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THE article on the Wabash & Erie Canal, printed in this issue, entitles its author to a mental vote of thanks from our readers. No one who has not tried it, can realize the work necessary to gather even a little information about a business venture which was abandoned a couple of generations ago. Those who have walked along the tow-path of the old canal near Terre Haute or seen the remains of the storage reservoirs and lock gates, knowing of it only what could be learned by observation, must have wished that they might learn more about that enteprise of the past, and we are glad to present Mr. Cash's paper on the subject.

IF the calculus method of maxima and minima could be applied to the solution of the problem of how far it is possible to be loyal to the baseball team and still keep away from the dead line of the athletic rules, it is probable that that abstruse science would receive a great deal of attention for a little while. When the time that such a sport requires of its devotees is considered, along with the amount of work which a student must do to keep up in his class work, the wonder is that the whole team is not on the black list.

In comparison with the enthusiasm which shows itself in the constant giving of time by those who love not study less but baseball more, the rather lethargic state of some other organizations of the school is striking. The Scientific Society has not been markedly active lately, as persons willing to work for it were not to be found; in the last prize competition of the Camera Club there were only two contestants; and the Y. M. C. A. would very much like to see a larger attendance at its meetings.

The trouble is that the active work of all the organizations is done by a comparatively few men, and when one club or team demands attention, some other one has to suffer, and how a man who belongs to three or four organizations, perhaps as an officer, can satisfy the professors in the class room after spending his afternoons at athletic work, or his evenings at rehearsals or meetings, is a riddle fit for the Sphinx to propound. It seems to us that if some of the undoubtedly brainy men of the school who are not connected with any of the societies, would step into one of the many of them and exhibit an interest in it, that they would find a hearty welcome and appreciation, and that the action would show their school spirit and might be of benefit to them as well as to the society.

THE FIXATION OF ATMOSPHERIC NITROGEN.

By JOHN WHITE, Ph. D.

OF all the chemical elements nitrogen is, with the sole exception of oxygen, of the greatest value to mankind. It is probably the most important constituent of the food of both animals and plants; it is besides this an apparently necessary constituent of many of the more important dye stuffs, and all explosives contain nitrogen as one of their components.

But in order that it may be used for any of the purposes mentioned, it is necessary that the nitrogen shall be in a state of combination, for when in the free or elementary condition, it is an extremely inert, inactive substance, while in combination it can be readily transformed into any desired compound.

Fortunately for mankind, there are a number of compounds of nitrogen ready formed in Nature, and from which we can start in the preparation of other nitrogenous substances as desired. Chief of these natural sources are the great saltpeter deposits in South America, where the nitrogen occurs mainly as nitrate of soda. In addition to this source, but secondary to it, we obtain a large amount of nitrogen yearly, in the form of ammonia, as a by-product in the distillation of coal, either from the gas works or the coke ovens.

The former source of supply is diminishing yearly, while the latter is increasing, but not at an equal rate, so that with the steadily increasing demand for nitrogen compounds, either as a plant food or in the chemical industries, it becomes simply a question of mathematics to demonstrate that, without any other source being discovered, the supply is destined to become practically exhausted. In proof of this the Chilean statistician Vergas in 1904 estimated that at the then rate of consumption, the saltpeter deposits of South America will be exhausted in about twenty years. In that year 1,447,000 tons of nitrate were exported, of which about four-fifths was used as fertilizer, valued at $64,000,000. The remaining one-fifth was used in the chemical industries.

Naturally enough the thought comes to one that, if we could only find some way of fixing the nitrogen of the air, whence an inexhaustable supply can be drawn, we would at once solve the problem as to whence our supply is to come in the future. This suggestion is by no means new, and the problem is one which has been worked at for many years, but only within the past five years can it be said to have approached a solution from a commercial standpoint. I now invite your attention to a brief history of the attempts to accomplish this.

As early as 1781 Cavendish observed that when hydrogen is burned in air the water formed has an acid reaction, and later in 1786 both he and Priestley showed that all the nitrogen in a given volume of air could be burned by supplying a sufficient quantity of oxygen and passing electric discharges through the mixture. Bunsen similarly proved that at the temperature of the oxy-hydrogen flame (i.e., when the two are exploded) a combination of nitrogen with oxygen takes place. These observations were destined later to be made the basis of one of the two successful methods for the fixation of nitrogen.

So far four methods have been employed for the conversion of the inert atmospheric nitrogen into useful forms, one of these is bacterial, the others chemical.

The bacterial method is based upon an observation of Hellriegel's, viz, that leguminous plants, and lupins in particular, possess the power of assimilating, with the aid of lower organisms, the nitrogen of the air. Subsequently, mainly through the efforts of the Agricultural Department in Washington, these bacteria were isolated, and methods for their propagation were worked out, so that by an impregnation of the soil or seed with such bacterial growths the assimilation of nitrogen can be materially increased. This

method, while important, is limited in its application, and has in consequence not been seriously considered as of technical value.

The first of the chemical methods depends upon the discovery made by Woehler and Deville, that certain metals and metalloids, such as magnesium, calcium, lithium, boron and the like, have the property of combining directly with nitrogen when heated in an atmosphere of it. An attempt has been made to utilize this property in the case of lithium, the reactions being indicated by the following chemical equations:

(1) $6\,Li + N_2 = 2\,Li_3N$

(2) $2\,Li_3N + 6\,H_2O = 6\,LiOH + 2\,NH_3$:

the lithium could then be regenerated by means of electrolysis. Technical difficulties and the high price of the metal have so far operated to prevent the carrying out of this process on a commercial scale.

A second and more successful method for the fixation of nitrogen was discovered in 1895 by Prof. Adolph Frank and Dr. N. Caro. They observed that when barium carbide is heated to a sufficiently high temperature in an atmosphere of pure nitrogen, the latter is absorbed, entering into combination to form the cyanide of barium according to the equation, $BaC_2 + N_2 = Ba(CN)_2$. Since this barium cyanide by fusion with alkali carbonates yields alkali cyanides, the process was utilized by "The Cyanide Co.," of Berlin, as commercial method of making alkali cyanides, which are so largely used in the extraction of gold and silver from their ores. The Boer war, which caused a cessation of gold mining in South Africa, brought about such a "slump" in the price of cyanide that Frank and Caro found it necessary to cheapen the method of its production. They, therefore, substituted the cheaper cacium carbide for the barium compound, and found that in this case the reaction took place somewhat differently, producing the cyanamide instead of the cyanide, e. g.:

$$CaC_2 + N_2 = CaCN_2 + C.$$

This compound also gives alkali cyanides when fused with an alkali carbonate,

$$CaCN_2 + C + Na_2CO_3 = CaCO_3 + 2\,NaCN,$$

so that it is equally well suited to the production of cyanide.

Meanwhile the Cyanide Co. had withdrawn, and Siemens and Halske had taken over the plant, operating under the Frank and Caro patents. They discovered that the cyanamide would yield ammonia when treated with water under proper conditions, and this fact led Dr. Albert Frank, son of the patentee, to suggest that calcium cyanamide might be used directly on the soil as a fertilizer. This has been tried with marked success, the cyanamide (trade name "Kalkstickstoff") being found to possess a fertilizing value intermediate between ammonium sulphate and sodium nitrate. This discovery at once gave a new direction and importance to the industry, which was still further increased when it was later found that a number of valuable nitrogenous compounds could be obtained from calcium cyanamide. Thus superheated steam liberates the nitrogen as ammonia, while hot water gives dicyanamide, which is used in the production of artificial indigo, and acids give urea. Another product, dicyandiamide, has been found useful as an addition to powder and explosives, since it gives off a large volume, 66.6 per cent., of nitrogen without burning, hence has the effect of lowering the temperature in the gun barrel without decreasing the pressure. Calcium cyanamide itself has been found to produce excellent effects in the hardening of steel, and a compound for this purpose is now marketed as "Ferrodur."

There are certain technical difficulties in the Frank-Caro process which have had to be met. First, the carbide has to be heated to a high temperature, about 1700° C., before combination with nitrogen occurs, but it has been found that through the addition of calcium chloride, or better, calcium fluoride, combination will take place at a temperature of 700° C. Also the nitrogen used must be in pure condition, i. e., free from oxygen, which means that to utilize the nitrogen in the air, the oxygen must first be separated. In the earlier stage of the process this was done by passing air over heated copper, but lately the air

has been liquified and then the oxygen and nitrogen separated, through the difference in the boiling points of their respective liquids. This gives a quantity of pure oxygen for which there must be found a use. It has been suggested to use this oxygen in the oxidation of the ammonia obtained from the cyanamide to form nitrates, in which form the nitrogen has a greater value than as ammonia.

The Frank-Caro process has been proven a commercial success, and plants are being rapidly erected in a number of places where water power is abundant and electricity consequently cheap. Within the past year one such plant, utilizing 3000 h. p., has been started at Piano D'Orte in Italy, and others are in process of erection.

It is difficult to procure exact figures as to the yield of this process. Conservative estimates seem to indicate that 1 h. p. year suffices for the fixation of 300 to 330 kilograms of nitrogen, equivalent to 2000 kg. Chili saltpeter, or 1600 kg. ammonium sulphate.

The third chemical method for fixing atmospheric nitrogen is based upon the observations of Cavendish, Priestley and Bunsen, already mentioned, viz: that at a high temperature nitrogen and oxygen will combine directly to form nitric oxide. Before taking up a consideration of the processes based upon this fact, it seems desirable to briefly discuss the theory of this combination of nitrogen and oxygen. We owe our knowledge of this mainly to the work of Nernst, Guye, Crookes, Rayleigh and Brodie, though others have also contributed to it.

Crookes and Rayleigh were the first to show that the reaction is an endothermic one, viz: that energy is absorbed, and they, as well as Nernst, have proven that it is a purely thermal, not electrical effect which is produced when electric sparks are used to bring about the combination

At high temperatures two reactions may be shown to take place, the first is the breaking down of the molecules of nitrogen and oxygen into their component atoms, $N_2 = 2\,N$ and $O_2 = 2O$, which then unite with each other, forming nitric oxide,

$$2\,N + 2\,O = 2\,NO.$$

As a matter of fact the second reaction is not complete, it being a reversible reaction, i. e., some of the molecules of nitric oxide dissociate into nitrogen and oxygen. This reversibility may be expressed thus:

$$2\,N + 2\,O \rightleftarrows 2\,NO,$$

which means that at any given temperature a condition of equilibrium will be reached, when the amount of each of the substances present will be constant for that temperature, and it remains to be determined at what temperature the conditions favor the maximum yield of nitric oxide. The relation of yield to temperature has been studied by Nernst, who obtained the following results:

T° absolute	Per Cent. by Vol. NO, observed	Per Cent. by Vol. NO, calculated
1811°	0.37%	0.37%
2033	0.64	0.67
2195	0.97	0.98
3200	5.0	4.4

From this it can easily be seen that high temperatures favor the production of nitric oxide. It has also been shown that the time required to obtain equilibrium at a given temperature is shorter the higher the temperature. The following table gives the time in seconds needed to produce *one-half* the limiting value of nitric oxide at the temperatures given:

Temp. in °C.	Time in Sec.
1200	Very long
1538	9.7
1737	3.5
2600	about 0.018

The advantages, therefore, in using a high temperature are that more nitric oxide is formed, and combination takes place more rapidly.

The same applies to the reverse reaction on cooling, viz: as cooling proceeds, more and more nitric oxide is dissociated into oxygen and nitrogen, the dissociation continuing until equilibrium is reached. The time required to establish equilibrium is, however, longer the lower the temperature, and it has been found that at temperatures of 1200° C. or under, it is very slow indeed. Further, when the cooling has been car-

ried to 600° C. or below, the nitric oxide combines with some of the oxygen present to form nitrogen peroxide, $NO + O = NO_2$, which is not further dissociated.

It will be at once apparent from this that the ideal conditions for effecting the combination of nitrogen with oxygen are a high temperature, followed by a rapid cooling of the gases. These conditions can only be met practically by the use of some form of electric discharge. Hence it is that until methods for the development of electricity at a relatively low cost had been worked out, there was no possibility of accomplishing the direct combustion of nitrogen, which in some measure explains the fact that it has taken a century and a quarter to bring Cavendish's discovery to a commercial fruition.

We shall now consider some of the methods which have been employed in the carrying out of the theoretical principles enumerated above.

The first of these was the Bradley-Lovejoy process, which was exploited by the Atmospheric Products Co. at Niagara Falls in 1902. This was declared to be a success technically, but not sufficiently economical at the then cost for power, and was abandoned in 1904.

The Bradley-Lovejoy apparatus is illustrated in section in Fig. 1.

"A rotating vertical axis carries a circle of electrodes *a*, projecting from the axis at a right angle to it. Opposite to them, on the periphery of a circle, are a number of electrodes *b*, each connected with induction coils, *c*; as the axis rotates, a moving electrode approaches a fixed electrode and an arc forms, which then tears off, but in the interval, other electrodes have approached, forming new arcs. The resistance of the induction coil causes a sudden expenditure of energy at the instant the arc is torn away, with resulting high temperature; as, in the next instant, no heat is generated at this point, sudden extreme cooling occurs." The whole apparatus has the form of a cylinder with teeth along its entire length, projecting inwards, while other teeth, attached to a revolving spindle in the center of the drum, project outward. The air is forced or drawn through the cylinder at a sufficient rate to aid in the cooling effect by rapidly sweeping away the products of combustion.

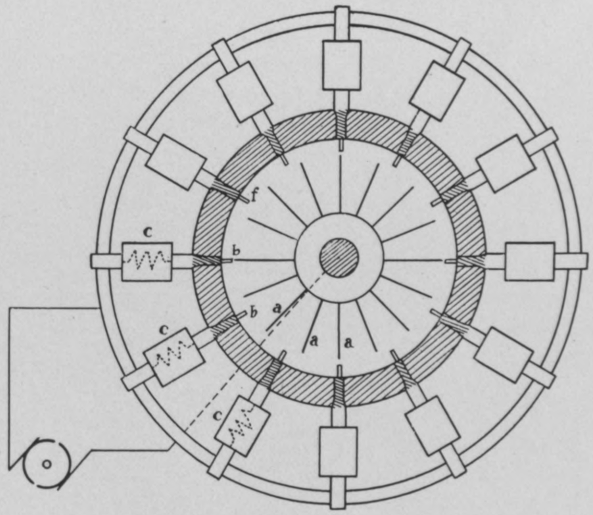


Fig. I.

The apparatus gave a maximum yield of 88 grams of nitric acid per kilowatt hour, using a direct current of 10,000 volts. But for the velocity and the difficulty of effecting complete absorption of the nitric oxides, owing to the extreme dilution of the gases passing from the apparatus, it is believed that the process might have proven successful.

The process of von Kowalski and Moscicki, patented in 1903, operated upon a similar principle, viz: rapid discharges of high intensity in a vessel filled with air, but their method of intensifying the current at the moment of discharge, and also of providing for the frequency of arc formation was quite different, as will be seen by reference to Fig 2.

The apparatus is described by them as follows: "*b* is an alternator, and *a* the primary of a transformer, the secondary *c* supplying currents to the leads, across which are arranged in parallel the 'consumption branches.' Each of the latter contains a pair of electrodes *e* and *f* in a receptacle *k*, to which the air, or other gases to be acted upon are supplied, in series with a condenser *g* and an induction coil *h*. In order to eliminate or materially reduce the production of a wattless com-

ponent in the secondary, a main inductance coil *i* is connected across the leads in parallel with the consumption branches. Each group of parallel

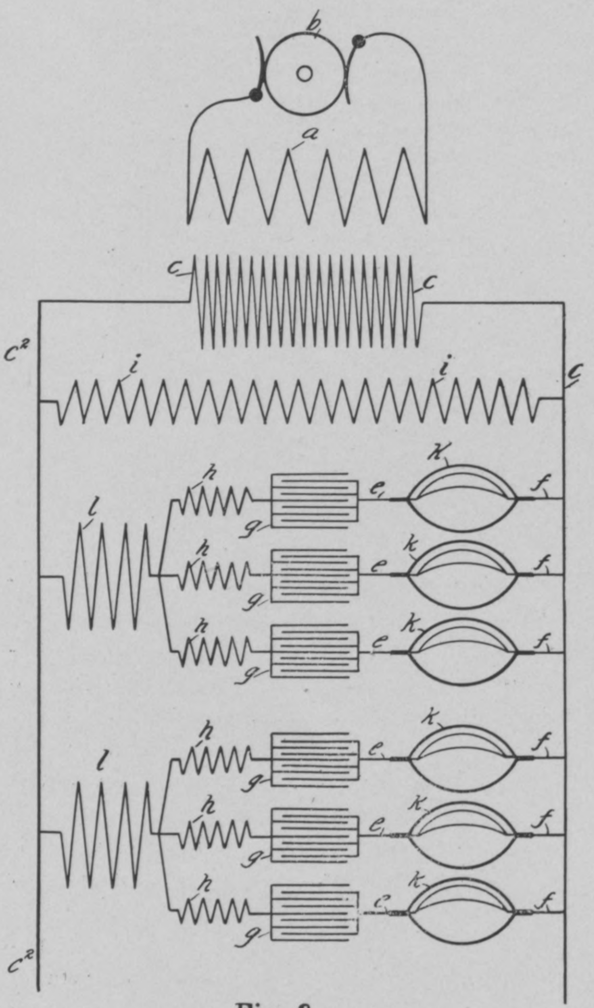


Fig. 2.

consumption branches is in series with a group inductance coil *l*, so proportioned that it will maintain the original frequency of the alternating currents in all that part of the secondary circuit outside of the consumption branch, by preventing the propagation of the oscillatory currents beyond its respective consumption branch. A series of electric arcs are formed between the electrodes *e* and *f* by the charging and discharging of the condensers *g*, the reciprocal action of the condensers on each other producing oscillatory currents of high frequency in each consumption branch, modified by the inductance of the coils *h*, whereby a stream of sparks in the nature of an arc is maintained in each receptacle *k*, where the desired reaction takes place."

The secondary circuit in this apparatus has an e. m. f. of 50,000 volts, producing spark-arcs of about 24 c. m. In each consumption branch the current was 0.05 amp. and the frequency was maintained at 6,000 to 10,000 alternations per second, above which it was found not advisable to go.

This apparatus was tried on the large scale and was found to give a yield of 52 to 55 grams of nitric acid per kilowatt hour, which could be materially increased by enriching the air used with about 50 per cent. of oxygen.

The apparatus was unquestionably based upon sound scientific principles, for, by the use of condensers the energy of the spark discharge can be largely increased, making a sharply defined hot zone in which the oxidizing action can take place. A great deal of difficulty has, however, been found in practice in obtaining condensers which are sufficiently durable. Small glass tubes, silvered both inside and out, have so far been found to give the most satisfactory results. For this or other reasons, not made public, the process has not yet proven a commercial success, and recent reports state that it has been abandoned in most of the plants where tried.

Practically the only oxidation process which up to the present time has proven successful when tried on a large scale is that of Birkeland and Eyde. In this both the heating and the cooling effects are obtained in a way notably different from those previously described. Instead of single arcs or oscillating discharges a veritable glowing disk of electric arcs (see Fig. 3) is used, obtained by deflecting the arc by means of electro magnets, the deflection being at a right angle to the lines of force. If the horizontal electrodes are connected to a generator in series with a suitable inductance coil, and a strong magnetic field is applied near the electrodes in a horizontal direction and at a right angle to the direction of the

electrodes, the arc between the electrodes will momentarily be carried upward or downward. It will then be broken, while simultaneously a new

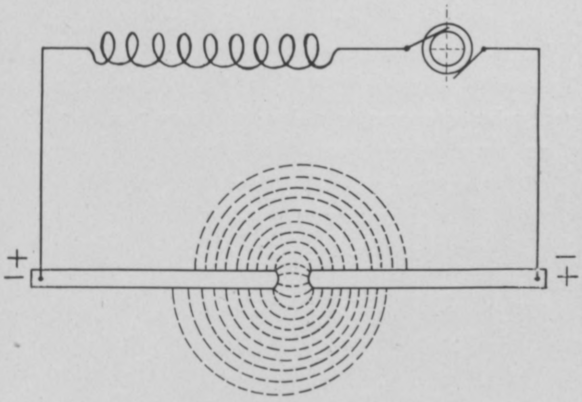


Fig. 3.

straight arc is formed between the electrodes, which is again blown away by the magnet. By this means the arc can be formed and broken as frequently as desired, the frequency giving the disk-like effect to the arc. Either direct or alternating current can be used.

The latest form of the Birkeland-Eyde furnace is shown in Fig. 4. The electrodes are of copper, made hollow so as to provide for water cooling, and approach each other within one third inch. They are not consumed, and need to be replaced only at long intervals. The "roaring disk of flame" is enclosed by fire clay cheeks pierced with holes for the inlet of air, which is driven through the furnace by means of a Roots blower. The whole apparatus is enclosed in an external copper case, pierced for the introduction of the poles of a large electro-magnet. The furnace is extremely simple of operation, as practically the only attention required is an occasiona adjustment of the electric current, and one man can attend to several furnaces.

The factory is located at Nottoden, in Norway, where water power is abundant and electrical energy is extremely cheap. Each furnace, as at present constructed, consumes 750 kilowatts, and it is claimed the process yields 900 kilograms of nitric acid per kilowatt year. Recent enlargements have been made in the plant, so that it will use a total of 30,000 horse power.

The volume of air being treated at present is 75,000 liters per minute, which as it passes out contains not above 2 per cent. of nitric acid. The extraction of this nitric oxide presents a serious problem. On account of transportation difficulties it has been found inadvisable to convert it into and ship the oxides of nitrogen either as nitric acid or as nitrate of soda, but as calcium nitrate, for which a very pure calcium carbonate, found abundantly in that section, is made use of. The following process of extraction is used for the nitric oxides: the gases which leave the furnace at a temperature of 600°C. to 700° C. are passed directly through the evaporation tanks, where their heat is util-

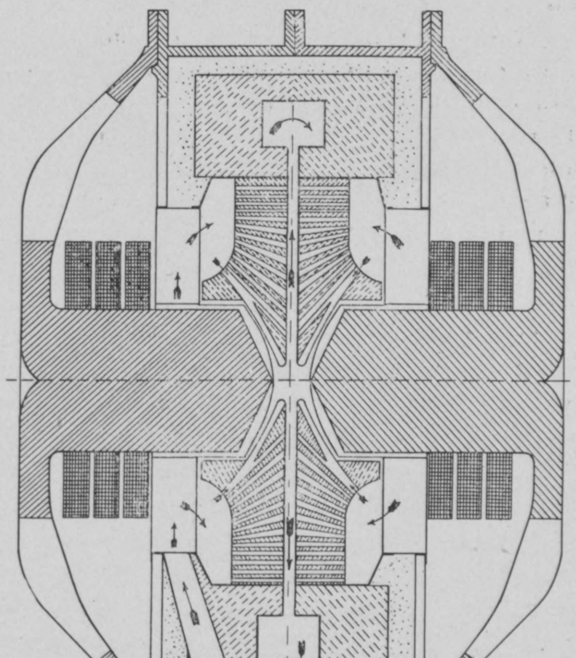


Fig. 4.

ized. From here they pass at a temperature of 50° C. through two large oxidation chambers with acid proof lining, where the nitric oxide is

converted into the peroxide, which is then passed through an absorption system. This system consists of two series of stone towers, each series containing five towers, two of granite and two of sandstone, filled with quartz, over which water, and the nitric acid formed, are made to trickle, while the fifth tower of each series is filled with ordinary bricks, over which trickles milk of lime. This absorbs the rarified nitrous gases, which escapes the other towers, with great readiness, and is converted into a mixture of nitrate and nitrite of calcium. The first tower yields a 50 per cent. acid, the second 25, the third 15, and the fourth 5 per cent. The liquid from each is pumped up and used in the one ahead, until the whole has been converted into an acid of 50 per cent concentration.

By causing the acid to react on limestone it is converted into calcium nitrate, or a basic nitrate, as the latter is not hygroscopic, and is used in this form as a fertilizer. Tests of its fertilizing value show that it is nearly, if not quite, equal to saltpeter, and on certain soils, e. g., sandy soils, it said to give even better results owing to the calcium which is present. A statement of the cost of production of calcium nitrate by this method shows that for a nitrate containing 13.2 per cent. of nitrogen, the cost per ton is $20.00, while the selling price is $40.00 per ton ; at these figures the nitrate made in this way can compete with Chili saltpeter, selling price $50.00 per ton, thus establishing the commercial success of the process.

To sum up ; two processes for the extraction of nitrogen from the air have been found commercially successful, the Frank-Caro process, whereby nitrogen combines with calcium carbide, forming calcium cyanamide, and the Birkeland-Eyde process, in which the nitrogen of the air is oxidized by the oxygen present into nitric oxide, which can then be transformed easily into nitric acid.

Work has but just begun on this important problem, and with such encouragement we can confidently expect that long before the arrival of the time of threatened starvation due to lack of nitrogenous compounds with which to enrich the soil, the electrochemist will be able to supply us with all that is needed taken directly from that inexhaustable store, the air.

In preparing this article I have been greatly assisted by the nmerous excellent articles on the subject contained in the "Elektrotechnische Zeitschrift," the "Electrochemical and Metalurgical Industry Journal," "The American Chemical Journal," and others, to all of which I here wish to render due indebtedness.

ALUMNI NOTES.

Samuel D. Burge, of the class of '02, was married to Miss Anna Constance Butterwick, on April 11th, at Kewanee, Illinois.

Cleo B. Cook, '05, was transferred, on May 1st, from the Main Sales Department of the Bullock Electric Manufacturing Co. at Cincinnati to the Cleveland office of the Allis-Chalmers Co.

T. E. Morford, formerly a member of the class of '90, was recently in Terre Haute, stopping over on his return from a short visit at French Lick Springs.

W. S. Hanley, '05, was in the city for a few days early in May. He is in the employ of the C. & E. I. Railroad, stationed at present at Chicago, though until recently he was with the same company at Danville, Ill.

C. C. Modesitt, '06, and J. S. McBride, '05, are also with the C. & E. I. at Danville.

W. F. Freueenreich, '98, attorney-at-law and solicitor of patents, has opened an office in the Marquette Building, Chicago. He has been connected with the legal department of the General Electric Co. at Schenectady.

W. D. Ingle, '03, visited the Institute during his stay in Terre Haute at the beginning of last month.

A PASSING LANDMARK—THE WABASH AND ERIE CANAL.

By F. H. CASH, JR., '07,

ONE of the most expensive, and at the same time, least useful outlays of money in the history of the State of Indiana was the construction of the Wabash & Erie Canal. This canal was constructed in order to furnish a means of transportation from the navigable waters of Lake Erie to the Ohio river, and also to enable the productions of one of the richest portions of the United States—the Wabash valley—to be readily marketed. This was early recognized by the people of the United States as a necessity, and in the early twenties we find the Hon. Thos. H. Blake introducing in the State Legislature a measure advocating the building of some such waterway.

In 1825 Gov. Ray made mention of the need of, and a noteworthy plea for some sort of internal improvement system, which eventually led to the passage of the famous bill authorizing the Internal Improvement System in 1836. In 1827 Congress granted to the State the right-of-way and a large quantity of land, equal to five sections in length for each mile, to aid in building a canal to extend from the Maumee river, which furnished an outlet into Lake Erie, to some point of the lower Wabash where that stream would be navigable on south, or else on directly to Evansville.

By act of 1838 Indiana accepted the grant—a portion of which she surrendered to Ohio on condition that she (Ohio) would construct a waterway from the east boundary of Indiana to the lake—and the work of constructing what was to become eventually the longest canal in the United States and second only to the Chinese canal, in the world, was begun.

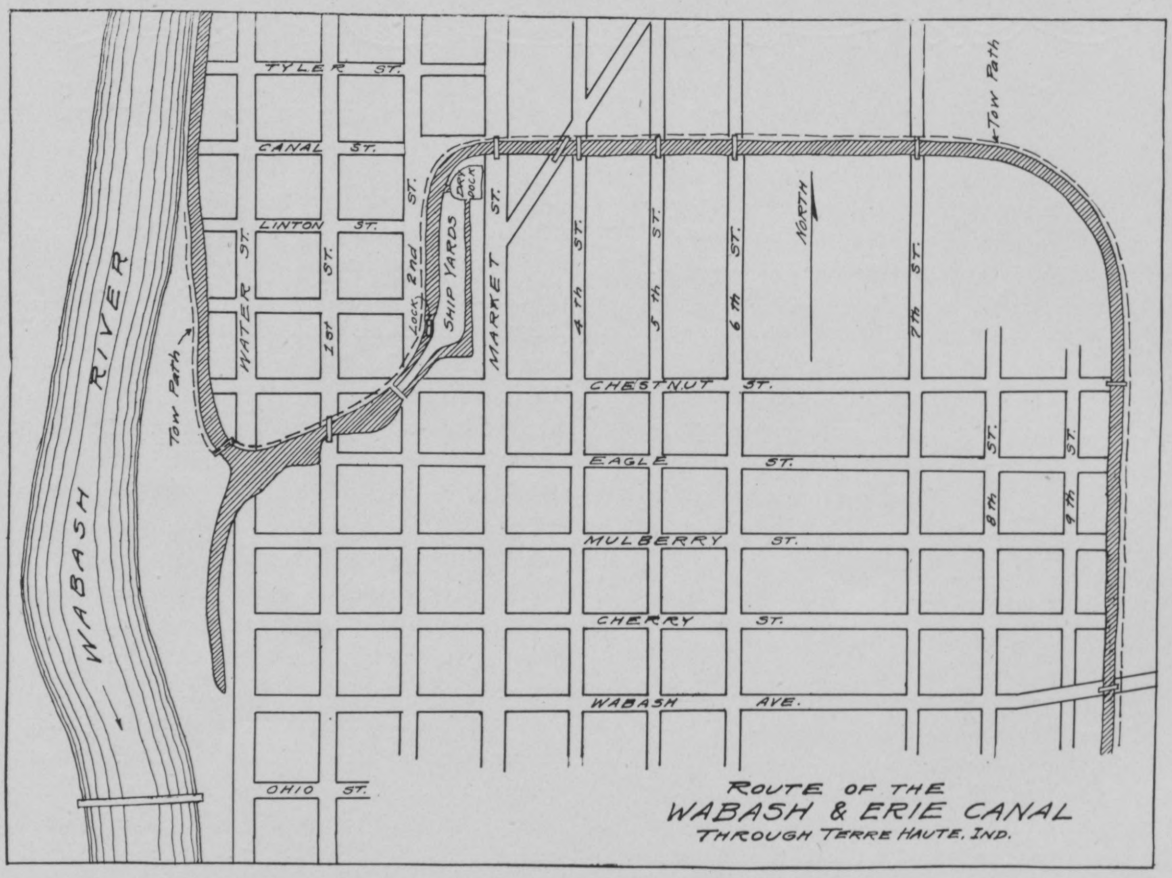
Under the administration of Gov. Noble, surveys were made, contracts let, and in 1832 the contract was let for the construction of 32 miles of the work. During the years '33, '34 and '35 the work was pushed with great energy, although a variety of ways and several enactments by the State Legislature were resorted to in order to raise money for the project. By the year 1837 the canal had been completed as far as Lafayette, which had since been chosen for the western terminus of the first division instead of the mouth of the Tippecanoe river, which was first chosen, and placed in operation.

In 1836 the Internal Improvement System was authorized by the State Legislature, and among other numerous improvements, provided for the completion of the canal from Lafayette on down the Wabash Valley to Terre Haute, and thence by a route surveyed along Eel river (to be known as the Cross-cut canal) and to connect with the Central canal which reached the Ohio at Evansville.

The panic of 1837, however, put an end to these enterprises and finally resulted in the surrender of the canal and accessory grants to the bondholders in 1847 in the following manner: For about five or six years Indiana had been unable to pay the interest on her unusually large public debt, which had been created by the Internal Improvement System. She could easily

have repudiated the debt, as did many of her Eastern sisters, but her Legislature held firmly against this plan of action as being dishonorable, and as it was practically impossible to increase the tax while the country was in the condition prevailing at that time, they insisted that the creditors must wait for better times.

Government grants of land alone for the other half of the indebtedness—such of the creditors as should contribute to the $800,000 to have preferred stock with the privilege on the part of the State after twenty years to take back the canal upon the payment of the moiety of the indebtedness for which it was held, or such part of it as



The creditors—the majority of whom were Englishmen—finally tired of waiting, and in 1845-6, through Chas. Butler, of New York, as their representative, made to the State the following proposition:

The State was to pay one-half her debt and interest and turn over the canal extending from the Ohio state line to Evansville to a board of trustees under whose supervision the canal was to be completed, to aid in accomplishing which the creditors were to advance $800,000 and were to look to the canal, its tolls and revenues and the

should remain unpaid by its tolls, water rents and the unsold lands donated by the General Government. By legislation in 1846-47 this proposition was accepted and plans for finishing the canal were placed in operation, Chas. Butler of New York, and Thos. H. Blake of Indiana being appointed by the creditors and Nathan B. Palmer by the State Legislature to act as the Board of Trustees. Under the leadership of Wm. J. Ball, who was retained as Chief Engineer, the work of completing the canal was begun, and in 1853 the whole line was opened up to Evansville.

The Wabash & Erie Canal as completed was 467 miles long and over 100 miles longer than the famous Erie Canal. It connects the Maumee river at Toledo with the Ohio river at Evansville, having 67 miles of its course in Ohio and 374 miles in Indiana. Among the chief places through which it passed are Fort Wayne, Huntington, Wabash, Penn, Logansport, Delphi, Lafayette, Attica, Williamsport, Covington, Montgomery, Terre Haute, Worthington, Bloomfield and Petersburg. The canal was 40 feet in width at surface, 26 feet in width at bottom and for the most part about 4 feet deep. The right-of-way varied from 90 to 100 feet. The canal contained 64 locks, the average size of which was 90 feet long, 15 feet wide and which provided for a total rise and fall of 505 feet.

Its route through the city of Terre Haute is shown in the accompanying sketch, which is a reproduction of one of the oldest existing maps of Terre Haute, having been made in the year 1854. One of the original intentions of the builders was to run the canal into the Wabash river just below the bridge, shown in the cut at Ohio street, and the canal was cut down to Main street with that aim in view. However, it was found that the Wabash from Terre Haute on down was not sufficiently navigable to justify making this the terminal point, so the canal was turned at Eagle street, being known as the Cross-cut canal from this point on down, and following a southeasterly direction down through Vigo county parallels Eel river for some distance, then passes on southward to Evansville. The bridges, as shown in the cut at the following streets—Water, First, Second, Third, Fourth, Fifth, Sixth, Seventh, Chestnut, Main and Poplar—were all of the same type, and were small, high wooden bridges of short span. The bridge was placed high enough above tow-path to admit of the passage of the mules used in pulling the boats under the bridge. The bridge at Lafayette avenue was a more pretentious affair, however, having a short revolving draw span. The bridge at Poplar street, being the last one for some considerable distance down, shared the burden of travel with the one on Main street—which is the State road. An interesting and important feature to Terre Haute was the ship-yard, lock and dry-dock arranged for storage and repair of canal boats. The yards occupied a considerable space, extending from Canal to Chestnut streets and lying between second and Market (Third) streets. The lock was near the junction of Second and Chestnut, was 109 feet long, 16 feet wide, and provided for a rise (or fall) of about 10 feet.

A journey for either pleasure or profit via canal boat was neither sure nor safe. Breaks in the banks occurred not infrequently, and often all traffic was tied up until the break could be located and repaired and the canal refilled, while the character of the country through which the canal passed—low, swampy land—made the contraction of some kinds of fever comparatively easy. Connections were made with various streams of water, also large ponds of water were provided at several places along the canal, for the purpose of keeping up the water supply. The canal bed was given just slope enough to keep the water running very slowly, thus preventing its becoming stagnant. The boats used were, in miniature, practically the same as those used on the lakes and rivers, and were furnished with all the absolute necessities. The motive power was supplied by one, two or three horses or mules, as the case might be, hitched one behind the other, and fairly good time was made—a journey from Terre Haute to Lafayette being made in about 24 hours, and from Terre Haute to Toledo in about 3½ days, for which passage a man paid about forty-five dollars.

The canal required in all about 21 years for completion and was in operation less than ten years. It cost something over six million dollars, and while it brought prosperity to many of the towns through which it passed, Terre Haute in particular, it was far from being a paying investment for the stockholders. Shortly after its completion its course was practically paralled by railroads and its day of usefulness was nearly over. For some time after its abandonment an effort was made by citizens of Terre Haute to keep

it open as far as Worthington, but was soon given up.

To-day it remains simply a relic of the days of old—its tow-paths are leveled and in many places wagon roads are found thereon, high and dry, while in some places the canal bed is used in forming part of some modern drainage system—and as such it will continue to stand for years to come, a monument to the ever-increasing strides of progress.

LAKE GENEVA.

Again it is time to commence thinking of the big college men's conference at Lake Geneva. Here annually in June, gather 500 picked men from the colleges of the Middle West, men who rank among the best athletes, men who stand for the best scholarship and the best social life, and above all, men who stand for the highest type of manhood. From as far north as Manitoba to as far south as Kentucky, from as far west as Colorado to as far east as Ohio, come these 500 college men, with whom to mingle and to know is no small opportunity to any college man. To have mingled with such men is a rare opportunity in a man's education.

Lake Geneva is ninety miles north of Chicago. It is ten miles long, averages two miles across and is one of the most beautiful of the famous lakes of southern Wisconsin. Only one who has been to Geneva can realize the natural beauty of the place. Many beautiful summer homes, belonging to Chicago business men, are built along the shore line.

In this environment, in one of the most favored spots, the camp of the Young Men's Christian Association is located. The camp covers about four acres of ground, consists of about 75 tents and several buildings, is equipped with row and sail boats, tennis courts, running track, baseball diamond, and in fact all facilities for every phase of athletics. The delegates from each state are grouped together, some states having several tents. A store is on the ground where one may buy almost anything he needs. The dining hall is large, accommodating over 300 at one time. Mail comes in twice every day.

The student conference this year comes on June 14 to 24, just an ideal time for Rose men, ten days following Commencement. It is just the thing to work in between Commencement and your work for the summer. These ten days have just enough seriousness and enough pleasure to make them ideal yet real. Mornings and evenings are given over to Conference sessions and the afternoons to recreation. Every college of importance in the west this side of Rocky Mountains will be represented. No college association can afford to fail to be adequately represented. No man goes but receives an impression that life cannot outlive. Advance programs show that the leaders of the Conference this year are to be especially strong. The presence of the strongest men in the leadership of students has been assured. One cannot estimate the value upon his own life of getting in touch with such men. Investigate this matter at once and decide soon that you will go with the Rose delegation.

At a meeting held on May 10th, THE TECHNIC editorial board elected their successors for the school year 1907-08, as follows:

Editor-in-Chief—Carl B. Andrews.
Assistant Editor—E. M. Brennan.
Reviews—Jas. A. Shepard.
Alumni—Emil J. Fischer.
Athletics—J. E. Bernhardt.
Local, '09—Clarence W. Sproull.
Local, '10—Harry W. Watts.
Artist—R. M. Stubbs.
Business Manager—J. R. Ralston.
Asst. Business Manager—Paul F. Stokes.

In accordance with the usual custom, the newly elected board will have charge of the June issu-

of THE TECHNIC, although the retiring board is nominally in control until the end of the school year.

The Sophomore chemists entertained the upper classmen of that course and Dr. and Mrs. White at dinner in the ordinary of the Terre Haute House, on May 6th.

The Rose Symphony Club gave a well rendered concert at the Central Presbyterian Church on the evening of May 6th, for the benefit of the Modulus fund. The three organizations of the Symphony Club were represented on the program, which was as follows:

PROGRAM.

PART I.

1 a Ripples, ... R. H. Brewer
  b Love's Lottery (selection), ... Julian Edwards
Orchestra.

2 a The Wayside Cross, ... Palmer
Solo Part, E. J. Fischer, '08.
  b Carry Me Back to Old Virginia, ... Foster
Glee Club.

3 a The Runabout, ... Kent
  b My Dusky Rose, ... Allen
Mandolin Club.

PART II.

1 a Hie Thee Shallop, ... Kucken
Solo Obligato, W. C. Knopf, '08.
  b There Once Was a Bird, ... Dekoven-Adams
Glee Club.

2 a Il Trovatore (selection), ... Verdi
  b Laughing Sam, ... Rolfe
Mandolin Club.

3 a The Ham Tree (selection), ... Schwartz
  b George Washington, Jr., ... Cohan
Orchestra.

A large audience was present, in spite of threatening weather, and the selections rendered were generously applauded.

Under the auspices of the Poly Y. M. C. A., Mr. Dodge, of the city Y. M. C. A., gave three interesting and instructive talks to the students on Saturday forenoon and evening and Sunday afternoon, the 20th and 21st of April. The first talk was made at a general assembly, at which there was the usual good attendance, and the boys showed their interest by turning out in good numbers to hear the other two. The orchestra played several selections at the first meeting and received much deserved applause.

The Glee Club gave a concert at the first Methodist Church on the evening of April 23rd. The musical program was varied by several readings by Miss Steadington, which brought great applause. Harry Shickel played a trombone solo and responded to an encore. About three hundred persons were present.

The Glee Club gave a concert at the Maple Leaf Club House on the evening of the April 19th. There was a large and enthusiastic audience present. After the concert ice cream was sold and everyone spent an enjoyable hour with refreshments and conversation.

Stafford Hathaway, '08, was recently seen by accident wearing a "Delta Beta" pledge pin.

Trafford B. Tallmadge, ex-'02, was recently in the city, renewing his acquaintance with the boys.

Lewis A. Snider, '05, with Fairbanks, Morse & Co., Indianapolis, recently spent a few hours in Terre Haute, stopping over while on a trip.

Jas. S. Jackson, '06, who is with the Allis-Chalmers Co. at Milwaukee, was in Terre Haute recently on account, of his mother's illness, which resulted in her death.

A TECHNIC MEETING.

Orr was leaving recently to help on a test at the brewery.

Orr:—"Well, I am getting thirsty. I must go."

Editor:—"Why, here, Blondy, I'll give you some water."

(Blondy declined with thanks.)

Dr. Gray:—"What will be the result of touching a live wire?"

Douthett:—"You will become ground."

Prof. Johonnott says that the big four train prism in the laboratory gives a wide dispersion. (Probably something like an explosion at Sanford.)

It is said that Douthett, while boarding the train at Charleston, was claimed as papa by a little orphan. Douthett explains that his present careworn paternal look is the result of the many hours of study which he puts in daily.

Heidenger was contemplating helping on a Senior thesis test at the brewery.

Heidenger:—"And I won't drink a drop, either."

Baylor:—"He means he won't drop a drink."

Smith, '10 (to Dabney, who has the level in civil practice):—"Hurry up, let's get out of here."

Dabney:—"Well, wheah's that stake that Ah'm to set up ovah?"

Lindeman:—"Are you one of the fellows that Jo called a snake or a goose?"

J. H. Johnston:—"Oh, no, he would'nt make that mistake, because he knows that I'm a gobbler."

Lester J. Backman, '10, has been initiated into the Sigma Nu fraternity, and Bernhart, '08, and Calvin, '10, have joined the P. I. E. S.

The new catalogue states that the foundry is 26 by 100 feet in size. Harry wants it measured by a standard tape to make sure.

Kerrick, '08:—"Fischer has awfully accommodating dreams. He said the other day that he'd dreamed the night before that I'd won two dollars, and then he wanted to borrow a quarter."

Krueger, '09, says that when he wants a real good time he lights his pipe, sits down and works a descriptive problem.

ROSE TAKES FIRST.

By Heidenger, '08.

On Friday, April 19, Rose opened the baseball season by defeating the strong Indiana team to the tune of 5 to 3. Although the game was very slow and both teams played poorly at times, still it was interesting all the way through and ended in a nerve-racking finish that brought disappointment to the I. U. Rooters and to Coach Stahl on Indiana's bench.

Rose was blanked in the first, Bossert, a new man, performing for Indiana. I. U. scored one on a hit and an error. Rose again failed to score in the second, while Indiana added one more to her list—score 2-0 in favor of Indiana.

In the third Rose started the fireworks and when it was over, the blacksmiths had introduced their famous squeeze play for a total of three runs. Baylor led off with a hit, stole second, took third on Miner's hit and was squeezed in by Douthett's sacrifice. Miner scored on a bunt hit by Heidenger, who came in on a hit by Shickel.

Bossert gave way to Mutz in the fifth, to whose slants Rose took a liking for scores in both the seventh and eighth, while Indiana scored one more in the eighth.

In the ninth, the battery work of Douthett and Mooney featured. With men on second and third and Stahl praying for a hit, they struck out Bossert, ending the contest. Score: Rose, 5; Indiana 3.

The work of Douthett, Backman and Mooney was good. "Maude" and the "Kid" had 17 strikeouts to their credit. Backman accepted four chances cleanly, which was remarkable considering the condition of the infield. He promises to be the best find since the time of Demmitt.

ROSE.	A.B.	R.	H.	P.O.	A.	E.
Baylor, 2,	5	2	2	0	1	2
Miner, c. f.,	3	1	1	1	1	0
Douthett p.,	4	0	2	0	1	1
Heidenger, s. s.,	5	1	1	1	1	0
Backman, 3,	5	0	2	2	2	0
Shickel, l. f.,	2	0	1	1	0	0
Schmidt, r f.,	4	1	0	0	0	0
Hadley, 1,	3	0	0	5	0	2
Mooney, c.,	4	0	0	17	1	0
Totals,	35	5	9	27	7	5

INDIANA.	A.B.	R.	H.	P.O.	A.	E
Robinson, 2,	4	1	2	2	2	0
Balfour, 1,	5	0	0	9	0	1
Cartwright, c. f.,	5	0	0	4	0	0
Williamson, s. s.,	5	0	0	1	3	1
Hill, c.,	4	1	2	7	0	0
Jones, l. f.,	4	1	2	0	0	1
Johnson, 3,	4	0	1	0	1	0
Heckeman, r. f.,	3	0	0	3	0	2
Bossert, p,	2	0	0	0	0	0
Mutz, p.,	2	0	0	1	0	0
Totals,	38	3	7	27	6	5

Rose.	0	0	3	0	0	0	1	1	0—5
I. U.,	1	1	0	0	0	0	0	0	1—3

Innings pitched—Bossert, 4; Mutz 5.

2-base hits—Johnson, Jones, Douthett.

Struck out—By Douthett, 17; Bossert, 1; Mutz, 2.

Base on balls—Off Douthett, 1; off Bossert, 1; off Mutz, 2

Sacrifice hits—Douthett.

Stolen bases—Baylor, Heidinger, Hill.

Umpire—Harris.

I. U., 4; ROSE POLY, 0.

Aided very materially by Johnson, Indiana took the second of a series of four. In fact,

Johnson was the principal feature and with some questionable decisions from a Dr. Harris, who handled the indicator, the best thing Rose could do was to hold Indiana down to as few runs as possible. April 20 saw the first defeat for Rose. Mooney's men had but little trouble in hitting the ball, but fast fielding kept the hits down to three and they were scattered.

Johnson pitched a good game, but not as good as Backman, though the former was blessed with good support.

Rose started in, in a hole. Robinson was given a pass and went to second on a sacrifice. Jones also received a pass and an error at third, a hit and a fielder's choice gave Indiana three runs. After that it was easy until the eight inning, when Cartwright got to first on an error and scored on a long two-base hit by Bossert. The next man flew out to Backman.

Rose had men on bases at times, but the necessary hit was not forthcoming.

In the fourth inning, with one out, Miner walked and stole second. Douthett got a hit and went to second on the next ball, but both men died on bases.

Score:

INDIANA.	A.B.	R.	H.	P.O.	A.	E.
Robinson, 2,	3	1	0	3	3	0
Jones, r. f.,	4	0	0	0	0	0
Hill, c.,	3	1	0	5	0	0
Johnson, p.,	4	1	0	2	3	0
Balfour, 1,	4	0	1	12	1	0
Cartwright, c. f.,	4	1	1	1	0	0
Bossert, 3,	4	0	1	1	0	0
Williamson, s s.,	3	0	0	1	3	0
Heckeman, l. f.,	1	0	0	0	0	0
Totals,	30	4	3	27	11	0

ROSE.	A.B.	R.	H.	P.O.	A.	E.
Baylor, 2,	4	0	1	1	2	0
Miner, c. f.,	3	0	0	2	0	0
Douthett, 3,	4	0	2	0	3	2
Heidenger, s. s.,	3	0	0	1	2	1
Backman, p.,	3	0	0	1	4	0
Shickel, l. f.,	3	0	0	1	0	1
Frisz, r. f.,	3	0	1	1	0	0
Hadley, 1,	3	0	1	10	0	0
Mooney, c.,	3	0	0	7	0	0
Totals,	29	0	5	24	11	4

Indiana,	3	0	0	0	0	0	1	0	0—4
Rose,	0	0	0	0	0	0	0	0	0—0

2-base hits—Cartwright, Bossert.
Sacrifice hit—Jones.
Struck out—By Johnson, 4; by Backman, 7.
Bases on balls—Off Johnson, 1; off Backman, 4.
Wild pitches—Johnson, 1; Backman, 3.
Stolen bases—Jones, Cartwright, Williamson, Heckeman, Miner.
Double play—Hill to Bossert.
Attendance—600.
Umpire—Harris

ROSE POLY, 4; JAS. MILLIKIN U., 2.

The first at home game was won from Millikin University April 22. With Douthett out of the game, the team was shifted considerably, and even with changed lineup, Rose put up a good game. Backman allowed only two hits in the first and one in the fourth.

Baylor started with a hit, went to second on a pass ball, but died there. Miner followed with a hit and stole enough bases to score. There was nothing exciting until the seventh. Backman got a hit, Shickel struck out and Schmidt got a hit which, with an error by Swisher, let Backman in. Hadley struck out.

Again in the eighth inning, Rose increased her lead. Mooney reached first on an error by Smith, was advanced by a hit by Webster. Three more hits scored Mooney and Webster, and that was all.

It was one, two, three, almost, for Millikin until the eighth, when Benton reached first on Backman's error and went to second on Swisher's out, second to first. Davis started around on an error by Heidenger, stole second and went to third on a grounder, and scored on another. The next two men were retired in short order. Smith flew out to Miner and Pierson was out on a grounder to Backman, unassisted.

Stocks and Benton struck out in the ninth, and Wasson was out, Backman to Hadley.

Score:

ROSE.	A.B.	R.	H.	P.O.	A.	E.
Baylor,	4	0	2	1	3	0
Miner	4	1	2	2	0	0
Heidenger,	4	0	0	0	2	1
Backman,	4	1	2	4	3	1
Shickel,	4	0	1	0	0	1
Schmidt,	3	0	1	4	0	0
Hadley,	2	0	0	8	0	0
Mooney,	3	1	0	7	1	0
Webster,	3	1	1	1	0	0
Totals,	31	4	9	27	9	3

M. U.	A.B.	R.	H.	P.O.	A.	E.
Moeller, p.,	4	0	1	6	3	0
Smith, r. f.,	3	0	1	0	0	1
Pierson, 3b.,	4	0	0	1	1	0
Stocks, c. f.,	4	0	0	0	0	0
Wassen, s. s.,	4	0	0	0	0	0
Benton, l. f.,	4	1	0	0	0	0
Swisher, c.,	3	0	0	5	2	1
Davis, 1b.,	3	1	0	10	0	0
Hamilton, 2b.,	3	0	0	2	2	0
Totals,	32	2	2	24	8	2

Rose,	1	0	0	0	0	0	1	2	*—4
J. M. U.,	0	0	0	0	0	0	0	2	0—2

Earned Runs Rose, 2.
Two-base hits—Schmidt, Backman.
Struck out—By Backman, 7; by Moeller, 4.
Left on bases—Rose, 4; M. U., 4.
Double play—Moeller to Pierson.
First base on errors—Benton, Davis, Mooney.
Hit by pitched ball—Hadley.
Time—1:25.
Umpire—Martin, of Central League.

E. I. S. N., 1; ROSE, 0.

When the team left for Charleston, April 27, everybody expected a victory for us, and it should have been—but was not. We made four hits, but they were scattered throughout as many innings and helped but little. Douthett pitched a good game, only thirty players coming to bat during the game. Tarbell, who has pitched ball for several years, had the Rose batters at his mercy and he was practically the whole team.

Rose never had any good chances to score and a slow game made everybody glad when it was over.

Normal made her run in the fifth after two men were out. Fuson reached first and stole second and third, but was caught at third on a fielder's choice, Brown landing on first. He stole second and scored a minute later on a three-base hit by Vaughn. Bradford knocked a fly, which Douthett caught, retiring the side.

E. I. S. N.	A.B.	R.	H.	P.O.	R.	E.
Vaughn, 3b.,	4	0	2	0	3	0
Bradford, 2b.,	4	0	0	2	4	0
N. Tarbell, p.,	3	0	0	0	3	0
Gaston, c. f.,	3	0	0	1	0	0
G. Tarbell, c.,	3	0	0	11	0	0
Ivy, s. s ,	3	0	0	0	1	0
Fuson, l. f.,	3	0	1	2	0	0
Corzine, 1b ,	3	0	0	11	0	0
Brown, r. f.,	3	1	0	0	0	0
Totals,	29	1	3	27	11	0

ROSE.	A.B.	R.	H.	P.O.	R.	E.
Baylor, 2b.,	3	0	1	1	1	2
Miner, c. f.,	2	0	1	0	0	0
Douthett, p.,	4	0	0	2	5	0
Heidenger, s. s.,	4	0	0	0	2	0
Backman, 3b.,	4	0	1	2	0	0
Shickel, l. f.,	4	0	0	1	0	0
Schmidt, r. f.,	3	0	0	0	0	0
Hadley, 1b.,	3	0	0	5	0	0
Mooney, c.,	3	0	1	13	0	0
Totals,	30	0	4	24	8	2

E. I. S. N.,	0	0	0	0	1	0	0	0	0—1
R. P. I.,	0	0	0	0	0	0	0	0	0—0

Two-base hits—Backman, Miner.
Three-base hit—Vaughn.
Base on balls—Off Tarbell, 3; Douthett, 1.
Struck out—By Tarbell, 10; Douthett, 9.
Left on Bases—Normal, 4; Rose, 4.
Double play—Ivy to Bradford to Corzine.
Passed ball—Mooney, 1.
First base on errors—Normal 2.
Time of game—1:40.
Umpire—Latshaw.

ROSE, 3; DE PAUW, 1.

At Greencastle, April 29, Backman equalled Douthett's record of the previous game—only 30 men faced the pitcher, and for the first eight innings there were twenty-four men at the bat, and the next two in the ninth were easy outs. The third, however, broke the spell and three successive hits were made before the tide could be stopped. The three hits and three stolen bases gave D. P. U. her one run. At the close of the game it began to rain, and the ball becoming wet and muddy, made it impossible for good control, and but for the weather it would probably have been a one hit, shut-out game for Back.

Rose could do nothing worthy of mention until the sixth. Mooney got to first on an error. A hit, a sacrifice, a hit, an error by short and another hit gave Rose two runs and then nothing more was done until the ninth. Two hits, one a two-bagger, gave us one more run.

DePauw simply didn't have a chance until the ninth inning—not a man saw second base. Holderman and Lantz were easy outs in the ninth, but Wiley, the last man on the list, got a hit and stole second. Shirley got a hit and pilfered second. Tucker also got a hit and scored Wiley.

But the next man struck out and everybody made a run to shelter.

Score ·

ROSE.	A.B.	R.	H.	P.O.	A.	E.
Baylor, 2b	4	0	1	1	4	0
Miner, c	3	0	0	1	0	0
Douthett, 3b.,	4	1	1	1	1	0
Heidenger, s s.,	4	1	1	2	3	0
Backman, p.	2	0	2	1	3	0
Shickel, l. f.,	4	0	1	0	0	0
Schmidt, r. f,	4	0	0	0	0	0
Hadley, 1b.,	3	0	0	10	0	0
Mooney, c,	3	1	0	11	0	0
Totals,	31	3	6	27	11	0

D. P. U.	A.B.	R.	H.	P.O.	A.	E.
Shirley, c. f,	4	0	1	0	0	0
Tucker, c.,	4	0	1	8	2	0
Collins, r. f,	4	0	0	0	1	0
Yocum, 2b.,	3	0	1	1	2	1
Matthews, s. s.,	3	0	0	1	4	1
Rhodes 1b,	2	0	0	14	0	0
Holderman, l. f,	3	0	0	0	1	0
Lantz, 3b.,	3	0	0	3	2	0
Wiley, p,	3	1	1	0	4	0
Totals,	29	1	4	27	16	2

Rose,	0	0	0	0	0	2	0	0	1—3
D. P. U.,	0	0	0	0	0	0	0	0	1—1

Earned Runs - Rose, 2; D. P. U., 1,
Two-base hit—Heidenger.
Base on balls - By Backman, 1.
Struck out—By Backman, 9; Wiley, 6.
Left on bases—Rose, 3; D. P. U., 2.
Double play—Baylor to Heidenger to Hadley.
Hit by pitcher—Backman, 2.
Time of game—1 hr. 15 min.
Umpire—Shoptaugh.

PURDUE WINS ON ERRORS.

Purdue's victory over Rose at Lafayette, April 30, was in no way a fair test of the ability of the Rose team. The day was very cold, and with the grassy diamond literally soaked with water, conditions were far from ideal. Rose Poly started off badly in fielding and before the team became accustomed to the slip-slide style of play necessary, five errors in three innings gave Purdue enough scores to claim the game.

Baylor started the game by getting a hit into right and was sacrificed to second by Miner. Douthett scored Baylor on a two-bagger to right field. The next two were outs. This ended the scoring for Rose, and but for one inning the chance to get a run was slight. In the eighth, with two out, after Miner had been passed to first, Douthett got his third hit and sent Miner around, but another out downed all hopes. The ninth was one, two, three.

Purdue got two runs in the first inning on three hits, a stolen base and an error. They scored one more in the third inning. Fleming reached first on an error. Kelley struck out and Boltz was hit A ground hit advanced both men and an error let Fleming score. From that on, however, it was practically three men to an inning, and the hits Purdue made—one each in the eighth and ninth innings—netted nothing.

The score in detail :

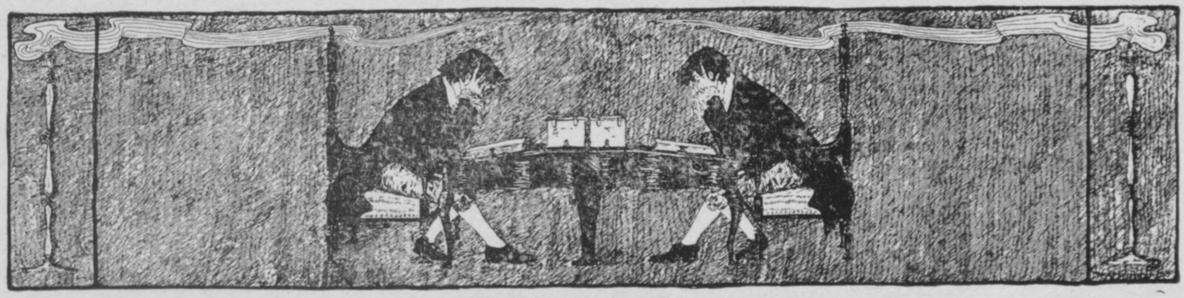
PURDUE.	A.B.	R.	A.	P.O.	A.	E.
Babcock, s s.,	4	0	1	1	6	0
Driver, r f.,	4	1	1	2	0	0
Fleming, 1b.,	4	2	1	11	0	0
Kellogg, (capt) 3b.,	4	0	0	2	2	1
Boltz, c. f,	3	0	0	2	0	0
Bird, 1 f.,	4	0	2	0	1	0
Sherwood, 2b.,	4	0	0	2	0	0
Rosenbaum, c.,	3	0	0	7	1	0
Rice, p,	3	0	1	0	5	0
Totals,	33	3	6	27	15	1

ROSE.	A.B	R.	A.	P.O.	A.	E.
Baylor, 2,	4	1	1	0	0	2
Miner, c. f.,	2	0	0	3	0	0
Douthett, p,	4	0	3	1	4	0
Heidenger, s. s,	4	0	0	0	2	0
Backman, 3.	4	0	0	1	0	0
Shickel, l. f.,	4	0	0	2	0	0
Schmidt, r. f.,	3	0	1	0	0	0
Hadley, 1.	2	0	0	7	0	1
Mooney, c,	3	0	0	10	0	1
Totals,	30	1	5	24	6	4

Purdue,	2	0	1	0	0	0	0	0	*—3
Rose,	1	0	0	0	0	0	0	0	0—1

Earned runs—Purdue, 2; Rose, 1.
Three-base hits—Babcock, 1.
Two-base hits—Douthett, 2.
Bases on balls—Off Rice, 1
Struck out—By Rice, 7; Douthett, 9.
Left on bases—Purdue, 8; Rose, 6.
Wild pitches - Rice, 1.
First base on errors—Purdue, 4.
Hit by pitcher Boltz, Rosenbaum, Hadley, Schmidt.
Umpire—Jones, of Crawfordsville.
Time—1:30.

The game scheduled with Jas. Millikin University, at Decatur, May 7, was called off on account of wet grounds, and it is not likely that the game will be played, as there are no open dates left in McDaniel's schedule.



REVIEWS

The Dyke Type of Earth Dam.

"The dyke type of earth dam, first introduced on an extensive scale at the Wachusett reservoir at Clinton, Mass., is in no way discredited by the recent sliding of a portion of the face of one of the dykes of that basin. The portion of the structure which slid a fortnight ago, was made of rather poor sandy material removed from a cut-off trench and placed on the two toes of the dyke as secondary embankments to face the impervious material which was relied upon to make the work water-tight. It is generally understood that this use of this sandy material at the toes was not originally contemplated when the plans for these structures were outlined by the former chief engineer of the water works, Mr. R. P. Stearns, but were adopted later at the suggestion of the consulting engineers of the Metropolitan Water Board. Nobody would rely on the material, which was in them, for a reservoir embankment, and apparently the reason it was used at Clinton was because it had to be placed somewhere, and this position for it was as good as any. The fact that it has slid cannot be wholly explained, in the light of the present knowledge, by its fine sandy character, for it rested on a rather bad stratum of soil, which may itself have been the cause of the slip, and carried a very heavy load of rip-rap on a berme som distance above the water line in the reservoir at the time the slide occurred. Either or both of these factors may just as likely have been the cause of the slide as the charrcter of the material used in the embankment. All that the incident shows is that where material of a pervious, sandy nature is used for facing a reservoir embankment it must be placed on a slope considerably flatter than that which it naturally assumes when dumped from a height. The slip of this embankment is no more a proof of the lack of merit of the dyke type of construction than the slips of linings of reservoirs of the usual construction are demonstrations that that type of embankment is unreliable."—*The Engineering Record.*

Electricity at Jamestown.

"Electric power for the approaching exposition at Jamestown, like that of the Buffalo Pan-American Fair, will come from a distance. Having no Niagara to rely upon, however, power for the Jamestown Exposition will be furnished by steam turbines located in the power house of the Norfolk Railway and Light Co., about seven miles from the exposition grounds. This fair will be the first at which electric power will be generated by steam turbines. The machines will be of the Curtis type, these, as well as the complete electrical equipment being supplied by the General Electric Co.

The Exposition authorities have entered into a contract with Norfolk Railway and Light Co. to furnish all the electricity required for illumination and power purposes. The electricity generated at their Jamestown power house will be transmitted on specially constructed lines to a model sub-station in Machinery Hall. Here will be located the transforming and distributing apparatus. This equipment consists of large air-cooled transformers, many smaller type H transformers for general illumination, as well as con-

stant current transformers for the series-arc lighting system, which will be used for police illumination. At the sub-station also are motor-generator sets to provide direct current for the operation of searchlights and small motors where they may installed by exhibitors

The switchboard for controlling the various circuits throughout the exposition grounds is located in a gallery and is typical of modern switchboard engineering. All the electrical machinery follows standard lines similar to that installed at the St. Louis, the Pan-American and other American expositions.

Those who have seen the plans of the Jamestown Exposition predict that the electrical features, particularly the illumination, will equal, if not excel, the display at the famous Pan-American Exposition. Thousands of Edison lamps will be supplemented by searchlights both on land and on the fleets anchored in Hampton Roads, combining to make the mighty pageant magnificent and beautiful."—*Electrochemical and Metallurgical Industry.*

The Microscope for Testing Metals.

The *American Machinist*, in discussing the testing of metals by the microscope, as performed by Dr. William Campbell, of Columbia University, says: "The preparation of the specimen simply means the use of fine emery and rouge to obtain a high polish. Etching with acids sometimes gives better results, but is not often necessary.

With lantern slides he showed the difference in the qualities of iron and steel by his method and how the microscope will detect the effects of overheating, the varying proportions in mixing and give a direct clue to the physical properties. A specimen from a chilled car wheel showed very clearly where the hard chilled surface merged into the softer gray-iron backing or center of the wheel.

An instance of the practical application was cited where a large tank had collapsed and killed several workmen. The maker of the plates and the party who erected them each blamed the other, the rolling-mill people claiming the plates were of the best steel. Microscopic tests showed large streaks of slag, proving it to be iron instead of steel, and poor iron at that.

In another case Dr. Campbell tested blades of one of the numerous safety razors now on the market and found they varied greatly, that some gave excellent results, others very poor, and that the fault lay in the treatment of the steel in hardening and that this fault could be detected very much better by the microscopic examination of the polished surface than by fracture.

The testing of steel, however, should be done after it has reached the stage at which you use it, instead of when it comes from the rolling-mills. The tests should be made after heating, forging and machining, as these change its structure and affect the value of the material.