in preparation.

For further reading the following books are suggested:

Wiley and Sons Laboratory Manual of Colloid Chemistry is planned as a self-teaching book, containing much text discussion and explanation.

A beginner in this subject will do well to read Jerome Alexander's little introduction, "Colloid Chemistry," or Hatschek's "Introduction to the Physics and Chemistry of Colloids" or Zsignondy's "The Chemistry of Colloids."

More advanced readers should have Bancroft's "Applied Colloid Chemistry" and Martin Fischer's "Soaps and Proteins."

LOWETH TALKS ON ENGINEERING SOCIETIES

"The young engineer should first join the local engineering society; later, when he can afford it, he should become a member of one of the national societies," said Charles F. Loweth, chief engineer of the Chicago, Milwaukee and St. Paul Railway, and president of the American Society of Civil Engineers, speaking before the Engineering Society of Wisconsin and the Technical Club of Madison, meeting in joint session, on the evening of February 23.

C. F. LOWETH

"There was a time when membership in the national societies carried with it some decidedly attractive perquisites," Mr. Loweth stated, and cited in evidence a meeting of the American Society of Civil Engineers, held in the Twin Cities along about 1883, at which meeting passes over all the roads entering the Twin Cities—passes good for the remainder of the year—were furnished to every member of the society. But those days are gone forever; today the young engineer gets more immediate benefit from the *local* society because it is possible for him to attend its meetings and become acquainted with the engineers who are practicing in his vicinity.

(Continued on page 106)

EDITORIALS

THE CASE OF POLYGON

The hesitation and uncertainty with which plans for this year's Parade went forward has focused attention upon the college executive committee known as "Polygon". The parade resulted, not through the efforts of Polygon, but through the activity of individuals here and there in the college who wanted to see the Parade a success. Polygon has been a dead organization this year.

When Polygon was organized a couple of years ago, we congratulated ourselves that we had provided leadership for our college activities. Polygon was to see that our mixers, dances, parades, and minstrel shows were properly organized and carried out. Judging from events of this year, however, an important element was omitted when Polygon was put together; it may look like a good machine, but it lacks a self-starter; it doesn't function. Unlike the Ford of the funny man's imagination, it can't run on its reputation alone for the very good reason that it hasn't any reputation worth mentioning.

An investigation shows that Polygon's trouble seems to be the result of indifference upon the part of officers duly elected. There is a president and secretary-treasurer. Both were in school during the first semester, but neither one seems to have felt any responsibility about calling meetings, although the constitution of Polygon specifically states that the president shall call meetings and that the secretary shall act as president if the latter is unable to do so. Both men will have to shoulder the responsibility for the inaction of Polygon, although the other members are not blameless in the matter.

We need the leadership in the college that Polygon could supply. Can the organization be made to function? We think it can, but it will mean that the members of Polygon must be selected because of their interest in college affairs, their knowledge of available executive talent in the college, and their own executive ability. Membership in Polygon should not be wished upon a man who is not interested in it, nor passed out to someone to swell his list of honors. It's a working job that requires workmen of energy and talent.

The members of Polygon are appointed by the engineering societies, a junior and a senior from each society. The failure of Polygon to function goes back to these societies. They should choose their representatives for their ability to do things that a member of Polygon should do. There is no lack of leaders in the college; it is merely a matter of recognizing them and getting them on the job. The president of an engineering society who appoints members to Polygon without careful consideration of their qualifications is derelict in his duty; he is interfering with the activities of the college. We want a Polygon that produces results.

The world demands men and women who can think independently rather than those who can think only as taught. The world progresses by development of new ideas rather than by the continued application of old ones.—Dean Cooley, Michigan.

THE ENGINEER OF AFFAIRS

What a difference there is between the Engineer of today—a man of wide interests and activities—and the Engineer of former years—essentially a technician. And this expanded mental outlook is still growing; business, politics and economics are claiming a share of his time and attention, are encroaching upon the former isolation of his position.

We believe this increasing interest in general affairs to be a healthful indication. The Engineer is better equipped to attack many of the pressing problems of public life than is the politically placed official who holds his position by virtue of almost everything but directed ability.

A friend of progress, yet realizing that true progress consists not alone in doing something a new way but in doing the thing in a better way, the Engineer moves forward with sureness and certainty.

Possessed, by training, of power of analysis, schooled in the exercise of careful judgment and sound common sense, the Engineer is not likely to be deceived by specious argument or gilded sophistry. He can be a man valuable to any community for his able public activity as well as for his more restricted professional work.

From bottom to top, our education is suffering from kindergarten ideas. The American student has been accustomed to too much help. He relies on the teacher to such a degree as to lessen the teacher's efficiency. He has been so coddled in the early years of his schooling that when he comes to take up professional education and wants to work hard he often does not know how to do so if he would. Our army experiences in this respect were appalling. Thousands of American lives were lost in the last war because men who were otherwise qualified to be artillery officers could not do sums in logarithms straight unless they had a professor to help them.—President Hadley, Yale.

SELLING THE TERM ENGINEER Some of the big manufacturing companies have been selling engineering to the students of engineering colleges through the medium of unusually thoughtful and illuminating advertisements placed in the college magazines. Now we find the same type of advertisement—sometimes the identical advertisement—displayed in the pages of popular magazines. The term "engineer" is being sold to the public by these progressive and far-seeing companies.

Engineers often complain that their accomplishments do not receive a full measure of public recognition and appreciation. One of the things that must precede such recognition and appreciation is to educate the public to understand the functions of an engineer and when his services are needed.

The public knows what a physician is and when he is to be consulted. The lawyer, likewise, has an established place. But the engineer is an unknown yet. The condition is readily explained: The engineer does not, as a rule, work for an individual; he works for a big company or for one of the many branches of government. The average citizen does not call upon him for personal service and, therefore, does not understand him.

The men who are preparing the publicity for the big engineering companies are to be commended for a work that is bound to have a beneficial effect upon the engineering profession.

ENCOURAGING THE RUSSIAN INVENTOR Ludwig Martens, former Soviet representative in the United States, has been made head of the Russian patent office. Instead of carrying out the spirit of the Soviet law, which gives the government claim on all patents, he is attempting so to interpret it that the individual inventor may reap some personal profit. This indicates that a system of government ownership of all property and rights, which denies an inventor a personal profit from his invention is not practicable. It is to be assumed that the system has not tended to a satisfactory advance in science and industry.—E. D. L.

THE CONSTITUTION OF POLYGON

The obvious lack of leadership in the College of Engineering during the current year has called forth numerous cries of "What is the matter with Polygon?" From the newer men comes another cry: "What is Polygon?" Polygon is an organization, created, we are told, to act as a director and co-ordinator of our college activities. It has always been surrounded with more or less mystery; it seems to be time to bring it out into the light so that we can examine it and determine why it doesn't function. As a step in that direction we are presenting herewith the constitution of the organization.

CONSTITUTION

Art. 1. The name of the organization shall be "The Polygon."

Art. 2. The purpose of the organization shall be to promote the activities of the students of the College of Engineering of the University of Wisconsin.

Art. 3. The membership shall be limited to a junior and a senior member from each engineering society. If a member be a junior on election he will continue as a member for two years. These members shall be elected by the societies.

Art. 4. The officers shall consist of a president and a secretary-treasurer.

Sect. 1. The duties of the president shall be to conduct all meetings, appoint such committees as are necessary, and to call meetings.

Sect. 2. The duties of the secretary-treasurer shall be to take care of finances, to take minutes at meetings, to take care of all records, and to act as president if at any time that member should be unable to act.

Art. 5. The constitution shall be ratified by the majority of the engineering societies and likewise shall cease to function if the majority of these societies so desire at any time.

Sect. 1. Amendments to the constitution must be approved by three-fourths of the members at the meeting following its proposal.

Art. 6. Regular meetings shall be held the fourth Tuesday of every month.

Sect. 1. Special meetings shall be called at the discretion of the officers.

Sect. 2. Nine members shall be necessary for a quorum.

Art. 7. Election of officers shall be held at the last regular meeting of the school year.

Approved,

F. E. TURNEAURE, Dean,

(Signed)

RALPH E. HANTSZCH,
Chairman A. I. E. E.

ENGINEERING COLLEGE MAGAZINES, ASSOCIATED, HOLDS CONVENTION AT URBANA

A gathering of engineering students from all parts of the country for the purpose of discussing literary matters sounds like an anomaly, but such a gathering was held at the University of Illinois on February 16 and 17. It was the second annual convention of the ENGINEERING COLLEGE MAGAZINES, ASSOCIATED. About twenty-five delegates were present to represent fourteen magazines. The meeting was presided over by Professor Leslie F. Van Hagan, advisory editor of the Wisconsin Engineer and vice chairman of the association.

The following magazines were represented:

The Transit—University of Iowa.
The Michigan Technic
The Virginia Journal of Engineering
The Wisconsin Engineer
The Technograph—University of Illinois
Tech Engineering News—Mass. Inst. of Technology
Princeton News Letter
Iowa Engineer—Iowa State College
Rose Technic—Rose Polytechnic Institute
Colorado Engineer—University of Colorado
Nebraska Blue Print
Minnesota Technolog
Ohio State Engineer
Penn State Engineer

That articles in college magazines should not be too technical in character seemed to be the consensus of those present. The present policy of the magazines in selecting material that dovetails in between the popular science type on the one hand and the standard engineering journal type on the other hand was upheld. Experience was cited to indicate that if the magazines attempt to be strictly technical they will not be read and supported by the student body. The need for a touch of humor in the college magazine was generally conceded although there was difference of opinion as to the form such humor should take.

A plea for improvement in the editorial column was made by Professor Van Hagan, who criticized the recognized tendency of college editors to write "uplift" editorials, of the "Let us then be up and doing" type. "The student will not trouble himself to read sermonettes by his class-mates," he said; "they are more apt to be interested in editorial comment upon matters that have a news flavor. Try your hand at interpreting events of interest to engineers. Make your editorial page more attractive than the funny column,—if you can."

"The engineering college magazines of the present day are noticeably better written than those of ten or twenty years ago," said Professor C. C. Williams, of Illinois, at the banquet on Saturday evening. "The earlier numbers of the magazines carried excellent technical matter, but the writing was not so good as writing of today."

The following officers were chosen to take office on May 1: Chairman, Professor Edwin B. Kurtz of the Iowa Engineer; vice-chairman of the eastern group, Forrest G. Harmon of Tech Engineering News; vice-chairman of the western group, S. H. Ruggles of Ohio State Engineer. The election of Professor Kurtz is of interest to Wisconsin men as he is a Wisconsin product, having been graduated from the course in electrical engineering in '17. While in college he was interested in college journalism and was a member of the staff of the Wisconsin Engineer.

LOWETH TALKS ON ENGINEERING SOCIETIES

(Continued from page 103)

"The national societies *have* been progressive," asserted Mr. Loweth, answering a charge often laid against them at the present time. "They have been leaders in technical progress as is demonstrated by the work of the American Society of Civil Engineers in producing a rail section that was the accepted standard for many years, and by its research in cement, concrete, steel, and hydraulics,, and the present investigation into track stresses and the bearing power of soils."

"The activities of the societies in matters of human interest have not been so prominent as they might have been, perhaps," said the speaker, "but a great *deal* has been done." The investigation into the employment and compensation of engineers made about ten years ago, and the recent study of licensing of engineers were mentioned as illustrative of what has been accomplished.

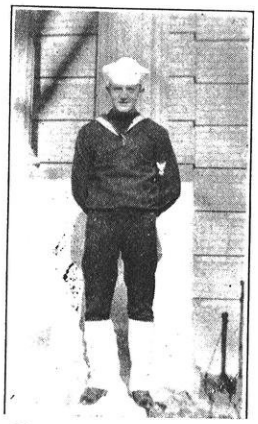
ALUMNI NOTES

CIVILS

M. S. Douglas, c '22, who has been with H. Schmidt & Son in contracting, has started to work with the Milwaukee Sewage Commission on February 16, 1923.

V. G. McGraw, c '20, is structural engineer with J. E. R. Carpenter, architects, at New York City. Address: 81 Forley St., Elmhurst, L. I.

Finley L. Fishbeck, c '19 is in the warehousing business with his father and brother at Terra Haute, Indiana. Residence: 1100 South Center Street. He writes under date of February 10 as follows:



FINLEY FISBECK

"It has been over a year since I have done any engineering work but every day something comes up that reminds me of my university connections. The other day C. D. Stone, a Wisconsin Commerce man dropped in on me. He is connected with The Linde Air Products Company of New York and we are handling this distribution of oxygen in and around Terre Haute thru our warehouse.

"In addition to the warehouse business my brother and I have formed a new company called the Wabash Valley Sales Company. We are doing a wholesale jobbing business in motor oil and flour. We have two salesmen giving their full time to this and altho we have only been organized eight months, we are doing nicely and have great expectations for the future.

"I seem to be a long way from engineering work but I shall never regret the technical training and if I were to go to school again, I believe that I would take the same course with a little more stress on the commerce studies.

"I hope to take a trip to Madison this spring and see my friends again. One thing that I have always noticed among the Wisconsin men is that they are always "boosting" for Wisconsin and always think "When we go back to Madison."

"The Wisconsin Engineer continues to show improvement every year. The alumni section of the engineer is almost the only connection we have with our classmates and I certainly approve of the way you are keeping this up."

N. A. Saigh, c '15, is head of the N. A. Saigh Company, Engineers and General Contractors, at San Antonio, Texas. Address: 202 Gibbs Bldg., San Antonio, Tex.

W. F. Gettelman, c '14, is City Engineer of the city of Minot, N. Dak. Address: City Engineer's office, Minot, N. Dak.

Herman Larson, c '13, is a member of the Municipal Construction Company, General Contractors, of Boonville, Ind. The company is now beginning work on 26 miles of highway in Warrick County, Ind.

Richard H. Merkel, c '12, is engineer with Frank Hill Smith Inc. Residence: 121 South Summit Street, Dayton, Ohio.

I. F. Waterman, c '12, is Assistant Professor of Mechanics and Materials at the Oregon State Agricultural College, at Corvallis. Address: 234 N. 29th St., Corvallis, Ore.

Clement T. Wiskocil, c '12, CE '13, assistant professor of civil engineering at the University of California, who has been making some tests for the Pacific Coast Steel Co., is pictured with some of his test specimens in the January issue of the California Engineer.

C. T. WISKOCIL

W. H. Curwen, c '11 is Highway Engineer with the U. S. Bureau of Public Roads, at Denver, Colo. Address: 1540 Logan St., Denver.

J. C. Beece, c '10, is engineer and manager of the Glen Lake Irrigation District, at Eureka, Mont.

J. A. Pierce, c '10, is manager of the Riverside Branch of the Fisk Tire Company, at Riverside, Cal. Address: 440 W. 8th St., Riverside, Cal.

John W. Bach, c '09, is with the Mead-Balch Construction company. Business address 441 Postal Station Building, Indianapolis, Indiana.

George H. Lautz, c '08, is now assistant chief engineer of the U. S. Forest Service. Business address: U. S. Forest Service, Washington, D. C.

Howard A. Parker, c '08, is Principal Assistant Engineer with the Spavinaw Water Supply Company, of Tulsa, Okla.

Sylvester Schattschneider, c '05, is associate manager of the Group Insurance Department, Prudential Insurance Company, of America. Address: 148 Hillside Ave., Newark, N. J.

R. H. Whinery, c '05, is an engineer and contractor at Los Angeles, Cal. Address: 4527 St. Charles Road, Los Angeles, Cal.

Eugene A. Balsley, c '02, formerly with the American Bridge Company, has opened an office with Albert E. Fisk under the name of Balsley and Fisk, for the practice of consulting engineering.

William G. Kirchoffer, c '97, C. E. '01, consulting engineer in sanitary and hydraulic practice with an office in Madison, was elected vice-president of the Engineering Society of Wisconsin at the convention held in Madison on February 22, 23, and 24.

CHEMICALS

Waldemar Velguth, ch '20, is metallographer with the Buick Motor Company. Residence: 619 Newall Street East, Flint, Michigan.

Ronald I. Drake, ch. '20, is chemical engineer in the development division of the Western Electric Company, Hawthorne Station, Chicago, Ill. Address: 4706 W. Harrison 511, Chicago, Illinois.

W. T. Cushing, ch. '11, is sales engineer for the Norton Company. Residence: 704 Oakland Avenue, Birmingham, Micchigan.

E. J. Springer, g '09, is eastern manager of the Heine Chimney Company. Business address: Suite 1936, 30 Church Street, New York City.

Wilfred C. Parker, g '06, is vice-president and treasurer of the Mueller and Son Company. Business address: The Mueller and Son Company, 361-389 Canal Street, Milwaukee, Wisconsin.

James I. Bush, g '06, is vice-president of the Equitable Trust Company of New York. Business address: 37 Wall Street, New York City.

ELECTRICALS

H. S. Mansfield, e '22, is assistant examiner, U. S. Patent Office, at Washington, D. C. Address: 1842 Calvert St., N. W., Washington, D. C.

W. C. Lallier, e '22, is transmission engineer for the Wisconsin Telephone Company. Business address: 418 Broadway (8th floor), Milwaukee, Wisconsin.

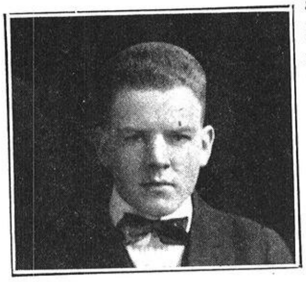
George J. Flatman, e '21, is an engineering inspector. Residence address: 214 Madison Avenue, Dixon, Illinois.

W. E. Blowney, e '20, is with the Turbine Engineering Department of the General Electric Company, at Schenectady, N. Y. Address: 149 Glenwood Blvd., Schenectady, N. Y.

Everett L. Cole, e '18, is sales engineer (Spokane Territory) for the Edwards Ice Machine & Supply Company of Seattle, Washington. Business address: 2223 First Avenue South, Seattle.

Frederick Livingston Re Qua, e '18, is welding engineer for the Re Qua-Wearst Company. Business address: 270 Tehema Street, San Francisco, California.

A. W. Gower, e '17, is captain, U. S. Infantry, at the Post Signal Office, Fort Bliss, Texas. Address: Quarters 41, Fort Bliss.


E. B. KURTZ

Edwin B. Kurtz, e '17, who is a member of the faculty of Iowa State College, was elected chairman of the Engineering College Magazines Associated at the annual convention of the association which was held at Urbana on February 16 and 17.

Verle E. Williams, E. E. '15, is industrial engineer with the Forest Products Engineering Company. Business address: 431 South Dearborn Street, Suite No. 511, Chicago, Illinois.

Carrington H. Stone, e '15, is engineer with the Western Electric Company at the Hawthorne plant. Residence address: 5726 Maryland Avenue, Chicago, Illinois.

Edmund Ryan, e '14, is farming and gives his home address as Castle Rock, Washington, Route 3.

Alvin E. Meinicke, e '10, is supervisor of power line protection, with the Illinois Bell Telephone Company, at Chicago. Address: 4422 N. Lincoln St., Chicago, Ill.

Frederick F. Farnham, e' 09, assistant superintendent of foundries of the American Bridge Company, lives in Fair Oaks, Pennsylvania.

H. E. McWethy, e '09, is street railway engineer of the Minnesota Railroad and W. H. S. E. Commission. Business address: State Capitol, St. Paul, Minnesota.

Raymond J. Hardacker, e '06, is an electrical engineer with the City of Los Angeles, Bureau of Power and Light, Los Angeles, California.

MECHANICALS

T. B. Maxfield, m '22, is production clerk with the General Electric Company, at Schenectady, N. Y. Address: R. D. 8, Box 12, Schenectady, N. Y.

Irving Willis, m '21, at the beginning of the current semester, accepted a position as teacher of mathematics in the University of North Dakota, University Station, Grand Forks, N. D.

C. W. Burgess, m '19, is in the brass and bronze foundry industry. Address: Care of Y. M. C. A., Los Angeles, Cal.


GLEN B. WARREN

G. B. Warren, m '19, sending in his subscription to the WISCONSIN ENGINEER, gives an interesting account of a gathering of Wisconsin Alumni at Schenactady, on January 31. He writes as follows: "We had a mixed alumni club dinner here on Wednesday, to which each member who could come was invited to bring either his wife or a guest. We are happy to say that it was a real success, and that those who attended were eager to stage another affair in the near future. The following members were there: **M. C. Olson, e '99, F. H. Blood, e '04, D. K. Frost, e '04, C. A. Hansen, ch '05, E. C. Griswold, e '09, E. S. Henningsen, e '12, E. Horstkrotte, e, 12, L. A. Norris EE '12, G. B. Warren, m '19, W E. Blowney, e '20, H. D. Taylor, m '21, J. S. Baker, e '22, P. Heins, e '22, R. Kellogg, m '22, T. B. Maxfield, m '22, D. McLenegan, m '21.**

Thomas N. Gilder, m '16, is assistant valuation engineer of the Portland Railway Light and Power Company. Business address: Portland, Oregon.

Rudolph Michel, m '16, is assistant professor of engineering drawing at Virginia Polytechnic Institute, Blacksburg, Va.

I. A. Bickelhaupt, m '14, is Southern Manager of the Pittsburg-Des Moines Steel Co. at Richmond, Va. Address: 2610 Floyd Ave., Richmond, Va.

Roger S. Moore, m '11, is efficiency engineer for the Chicago By-Product Coke Company. Address: 851 Washington Blvd., Apt. "A", Oak Park, Ill.

Elmer H. Whittaker, m '09, is engaged in contracting. Home address: "Los Qules" Hollister Avenue, Santa Barbara, Caliifornia.

Russel W. Hargrave, m '98, is in charge of tool production with the De Laval Separator Company, at Poughkeepsie, N. Y. Address: Arlington, N. Y.

Christian Hinrichs, m '90, consulting engineer, gives his business address as Todd Dry Dock and Construction Corporation, Tacoma, Washington.

MINERS

W. F. Uhlig, min '22, may be reached temporarily at 1826 Lewis St., Marinette, Wis.

C. A. Larson, min '22, and **M. H. Howes**, min '23, are at Jerome, Ariz., having entered a training course with the United Verde Mining Company.

R. L. Jourdan, min '22, is with the Utah Copper Company, at Garfield, Utah.

William G. Pearsoll, min '11, is working on the exploration and development of iron ore properties at Ironton, Minn. Address: Derwood, Minn.

H. L. Welsh, min '10, is consulting mining and petroleum geologist at Billings, Mont. Address: 607 N. 31st St., Billings.

HOW TO SUCCEED IN BUSINESS

(Continued from page 100)

you will give me the money to build this mill I can save 50 cents a ton." Of course he provided the money, and the mill was built. He came out to see it. I walked around with him. He saw the look of disappointment in my face and said: "Charlie, there is something wrong here. What is it?" I said: "It is exactly what I told you, and it is better than I told you. We save more than I said. But I don't mind saying that if I had to do the whole thing over again I would do it so and so. I made a mistake in that particular." He said: "Can you change it?" I said: "No." He said: "What does it mean?" I said: "It means tearing it down and doing it over again." He said: "Go ahead and do it. Don't make the same mistake a second time." Do you suppose if he had been a fault-finding man I ever would have told him? Not at all. He brought out the best in me. When that mill was torn down and a second took its place it was as great a success over the first as the first had been over the old one.

Mr. Carnegie had my confidence, and I had his confidence. He believed in everything I had told him. If I had told him something that was wrong and not admitted my mistakes he would never have helped me to progress, and his works and his great establishment would never have progressed as they did.

Now, in my own establishment you will be interested to know something about how we do things. You boys will all, probably, have to start to work upon a salary. But the quicker you get out of working for a salary the better for all concerned. In our works at Bethlehem and San Francisco, and all over the United States, I adopted this system: I pay the managers of our works practically no salary. I make them partners in the business, only I don't let them share in the efforts of any other man. For example, if a man is manager of a blast furnace department he makes profit out of the successful conduct of his department, but I don't allow him to share in the prosperity of some other able man in some other department of the establishment. I give him a percentage of what he saves or makes in the department immediately under his own control and management. For example, if it takes a dollar a ton to make pig iron, and it takes him a dollar a ton to make pig iron, I say to him, "Well, you are no better than the average manager over the country, therefore you are entitled to only the usual wages. But if you can make pig iron at 90 cents a ton you are entitled to share with me in a large part of the profits, and if you make it for 40 cents or 50 cents a ton you share to a very large degree."

Therefore, I don't care how much a man earns. The more he earns the better I like him. And I pay in what I call bonuses to the various superintendents and managers of the different establishments more money for their successful management than I pay the stockholders of the concern in dividends. And it will surprise you to know the great sums of money that some of these men make. I would be afraid to tell you for fear of discouraging you in your start in life. But I don't mind saying that forty, fifty, sixty, a hundred thousand dollars a year for these men is not infrequent. And in the case of men like Mr. Grace, well, many, many times that.

If you have any influence in the world to get you a start in life, don't use it. The worst thing that can happen to a man is to start life with influence. He has got to do twice as well as the fellow that starts upon his own merits, because, after all, it depends on the general opinion of all those around you as to how competent and successful you are; and when everybody says that you do well because of the influence back of you, then you have got to do twice as well as otherwise. If you are going into any manufacturing establishment, don't go there by reason of any influence you may have. Start upon your own merits, and start in some lowly position, no matter what it is. Be a laborer, if you will. I don't know but that is the best way to start.

This great war has taught us many things. The one thing it has taught us above everything else is that the true life is the life of modern democracy and simplicity, that it is not one of show or of extravagence, that we are men because we are men and because we have the true instincts of men, and we are not men because we are rich or because we occupy a high social position or because we have influence.

Go at your work. You may not find yourself the first year. You may start at work that you think will not be agreeable to you. Do not hesitate to change. If you find that it is not according to your tastes and ultimate ambitions, then change and go into some that is more pleasant. No man can be successful at work if he doesn't find the work he has to do pleasant. No man can ever do a thing well that he is not interested in. When you start in life, if you find you are wrongly placed don't hesitate to change, but don't change because troubles come up and difficulties arise. You must meet and overcome and conquer them. And in meeting and overcoming and conquering them you will make yourself stronger for the future.

Then go on and select your work. Let us suppose you become a craneman. Suppose you become a clerk in a lawyer's office. Give the best that is in you. Let nothing stand in the way of your going on.

Opportunities must come naturally, and the only way that they can come naturally is to give your whole heart, give your whole soul, give your every thought, give your every act to the accomplishment of what you are going to undertake. If you will but make up your mind and determination to go through with what you undertake, you will do that which will bring you more genuine pleasure, satisfaction, and comfort in life than anything else you will ever do.

Engineering Levels Mountains

The Pack Train has become a relic of the past, along with the Prairie Schooner. Modern methods of transportation have leveled mountains, brought San Francisco nearer to New York, and widened the markets of all our great industries.

And the engineering brains and energy, that have developed transportation to the prominence it holds in the business of the world today, are no longer employed in improving means of overland travel alone. Street Railways, Elevator Systems, Interurban Lines and Improved Shipping Lines—these are some of the accomplishments of engineering in the development of better transportation.

Neither have the builders of such systems been concerned only in the actual hauling of people and materials. A study of the methods of handling passengers and freight at the large terminals has developed the Terminal Engineer, who has greatly improved existing methods, and has developed entirely new ones, as well.

Engineering, as it is applied to transportation, has had to concern itself with many kinds of materials and many ways of handling them under all manner of circumstances. For instance the problems surrounding the handling of iron ore, in bulk, are vastly different from those encountered in moving any one of the finished products manufactured from iron ore, that must also be transported in large quantities. But Engineering constantly meets each situation with improved transportation facilities.

Industry, as a whole, and the nations and the people of the world owe much to the engineers, associated with such large manufacturing industries as Westinghouse. They have not only brought about vast improvements, but they have done so at a constantly decreasing cost to those who derive the greatest benefit from them.

Westinghouse

WESTINGHOUSE ELECTRIC

ACHIEVEMENT & OPPORTUNITY

CAMPUS NOTES

EARL L. CALDWELL

HERE'S A TRUE SON OF ST. PAT

"When do we know we are to have rain?" asks a junior civil, writing about rainfall, and he answers himself; "Only a few hours notice can be given with any certainty, and then there is doubt."

THE ENGINEERING SOCIETY OF WISCONSIN

The fifteenth annual convention of The Engineering Society of Wisconsin was held at the University on February 22, 23, and 24.

There was a record attendance, 175 of the 250 members of the society registering, and 21 new members joining during the session. A total of 62 new members joined the society during the year.

A feature of the convention was the joint banquet with the Technical Club of Madison on February 23rd, at which Charles F. Loweth, President of the A. S. C. E., was the principal speaker.

Officers for the ensuing year are: John C. White, president; W. G. Kirchoffer, vice-president, and Professor L. S. Smith, secretary-treasurer.

MACINE DESIGN PROBLEM # O. L.

Design a machine for no purpose whatsoever, but so arranged as to operate in any position. From the diameter of the lag screws holding the machine, compute the necessary horse-power. If this computation is too high, fasten the machine with Lepage's glue and assume any horse-power. Be sure to compute all parts in accordance with the laws of mechanics, but do not take these as final, for as yet, you have made no assumptions. Assume anything you like—everything, if you like—and then discard your computations. Guess all the rest, for remember, this machine is for no purpose whatsoever.

POETRY AT LAWRENCE'S!

Teabone and French a pair,
One of 'em medium, one of 'em rare!

Every year, starting with 1923, a trophy will be awarded to the best hurdler on the Wisconsin track squad. The Phi Kappa Sigma fraternity has raised the funds to purchase the cup which will be known as the "Al Knollin Trophy".

The death of Knollin was a great blow to hundreds of Badger followers, and the Phi Kappa Sigma fraternity feels that the trophy should bear his name.

It is slated to bring out a spirited race in the hurdlers' division to win the cup which was named after Wiscconsin's greatest hurdler.

The following message has been received in acknowledgment of the flowers sent by the junior and senior students of this college: "We wish to thank you for the expression of love and sympathy sent with the flowers for Albert." (sgd.) Mr. and Mrs. A. J. Knollin and family.

YOU TELL HIM, PROF.

Here is a real electrical engineering problem for Professor Bennett to solve:

"* * * my family own a tract of bluff land in Portage County, Wisconsin. On a patch of from three to five acres the lightning so strikes that nothing grows, nor will fence posts last." What's the reason?

WHAT THE MAIL BRINGS IN

The University Extension Department gets some strange replies to its regular assignment questions. The following 'steals' from this source have at least the merit of originality.

"It is not safe to overheat an electric meter as the molecules work much faster and will not register right."

In answer to the question, "Are bar magnets permanent or temporary?" one correspondent wrote "Yes."

Here is an exposition that would have made the old two-fluid theorists applaud: "Electrical pressure, which is correctly knowen as Voltage is the cause of action of the electric current for we must have two currents to compleat a circute theace two currents are knowen as positive and the other negative.

"The positive current which is knowen as potential is higher than the negative current for we must have the potential current in order to have electrical energy, the negative current which is weaker in pressure is of no use without the potential current, so when the two currents are connected together the pressure or voltage causes the electric current to flow."

A PRACTICAL DEPARTURE

Pat Hyland has one of the best "stunts" ever shown on a blackboard. It is a practical way of making a dimension line and arrow-head at one easy sweep. Let us dimension the right hand side of this column. Put your pencil down any place, and draw a line to the column's edge. Then back up, forming the upper half of the arrow-head with a slight, gentle curve; reverse, and go down this time, and form a small concave back to the arrow-head; then return to the arrow-head point, mating the lower curve to the upper curve. It's done in four counts; all ready? by the numbers! But go in and see Pat do it—if you can't compre!

WHAT'S THE MATTER WITH MATHEMATICS? or DO FIGURES LIE?

Here is a little story that is going the rounds. Hop to it, you math hounds, and tell a palpitating public where the error lies.

One Flivver owner installed a carbureter that was guaranteed to save 20 per cent on fuel. Then he put in special plugs that were guaranteed to save 20 per cent. Then he added an intake superheater that was guaranteed to save 20 per cent. He next added a special rear axle that was also guaranteed to save 20 per cent. He put on high-pressure "cords" that promised a 20 per cent saving! And now, with a fuel economy of 120 per cent, he has to stop every hundred miles and bail fuel out of the gas tank to keep it from running over!

WASTED WATER POWER

"But I must pass this course," pleaded the co-ed while big, synthetic tears gullied their way through her make-up.

"My dear young woman," said Professor "Lennie," "this is a course in City Planning, not a course in Irrigation!"

AMPERICALLY SPEAKING

After several months of research, Bill Gluesing announces that the best way to Kilovolt is to push him off Wheatstone's Bridge into the Eddy currents below.

THE ROAD INSPECTORS' SCHOOL

A school for road inspectors was conducted under the auspices of the Wisconsin Highway Commission in the auditorium of the Engineering Building on March 1, 2, and 3. About one hundred took the course.

THE HEIGHT OF ?

Prof. "Dannie" Mead recently read some "horrible examples" of notes. The staff sleuth, he with the eagle eye, happened to be on the front row, and wishing to fathom the poor wretch's depth of failure, peeked on the under side of the notes. They were marked with a large G!

PLEASE BE DEFINITE

It is very hard to ask a perfectly definite question. Some of the profs are very careful with this point, but some are not; there is a loss of time and satisfaction to both parties, and some mutual discontent. For instance, the question was recently asked, "What is *a* current?" Now that in itself is definite, but since the answer was coulombs per second it was the wrong question to ask. It would have been as logical to ask, "What is water?" and then define it as a quart per second.

There is a tendency to abuse the word "why". In many cases, this "why" is unanswerable aside from accepting the facts of nature. The word "why" is always suggestive of the *prime* reason. If the prime reason is vague, indefinable, or not wanted, use the word "discuss" or some other synonym. An exam should be given to be answered, and not to be *reasoned out* and then answered.

If writing is the transportation of thought, does spelling indicate the means of its locomotion? We take the affirmative after reading a paper of a certain student, who, caring little for death and less for taxes, spells taxes, not once, but *four* times, T-A-X-I-S.

HE FORGOT TO REMEMBER

Who says advisors don't know their advisees? This happened on the Ag Campus. Prof. Fuller met one of his advisees and greeted him with: "Hello, Horne, are you in school this semester?"

WISCONSIN FOUNDRYMEN TO MEET AT UNIVERSITY

The first state convention of the foundrymen of Wisconsin will be held at the University of Wisconsin on April 4 and 5. At the same time the Milwaukee, Rockford, Moline, Chicago, and Minneapolis sections of the American Steel Treaters Association will hold technical sessions in Madison. In connection with the convention there will be an exhibition of foundry equipment in the stock pavilion. Foundrymen from Illinois, Iowa, Minnesota, and northern Michigan have been invited to attend.

The general program for the meeting includes technical sessions in the auditorium of the Engineering Building on the mornings of April 4 and 5. The afternoons will be devoted to inspections of points of interest in Madison, including the Forest Products Laboratory, the College of Engineering laboratories, and some of the local manufacturing plants. There will be a banquet at the Park Hotel at 5:30 p. m. on April 5.

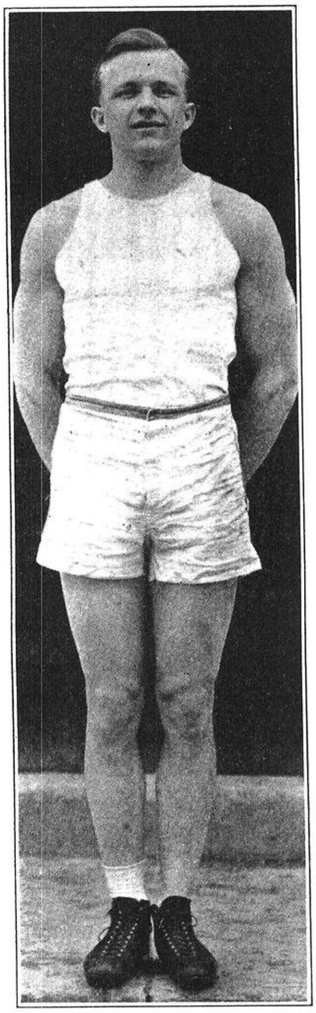
A special program is being arranged for the benefit of the ladies who are expected to accompany the delegates. Besides trips through the State Historical Library and Museum and the State Capitol, there will be entertainment by the Women's Physical Education Department and by the Home Economics Department of the University.

The convention is being sponsored by the Wisconsin Foundrymen's Association and the Department of Mining and Metallurgy of the University. Mr. W. J. Grady, of the Liberty Foundry Co., of Milwaukee, is president, and Mr. Joseph L. Wurm is secretary-treasurer of the foundrymen's association. The local committee in charge of the arrangements consists of Professors R. S. McCaffery and E. R. Shorey.

ATHLETICS

BILL HAMMANN, ATHLETE AND PLUMBER

Among the athletic luminaries that the College of Engineering boasts is one that has been scintillating in every indoor track meet in which Wisconsin has participated. Bill Hammann, junior civil, who is one of the best all around track men who ever wore the Cardinal, pole vaults, puts the shot, high jumps, runs, hurdles, and broad jumps with equal aptitude and ability. In the inter-class meet, held in January, Bill copped first in the broad jump and third in the pole vault. In the annual varsity-frosh meet, held early in February, he cleared 11 feet, 6 inches, for first place in the pole vault. Bill was high man in the Wisconsin Relay Carnival Saturday, February 17, winning first in the pole vault and second in both shot and high hurdles. In the Iowa meet, February 24, at Iowa City, which Iowa won 51 to 35, Hammann and Tomlinson, another Badger vaulter, tied at 11 feet for first place. In the all around championship event of the Illinois Relay Carnival, which includes seven track and field events, Hammann placed second. Some 500 athletes, representing 47 western and southern institutions, participated in this carnival. Bill, like much of our good track material, is a product of the Milwaukee high schools' intensive track training. Here he is repeating the fast pace he set for two years while wearing the colors of Milwaukee North Side High.

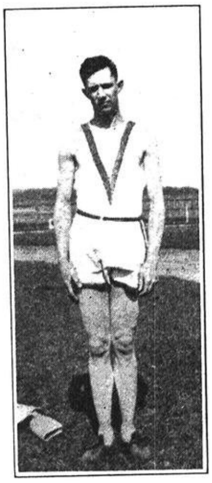


BILL HAMMANN

Scholastically, Hammann has never been the cause of worry to the coaches; his marks, like his vaulting, have always been "way up." Being but a junior, he has another year of intercollegiate competition and before graduating, should write his name along with names of our other famous engineer-athletes.

ANOTHER ENGINEER-ATHLETE, BROWN DONAHUE

Another junior civil who has been breaking into the sporting news at frequent intervals is Brown Donahue. High jumping is Donahue's meat; being some 6 feet, 4 inches in height, his legs are about as long as the average person is tall, so it is little wonder that he clears the bar at six feet with almost persistent regularity. His record reads much like Hammann's: In the inter-class meet he took first in the high jump and second in the shot; in the varsity-frosh meet he did 5 ft. 11 in. for first place, and at our relay carnival, six feet. In the dual meet with Iowa, Donahue tied with Pete Platten, Badger veteran, for first, but went him one better by placing fourth in the Illinois Relay Carnival.



BROWN DONAHUE

Donahue comes from Helena, Montana; he saw service overseas with the engineer corps. Like Hammann, he too has another year of varsity competition in which he should show up some great stuff.

EXTRA!

Wisconsin is now tied for first place! A win over Chicago, 33-11, and another over Indiana, placed the Badgers on a par with Iowa. Indiana, who beat Iowa, never had a chance, the final score being 37-15.

CONFERENCE BASKETBALL

A review of the basketball season is hardly in order in a monthly magazine, until the season is over, because games are being constantly played and the team standings are constantly changing; but a word in regard to Wisconsin's wonderful rise from the depths of pre-conference despair to second in the conference is not out of place. On December 15, the season opened with a defeat at the hands of Butler College; a game with Marquette, on our own floor, resulted in a heart breaking defeat, 9 to 8. Sport critics reserved a lower berth for Wisconsin in the Big Ten race. The Conference season opened and the Badgers successively, and successfully, defeated Northwestern, Indiana, Chicago, and Minnesota. The good luck broke, though, when we hit the Boilermakers at Purdue and the Badgers dropped to second place with five games won and one lost. Since then the record has remained unblemished by defeat. Michigan succumbed twice in rapid succession, and, with a vengeance, the Cardinal jersey-clads beat Purdue by a single point in the last two minutes of play; Minnesota dropped another, 36 to 10. Undefeated Iowa leads the conference, and if the dope holds, she will win a 1000% championship with the Badgers a close second with one defeat and eleven victories.

SECTIONAL PAPER MACHINE DRIVE

(Continued from page 98)

range of the paper speed without having to adjust or give personal attention to the individual motors.

Such a system of sectional drive consists of an adjustable voltage, direct current generator, with direct connected exciter, a direct current adjustable speed motor for each section of the machine, suitable means for connecting the motor to each section of the paper machine driving shaft, and a control system which automatically maintains the correct speed of each individual motor, together with push button stations for starting or stopping, and adjusting the speed of the paper machine. Figure 2 is a photograph of an actual machine showing the location of the motors, control panels, etc.

The generator, which usually forms part of a standard synchronous motor generator set or turbine generator unit, is usually a 250 volt, adjustable voltage, separately excited machine, with a constant voltage 250 volt exciter of sufficient capacity to furnish excitation for the synchronous motor fields, the generator and motor fields and for the control circuit of the regulator. This generator unit can be located in the mill power plant, in the basement of the machine room, or in any convenient point, but preferably not far from the paper machine so that wiring may be cut down to a minimum.

Each section of the machine is driven by an individual adjustable speed, direct current motor operating at 600 to 900 R. P. M. for the larger size motors and at a maximum speed of 1200 to 1300 R. P. M. for the very smallest size motors. The motor is connected to the paper machine section driving shafts through a high grade, high efficiency, totally enclosed reduction gear unit of either the herringbone or worm gear type. In the case of high speed machines, low speed direct connected motors may be used if desired, without the use of any reduction gear. Figure 3 shows a photograph of a unit with herringbone reduction gear.

The regulator and control equipment consists of a control board having a master control panel, a unit section control panel for each section motor, a reel control panel for the control of the reel drive, a control speed changer and section frequency generator for each section, a master frequency generator and push button stations for the machine as a whole and for each individual section. The master control panel, in addition to having generator and exciter knife switches, overload protection, and other ordinary panel equipment, carries a motor-operated field rheostat for the generator which is under the control of two push button stations, one located on the panel itself and one on the front of the machine at any convenient point. By means of these push buttons the generator voltage is raised or lowered at will, and the speed of the entire paper machine as a whole is controlled without any hand adjustment being necessary for the individual sections. Each of these two push button stations has three push buttons, one to increase the speed of the paper machine as a whole, one to decrease the speed, and one to stop the entire paper machine. There is also provided on the master control panel means for automatically starting up the master frequency generator as soon as the exciter comes up to the voltage, so that the operator does not have any of these details to attend to. The master control panel, in addition to having approximately 100 steps covering the entire range of paper speed from the highest to the lowest, has several additional steps for lower speeds to be used when washing felts.

Each of the unit section control panels carries a motor-operated field rheostat connected in the field of the driving motor for that particular section and under control of the regulator control contacting element or rotary contactor, which is also mounted on the panel. A magnetic line contactor, and motor-operated cam accelerating switches are mounted on this panel for starting and stopping the driving section motors. The contactor and switches are under the control of the two push button stations, one of which is located on the panel and the other at the front of the machine at any convenient point in close proximity to the section being controlled.

Each of these push button stations has a "start" button, a "stop" button and a "jog" button, used for starting and stopping the motor and for "inching" along at a very slow speed in putting on felts and like operations. In addition to the apparatus described, each of these unit section control panels has the usual protective apparatus, a knife switch, and a shunt for the instruments.

The master frequency generator is driven by a small direct current motor operating in parallel with the section driving motors. The speed of this set is increased or decreased with the speed of the paper machine whenever adjustments are made, and it is to this set that the speed of each section of the paper machine is referred and regulated by the regulating system. The master frequency generator and its driving motor are coupled together and mounted on a common bedplate forming a very small motor generator set.

The control speed changer, the function of which is to enable the operator to change the relation of speeds between the section frequency generators and the section driving motors to obtain the draw required and at the same time maintaining an absolute balance of frequencies between the section frequency generators and the master frequency generator, consists of a pair of small cone pulleys with a very slight amount of taper, equipped with ball bearings

SHOP LIGHTING.

In an address delivered before the members of the Western Pennsylvania Division of the National Safety Council, Pittsburg, Pa., March, 1918, by C. W. Price, the importance of good lighting in industrial establishments was discussed, and the disalvantages of poor lighting were clearly shown by some figures mentioned by Mr. Price.

A large insurance company analyzed 91,000 accident reports, for the purpose of discovering the causes of these mishaps. It was found that 10% was directly traceable to inadequate lighting and in 13.8% the same cause was a contributory factor. The British Government in a report of the investigation of causes of accidents determined a close parallel to the findings of the insurance company above quoted. The British investigators found that by comparing the four winter months with the four summer months, there were 39.5% more men injured by stumbling and falling in winter than in summer.

Mr. John Calder, a pioneer in safety work, made an investigation of accident statistics covering 80,000 industrial plants. His analysis covered 700 accidental deaths, and of these 45% more occurred during the four winter months than during the four summer months.

Mr. C. L. Eschleman, in a paper published in the proceedings of the American Institute of Electrical Engineers several years ago, reported the result of an investigation of a large number of plants in which efficient lighting had been installed. He found that in such plants as steel mills, where the work is of a coarse nature, efficient lighting increased the total output 2%; in plants, such as textile mills and shoe factories, the output was increased 10%.

In an investigation of the causes of eye fatigue, made by the Industrial Commission of Wisconsin, it was found that in a large percentage of industries, such as shoe, clothing and textile factories, the lack of proper lighting (both natural and artificial) resulted in eye fatigue and loss of efficiency. At one knitting mill, where a girl was doing close work under improper lighting conditions, her efficiency dropped 50% every day during the hours from 2:30 to 5:30 P. M.

The above mentioned incidents indicate how important a factor lighting is in the operation of the industrial plant. It has been well said, "Light is a tool, which increases the efficiency of every tool in the plant." Glare or too much light is as harmful as not enough lighting, and in no case shou'd the eyes of the workers be exposed to direct rays, either of sun or electric light.

Windows and reflectors should always be kept clean; that is, cleaning them at least once a week, for where dust and dirt are allowed to collect, efficiency of the light is decreased as much as 25%.

Good lighting, in addition to its other marked advantages, is a strong incentive towards keeping working places clean, for it clearly exposes any place where dirt or other material has been allowed to collect. White walls and clean windows glazed with Factrolite Glass will eliminate the sun glare and increase the illumination 25 to 50 feet from the window from 38% to 72% as compared with plain glass.

Lighting is of primary importance to every employer and fully warrants a careful investigation of the subject, for there is no substitute for good lighting, and if it is not supplied the efficiency of the entire working force must suffer a serious reduction.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,

220 Fifth Avenue,

St. Louis. New York. Chicago.

No. 5.

and a very accurate belt shifting device. The control speed changer is driven from the motor shaft by a small chain drive and as this is merely an indicating and protecting device, no power is transmitted in one way or another and the only work required of the belt on the small cone pulleys is to overcome the slight bearing friction of the device.

These section frequency generators are very small machines coupled to, and mounted on, the same bed plate with the small control speed changers. It is by means of the small hand adjusting wheel on the control speed changer that the amount can be determined by the operator and when set for a given value the relative speeds of the various sections of the machine will thereafter be maintained with great precision.

The regulator control element, or rotary contractor, as it is called, is really the heart of the regulating system. It is mounted on each of the unit section control panels and consists of two pairs of disc contractors actuated by a normally balanced rotative member of a powerful relay. This balance is only obtained when there is an exact balance of frequency between the master frequency generator and the section frequency generator. An exceedingly effective anti-hunting device is also made a part of this equipment, which positively prevents over-travel or hunting.

A 60 cycle source of power is required for the excitation of the fields of the master frequency generator and the section frequency generators, but does not have to be of uniform frequency or voltage, as such variations do not affect the regulation of the paper machine sections. In cases where no 60 cycle current is available, a small 60 cycle motor generator set is provided, the motor being driven by direct current from the exciter and the generator furnishing the excitation current for the regulator circuit. Means are also provided on a master control panel for automatically starting up this set when the exciter comes up to normal voltage, so that the operator does not have to start the set manually or to give any attention to it.

In starting the equipment, after everything has been entirely shut down, as on a Monday morning, the operator or engineer will first start the motor generator set or turbine generator unit, as the case may be, in the same way that he would start any other similar machine. As it is assumed that the generator and exciter switches were left closed as they should be, and that no change has been made in the setting of the master rheostat, the generator and exciter repidly come up to their proper voltages, the exciter to normal voltage and the generator to the voltage which it had when the machine was shut down. As the exciter comes up to its normal voltage, the master frequency generator automatically starts and comes up to the proper speed as will also the 60 cycle motor generator set used for excitation of the regulator system. All of this takes place in the period of a few seconds and the paper machine is ready to be started. When the operator is ready to start up a section, he simply presses the "start" button for that section and the driving motor immediately starts and comes up to the speed at which it was running when the machine was shut down.

The automatic regulator also comes into action on this section which has been started and holds it at the proper speed. Each of the other sections is started and held at its proper speed. Each of the other sections is started in like manner by pressing the "start" button for that section, the regulator automatically coming into action as the sections are started up without any attention or thought on the part of the operator. As soon as the "start" button is depressed, the magnetically operated line contactor comes in, which puts current on the motor with full resistance in series with the armature circuit and with full field on the motors. The motor-operated accelerating switch also at the same time starts up, slowly bringing one accelerating switch after another into contact until all of the resistance in series with the armature circuit has been cut out, at which time the motor is placed directly across the line, still with full field strength. At this point, or as soon as the motor has reached its maximum speed under this condition, the field relays gradually weaken the motor field, bringing the motor up to the speed for which the master rheostat is set. At this point the automatic regulator takes hold and through the rotary contactor, motor-operated field rheostat and anti-hunting devices, maintains the proper speed. When all of the sections have been started up, the operator puts the paper over the machine in the usual way, and the regulator takes care of the draw and maintains the proper speeds.

After the paper has been put over the machine, if the operator finds that on account of any change in the stock, he wishes to change the relation of speeds between any of the sections, in order to get a different draw, he accomplishes this by turning the small hand wheel on the control speed changer, which definately changes the relation of speeds between sections. After this is done the new speed is maintained automatically. If the operator desires to raise or lower the speed of the entire machine, he does so by depressing the "fast" or "slow" button until the speed has reached the value he desires. This changes the voltage of the generator and thereby changes the speed of the motors. If operating in the higher ranges of speed, field control also is used.

The "stop" button on the master control push button station on the front of the machine can be used for stopping the entire paper machine as a unit without having to stop each individual section separately by the individual "stop" buttons.

When any motor has been started up the automatic regulator controls the speed and if any tendency of the motor to change speeds takes place, no matter how small, the regulator immediately detects and corrects it by making the proper adjustment in the field strength of the motor. Thus, the speed of every section of the paper machine is maintained at its correct value. Whenever the operator finds that he can speed up the machine a little, it is only necessary that he push the "fast" button on either one of the two stations in connection with the master control panel, and as long as he holds down the button the machine will continue to increase in speed. On the other hand, if he wishes to slow down the speed of the machine, he pushes the "slow" button, keeping it depressed until the speed has reached the point desired. Should it be necessary for any reason to shut down a single section, the operator simply pushes the "stop" button for that section and the motor driving that section stops at once. It may be again started by pushing the "fast" button as previously indicated. While this stopping and starting operation is being carried on the other sections of the machine continue to operate at exactly the correct speed without interference in any way.

With this system the direct current motors operate almost exactly as synchronous motors, but they can be locked together in any desired speed relation, whereas synchronous motors can only be locked together in one speed relation.

Synchronous motors fall back in angular position with respect to each other or to the generator furnishing the source of current when a load is thrown on, and in the same mannner, the direct current motors fall back slightly in angular displacement when the load is thrown on or a considerable change in temperature occurs, but the change is so small as to be practically imperceptible. It should be understood, however, that the speed in revolutions per minute does not change.

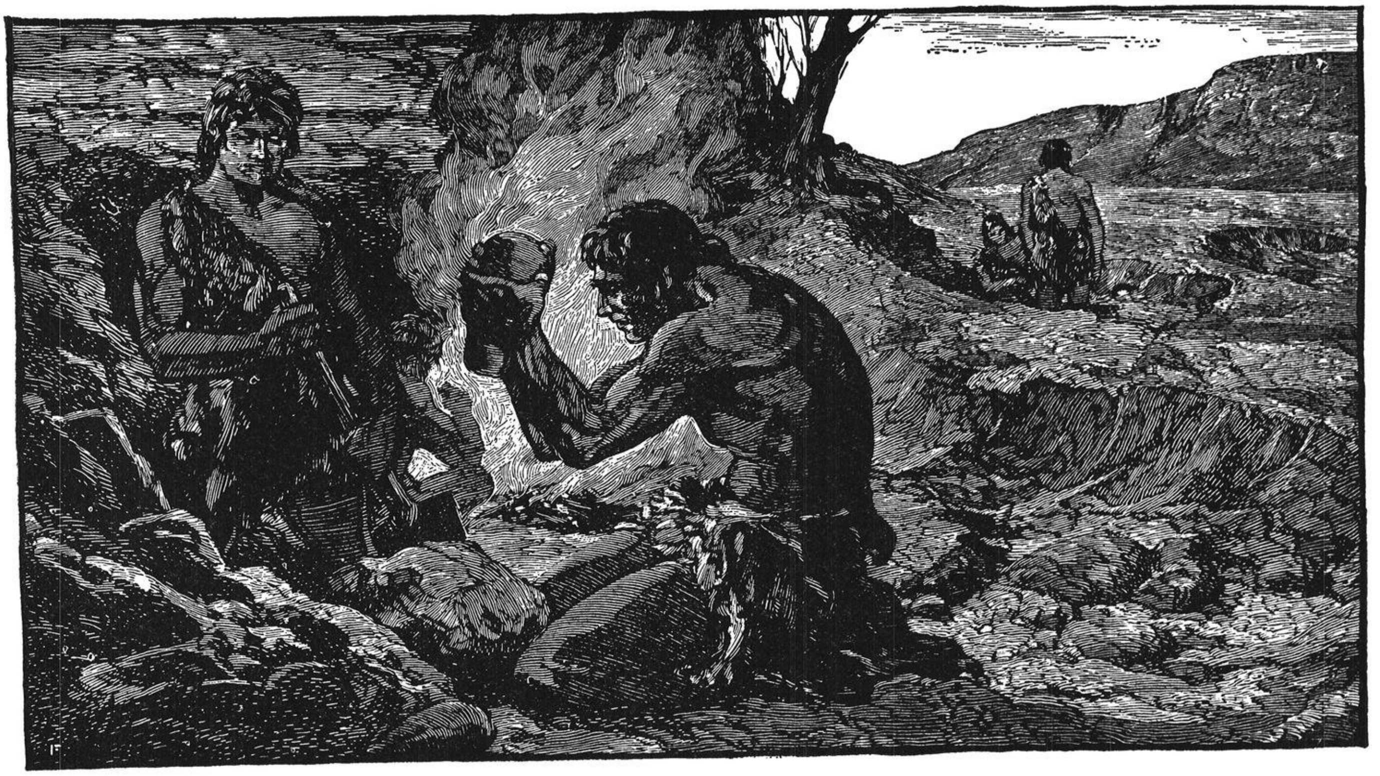
The work of the operator is very simple in so far as the drive and regulator is concerned. After the generator has been started up, which is also the simplest of operations, the operator has nothing further to do except to operate the several push buttons, to start, stop or jog any section, or to increase or decrease the speed. In case it is necessary to change the relation of speeds between any of the sections in order to compensate for changes in stock, it is only necessary for the operator to turn a small hand wheel on the control speed changer. It will be seen that the operator has absolutely nothing to do with the regulator, in fact it is not necessary that he know that there is a regulator, as the regulator is started and stopped automatically and takes care of the regulation of the various motors without any personal attention.

To get a broader idea of the very exacting speed regulation requirements that have to be met in sectional drive, it may be said that it has recently been discovered that in order to make good strong paper, without breaking or straining the sheet, any variation of speeds between sections must be kept well within one-tenth of one per cent. Doubtless the reason that this has not been known before is because no ordinary instrument is sufficiently sensitive or accurate to detect such small changes in speed, and it was only through the development of very special apparatus that such small measurements could be made.

Before any governor or regulator can function, there must be a change of some kind, either a load change or speed change. However, these changes in speed which may not be large enough to be perceptible to the eye or detectable by any ordinary type of indicating or recording apparatus are detected by this regulation as it is only necessary that changes in speed of as small a value as a few thousandths of one per cent take place before the regulator will make the necessary correction. As soon as any speed change in any section is detected by the regulator, a change in the field strength of the motor is accomplished which immediately corrects it. As soon as there is any change of speed between sections or between any section and the master frequency generator, an unbalancing of frequencies results. The effect is instantly transmitted to the rotary contactor heretofore mentioned and a rotation of the powerful relay in one direction or the other results. Through the contact making mechanism, the motor-operated field rheostat, and the anti-hunting device, the proper change in field strength is accomplished and the motor speed is corrected without any overtravel or tendency to hunt.

From very careful tests and observations which have been made, lasting over many months, it has been found that there are certain load changes taking place on the various sections of the paper machine almost continuously. These variations due to changes in lubrication and in bearing friction, to variation in the weight on the presses, and to various minor fluctuations, as well as changes in the load on the dryers caused by the pull of the calendars on the dryers. Similar changes also occur on the calendars on account of the load which they have taken from the dryers. These changes are considerable, varying perhaps from five to fifteen per cent on the couch and presses, and in some cases to as much as twenty per cent or more on the dryers and calenders, particularly in cases where the paper breaks between the dryers and the calendars, for then any load that the calendar may be taking from the dryers is instantly dropped. All of these changes in load have a tendency to cause a change in speed of the driving motors, and these tendencies to speed change must be immediately corrected by the regulator in order to prevent breakage of the sheet on the paper machine.

The system of drive which has been described in this paper is equally satisfactory and suitable for machine requiring extremely wide ranges of speed, such as ten or fifteen to one, or even greater if desired, and for machines requiring only a small range of speed, such as news machines with perhaps only two to one speed rang. The system has proven capable of maintaining the relative speeds of the various sectional drives within the very close range of one-tenth of one percent.



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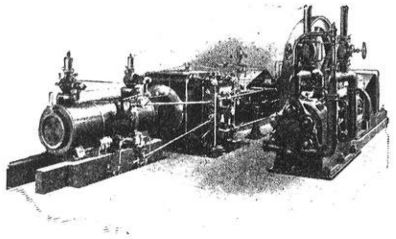

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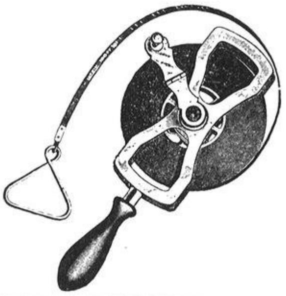

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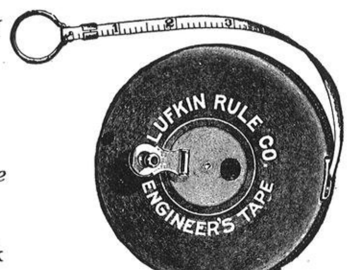

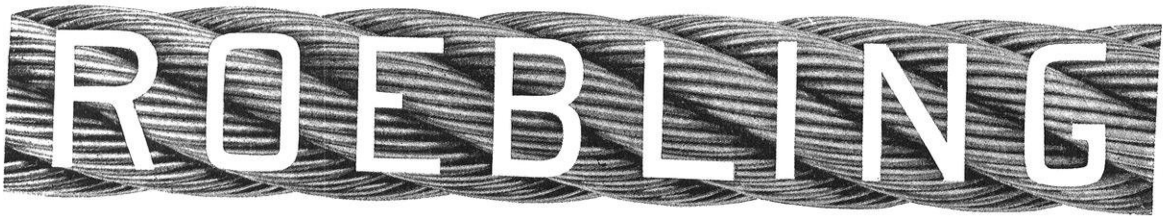

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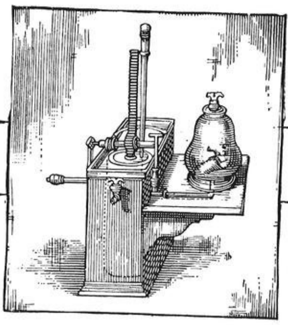

The "*PRACTICAL*" Alchemist *and* "*THEORETICAL*" Robert Boyle

THE alchemists wrote vaguely of "fluids" and "principles." Copper was potentially silver. Rid it of its red color and the "principle" of silver would assert itself, so that silver would remain. With a certain amount of philosopher's stone (itself a mysterious "principle") a base metal could be converted into a quantity of gold a million times as great.

This all sounded so "practical" that Kings listened credulously, but the only tangible result was that they were enriched with much bogus gold.

Scientific theorists like Robert Boyle (1627-1691) proved more "practical" by testing matter, discovering its composition and then drawing scientific conclusions that could thereafter be usefully and honestly applied. Alchemists conjectured and died; he experimented and lived.

Using the air pump Boyle undertook a "theoretical" but scientific experimental study of the atmosphere and discovered that it had a "spring" in it, or in other words that it could expand. He also established the connection between the boiling point of water and atmospheric pressure, a very "theoretical" discovery in his day but one which every steam engineer now applies.

He was the first to use the term "analysis" in the modern chemical sense, the first to define an element as a body which cannot be subdivided and from which compounds can be reconstituted.

Boyle's work has not ended. Today in the Research Laboratories of the General Electric Company it is being continued. Much light has there been shed on the chemical reactions that occur in a vessel in which a nearly perfect vacuum has been produced. One practical result of this work is the vacuum tube which plays an essential part in radio work and roentgenology.

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