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THE TECHNIC.

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SINCE the last issue of THE TECHNIC two additions have been made to the editorial staff, Mr. Fred B. Lewis being elected Freshman representative and Mr. Robert F. Garrettson, Asst. Business Manager. Both men are well qualified for the positions, and will no doubt add considerably to the efficiency of the Board.

THE change recently made in the Institute calendar which shortens the Spring vacation and brings Commencement on June 12th, is expected to benefit graduates and students who wish to take positions immediately after Commencement. It seems to us that the week can make but little difference this year, however, if the date of Commencement were to be made one week earlier each year until carried back to the 1st of May, the opportunities then for the graduate would certainly be greater than a month later. A still better arrangement would be to have the Seniors graduate at the first of the year when engineering firms are making changes and men are in demand. A change to bring this about would, however, necessitate a shortening of the Course or of the Summer vacation.

IT appears that whether a student may make up lost time or not depends, not only on his properly filling out the blank form giving cause for the absence, but also on whether the cause given satisfies the professor, and, at times, what one has considered a good excuse another has not. If such cases where this has happened had been passed upon by the Faculty, there is reason to believe that the absences would not have been excused, so there is no just cause for complaint.

IT is announced that the marks of the Spring vacation will be averaged with those of June. No one will be dropped though they fail to make the passing mark, but will be conditioned and carried on till June.

THE Juniors hope to outdo all preceding classes in presenting a Modulus of superior literary and artistic merit. We look for its appearance on May 1st.

WE present this month a leading article by Dr. Gray on "Sources of Power."

Sources of Power.

By THOMAS GRAY.

The source of power on which we mainly depend at the present time is coal. This is due to the comparative cheapness and large available supply of coal in many localities and the consequent development of the steam engine. As a direct consequence we find the location of nearly all the great centers of industry over the world determined by the proximity of coal mines. If, however, present methods of obtaining and utilizing power be not supplanted by others, which either do not involve the use of coal or which use it much more economically, there is good reason to fear failure of supply in many places and consequent changes in the position of the centers of industry. The present demand for power is, in many places, enormous and it is rapidly increasing, while, with all our vaunted progress in the perfection of steam engines and other motors, we still continue to waste nine-tenths or more of the coal used for power purposes. That the total coal supply of the world will fail in the near future there is no reason to fear. There is coal enough for centuries, but the possession of that coal may be a large factor in determining the future wealth and importance of several nations not now in the first rank.

The primary source of power on this planet is the sun and one of the important ways in which it is made available is through plant growth. In early ages the energy stored by plant growth was not all used and fortunate conditions caused part of the excess of vegetation to be covered up and its potential energy saved for future use. Lord Kelvin referred in an interesting way to this storage of fuel in a paper read before the British Association for the Advancement of Science at Toronto in 1897. The starting point in the paper was the assumption that initially the earth was so hot that there could be no vegetation on its surface and besides, drawing inferences from the spectra of other bodies, that there was probably no free oxygen in the atmosphere. He then made a rough estimate of the amount of oxygen now existing in the atmosphere and calculated how much carbon must have been absorbed by vegetable growth and not again burned in order to set free that oxygen. He came to the conclusion that there is about ten tons of air or about two tons of oxygen to every square meter of the earth's surface. There is about 510,000,000,000,000 (five hundred and ten million million) square meters of surface and hence, taking three tons of oxygen to one ton of coal, that there is stored somewhere in the earth's crust about 340,000,000,000,000 (three hundred and forty million million) tons of coal. He found as a particular case that the estimated coal supply of Great Britain was rather greater than her share of oxygen would burn and hence that if all parts of the earths crust was equally well supplied animal life would be more likely to cease from want of oxygen than from want of fuel.

Of course a large part of the fuel estimated by Kelvin to exist will be unavailable due to its being under ocean beds or distributed through the strata in such a way that it can not be economically obtained. The figures and the point of view are, however, both of them very interesting and suggestive.

Let us compare the total coal supply above referred to with the present rate of coal consumption and with the Geological estimate of available coal beds. At present there is mined annually about six hundred million tons and the Geological estimates of available coal place the total known coal at about one thousand times this much. We see, therefore, that even the total known coal is only a small fraction of the amount estimated by Kelvin to exist. Supposing, for instance, that the coal under the ocean is as plentiful as under the land, but that it is unavailable, we should have left under the land about

80,000,000,000,000 (eighty million million) tons which, even if the consumption reach one thousand million tons per year, would last for eighty thousand years. Apparently only about one per cent. of the theoretical coal under land has been discovered. It is known, however, that there are very extensive coal beds in many parts of the world, particularly in Asia, which have never been surveyed. One thing seems certain there is coal enough to last until our present methods of using it have been forgotten. There will be ample time to find means of economizing power and to contrive other ways of getting it before we are hard pressed for fuel.

As regards the production of power from coal; the total coal mined, if utilized for power purposes, using first class steam engines, would give about seven hundred thousand million horse power hours per annum. This at ten hours per day for three hundred days in the year represents an engine power of two hundred and thirty million horse power, which is perhaps ten times the actual engine power in nse. A large part of the coal mined is, of course, used for other purposes and a large fraction of the engines in use are of much lower efficiency than that here assumed.

Since by the combustion of all this coal a large amount of oxygen is annually taken from the atmosphere it may be interesting to make a rough comparison with the above of the probable equivalent, in fuel value, of the vegetable growth of the earth's surface. The fertile area of the earth's surface is about twenty-eight million square miles and there is besides this fertile area about fourteen million square miles of steppes on which there is considerable vegetation. The remainder of the land surface is desert and polar regions. Take as a rough approximation thirty million square miles of average fertility and assume that each square mile produces annually six hundred tons of vegetation. This gives a total of eighteen thousand million tons of vegetation which is equivalent to about half as much coal. We thus see that annual production of fuel by vegetation must be ten times or more the corresponding consumption of coal. Of course a large part of this vegetation is consumed by animal life and by slow spontaneous oxidation but we can readily see how nature keeps up the supply of oxygen. We can readily imagine that vegetation will increase as the amount of combined oxygen in the atmosphere increases and the free oxygen diminishes.

It is interesting also to compare this annual production of fuel by vegetable growth with the total fuel as estimated by Kelvin. At our present annual rate of production of nine thousand million tons it would take nearly four hundred thousand years to produce the three hundred and forty million million tons in that estimate. When we consider that only a fraction of the annual production can have been stored there must either have been very much more rapid vegetable growth in former ages or the earth must have been cool enough for life to exist on its surface for millions of years.

That there is any important amount of storage of fuel going on at the present time seems doubtful. There is of course some in the form of beds of peat. A large part of the vegetation at present produced is used for animal food and probably a larger part is lost by slow oxidation in the atmosphere. The number of human inhabitants on the globe is about one hundred and fifty millions. If they were all vegetarians they might use about two million tons per day or perhaps, allowing for waste, about one thousand million tons per year. There is of course a large consumption by other animals, a small fraction of which is returned as human food for those who are not vegetarians. There is also a large consumption of vegetation in the form of timber, etc., but allowing for all these there is undoubtedly a large residue which if properly preserved could be used for fuel.

Taking the United States alone, the total area is about three million square miles. Suppose one third of this to be productive of vegetation at six hundred tons per square mile and we get eighteen hundred million tons or the equivalent of nine hundred million tons of coal per year. The actual consumption of coal is about two hundred and thirty million tons. The steam horse power, including manufactures, merchant marine, war ships, etc., is perhaps ten million horse power for which fifty million tons of coal should be sufficient.

There are about fifteen million horses and mules in the United States, about fifty million cattle and a similar number of sheep and swine. If we consider how inefficient a horse is as a source of power, and remember that these animals eat whether they work or not, we get a rough idea of where a considerable part of the vegetation goes. We also see that our live horses consume much more fuel than our steam engines.

Turning now to another source of power we find that, in the United States, there is used a little more than a million horse power obtained from water wheels of various kinds. The question as to the possible development of this source of power is at present of great interest because economical methods of distributing it are being found. This power depends on rainfall. The average rainfall of the world is about thirty-six inches and it falls on fifty million square miles of surface at an average elevation of fourteen hundred feet. The stored energy represented by this water is enormous but only a small fraction is practically available. A large part of this water is again evaporated, another large part is taken up by plant growth and the remainder loses much of its elevation before it reaches the rivers where it can be utilized. A great many rivers which carry large volumes of water to the ocean are so long and hence have such a gentle slope that they are useless as power producers. When all these deductions are made only an insignificant fraction of the enormous total remains. Let us try to get a little data from one or two well-known localities in this country.

Take first the great lakes and the Niagara Falls. The area west of Niagara Falls which is drained by the lakes is somewhere about three hundred thousand square miles and the power available at the falls is about six million horse power. This gives twenty horse power to the square mile. The average rainfall is about thirty inches. Probably it will be difficult to find another equally favorable case, because a large part—twenty-five per cent. or more—of the water actually falls in the lakes and hence is not drawn upon for vegetable growth. Another favorable condition is the low average temperature over the lake region. Even under these favorable conditions only about one-fourth of the water goes over the falls.

As another example take the Mississippi river above the Des Moines rapids. The drainage area is about one hundred and seventy thousand square miles and the average rainfall thirty-five inches, while the water passing over the Des Moines rapids is probably on the average about one hundred thousand cubic feet per second. There are three good falls, one of nearly eighty feet at Minneapolis, one of twenty-two feet at Rock Island and one twenty-four feet at Des Moines rapids. The total available power is somewhat less than one and a half million horse power. This gives about eight horse power per square mile. It is to be remembered, of course, that in cases like these the power is available for twenty-four hours per day.

Suppose we assume that on the average there is a possible ten horse power per square mile available from water power. The total water power of the United States should be about thirty million horse power for twenty-four hours per day. That of the whole world should be about five hundred million horse power Such an amount of power is more than sufficient for all purposes but to utilize it would either involve great changes in the location of industrial centers or expensive transmission plants. The interest on the capital outlay would probably, in most cases, render the power more expensive than it is at present where coal is used. It is even doubtful whether, with all its advantages, the large Niagara power installation will prove a great commercial success.

Closely allied to the water power just discussed is the possible power obtainable from the tides. Tidal power has been often talked about and many proposals have been made as to means for its utilization. The average rise and fall of the tide is small and hence the use of this power is only likely to be economical at a few places where local conditions render the tidal rise and fall abnormal. It is possible that at some future time, when power becomes much more expensive than it is at present, some artificial means may be adopted in order to produce abnormal rise. Such for example as the artificial production of "bores" by means of which the moderately rapid flow of a large volume of water may be made to raise a portion of it to a considerable height. Storage room would of course be required and in many cases would be too expensive. There is, in fact, little prospect that tidal power can be made valuable under present conditions.

Another source of power, which has been utilized with great advantage for some purposes, is the wind. Wind power probably shows to greatest advantage in the propulsion of ships for which purpose it would be ideal were it not for its unreliable character. The great variability in direction and intensity of the wind has led to the adoption of steam power for ship propulsion in all cases where time of transit is important the greater cost being more than offset by the punctuality and promptness of delivery. There remain, however, a great many cases where the time of transportation is not an important element commercially. This is particularly the case where the value of the cargo is intrinsically small or in times of depression when sales are slow the ship may form a convenient means of storage. At certain seasons also cargos of grain may be shipped from distant parts for the purpose of supplying a demand which can only come some months later. In such a case a sailing ship serves for storage while the cargo may be bought and sold several times on the speculative market while it is in transit.

The use of wind power on land has been restricted almost entirely to small units applied to such purposes as pumping water for domestic purposes or for farm stock. Even within these limits, however, it has been of great value. For ordinary industrial applications its variable character renders it unsuitable unless supplemented by ample storage, the provision of which involves such an expense as to be prohibitory. As an auxiliary source of power there seems little reason why wind power should not be more used and an increase in the price of coal may lead to this being more commonly the case. If a cheap enough means of storage can be devised there will be no difficulty in obtaining ample power for all purposes from the winds.

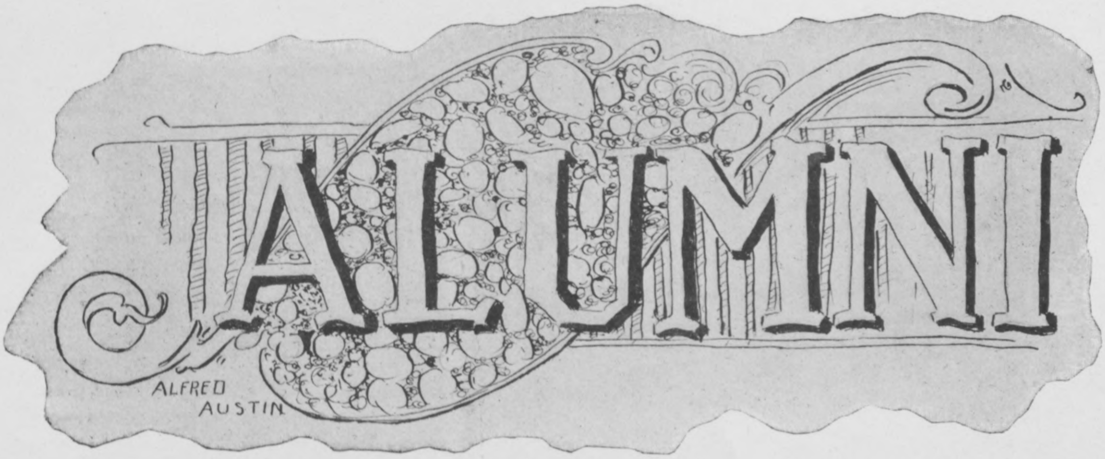
The sources of power discussed above are with the exception of the tides all of them secondary products of the action the sun's rays. There remains, perhaps the most interesting of all, the possibility of directly utilizing the heat radiated from the sun. Very few have any conception of the enormous amount of heat energy which is received by the earth from the sun. Langley has proved experimentally that, if the earth's atmosphere was removed, every square centimetre of surface which is normally exposed to the heat of the sun would receive enough heat per minute to raise the temperature of a gramme of water three degrees centigrade.* In more familiar units every square foot of surface placed at right angles to the suns rays would, if there were no atmosphere, receive enough heat in a minute to raise the temperature of a pound of water about six degrees centigrade or about eleven British thermal units. This is the equivalent of a quarter horse power per square foot. A considerable part of this theoretical heat is lost on account of atmospheric absorption. The results of Langley's measurements are given on the same page of the tables already referred to. The percentage absorption varies with the wave length of the heat rays and may on the average reach forty or fifty per cent. in a clear atmosphere but even with this loss enough remains to give a horse power for every eight or ten square feet. Ericsson in a work published in connection with the Centennial Exhibition in 1876, devotes considerable space to this subject and states that the results of repeated experiments with his concentration apparatus showed that three and a half British thermal

*Smithsonian Physical Tables, p. 177.

units of heat could be obtained for each square foot of surface per minute in latitudes between the Equator and 45°. This is equivalent to one horse power for twelve square feet. In estimating the possibilities of the solar engine Ericsson assumed that one horse power could actually be obtained by means of a steam engine for every hundred square feet of surface expose to the sun. He recognizes the fact that an engine depending on direct radiation from the sun would be a very uncertain source of power in our climate, would in fact, be fully as erratic as a windmill because of the great amount of cloudy weather. On the other hand there are millions of square miles of the earth's surface over which a cloud is seldom seen. In such a region the solar engine might be made perfectly reliable. Suppose that in such a region, say in Upper Egypt or along the coast of Lower California, we were to cover, say one-tenth of the surface with apparatus for concentrating the sun's rays on steam boilers. For every square mile we would have on the above assumption about three million square feet of absorbing surface, which at one hundred square feet per horse power would give thirty thousand horse power. It will be seen that a few hundred miles of coast line a mile or two wide down in Lower Calfornia may be utilized to provide more power than is now used by the whole country both on land and sea.

Ericsson's concentration apparatus consisted simply of a very large conical mirror on which the sun's rays were received and reflected to a focus on a steam boiler. To be efficient the whole apparatus should be turned continuously so as to face the sun.

That we can get energy enough to do our work by direct radiation, if in no other way, is evident and probably we can get it as economically as we now obtain it from coal. Such a change will, however, move our centers of industry to Lower California, the table land of Mexico, the Upper Nile, the Northwest coast of Africa, or some equally undesirable region. Who can tell what changes may come before such an expedient has to be resorted to. It is not unlikely that means may be found of picking up power in such a region and transmitting it economically to another where the human population can enjoy a suitable climate.



Chain Belt Drives.

By ALLAN S. BIXBY, '02.

ABOUT twenty-eight years ago the necessity for a belt giving a positive drive or absolute fixed velocity ratio became apparent. The leather belt would not answer the purpose and a long train of gears was not the proper solution for this particular case at least; so the necessity of wheels having teeth and a chain belt having recesses for contact with these teeth became apparent. Since that time chain or link belt drives of all descriptions have been manufactured.

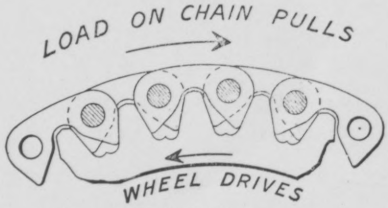
The pitch of these chains when new corresponded with the pitch of the wheels, and for a while ran along and were a noisy pair. Gradually but surely the chain became longer, leaving only one tooth in contact with the chain at a time and that tooth giving way to the next tooth under strain, causing a very destructive action between chain and wheel. It filled the want for the time being and would run outdoors as well as in and in many cases would last as long as the machine it was on.

The feeling that something better was needed led to the manufacture of steel chains with hardened surfaces, such as bicycle chains and ones of a similar class for heavier duties; but the fact that these surfaces were hardened did not prevent their wearing some, making the pitch long, so that they no longer fit the wheels, and this misfit caused a more rapid wear on both chain and wheel, because the link in contact was always being dragged off the tooth, and in addition to the increased wear there was also an increase in noise. However, the men who were using link belt, and the men who were making it did not give it up, for barring these difficulties, the benefits to be derived from having a positive drive were apparent to all.

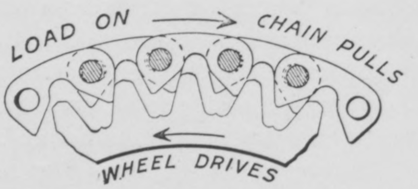
Some one suggested putting a roller on the part of the link which came in contact with the wheel tooth and letting it roll off of the tooth. This was indeed a good idea. If the chain could not be prevented from wearing the friction could at least be reduced by the use of this roller.

For a number of years the manufacturers of the chains have been carrying on experiments to better the product and the wheels have been tried with different forms of teeth, all with one end in view, to compensate for the wear of the chain. In other words to get a form of tooth and contact part of the link, so that the pitch diameter of the wheels will increase as the pitch of the chain increases, always getting a perfect fit and enabling the chain embracing the wheel to be in contact with every tooth. This has at last been accomplished and we have the Renold Silent Chain Transmission Gear, named after the inventor, Hans Renold, of Manchester, England.

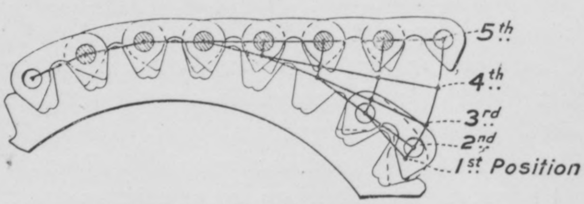
I shall endeavor to briefly describe this chain and its action. The upper illustration shows the meshing of the chain when new. The middle one when the chain has elongated .6 inches per foot and the lower one shows the action of the chain when coming on and when leaving the wheel



NEW CHAIN.



WORN CHAIN. CHAIN ELONGATED .6″ PER FT.



LINKS COMING INTO MESH.

From the third illustration one can readily analyze the action of the chain. The link or section which is coming into mesh is rotating into position on its joint with a link or section already against the wheel tooth. This link rotates about the joint until the face of the link comes in contact with the tooth face, the inclination of this face being such as to prevent any wedging. It may readily be seen that as the chain pitch increases the link finds its seat farther up the tooth face, thus automatically adjusting itself to the wheel.

As the chain elongates from use it assumes a position farther and farther out on the wheel's teeth, forming a larger pitch circle, exactly proportional to the increased pitch of the chain. The middle illustration shows the chain after having elongated .6 inches per foot and giving the same perfect action as the new one.

The advantages of chain driving in general is that it gives an absolutely fixed velocity ratio, can be run slack, and the only pressure on the journals is that necessary to perform the work required.

As the chain is not required to be tight it may be run on short centers, thus accomplishing a saving of space and making many drives possible, that would otherwise be very difficult. It is also adapted to damp and hot places where a belt cannot be used. The particular advantages of the Renold chain are the absolute silent running and the high speed at which the chain may be run.

It is stated that a motor car ran 30,000 miles with a chain of this type, which was in good order and entirely serviceable after this performance. The normal speed of the chain in this case was 2000 feet per minute. In general practice it is not best to run the chain over 1200 or 1500 feet per minute.

The chain is not new, having been in use in Europe about four years. There are several hundred drives in use in this country. The chain is being used for a great variety of purposes, such as positive drives and feeds on machines, driving governors on engines, automobiles, direct connecting motors to fans and motors to line shafting and many others. Among recent complete installations may be mentioned that of the Natural Food Company, Niagara Falls, about the equipment of which several articles have recently appeared in Scientific Journals.

When a chain becomes too wide for convenience in manufacture or handling, two chains may be run side by side, and because of the fact that each chain adjusts itself to the sprocket, each chain will bear its share of the load. By this means heavy drives are made possible.

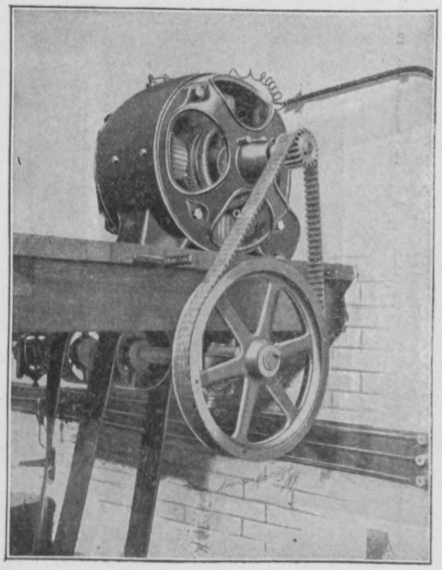
As to the manufacture of this chain the first thing to consider was the material. Not only should it be strong but it should be able to withstand several different physical tests and be of a good wearing quality. On account of the thinness of the several links composing one section of chain, it would be impossible to harden them, consequently a material of such a temper as to withstand the wear in the joint must be chosen. The external wear from contact with the wheels may be neglected as we have seen that this contact is neither a sliding nor rolling one. The life, therefore, of the chain all depends on the pin joint, and in order to get a durable joint there should be a difference in temper between the parts in contact, so that no abrasion can take place. A material was finally selected after many tests and much experimenting coupled with many year's experience in chain manufacture, which seems to answer all of the requirements.

This material has a tensile strength of 100,000 pounds per square inch and a per cent of stretch and reduction of area, which are correspondingly good, also it may be bent across the grain to a right angle only about 25% of the specimens showing a crack. It may also be bent with the grain to a right angle about 50% breaking off. It is also a material that shows a clean cut edge on the links when stamped from the bar; this is important as it must present an even flat surface to the tooth of the wheel.

The material for the pins is of such a different temper from that of the links as to insure a good wearing surface and a long life to the chain.

As to the making of the parts and assembling them into complete chains, it was found necessary to build special tools for all of the operations. Tools such as punch presses and drill presses were at first purchased to carry on the manufacture, but were soon found to be inadequate and ones had to be manufactured for this work, as it was found that when strong enough to perform the work, without undue springing, and thus spoiling delicate tools, they were too clumsy to handle.

I may say in conclusion, so as to give an idea of the labor necessary to make this chain, that at present there are five operations performed on each link before it is ready to be assembled, and in a chain of 1½″ pitch 5″ wide there are twenty of these links to every section. The load required to break this chain is 20 tons.



ALUMNI NOTES.

Chas. H. Fry, '97, is in the editorial department of the Railroad Gazette at Chicago.

Thomas Fletcher, '98, is with the Little Rock Edison Light & Power Co., Little Rock, Ark.

Cale Wamsley, '98, is Engineer of Construction of the Oklahoma City & Western R. R.

Harry C. Schwable, '99, is manager of the production and cast department of the Ohio Brass Co., Mansfield, Ohio.

Chas. R. Crockwell, '95, has been appointed Engineer of Mines, of the Cambria Coal & Coke Mining Co., at Cambria, Wyoming.

Arthur F. Gordon, '97, is with the McClintic Marshal Construction Co., of Pittsburg, Pa., as designer and draftsman. He is now located at Rankin, Pa.

F. Elbert Smith Jr., '96, is Supt. of Avondale factory of the Continental Gin Co., at Avondale, Alabama.

R. W. Beebe, '96, has been recently appointed manager of the Motor, Truck & Vehicle Co., of Columbus, Ohio.

S. L. Henrickson, '94, has been compelled to give up his position with the Union Iron Works, San Francisco, Cal,, because of ill health. He is now at Passadena, Cal.

In the notes of last month a missprint was made where the announcement of the marriage of A. G. Shaw was made. It should have been Archie Shaver, '97, instead.

W. D. Elder, '90, spent a day here lately. He is located at Niles, Michigan, in the engineering department of the Michigan Central Ry.

John D. Galloway, class of 1889, visited the Insiitute recently. He is consulting civil engineer at San Francisco and has been in Texas and New Orleans on business.

Mr. Galloway had not been here for nine years and returned to San Erancisco via Terre Haute that he might visit the Institute and his friends here.

Gilbert Crawford, '01, is with the Serage Smelting Works, Galena, Kans.

T. L. Condron, '90, has been very ill with appendicitus.

Abe Balsely, '91, formerly with the Terre Haute Electric Street Railway Co., is now Operating Superintendent of the Lachine Rapids Hydraulic and Land Co. Ltd., No. 160 McCord street, Montreal, Quebec.

H. D. Piper, '01, has accepted a position with the Ewart M'fg, Co,, Indianapolis.

F. J. Jumper, '99, has been ill with typhoid fever for several weeks at his home in Bellevue, Pa. We are glad to know that he is rapidly recovering.

Martin Troll, '01, of Indianapolis, was in the city a few days ago visiting friends.

O. E. McMeans has left Richmond, Ind., and is now with Nordyke & Marmon Co., Indianapolis, Ind.

L. L. Helmer is now with the Maryland Sheet and Steel Co., at Cumberland, Maryland.

Liquid Air.

By HENRY W. UHL, '02.

LIQUID AIR, as a substance of commercial value, was first introduced by Charles Tripler, who claims to have succeeded in liquifying the atmosphere as far back as 1891. The liquification, as accomplished by Tripler, consists practically of subjecting the air to a high pressure and by allowing a part of it to expand in such a manner as to cool that which remains, below the critical temperature, which is —140″ C. or —220° F. The high pressure is obtained in his plant by means of a 90 h. p. compressor of 16 inch stroke, and making 150 strokes per minute.

The compressor is a steam engine, consisting of three compression cylinders of diameters 10½, 6⅝, 2⅝ inches, arranged in a line so that each one is operated by the same piston rod. The compression is brought up by three steps; the first cylinder having a pressure of 60 lbs. above atmosphere; the second between 350 to 400, while the third ranges from 2,000 to 2,500 lbs. Between the cylinders are surface condensers to remove the heat caused by the high compression. Also a surface condenser is used to give the final cooling after the gas leaves the high pressure cylinder. From here the gas goes to the liquifiers. The construction of the liquifiers has not been fully divulged, although practically they consist of a special valve, invented by Mr. Tripler, so constructed that a part of the gas is allowed to escape through a long and narrow tube, while the remainder escapes through a tube surrounding the smaller one. Thus the temperature of the air passing through the interior tube is reduced to such an extent that it liquifies. A 200 h. p. plant of this description will liquify a gallon per minute. The cost of production is estimated to be five cents per gallon.

A few years back Prof. Raoul Pictet, of Geneva, Switzerland, noted as an authority on the liquification of gases, succeeded in liquifying air at the low pressure of 15 lbs. to the square inch. Heretofore the liquification of the atmosphere had only been accomplished by means of at least 1,200 lbs. pressure.

Pictet, in his method, required liquid air, manufactured by high compression, to start the liquification. In the simplest apparatus used, air under pressure was forced through a small coil of pipe submerged in liquid air, contained in a Dewar bulb.

The Dewar bulb is practically two electric light bulbs, one contained within the other, with the air exhausted from space between them, thus forming a splendid insulator.

One end of the coil was connected to a hand pump, while the other end was bent so as to discharge into a vessel. Upon the introduction of air under only 15 lbs. pressure, the liquid air boiled violently, caused by the air under pressure giving out its heat so rapidly, and the atmosphere in the tube immediately liquified. A few seconds after the pressure had been applied, a continuous stream was discharged, which continued as long as the pump was operated.

The remarkable part of this method is that the liquid air produced is not only sufficient to compensate for the loss due to evaporation, radiation and to the solidification of carbon dioxide, but a remainder is left which may be reserved for other uses.

As nitrogen boils at a temperature of —194.4° C. (—318° F.) and oxgen at —181.4° C. (—294.5° F.), the nitrogen will be given off first by liquid air, from which carbon dioxide and moisture have been filtered off. The first gas therefore does not support combustion, but the gas given off later will even support the combustion of steel.

An experiment consisting of welding two pens together in a tumbler of liquid air, in the bottom of which is frozen mercury, serves well to illustrate the support of combustion by liquid air and also its low temperature.

This is accomplished by merely pouring the liquid air on the mercury, which is immediately frozen, and then introducing the pen points, between which a burning match is held, into the liquid air. It only requires a fraction of a second for the pens to weld. The mercury if frozen into a handle could be used to drive an ordinary nail without much difficulty.

The intensity of the cold is better shown by the solidification of steam. Steam is regarded as a very warm substance, but if a jet of steam is passed over a vessel containing liquid air, the steam will be instantly frozen, ice falling like a shower of hailstones around the vessel. Supposing that the steam was only cooled down to the temperature of ice, it lost in an instant 1290° F. By use of the intense cold of the liquid air many achievements have been accomplished in the sciences which before its time were out of consideration. The obtaining of helium by liquification of the gas from King's Well at Bath, England, an element not known to exist upon the earth up to that time; the liquification of hydrogen and the isolation of fluorine are among them. Fluorine, one of the most active elements at ordinary temperature, and an element which for generations could not be separated from its compounds, was found to have such little chemical power left as to be unable to act upon the majority of the elements when liquified.

It might be well to look into a few properties of liquid air and the effect that it has on various substances.

Liquid air has ordinarily a milky appearance, due to the solidified carbon-dioxide, which, however, can be filtered off, leaving a light blue color. When it is solidified by hydrogen it still has the blue tint. The constituents, as in the atmosphere, are not in chemical combination, but as stated above, can be separated by exposure to the atmosphere.

Neither do the constituents—principally nitrogen, oxygen and carbon-dioxide—lose their chemical properties when in the liquid state. Oxygen, however, when liquified becomes magnetic, which may be readily shown by bringing a magnet near a tube containing it. If suspended, the tube will be deflected to a marked degree.

The specific gravity of liquid air is almost that of water, being .933 at —191.4° C. The latent heat of vaporization is 80. Air in the liquid state occupies $\frac{1}{800}$ of its volume when as a gas at ordinary temperature and pressure.

Substances, such as iron and tin, become very brittle, breaking like glass, when subjected to the low temperature of liquified air, while materials such as copper and aluminum do not change at all. Rubber, such as is used in rubber balls, which is hard to imagine to have any other than that of a soft, elastic state, will break similarly to glass.

The tensile strength of all materials are increased with the lowering of the temperature, which, in the case of iron at —292° F., is twice that of ordinary temperatures. Soft lead, bent in the form of a spiral, can be made to vibrate with the elasticity of a watch spring at this temperature.

The effect of the low temperature on ivory is somewhat out of the ordinary. Ivory becomes phophorescent when exposed to strong light after being dipped in liquid air. An egg will exhibit the same peculiarity, although not to such a marked degree.

The resistance of all pure metals decreases greatly at low temperature, and with the exception of platinum, all show an increase of temperature coefficient of resistance as the temperature is lowered. Dewar and Fleming found that a coil of copper wire having a resistance of 17.5 ohms at 0° C. fell to 1.65 ohms at —201° C. Upon this as a basis, it has been proposed to lay the conductors carrying current from Niagara Falls in a pipe containing liquid air, the power not needed during the night being used to liquify the air. Dewar also found that by immersing a magnet in liquid air its power was increased 50 per cent.

Much has been said about the uses that liquid air could be put to, especially up to the last year. The liquifaction of the atmosphere in such large quantities was without donbt a great achievement as a scientific feat, but whether it will be of any commercial value is yet to be proven.

The various uses suggested for liquid air are without number, and the discussion spent upon them would fill volume upon volume. In the majority of cases, however, the conclusions have been arrived at that it is out of the question. In case of a steamship being propelled by liquid air, Hudson Maxim found that it would take more than was necessary to float the vessel. Another man makes the calculation that it would require but five tons for the same ship if a recondensation of the liquid air is obtained. However, at the present time no recondensation method is known.

Prof. Morton of Stevens Institute, calculated that in order to use the oxygen for combustion of the coal on a steamship the space question again came in, and if a generating plant was used, the plant would be larger than that of the the present engines and boilers. So it is in most of the cases.

The only use that has been suggested which is generally met with approval is its use as an explosive.

It has been ascertained, both from calculations and experiments that liquid air would produce, with a suitable combustible element an explosive that would rival dynamite. The advantages in using it would be, that the products of combustion are smokeless, no nitrous fumes given off, and especially the fact that no thawing out would be required in cool weather, which is always accompanied by more or less danger. The explosion also would be so rapid that very little if any tamping would be required in blasting. In Europe a mixture of cotton and charcoal was used, it is understood, with much success in mining.

As a substance for refrigerating purposes liquid air has its advantages and disadvantages, and the use as such will, as in the case of explosives, depend uron the cost of production to a great extent.

In making the statement that the commercial value of liquid air was yet to be shown, one very important application was lost sight of—its application for medical purposes. It has been, and is at the present time, used with great success in the treatment of cancer, certain forms of bunions and corns, warts and superfluous hair, etc. It is also used as an invigorating agent. It is believed by many eminent physicians that in many cases where the knife is now used, liquid air will be found a most welcome substitute in the near future.

Pictet, a few years back, formulated a method by which the rectification of the atmosphere could be commercially accomplished. In the high pressure method of liqufiication too much energy was expended to make this profitable. In his method, which was explained at the first part of this article, this was avoided. The idea is to use the oxygen for chemical uses, combustion, etc., also the nitrogen for chemical purposes, while carbon-dioxide in brewing and the like. The method is based upon the fact that nitrogen evaporates before the oxygen from liquid air that has carbon-dioxide and moisture filtered off.

The apparatus proposed consists essentially of a compressor, cooler and the liquifying tank, which also answers the purpose of the separator. The combined liquifying tank and separator is practically a vertical cylinder containing a number of shelves extending almost across the cylinder. The shelves are of the form of a tray.

Before putting the plant into operation it is necessary to fill these shelves with liquid air, as use is made of the low pressure liquifaction. Pipes are run from the compressor through the liquid air on the shelves, starting at the bottom shelf and finally terminating above the top one. When the compressor is started, a continuous stream of liquid air is discharged from the pipe upon the upper shelf. The liquid air thus generated flows through a filter down on the next shelf and from here to the next lower, and so on until the lowermost tray is reached. The solidified carbon-dioxide is collected at the top for further use.

As the liquid air in the trays boils, caused by the air in the pipes giving up its heat, the nitrogen is readily given off, so that by the time the liquid reaches the bottom it is almost pure oxygen. Consequently, the nitrogen as a gas can be collected from a pipe connected with the upper part of the cylinder, while the oxygen in a form of liquid can be drawn off at the bottom, while a mixture of the two can be obtained from an intermediate shelf. The carbon-dioxide furnished is said to be sufficient to pay for the running of the plant.

The volumes of the gases thus separated by a 500 horse power plant in twenty-four hours, according to Prof. Pictet, would amount to 1,000,000 cu. ft. of oxygen, 2,000,000 cu. ft. of nitrogen at atmospheric pressure, and one short ton of solid carbon-dioxide.

At this rate, about 20 cu. yds. of oxygen which now costs $2 to $3 per cubic yard, could be produced for one cent.

Pictet, according to reports, erected, or at least started to erect, a plant of this description, but nothing further is known concerning it.

THE SYMPHONY CLUB.

After mature consideration by those interested the above name has been introduced in the constitution of the former Glee and Mandolin Club, and a very important change made in the substance of the document. As now agreed upon, the various musical organizations of the Institute are to have separate constitutions, and their own administrative officers, elected independently by each body. These officers are in turn voting representatives in the Symphony Club, the presidents of the various bodies being vice-presidents of the dominant organization in order of the establishment of their own distinct clubs. These officers of the minor bodies choose from their number the President of the Symphony Club, and all its other officers with the exception of the vice-presidents. Thus all the organizations have equal voice in the administration of the Symphony club, and the latter body has a representative upon the Student Council, in the person of the Symphony Club President.

The Glee Club held its first practice Saturday afternoon, March 1st, at the home of Mrs. Allyn Adams, who will teach and conduct the Club at its practices. Twenty men were present at the first practice, and the parts assigned balanced very well indeed for the first time. Great interest is being taken in these meetings, and it is the duty of each man who has any voice at all to come out and practice.

Don't think that because you have never sung that this means you cannot. You will never know until you make the attempt, and now is the time to secure competent instruction. It is very desirable that all intending to sing should appear at these, the first practices, that the preliminary instruction may be given to the members all at the same time. Come to the next practice.

The orchestra is practicing regularly once a week now, at 520 N. Center street. New music is being obtained as found necessary, and the members are getting down to steady work. Many of the men play in other city orchestras to help keep them in practice, and often visiting musicians practice with the Poly organization, which is becoming well known by reputation already. Unless otherwise advertised during the week, the regular practice occurs each Thursday night, at which time interested visitors are always welcome.

SCIENTIFIC SOCIETY.

A meeting of the society that had been postponed from time to time, for various reasons, was finally held Saturday forenoon, February 15th.

The subject under discussion was, "Underground Transit Systems." Mr. J. A. Cushman presented the paper upon the subject, and illustrated the form and method of construction used in building the new Boston subway.

After the reading of the paper many questions were asked about various points involved. We are glad to see this spirit manifested, as it will not only increase the interest in the meetings, but also the benefits to be derived from them.

THE Sophomores and Freshmen held their much talked of athletic meet in the gymnasium on Saturday afternoon, March 8th. The credit for the victory goes to the Sophomores who won by the score of 41 to 13.

Some weeks ago the Sophomores challenged both the Juniors and Freshmen to athletic meets in the gym, and the contest on Saturday was the result of this challenge. The Junior-Sophomore meet will be held on the 15th. The records made at the contest on Saturday were not extraordinary but the results in many cases were gratifying as they were accomplished with scarcely any practice, and thus give hopes of future improvement.

Peck '04, won the shot put at 33 ft. 9 in.

Von Borries '04, won the high jump at 5 ft., but Peddle '05 was a close second with 4 ft. 11 in. Both of these men made their records with scarcely any practice, and it was almost the first time that Peddle had tried the event at all.

McCormick '04, easily distanced his opponents in the snap under and made the good record of 9 ft. 9 in.

The broad jump was made, the contestants taking off from the bare floor. This accounts for the short distance accomplished in this event, Crane '04, won at 8 ft. 9¼ in.

McCormick and Larkins tied in the pole vault but on the toss up McCormick was given first place. The height was 8 ft. 8 in.

Knight won the one-eighth mile potato race with the time of 54⅖ sec.

Professors Hathaway, Johonnott, McCormick, and Mr. Crawford acted as judges, time-keepers, etc.

The results of the different events are as follows:

High Jump—First, Von Borries '04, 5 feet; second, Peddle, '05, 4 feet, 11 inches; third, Crain, '04, 4 feet, 9 inches.

Shot Put—First, Peck, '04, 33 feet 9 inches; second, Greenleaf, '05, 33 feet 2 inches; third, McDonald, '05, 32 feet 5 inches.

Snap Under—First, McCormick, '04, 9 feet 9 inches; second, Dorn, '04, 7 feet, 9½ inches; third, Larkins, '05, 7 feet 6½ inches.

Standing Broad Jump—First, Crain, '04, 8 feet 9¼ inches; second, Knight, '04, 8 feet 7¼ inches; third, Everson, '05, 8 feet 7 inches.

Pole Vault—First, McCormick, '04, 8 feet 8 inches; second, Larkins, '05, 8 feet 8 inches; third, Toner, '04, 7 feet 4 fnches.

One-Eighth Mile Potato Race—First, Knight, '04, 54⅖; second, Toner, '04, 55⅕; third, Reynolds, '05, 55⅗.

PARIS 14, ROSE 20.

The Rose basket ball team went to Paris, Ill. on the evening of March 7th to play a game with the Y. M. C. A. team of that place. Rose won the game but on account of the strangeness of the floor and the position of the goals were unable to run up the score as they had hoped to do. The score should be satisfactory, however, as it was a victory with some to spare. Score :

	PARIS. FIRST HALF.			SECOND HALF.		
	Field Goals.	Foul Goals	Fouls.	Field Goals.	Foul Goals.	Fouls.
Winn, c. (capt)	...	2	....	2	3	1
Wetzel, r. f.	....	....	....	....	....	2
Shaw, l. f.	1	....	1	....	....	2
Lycan, r g.	....	....	....	....	. ..	....
Strickle, l. g.	....	....	4	....	....	. ..
	ROSE.					
Daily, c.	1	....	1	1	....	.. .
N. H. Cox, l. f.	....	....	....	1	....	....
Nicholson, r. f.	....	....	2	....	....	....
Fitzpatrick, r. g.	....	5	2	1	3	2
Barbazette, l. g (capt)	....	....	1	....	....	....

Score : Paris, 14 ; Rose, 20.
Referee—Gilbert.
Umpire—Crawford.

Y. M. C. A. 42, ROSE 31.

On Feb. 14, the Rose basket ball team met its second defeat at the hands of the local Y. M. C. A. The final result of the game was doubly disappointing from the fact that the Rose team had it all their own way in the first half, with a score of 21 to 14 in their favor. In the second half the Y. M. C. A. overcame this lead, however, and were able to win the game by the following score :

	Y. M. C A. FIRST HALF.			SECOND HALF.		
	Field Goals.	Foul Goals.	Fouls.	Field Goals.	Foul Goals.	Fouls.
Schroer, l.f.	1	....	....	2	....	1
Paddock, Connors, } r. f.	1	....	....	2	3	2
Trueblood, c.	....	..	2	3	....	3
Ault, r. g.	....	1	....	1	1	....
Connors, O'Brien, } l. g.	2	1	....	....	....	....
	ROSE.					
I. J. Cox, l. f.	3	..	3	....	1	....
N. H. Cox, r. f.	3	....	2	1	....	....
Daily, c	1	....	...	1	....	....
Fitzpatrick, r. g.	....	....	....	1	...	2
Barbazette, l. g.	....	....	....	...	....	....

Y. M. C. A., 32 ; ROSE, 29.

The basket ball team again played the local Y. M. C. A. team on Tuesday evening, March 4th. This time the Rose team almost turned the tables on the City and the game was one of the closest and best of the season. In the last four minutes the Rose team was playing fast ball and appeared to have the Y. M. C. A. team at their mercy, but just then Barbazette turned his ankle and time was called. This allowed the Y. M. C. A. a few minutes rest and in the last few minutes they threw two field goals which won them the game.

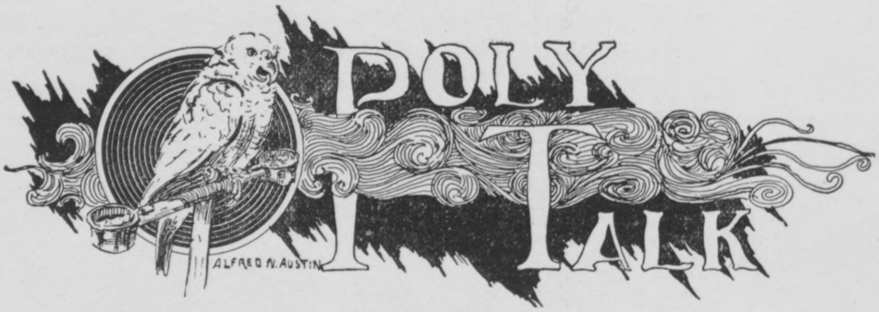
The whole Rose team showed great improvement over its playing at any previous game and the work of Dailey and Barbazette was especially good. Fitzpatrick made a record at throwing foul goals. Score :

	Y. M. C. A. FIRST HALF.			SECOND HALF.		
	Field Goals.	Foul Goals.	Fouls.	Field Goals.	Foul Goals.	Fouls.
Connors, r. f.	1	1	....	....	2	....
Thurman, l. f.	2	...	1	1	....	3
Trueblood, c.	1	....	3	2	....	4
Ault, l. g	....	2	3	1	3	....
O'Brien, r. g	....	....	1	....	....	....
	ROSE.					
I J. Cox, r. f.	1	....	1	2	....	....
N. H. Cox, 1 f.	1	....	....	1	....	2
Dailey, c.	....	....	....	2	....	..
Fitzpatrick, r. g.	....	3	1	....	5	4
Barbazette, l. g (capt.)	....	....	2	....	....	....

Score : Y. M. C. A., 32 ; Rose, 29.
Referee– McCormick.
Umpires—Fishback and Crawford.

The gymnasium classes which were recently organized are progressing nicely. Fifty per cent of all the students have enrolled in them and nearly that number have been on the floor at some of the classes. Physical director Crawford is fulfilling the highest expectations and it is safe to say that, not only will the athletics of the school be benefitted by these classes, but every man who attends them regularly will receive full reward for his time and trouble.

There are four classes each week, two evenings being given to basket ball. As soon as the basket ball season is over, these evenings will be given to the practice of athletic events.



Dr. Johonnott:—"This plus that equals itself."

"Dusty" Miller (translating):—"It is so gloomy in my head." Poor fellow!

Dr. Noyes (holding up a specimen of agate):—"Now, what is this?"

"Nervous" Miller:—"Why, that must be an opal."

Hahn, '04, says that lime is an important constituent of "Mollucks."

Regan comes hopping into Mechanics class. The Professor says: "Regan, just go back and try that again." Regan obediently hops in a second time; the Professor says: "You may leave the room for good, Mr. Regan." Regan departs with a mournful (?) expression upon his countenance.

Professor Hath. (writing across the blackboard):—"Now, here is something worth remembering."

Dr. Johonnott:—"You can always depend upon Mr. Crain for an answer. Sometimes it is valuable—other times not."

Professor: "Remember, Mr. Hahn, there are some desperate characters directly behind you." Then every one looked at Landrum and Tipton.

Mr. W. Frank Goode, of Appleton, Wis., is a recent addition to the Freshman class. Mr. Goode was a student of Cornell, until forced to leave on account of illness.

McFarland:—"What is the mineral known as theodolite?"

Dr. Noyes:—"It is an instrument used in surveying."

Schroder:—"Say, I want to tell you a good one on McDonald, for The Technic. He once shot some little birds and ate them." How naughty of McDonald to do such a thing!

Dr. Patterson mourns the loss of a stiff hat, lost in the interest of science, at the Fontanet coal mines, March 1st. He evidently forgot that he was taller than Dusty Miller, who claims that even he bumped his head on the ceiling of the tunnel.

Landrum was heard to remark at nine different times in half an hour: "I attended gym. class last evening, and am very lame today."

Bryon (passing a cross-eyed youngster):—"There is a kid standing in the middle of the week and looking at both ends."

The fashion in salutation has changed. It is now considered correct to greet a friend thus: "How is your arm? Did it take? Mine did. Look out, there, don't you approach me in such a familiar manner!"

We understand several Juniors will change from the electrical to the mechanical course next term. Not liking the looks of those alternating current differential equations, being one reason—"and there are others."

Ketcham (translating):—"Poor little fool!"

Professor Wickersham:—"I am very sorry you have to call yourself such a name."

The Sophomores, Section B, are indebted to Robert Warren for a short intermission during laboratory hours recently. Warren filled the lab. with bromine, and soon he was left alone in the building, whence all but Bob had fled. Only the threat of being docked an hour caused the Sophomores to return to work.

Mr. Wires, instructor in wood work, took the two sections of the Freshman class through the plant of the Standard Wheel Works, and that of the Columbian Stamping and Enameling Company, on February 26th. This is the second trip to some of the larger manufactories of the city, the first being through the Car Works last December.

Kiefer should see that there are no holes in his pockets when matching pennies before going into Hath's room.

Did you see "the Rogers Bros. in Jo-jo's room?"

"Mexico" Wood, '05, says that down in his territory it is considered great sport to lasso a man running bases in a ball game. If you disagree with the umpire, you ventilate him. He does not advise the introduction of such tactics here, so the men need not be alarmed.

Cohn (translating): "Yes, Anna, the old maid of the Eyesettes—er, er, I should say the former maid."

The Junior electricals and mechanicals feel certain that after graduation, whether they are proficient in their respective courses or not, they will at least be able, after so much practical experience, to construct carpenter's benches and coal cars.

Holloway has been kept busy recently taking photographs for use in the Modulus. The Faculty has finally consented to have taken *new* photographs for the Modulus.

Earhart:—"Mr. Jacob, can you tell how to reduce the barometer to zero degrees centigrade?"

Jacob (not very loud):—"Put melting snow on it." (Louder): "Yes, sir."

"Good morning; have you been vaccinated?"

Dame rumor reports the engagement of a former member of the Class of 1903, now pursuing studies of a different nature elsewhere, to a young lady who has made Terre Haute her home for the past few years.

On February 26th Mr. Jacob, owing to the generosity of his classmate, Mr. Chamberlain, was able to procure a much-needed shave.

Some of the fellows say the worst feature about that small-pox business was that it prevented them from going calling on the ladies.

A TECHNIC representative, happening to be at the Big Four station Saturday evening, March 1st, as the eight-thirty train pulled in, saw getting off the train some half-dozen tired, wet, muddy and begrimed men, that he took for miners from Maxville. Imagine his suprise when one of them slapped him on the back, and turning, he saw under the coal dust the smiling faces of some Poly students. In the crowd he recognized Dr. Patterson, the efficient instructor in chemistry; Touzalin, Landrum and "Dusty" Miller, some of the '04 students in chemistry, Von Borries, a '04 civil who has had some experience in mine work, and Mr. Ed Tally of the city.

"What in the—well—what have you been a doing?"

"Why, we have been over to the Fontanet

mines to get some samples of ore for analysis,'' said one, as he let a heavily laden sack slide from his shoulder to the ground.

"Gee, but you are getting energetic,'' was all the surprised reporter was able to utter.

"Yes, we took the eight o'clock train this morning and rode out to the 'Diamond' switch. From here we walked about a mile to the 'Diamond' mine. As we got into the cage we told the engineer to let us down fast. Well, this seems to be a favorite sport when a tender-foot goes down in the mines. When we reached bottom, and regained our senses, we regretted having said anything about rapid transit.

The shaft was some seventy feet deep. From the bottom of the shaft we went back into the mines in some cars, like those they have been building in the shops, drawn by compressed mule power.

The coal is mined by means of compressed air. The miners object seriously to the use of compressed air in the mines, because with it one man is able to mine such a large quantity of coal that only at the busiest seasons can all the miners obtain employment. We stayed in this mine until about half-past eleven gathering those samples there of the slates, coal and iron pyrites. By the way, this iron pyrites is mined in large quantities and sold to the manufacturers of sulphuric acid.''

"I should think you would have been good and hungry by this time,'' interposed the reporter.

"Hungry, well I guess yes,'' replied all in concert. "But that was soon attended to. We got dinner at the farm house where the clerks of the mines board. And a good country dinner it was too.''

"Perhaps your hunger proved a good sauce.''

"Perhaps it did, anyway we did full justice to all in sight. When there was no more in sight we went into the front room where stood an old organ and proceeded to surprise the natives by singing, 'Spring would be but dreary weather' and 'The monkey's tail goes round and round.' ''

"I should think by this time they would have sent you twirling round and round.''

"Well, they did send us around for about another mile, to the 'Lawton' mine. This is somewhat deeper, the shaft going down about one hundred and twenty-five feet. The general equipment throughout is practically the same as that in the 'Diamond.' Many parts of this mine were burning with fire started by spontaneous combustion, but of course all these portions were blocked off.

We rode into Fontanet, a mining town of two or three thousand inhabitants, on the miner's train which consisted of a car, with bench seats down each side and down the middle, coupled to a locomotive. After loafing in Fontanet some time we caught this train and here we are.

Now you just wait until we get at those specimens and we will prove that there are useful properties in them never before known, in fact, that 'there are millions in them.''

Housum, to some one who had knocked his wash-bottle over. "That's right, fall it over.''

Cohn was seen looking at his quiz mark through a magnifying glass, "to make it larger'' he said.

Uhl says that .016 cu ft. is the volume of one cubic foot.

Prof. Wagner remarked to the Senior class that he didn't remember seeing the cold storage room at the Brewery.

A telephone message was received in the city about a week ago telling what a nice banquet had been given at the "Inn'' and how quiet and well-behaved the young men were.

Ask Wiedemann how he broke his finger.

Dr. Patterson, "Dusty'' Miller, Touzalin and Landrum made a trip to the coal mines across the river last Saturday. It is understood that nothing was said except "Doctor, what about this'' and "Dusty, why is this.''

See Touzalin do the grape-vine twist, and Dr. Jekyl and Mr. Hyde.

Uhl was seen pouring distilled water over sheet aluminum, "to generate hydrogen," he said.

The Chemists are trying to persuade Dr. Noyes to employ a typewriter. It would save him time and money, they say.

The new switch board has arrived.

Cushman speaks of the amorphous and homogeneous condition of CO_2.

ODE TO BROWN.

Schroeder is a kicker
He kicks from morn till night
He is a chronic kicker,
He kicks with all his might.

By C. C. McCormick.

Power and Power Transmission. By E. W. Kerr, M. E. Published by John Wiley and Sons. 6x9¼ inches. 356 pages. $2.00.

MR. KERR'S book is an elementary description of modern methods of Power Transmission. The book is divided into three parts. In the first part, under the head of "Machinery and Mechanics" is given a description of shafting, bearings, belt and rope gearing, toothed wheels, etc. In chapter on belt and rope gearing he gives a very useful table on the amount of power transmitted by ropes from ½″ to 2″ diameter, speed of rope from 1500 to 8000 feet per minute.

The second part, entitled "Steam Power," describes and illustrates the different styles of boilers, feed water heaters, and economizers, also the boiler fittings, (water column, safety valves, feed pumps and injectors). Some formulae are given for general dimensions but none of the details of theory or construction are given.

Part III considers Pumps, Gas Engines, Water Power, Compressed Air, etc., The text is mostly illustrative and descriptive of the machinery used for power in the above named subjects.

C. H.

THE following article is taken from the Engineering News of Feb. 13. It will prove of great interest to the student who is about to graduate and may be a guide for him in regard to his attitude towards his employers.

SIR:—In the regular course of our technical schools a large part of the fourth year is taken up with the preparation of a thesis. As a general thing, the subject is one which is far beyond the knowledge and experience of the student. He, however, flounders along and hands in something which he thinks about perfect. What is the result? It unduly elevates the student's opinion of himself, and the imperfect treatise injures the subject and also the profession. In other words, a large part of this fourth year has been worse than wasted.

Anyone who employes young graduates appreciates this. The graduate writes a letter of application, stating he has just taken his degree, having written a thesis on so and so—a subject that he will not be prepared to tackle until he has had many years of practical experience. * * * * * Before a student can be of any practical value he has got to get this idea of his superiority out of his head—and some of them have great tenacity. * * *

It is far better for the technical schools not to attempt to teach practice. Let them rather concentrate their efforts upon theory, as they have not the facilities to teach practice, and as it is changed before it is taught. * * * When they have had at least five years' experience with practical work, and upon writing a satisfactory dissertation on some theoretical or practical engineering subject, then let them receive their engineering degrees.

Yours truly,

NEW YORK, FEB. 3, 1902. ALEX. RICE MCKIM.

Cast Iron. By William J. Keep. Published by John Wiley and Sons. 6x9¼ inches 225 pages. $2.50.

"CAST IRON" is a book prepared by Mr. Keep to present to the public in a convenient form the results of his experiments with different kinds of cast iron. The first then, the nineteenth and twentieth chapters are devoted to descriptive and illustrative matter of the apparatus used in conducting the experiments. Other chapters give results of experiments showing the influence of carbon, silicon, phosphorus, sulphur, etc., on the physical properties of cast iron.

Chapter VIII gives an excellent description of "Keep's Cooling Curves," and a study of molecular changes in metals due to variation in temperature.

Chapter XIII is made up mostly of tables giving the results of tests made under the supervision of some of the engineering societies.

Chapter XV shows the influence of impact on test bars of different sizes. Numerous diagrams show the effects of the impact hammer on different metals.

From beginning to end the results of the experiments are presented in a very logical manner, and the book would prove a valuable edition to any engineering library.

C. H.

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