Winter 1-1914

# Volume 23 - Issue 4 - January, 1914

Rose Technic Staff
*Rose-Hulman Institute of Technology*


VOL. XXIII TERRE HAUTE, IND., JANUARY, 1914 NO. 4

# THE TECHNIC



TERMS.

One Year .....$1.00
Single Copy ..... .15

*Issued Monthly at the Rose Polytechnic Institute.*

Entered at the Postoffice, Terre Haute, Ind., as Second Class Mail Matter.

AS we go to press the definite announcement is made that the Institute has purchased the Hulman farm, east of Terre Haute, as a site for the new school. Thus the first step has been taken toward the fulfillment of the promise long held out to the loyal friends of Rose that the school shall be moved to a site well removed from the city, where new buildings will be erected and modern equipment installed.

Rose has long maintained an enviable reputation as an engineering school, but has been handicapped by the present location and equipment. The Hulman farm is an ideal site for a school. It is located about three miles east of the city limits along the Indianapolis interurban. The farm itself is probably the most beautiful in the vicinity of Terre Haute. It consists in all of one hundred and forty acres within whose boundaries there are two small lakes and one well of fine artesian water. We can easily imagine the spacious buildings, well-lighted and ventilated, and the laboratories and shops equipped with the latest improvements in apparatus and machinery. We can see a wonderful campus with separate base ball, football and tennis fields and a gymnasium large enough to afford the privileges of exercise to every student not to mention an artesian swimming pool and basket ball floor. If we follow our imagination a little further we can see the residences of the faculty, the dormitories and the fraternity houses, a little village in themselves.

With all these things added to Rose's present excellent faculty, curriculum and general policy we will have an ideal school and one which will "take its hat off" to no similar institution. However, let us not forget that it takes money and lots of it to carry to completion such an undertaking. Now we do not know what the policy of those in control will be in regard to increasing the present endowment, but we do know that Rose has never solicited financial aid. Nevertheless we are sure that every bequest could be used to advantage. We are sure that the sons of Rose are as loyal as the Alumni of any school even though they be remotely scattered and not in close touch with their alma mater. In view of the excellent work done by

the Alumni of other schools an instance of which we may sight in DePauw University, it is to be expected that our own Alumni will give substantial aid in this worthy project.

Remember then, you Alumni, that the eyes of every person interested in Rose will be upon you and be sure that you be not found wanting in this epoch of her history.

---

IN the November issue of the TECHNIC brief mention was made of the death of Harry Lamar Smith. In behalf of the student body we wish to express our belated sympathies to his parents and friends, and particularly to his brother, Herbert Smith, who graduates this year from Rose. It is to be regretted that one who gave so much promise should have been cut off in the bright morning of his youth, but "His will be done."

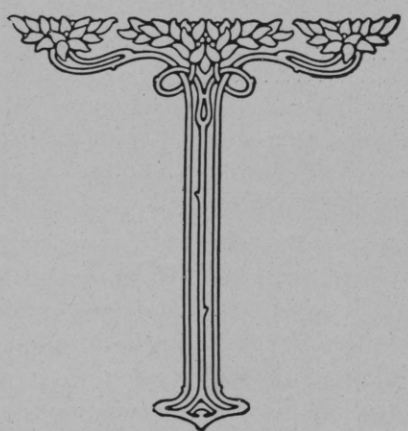
A brief outline of career after leaving Rose will be found in the Alumni notes of this issue.

---

AS a leading article for this issue we present a paper on European canals by J. D. Galloway, '89, of Galloway and Markhart, civil engineers, San Francisco, Calif. This paper was read before the Waterways Congress of the Commonwealth Club of California upon the fifteenth of this month, and we feel sure it will be well received by TECHNIC readers.

---

THE Alumni article for this month is by A. G. Shaver, '97, who is signal engineer for the Rock Island Lines. This paper treats the Caustic Soda Primary Battery and its use in respect to signal work. We recommend it to our readers.



# EUROPEAN AND AMERICAN WATERWAYS

By J. D. GALLOWAY, Consulting Engineer

Paper read before the Waterways Congress of the Commonwealth Club of California, Jan. 15, 1914.

## GENERAL STATEMENT.

ONE who visits Europe, as I had the pleasure of doing this summer, and who has an interest in the material well-being of the people cannot fail to be impressed by the fact that a much greater use is made of natural and artificial waterways in that country than in this. The vast river traffic on the Rhine in Germany, the restless activity at the Belgian and Dutch ports of Antwerp, Rotterdam, or the well developed traffic on the canals and rivers of France, impress the visiting American and cause him to wonder if such things can be done in slow and unprogressive Europe why cannot similar results be obtained in progressive America. Why is it that in Europe they use canals and rivers for the transfer of freight when we have been told that such work can be done much cheaper by railroads? As a matter of fact in this subject, as in many others, Europe can teach the self-satisfied American much and it behooves us to study what they have done and to adapt the results to our conditions, if possible.

This paper is merely a brief survey of some of the most obvious and important points of the subject of European and American waterways with some deductions relating to conditions in California. As an outline of what has been accomplished elsewhere, it may serve as a guide to procedure here. Use has been made of various sources of information, among which may be mentioned the paper by Mr. Isidor Jacobs in the Commonwealth Club transactions, the proceeding of the International Congress of Navigation, the transactions of the American Society of Civil Engineers, etc. Some of the data are obscure and some are lacking in exactness, but they will serve the purpose for a general paper.

Some reference will be made to the historical phase of the subject and also to statistics of commerce. Some slight review of the engineering aspects of river and canal traffic is also necessary. In America the canal system of early days can be used to point a moral and is of interest for that reason, if for no other. In considering the various phases of the subject a comparison with conditions in California, especially the central valleys and around San Francisco Bay, if necessary.

## GENERAL CONDITIONS.

Speaking generally, the physical conditions relating to water traffic are far more simple in California and the problem easier to solve than in Europe or in the eastern States. The harbor of San Francisco Bay is natural and needs nothing but wharves to accommodate traffic. The great ports of Rotterdam, Antwerp, Liverpool, Glasgow, London and Hamburg lie on relatively narrow tidal estuaries or rivers and require, generally, costly enclosed basins or wet docks on account of excessive range of the tide. Some lie far inland, as Manchester or Amsterdam, and require canals for sea-going ships; others, such as Genoa, Marseilles, or Barcelona, lie on the open sea which makes necessary expensive sea walls in open water. Such procedure, however, is possible and points the way for farther improvement of the Harbor of Los Angeles.

The subject of the harbor is vitally related to that of inland waterways for facilities of transfer from deep water ships to inland boats must take place at the harbor.

Again, the great valleys of California are level plains. Only in Holland and portions of Belgium and Germany are physical conditions equally favorable. England, France and parts of Belgium and Germany are rolling countries, where canals must overcome considerable elevations. The Languedoc Canal in France rises over six hundred feet. Locks are numerous in England on most canals.

Climatic conditions are also in our favor, as the canals of Europe are closed by ice during the year. There is, however, a more uniform rainfall and they have not our problem of the long dry summer.

HISTORICAL SKETCH AND STATISTICS.

*France.* Over three hundred years ago the Briere Canal, connecting the Seine and Loire, was opened to traffic. The Orleans Canal was opened in 1675, and the Languedoc Canal from the Bay of Biscay to the Mediterranean, 148 miles long, carrying 100-ton barges, was completed in 1681 after fifteen years labor.

In 1905 the length of inland waterways amounted to 7,200 miles, 373 miles having been built since 1878. Of more importance are the statistics of length of canals adaptable to boats of 300 tons, other waterways being for smaller boats.

Table I. French Waterways: Lengths of Rivers and Canals.

| Year. | Rivers and Streams, Miles. | Canals, Miles. | Total Miles. |
|---|---|---|---|
| 1878 | 617 | 287 | 904 |
| 1902 | 1,305 | 1,632 | 2,937 |

Thus the length of rivers and streams available for large boat traffic was more than doubled and of canals the increase was nearly 600 per cent in 24 years. This result was in conformity with the program of 1879. From 1880 to 1903 about $130,000,000 was spent on enlarging old canals, construcing new ones, rearranging the system and canalizing the rivers.

The depth of water is generally 6.5 feet, but in new projects the depth is 8.5 feet.

Traffic on the French canals increased from 2,250,000,000 kilometric tons in 1880 to 4,453,965,484 kilometric tons in 1902, or 98 per cent in 22 years, or at the average rate of about 4½ per cent per year. About one-fifth of the freight traffic of France is carried on inland waterways. In 1902 the average haul of one ton of freight was 89 miles. With the increase in facilities has gone an increase in the size of canal boats, which has a direct bearing on a reduction in the cost of carrying freight. In 1902 there were 15,380 canal boats of all sizes, of which 41 per cent were over 300 tons capacity.

All the canals of France are owned by the government, and with a few minor exceptions all craft can navigate the inland waterways free of tolls.

*Belgium.* The length of river and canal navigation in Belgium is over 1,000 miles. The government commenced to take over and organize the canals in 1830. They are of about the same capacity as the French canals and exchange traffic. In the neighborhood of the Rhine larger boats can be used and the 1,000-ton barges from that river reach Antwerp. Tolls sufficient to cover maintenance and operation are charged.

Belgium has spent nearly $80,000,000 in the period from 1830-1905, and has a number of projects on hand for enlarging the canal system. Traffic in the waterways increased from 24,836,000 tons carried in 1888 to 53,345,000 tons in 1905, or 114 per cent, or at the average rate of about 6.3 per cent per year. About 44 per cent of Belgian freight traffic is carried on the inland waterways. Practically all of the railways of Belgium are owned by the government.

*Holland.* In 1873 the inland waterways of Holland amounted to 2,936 miles, compared to a railroad mileage of 1,005. Railroads have since developed more rapidly, largely owing to the fact that canals had in 1873 reached nearly a maximum development. Since 1873 there has been constructed the canal from Rotterdam to the sea, the canal from Amsterdam to the sea,

and the Merwede Canal from Amsterdam to the two branches of the Rhine. There are now over 3,000 miles of inland waterways of which about 2,100 miles are comprised in 265 separate canals.

The canals are of various sizes, many having been constructed for drainage of the low lands. The last canal constructed for inland traffic, the Merwede Canal, between Amsterdam and the Rhine, is 44 miles long, 66 feet wide on bottom, 10 feet deep, and cost over $8,000,000. It accommodates the largest Rhine barges. The North Sea Canal from Amsterdam to the sea at Ymuiden is 17.4 miles long, 164 feet wide on bottom, and 32.2 feet deep. It is one of the great canals of the world, having a water section about as great as the Suez Canal. It has cost up to the present time over $23,000,000. Another inland canal constructed by the Dutch is the one from Ghent in Belgium to Ter Neuzen on the Schelde, thus making an outlet for the commerce of that part of Belgium thru Dutch territory. It is 19.84 miles long with a depth of 28′ 9″, a bottom width of 79 feet, and a surface width of 252 feet. The cost of the Dutch section was $4,530,000. Mention has been made of these canals to give an idea of the expenditures upon the canals of Holland. No estimate can be given of their total cost.

The canals and rivers of Holland support an enormous traffic, as on the River Rhine passes the traffic for the industrial part of Germany situated along that river. The following table shows the rapid increase in traffic in metric tons of 2,204 pounds:

| Year. | With Germany | With Belgium. | With Other Ports. | Total. |
|---|---|---|---|---|
| 1901 | 10,322,047 | 2,757,330 | 309,787 | 13,396,164 |
| 1907 | 17,799,974 | 4,937,736 | 342,411 | 23,080,121 |
| 1908 | 16,003,452 | 5,013,609 | 374,784 | 21,391,945 |

The increase from 1901 to 1908 was 60 per cent of the 1901 traffic, or at the average rate of 7½ per cent per year. The internal traffic on other canals shows an increase also.

*Germany.* At the present time Germany has about 6,200 miles of inland waterways and numerous projects are under .construction, especially a canal intersecting the several large rivers. A number of large rivers run from south to north thru the land and these have been regulated for traffic. The canals are largely modern; the program now being carried out calls for canals to carry 400 ton barges east of Berlin, and 600-ton barges west of Berlin. The Rhine is a broad, swift-flowing river navigable without locks for barges of 2,000 tons as far as Mannhein. The total expenditure is not available, but Mr. Jacobs states that up to 1906 Prussia alone has expended $132,000,000 on its waterways.

The traffic statistics for 1909 are as follows:

| | | |
|---|---|---|
| Rhine Districts | 58,390,068 | tonnen |
| Markgraviate District | 20,898,783 | " |
| Elbe District | 17,380,614 | " |
| Oder District | 8,485,005 | " |
| Vistula District | 7,962,984 | " |
| Vistula—Pregel District | 4,708,377 | " |
| Danubi | 669,587 | " |
| Total | 118,495,418 | " |

As showing the rapid growth of traffic on German canals the following notes are given.

On the Spree-Oder Canal, 54.7 miles long, equipt with 400-ton barges, the water traffic rose from 1,440,000 tons in 1896 to 3,300,000 tons in 1910, a gain of 129 per cent in 15 years.

On the Dortmund-Ems Canal, 141.7 miles long, equipt mainly with 600-ton barges, the traffic rose from 476,000 tons in 1900 to 3,163,000 tons in 1910, a gain of 565 per cent in 11 years.

On the Tetlow Canal, 24.2 miles long, equipt for 600-ton barges, the traffic rose from 300,000 tons to 1,250,000 tons in four years, or a gain of 316 per cent.

The growth of the Rhine traffic is indicated by the figures given for Holland and also by statistics of vessels. In 1907 there were 26,235 vessels of all kinds in use on the Rhine, the Elbe and the Weser of a rated capacity of 5,900,000 tons, being an increase in number in 30 years of 54 per cent, and of capacity of 322 per cent. The number of vessels alone give some idea of the intensity of the traffic.

*England.* I have left this country to the last, as of all the principal European countries England alone has stood practically still in the recent development of waterways. In 1890 the canals of England were as follows:

| | |
|---|---|
| Owned by Public Trusts | 927¼ miles |
| Independent Canals | 1,445¼ miles |
| Guaranteed and Owned by Railway Cos. | 1,333 miles |
| Derelict | 118½ miles |
| Ownership not known | 36¾ miles |
| Total | 3,860¾ miles |

In 1896 there were 2,768 miles of independent canals with a traffic thereon of 33,348,573 tons per annum, out of which a profit of $1,050 per mile was earned and 1,138 miles of canals under railway control with a traffic of 6,009,820 tons per annum, and a net profit of $194 per mile was earned.

The canals were commenced before the railroads and for a time earned considerable money. After the advent of the railroads, the canals were systmatically purchased and stifled by the railways, the above figures of earning indicating this effect. The canals are small, are laid out without any system or regard for each other in size or location, do not connect the main centers, and have had little done for them in sixty years. They carry less than 10 per cent of the traffic of the country and the rate of increase in traffic is much less than that of the railroads.

The canal system of England teaches us little as regards modern conditions except in a negative way. The necessity of keeping off the hands of the railways is emphasized and the system as built is a good example of how not to do it. England is studying the system and may improve it. From these remarks, the Manchester ship canal must be excepted. It is, however, a canal for ocean-going vessels and is not, in the main, an inland waterway.

United States. The history of American Canals is that of the English canals only with a more deplorable result. The canal building started early in the 19th century and for a while the canals paid a revenue. The early canals were built largely or entirely by the state governments although the National Government spent some money on them. Following is a table of statistics:

| | Constructed Miles. | Abanodned Miles. | In Use Miles. |
|---|---|---|---|
| Maine | 27.5 | 20.5 | 7.0 |
| New Hampshire | 10.73 | 10.73 | 0.0 |
| Massachusetts | 105.15 | 105.15 | 0.0 |
| Connecticut | 61.50 | 61.50 | 0.0 |
| Vermont | 1.50 | 1.50 | 0.0 |
| New York | 1,062.7 | 447.3 | 615.4 |
| New Jersey | 271.8 | ..... | 271.8 |
| Pennsylvania | 1,192.7 | 996.2 | 196.5 |
| Delaware and Maryland | 14.0 | ..... | 14.0 |
| Maryland & Dist. Columbia | 184.5 | ..... | 184.5 |
| District of Columbia | 1.2 | 1.2 | 0.0 |
| Virginia | 203.6 | 203.6 | 0.0 |
| Virginia and North Car. | 76.4 | ..... | 76.4 |
| North Carolina | 19.7 | 12.0 | 7.7 |
| South Carolina | 54.4 | 54.4 | 0.0 |
| Georgia | 37.0 | 12.0 | 25.0 |
| Florida | 10.5 | ..... | 10.5 |
| Louisiana | 51.8 | ..... | 51.8 |
| Ohio | 879.5 | 196.5 | 683.0 |
| Indiana | 453.0 | 453.0 | 0.0 |
| Illinois | 134.85 | ..... | 134.85 |
| Oregon | 0.6 | ..... | 0.6 |
| Total | 4,854.63 | 2,575.58 | 2,279.05 |

Of the improvement of rivers by the United States Government about 1700 miles have been rendered navigable at low water. The National Government has also constructed about 200 miles of canals.

The canals of the United States have never paid as a means of transportation. There are several causes of this. The canals were small, the systems were poorly designed and they were subject to the competition of railroads which extended beyond the subject of rates even up to influencing of legislatures and the actual purchase of canals to remove competition.

The canals were built and operated by the states and were subject to all the inefficiency and corruption that in the past have made our governments a national disgrace.

The State of New York has in recent years commenced on the renewal of its canal system by rebuilding the Erie Canal, always the best paying canal of the United States. They are spending about $130,000,000 in rebuilding the canal over a total length of about 450 miles. Throughout most of this length 1,000 ton-barges can be used. Aside from this no other work of

importance is being carried out in the United States in the way of canal building by states. Only time will tell if the money spent on the Erie Canal has resulted in a profit to the people as a whole.

CONCLUSIONS.

The space limit of this paper will permit of no discussion of the points noted. Following are the conclusions arrived at after a study of available material:

(1) All waterways traffic in Europe suffered a relative decline on, and some time after the advent of the railroads.

(2) In France, Belgium, Holland and Germany, waterborn traffic is rapidly increasing and during the last 25 to 30 years enormous sums of money have been spent in canals and rivers.

(3) That where this increase in traffic has developed there exists the densest population of Europe with a corresponding development in manufacturing.

(4) That in Belgium, Holland and Germany and partly in France, the railroads are owned by the Government and that as freight carriers they are distinctly inferior to English railroads and unquestionably inferior to American railroads, both in service and cost thereof. This is partly due to the small size of the countries and difference of nationality. The long haul of freight as we know it is unknown in Europe.

(5) That the development of water traffic has not interfered with a reasonable increase of rail traffic during the same period.

(6) That there is a steady decrease in the traffic on canals with boats of less than 300 tons capacity, pointing to the conclusion that small canals do not pay, except possibly as feeders to large canals.

(7) That the European governments provide the waterways and that the boats are privately owned and operated.

(8) That almost all canals are free of tolls but that there is an inclination in Germany to charge some tolls in order to make the canal pay expenses.

(9) That it is not possible to get very reliable information at hand as to cost of moving freight by water in Europe when the cost is made to include interest on investment, cost of operation, cost of repairs, a sinking fund to extinguish the original expenditures, and an inclusion in the cost that of canals abandoned, etc.

(10) That the canals of England and the United States do not now furnish any criterion one way or the other as to the wisdom of constructing a system of waterways in California. Their failure to serve was due to poor design, ill-advised construction, destructive competition and manipulation by railroads and political corruption and mismanagement, especially in America. They serve merely as an example of what to avoid.

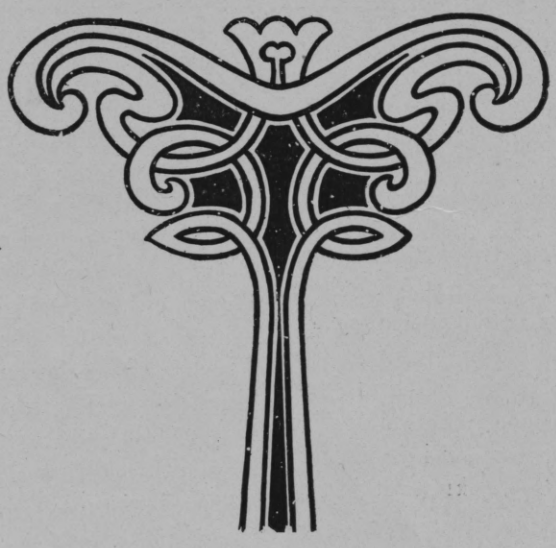
(11) That no system of waterways should be constructed on which the cost of traffic is greater than by rail as determined, not by what the freight charges now are, but as they might be in the future when raised or lowered by Government commissions. Included in the cost should be all the elements of first expenditure, interest, depreciation, renewals, obsolescence, operation and sinking fund. Any other course is likely to lead to wrong ideas as to cost of service and resulting economic loss.

(12) That on any system of waterways the railroads should be prohibited from owning traffic boats and from temporary rate cutting.

(13) That the problem in California is physically a simple one relative to that of Europe. Any system of waterways is a special problem by itself and one of the chief things to be considered is the existing cost of carriage by rail. The related subjects of density of population, manufactures, and type of industries should all be considered.

(14) My final and most important conclusion is that the question in California as to the

wisdom of constructing a system of inland waterways is, at the present time, an open one, and that the course of action to be followed can be determined after a thorough study of European methods and conditions and an impartial comparison with conditions in this state. It will involve such related problems as Irrigation, Flood Control, Hydro-Electric Power, and Storage of Water. To this, any association that may result from this gathering can well address itself.




# CAUSTIC SODA PRIMARY BATTERY

By A. G. SHAVER, '97

THE development of the oil engine, the railway signal, the telephone and the phonograph produced a demand for an efficient economical battery.

The caustic soda primary cell immediately came into prominence as meeting this demand. As all new devices in their first stages of development are usually imperfect and inefficient, so it was with this type of battery; but there has been a gradual improvement; the correct relation of weight and position of elements, the type of supporting frame, the density, shape and amalgamation of the zinc material, the quality of the copper oxide, the effectiveness of the electrical connections, and the kind and style of jar—all of these features and others have been carefully considered until it would now seem that further appreciable progress in obtaining a perfect cell is almost impossible.

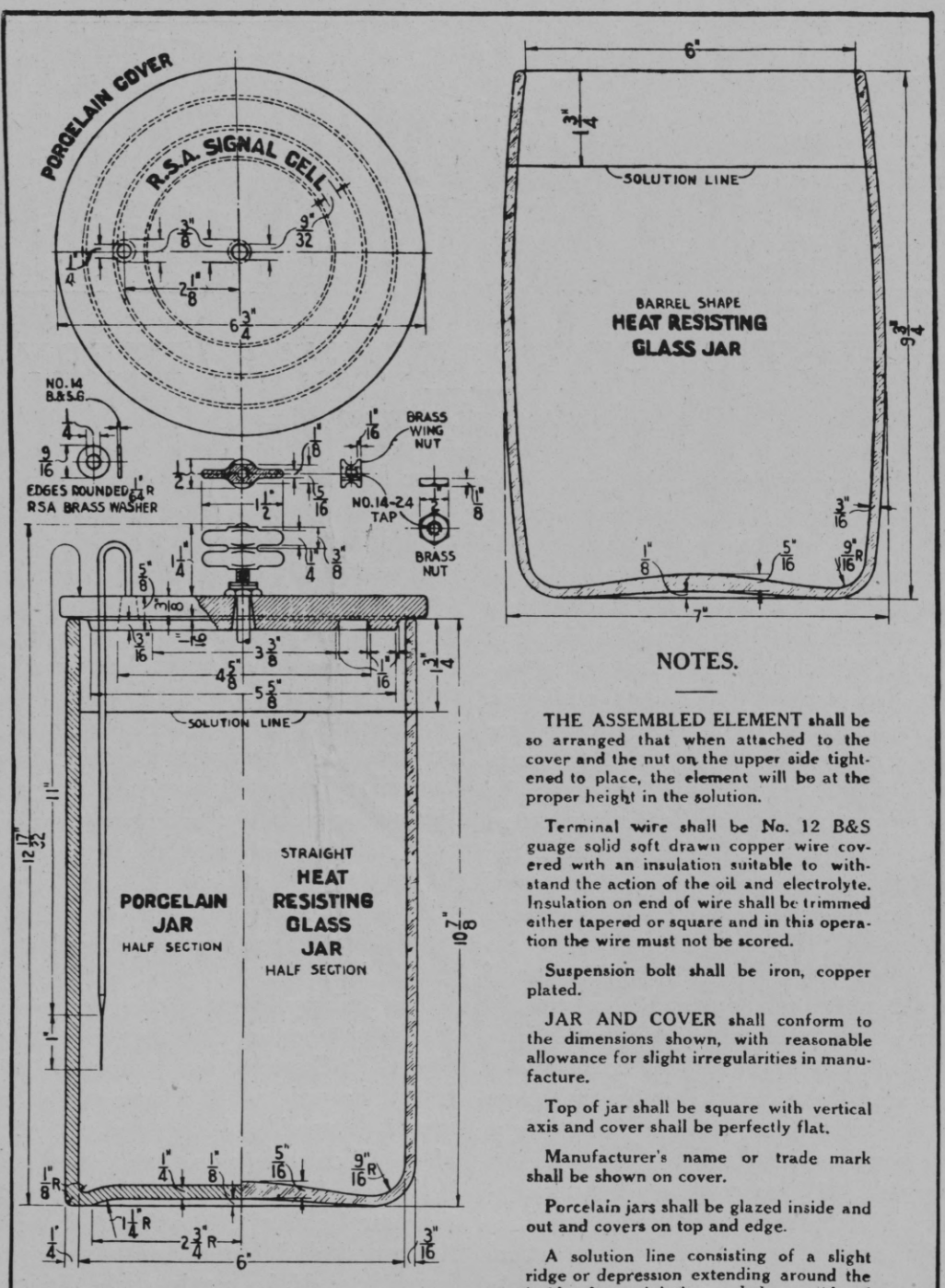
Most all of the automatic block signals on the railroads are of the electric motor semaphore pattern, requiring electric current at about eight volts to operate satisfactorily.

January 1st, 1912, there were about twenty-five thousand such signals in service and it is safe to assume that at least 80 per cent were operated by caustic soda primary battery. As ordinarily there are sixteen cells for each signal, there are at least three hundred twenty thousand cells in service today operating signals alone. Besides operating the signal itself, this same type of battery is used to furnish energy for relays, indicators and other appurtenances and adjuncts for signals.

More recently, it has been discovered that the caustic soda primary cell is superior to the gravity (blue vitrol) cell for operating the track circuit, and its use in that direction is becoming extensive.

Along about the year 1908 competition for the business of supplying new cells and renewals for railway signaling became very keen. There being no specification and no uniform basis for rating the capacity of the battery, the manufacturer who had the most persuasive power with the Purchasing Agent, as well as a fair reputation and performance of product, usually got the business.

The Railway Signal Association, recognizing the importance of this feature of signaling, started its Committee on Automatic Block (of which the writer was Chairman) at work to prepare a specification. Among the first acts of the Committee was that of determining a basis for cell capacity. On investigation with the manufacturers, it was found that one based the capacity of his cell upon the number of hours it could be continuously discharged at the one ampere rate before the voltage dropped below .5; another claimed the capacity was fixed by the quantity of material placed in the elements (this was partially true); and still an-




## NOTES.

THE ASSEMBLED ELEMENT shall be so arranged that when attached to the cover and the nut on the upper side tightened to place, the element will be at the proper height in the solution.

Terminal wire shall be No. 12 B&S guage solid soft drawn copper wire covered with an insulation suitable to withstand the action of the oil and electrolyte. Insulation on end of wire shall be trimmed either tapered or square and in this operation the wire must not be scored.

Suspension bolt shall be iron, copper plated.

JAR AND COVER shall conform to the dimensions shown, with reasonable allowance for slight irregularities in manufacture.

Top of jar shall be square with vertical axis and cover shall be perfectly flat.

Manufacturer's name or trade mark shall be shown on cover.

Porcelain jars shall be glazed inside and out and covers on top and edge.

A solution line consisting of a slight ridge or depression extending around the inside of porcelain jars and the outside of glass jars shall be placed as shown.

**R. S. A. SIGNAL CELL**
CAUSTIC SODA PRIMARY BATTERY

RSA 1053
OCT. 1912

other did not seem to know how the capacity of his product was obtained, except that it gave results in service comparable with his competitors.

The Committee prepared the appended specification, which was adopted by the Association. It covers a cell of 400 A. H. capacity, because that is the only size, for this type of battery. generally used in railway signaling; but this specification, by a change in the capacity and test requirements, can be used for a cell of any other capacity desired.

Attention is directed to the cell capacity being based on .5 of a volt as the minimum permissible. An inspection of the capacity curve accompanying this article will show that after the discharge of a cell has continued until the voltage drops below .5, the curve drops down very rapidly, indicating that the energy is about exhausted, and in service this is found to be an actual fact.

In R. S. A. drawing 1053, which forms a part of the specification, it will be noted that details of porcelain and heat resisting glass jars are shown. Porcelain jars have been mostly used in the past; heat resisting glass jars are a development of the last few years and are now rapidly displacing other types of jars, because the condition of the elements can readily be determined without disturbing the contents of the cell.

Since some of the railroads are now buying caustic soda cells and renewals in lots of five thousand to ten thousand at a time, so that quick tests and inspections are necessary, and since the improvements in the Railway Signal Model of the last two or three years have resulted in a considerable increase in capacity, the Railway Signal Association is now seriously considering the elimination of the one ampere test in its specification. Some of the manufacturers have declared their willingness to submit their battery to the three ampere continuous discharge test as meeting the capacity requirement where the one ampere continuous discharge test is now in the present specification.

Figure 1 shows the capacity curve obtained in a test, at one ampere continuous discharge, of caustic soda primary cells, representing one of the various lots of several thousand periodically purchased on the Rock Island Lines.

Figure 2 is a set of capacity curves recently published by the Edison Company to illustrate the improvements made in their battery within the last five years.

## SPECIFICATIONS FOR CAUSTIC SODA PRIMARY CELL.

1. General:

   This battery is to be used in the operation of signals, crossing alarms, etc.

2. Material:

   (a) Railway Signal Association drawing 1053, issue 1911, shows the general design and dimensions of the battery jar, cover, connections, wire and that part of the bolt, together with nuts and washers, shown above the cover for supporting the elements. The active part of the cell consists of the zinc, copper oxide, and caustic soda in the granular form, which, mixed with water, forms the solution in which the elements are placed, and a suitable mineral oil, which is used on top of the caustic soda solution to prevent evaporation and the salts from creeping over the top of the jar.

   (b) The assembled element shall consist of the zinc and copper oxide, suitably combined, together with the suspension bolt and terminal wire of sufficient length to extend twelve (12) inches above top of cover.

3. Requirements:

   Each complete cell or renewal shall have a capacity of at least four hundred (400) ampere hours, as provided for under the test in Section 4.

4. Test:

   (a) In order to determine the ampere hour capacity of the cell or renewal, one will be selected at random from each lot of one hundred (100), or fraction thereof, and placed on a continuous discharge of

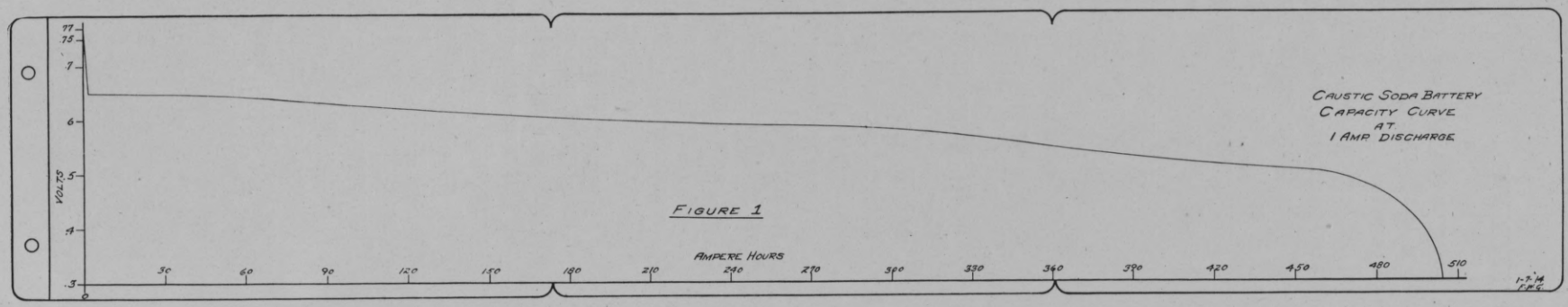



FIGURE 1

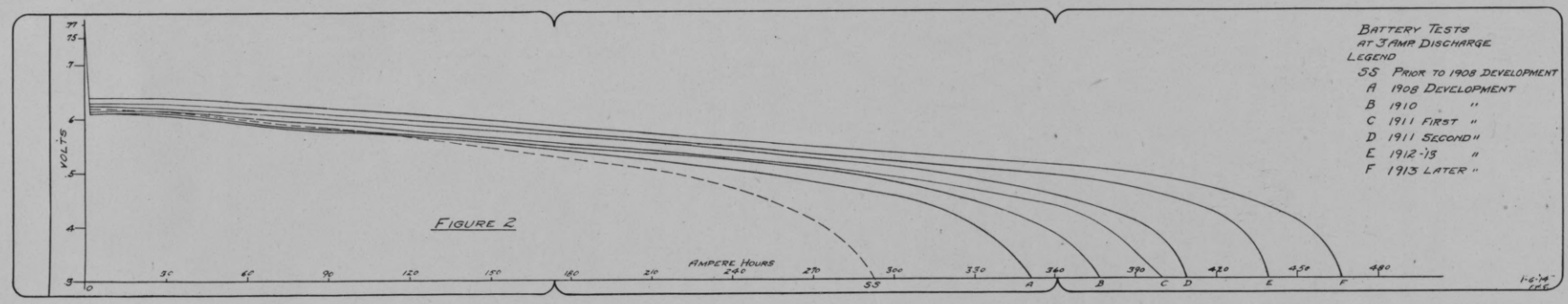



FIGURE 2

one (1) ampere. If the discharge continues four hundred (400) hours without the potential at the terminals of the cell dropping below five-tenths (0.5) of one volt per cell, the cell or renewal will be considered acceptable as far as capacity is concerned.

(b) One will be selected at random from each lot of one hundred (100), or fraction thereof, and subjected to a discharge of three (3) amperes continuously. If, during the first forty (40) hours, the voltage does not drop below fifty-three hundredths (.53) of one volt and during the next forty (40) hours the voltage does not drop below five-tenths (0.5) of one volt, the cell or renewal will be considered acceptable so far as drop in voltage test is concerned.

(c) Tests enumerated in paragraphs (a) and (b) will be made at a temperature of seventy (70) degrees Fahr.

5. Packing:

Complete cells and renewals must be packed and protected in such manner that breakages are not liable to occur.

Each package must contain either eight (8) or sixteen (16) cells, or renewals, and the package must be plainly marked on both in and outside with the name of the consignee, destination, contents of the package, and the purchaser's order number.

6. Acceptance:

If, after physical inspection of the shipment and in accordance with the above requirements and test, the specifications are met, the shipment will be accepted. If the specifications are not met, then the Manufacturer will be notified, and the test repeated at his option, he participating if he so desires. If the second test is satisfactory, a third test will be made. If two (2) out of three (3) tests are satisfactory, the shipment will be accepted. If two (2) of the three (3) tests are not satisfactory, the shipment will be returned at the expense of the Manufacturer who must pay all freight charges.

7. Guarantee:

Manufacturer furnishing complete cells or renewals must guarantee his goods to be free from defects and that in case there is a failure of one (1) or more cells in any set of sixteen (16), more or less, due to what are obviously defects in material, design or construction, the Manufacturer will replace such defective cells or renewals of the battery free of cost to the Purchaser.

---

## ALUMNI NOTES.

THE Rose Tech Club of Indianapolis held a meeting Tuesday noon, Dec. 23, at the Chamber of Commerce. Those present were:

Dr. C. L. Mees.
W. H. Insley, '00.
Herbert Foltz, '86.
A. C. Rassmussen, '12.
R. C. Rehm, '12.
O. E. McMeans, '96.
H. E. Rogers, '06.
L. F. Stahl, '10.
A. M. Hood, '93.
A. F. Brennan, '13.
B. G. Mering, '87.
W. C. Noelke, '04.
D. M. Hubbard, '12.
J. R. Curry, '06.
A. J. Paige, '02.
J. M. Rotz, '06.
L. A. Snider, '05.
J. C. Johnson, '09.

After the dinner a fine talk was given by Dr. Mees. He spoke of the new school, its possibilities, and the avenues for help that it offered the Rose Alumni. There were several short talks by Foltz, Insley and others.

The officers elected for the year were:

W. H. Insley, 1900, President.
John C. Curry, '06, Vice-President.
Albert F. Brennan, '13, Secy.-Treas.

The club has just passed through a period of suspended animation or sleep, extending

over several years. The meeting, however, was a very enthusiastic one, and promises well for the future. The next meeting will probably be held at the same place at 6:30 p. m. Friday, January 30th. Meetings will probably be once a month.

Mr. and Mrs. Frank E. Russell announce the marriage of their daughter, Selina Emily, to Mr. James A. Shepard, '10, Tuesday, December 24, 1913, Tuscon, Arizona. At home 503 East Fourth street.

Nathan A. Bowers, '10, Associate Editor of the Engineering Record, has been for the past year on special duty in the Pacific Northwest with headquarters at Vancouver, B. C. The work in that territory has been completed and after the first of the year Mr. Bowers will take over the entire Pacific Coast territory with headquarters at San Francisco. In the new location Mr. Bowers will manage the office, representing editorially all four of the McGraw publications, the "Engineering Record," the "Electrical World," and "Metallurgical and Chemical Engineering."

Mr. A. L. Robinson, '95, who held an important position with the Isthmian Canal Commission at Panama, is now associated with the Barber Asphalt Co., Philadelphia, Pa.

Mr. L. S. Rose, '92, has been appointed Engineer in charge of valuation work on the C. C. C. & St. L. Ry., with headquarters at Cincinnati, Ohio.

## Deceased

Harry Lamar Smith, civil class, 1910.

Died at Topeka, Kansas, Nov. 17, 1913, after a short illness.

Mr. Smith had been associated with the Scale & Mechanical Department of the Kansas Grain Dealers' Association previous to his death. After leaving Rose his business record began with his association with Condron & Sinks, engineering firm of Chicago, directing his attention to bridge design, later being retained in the same capacity by the Illinois Glass Works and Illinois Terminal Association, jointly, at Alton, Ill.

After some two years with the above firms, Mr. Smith took charge of monolithic concrete bridge construction for the Carmicheal Co. of St. Louis, Mo., leaving this work to take up special investigation for the Kansas Grain Dealers' Association, with special regard to heavy duty weighing machinery.

Mr. Smith's rise in his business career was consistent and rapid. He had attained an authoritative standing in his work and would have reached the highest goal in his line of endeavor.


## ATHLETIC ASSOCIATION.

Meeting of December 8.

Roll Call—Stevens and W. Carter absent.

Report of Officers—Henry, football manager, reports $97.45 cleared on alumni game. Cost of entire season $362. Letter received from St. Louis University for football game in 1914.

Unfinished Business—Election of assistant Basketball manager. W. Carter nominated. Moved by Hathaway and seconded by Schopmeyer that nominations be closed. Carter elected. Moved by Dr. White and seconded by Hathaway that vote be made unanimous. Carried.

Moved by Hathaway and seconded by Hewitt that tungsten lamps be installed in gym. Carried.

Moved by Dr. White and seconded by Hathaway that securing of basketball floor be left to manager. Carried.

Moved by Hathaway and seconded by Dr. White that the following receive football Rs.—Sheldon, Davis, Dutton, Pirtle, LeForge, Sommers, N. Carter, Cox, Hansen, Hewitt, J. Carter, Moore, Baxter, Stoms and Stevens.

Moved by Hathaway and seconded by Hewitt that $10 be allowed Dr. White for I. C. A. L. fee. Carried. Allowed.

Moved by Stevens and seconded by White that resignation of Asst. Basketball Manager Carter be accepted. Carried.

Basketball Manager Hansen states that he has received a very good recommendation of Mr. Gilbert, and believes that he would be a very efficient coach.

Moved by Dr. White and seconded by W. Carter, that Hansen engage Mr. Gilbert as basketball coach for 1913-14. Carried.

Nominations for assistant basketball manager. Arnold, Drake and Compton nominated. Moved by Trimble and seconded by Davis that nominations be closed.

Result of vote—Arnold 3, Compton 4, Drake 1. Compton elected.

Dr. White and W. Carter appointed as committee to see Mr. Frisz, concerning his employment as graduate manager. Moved by Stevens and seconded by Davis that Frisz be questioned as to salary he would expect for managing all athletics for the entire season.

Nominations for student football manager. Stilz nominated and unanimously elected.

Adjournment moved by Dr. White and seconded by W. Carter. Carried.

TRIMBLE, Secretary.

Meeting of Dec. 15.

Roll Call—Prof. Hathaway absent.

Report of Officers—Dr. White reports I. C. A. L. meeting at Indianapolis, December 13. Amendments proposed by Dr. White accepted; one that eligible lists be sent two weeks before games and protests filed ten days before game. The other amendment provided that the order of events at field meet be changed. The new order is to be tried at the next field meet. The 1914 meet will be held at Franklin if they can take care of it. Franklin is to give notice by January, and Wabash will take the meet if Franklin is unable to keep it. The secretary of the I. C. A. L. was instructed to correspond with the secretary of Butler College, and find out if they expect to meet the requirements of all league games. If not all athletic relations with Butler will be severed.

Eshelman reports that Madison had already returned the outstanding basketball money to the financial secretary. Eshelman also reports that the cost of lights for gym. will be about $40.

W. Carter reports that Stevens played in the required number of games and should receive an R. Moved by Dr. White and seconded by Schopmeyer that Stevenes be awarded an R. Moved by Dr. White and seconded by W. Carter that R. be voted to Poggensee to show appreciation of his work. Carried.

## STUDENT COUNCIL.

Meeting Held Dec. 18, 1913.

Roll Call—Absent, Ransford and Barrett.

Report of financial secretary:

| | |
|---|---|
| Symphony Club, balance | $ 1.64 |
| General Fund, balance | 303.95 |
| Camera Club, balance | 20.32 |
| Scientific Club, balance | 10.16 |
| Technic, balance | 173.00 |
| Y. M. C. A | 23.36 |
| Athletic Association | 450.00 |

Moved by Eshelman and seconded by Arnold that freshmen be informed that they must wear green caps not later than Feb. 1, 1914, the color of caps to be decided upon by the freshmen. A committee of freshmen is to be appointed to act in conjunction with the Council in making arrangments. Carried.

Moved by Eshelman and seconded by Henry, that Student Fund of Mr. Carson be retained, but that of Mr. Kelley be refunded, as Mr. Kelley had not really entered school last term. Carried.

Suggested by Mr. Henry that Symphony Club be warned that they must not overdraw the money alloted them.

Moved by Eshelman and seconded by Poggensee that regular meeting of Student Council be held the first Monday of each month at 4 P. M., to take effect the first Monday in February.

Moved by Nehf and seconded by Eshelman that meeting be adjourned. Carried.

Hild, Sec. Pro. Tem.


ROSE 22.—E. I. S. N. 21.

Rose opened the basket ball season on January 10, against Eastern Illinois State Normal at Charleston, registering a last minute triumph, 22-21. Hegarty tossed in a difficult goal, winning the game with less than 15 seconds to play.

Normal started the scoring and managed to keep ahead all through the game until the last minute. Before Rose could get started Normal had a lead of ten points, but this was gradually cut down by good team work of Rose, but the score shows what kind of a game it really was.

Hegarty and Davis did the heavy scoring work for Rose, while Deming showed up well on defense. Hampton, McIntyre and Helm starred for Normal.

| Rose (22). | Position. | E. I. S. N. (21). |
|---|---|---|
| Barrett, Davis | F | Hampton |
| Planque | F | Helm |
| Hegarty | C | Richmond |
| Deming | G | McIntyre |
| J. Carter | G | Wilson |

Field Goals—Hegarty 4, Deming 2, Planque 1, Davis 3, Hampton 4, Helm 1, Richmond 1, Wilson 2. Foul Goals—Planque 2, Hampton 5. Referee—Brooks.

Rose 33—Indiana Dental College 13.

The first home game of the season was played on January 16, with Indiana Dental College, resulting in a victory for Rose by a score of 33 to 13.

From the first there was little doubt who would win, as our opponents showed little or no team work, and could not seem to gauge the baskets.

Coach Gilbert used the second team during the first half and they put up a fine game, as did the regulars during the second half.

Planque proved to be the big point getter, tossing in five field goals. Hegarty played a good game, while Deming played up to his standard, until he had to be taken from the game, because of a bad cut over the eye. Joe Carter was the same dependable performer; indeed every one of the fourteen men used did good work.

The losers were the first to register a field goal, but their advantage was not maintained

for any length of time, and once in the lead Rose could not be stopped. The team work shown was of the best, and the game ended with all the students very favorably impressed with the team representing Rose for the present season. Lineup and summary:

| Rose (33). | Position. | I. D. C. (13). |
|---|---|---|
| Overpeck, Kline | | |
| Barret, Davis | F | Bebout, Bowen |
| Larr, Brown, Planque | F | Buchner, Mouser |
| Davison, Hegarty | C | Levorn |
| Kingery, Deming | | |
| Trimble. | G | Diefendorf |
| Swain, Carter | G | Miller, Buchner |

Field Goals—Planque 5, Barret 2, Hegarty 2, Carter 2, Larr, Brown Davison, Kingery, Diefendorf (for Rose), Levorn 2, Bebout, Diefendorf. Foul Goals—Kline 1, Bebout 2, Levorn 3. Personal Fouls—Kline, Larr, Kingery 2, Barret, Planque, Deming, Trimble 2, Carter, Miller, Mouser. Referee—Westphal. Timekeeper—Hathaway. Time of Halves—20 min.

ROSE (15)—WABASH (31).

Rose bowed to defeat for the first time of the present season, having as opponents Wabash, at Crawfordsville, on January 20.

The bitterest rivalry has always existed between Rose and Wabash, and this game was no exception. Both sides were worked up to the highest pitch which resulted in a rough and tumble game. Captain Leffel of Wabash and Carter of Rose were ruled out of the game on account of four personal fouls, and Deming for tripping. An agreement was made allowing them to re-enter the game, but later they were again forced out of the contest.

The victory of Wabash was accomplished by good team work and accurate passing and goal shooting. Rose could not seem to stop them, and the first half ended 12 to 7 in favor of Wabash.

In the second half Wabash put up even a better article of basket ball, and ran up a larger score.

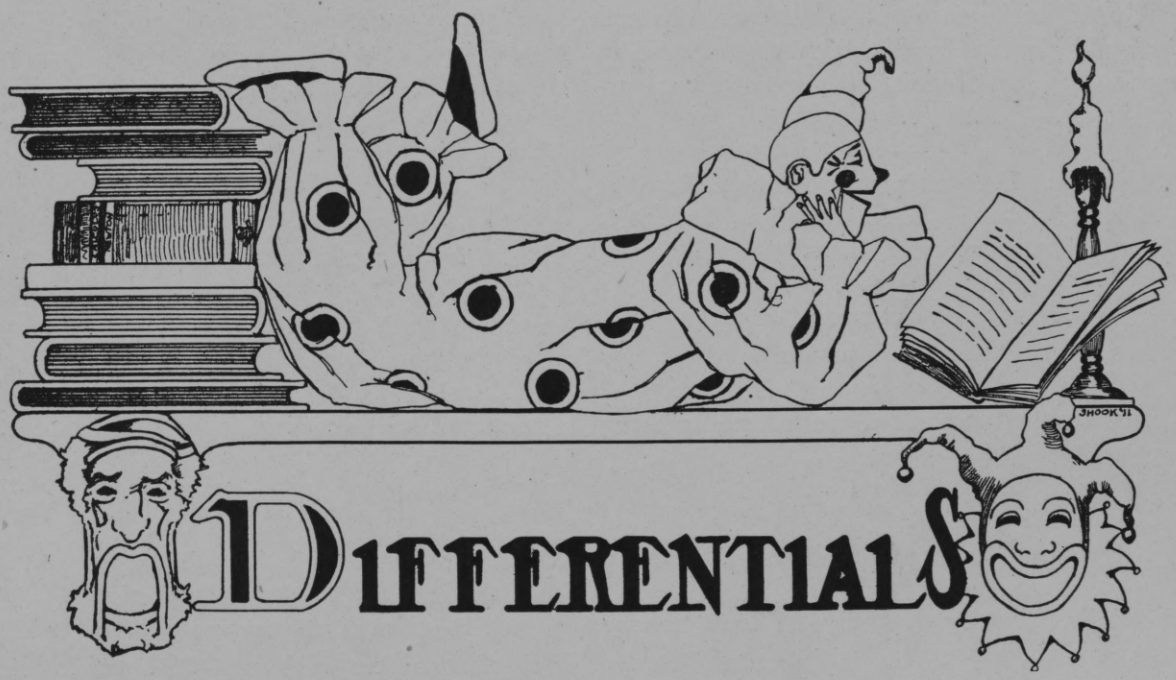
Eglin, Dale and Goodbar played a good game for Wabash, while for Rose, Kingery, Planque and Hegarty shared the honors. Lineup and summary:

| Wabash (31). | Position. | Rose (15). |
|---|---|---|
| Eglin, Dale | F | Barret |
| Hayman, Coffing | F | Deming, Planque |
| Ellis | C | Davis, Hegarty |
| Leffel, Goodbar | G | Kingery |
| Peters | G | Carter, Trimble |

Baskets—Eglin 5, Dale 4, Ellis 2, Goodbar, Kingery 3, Hegarty. Foul Goals—Eglin 6, Coffing 1, Hegarty 7. Referee—Malone, Notre Dame. Time of Halves—20 min.

Manager Hansen announces the following revised basket ball schedule:

Jan 24—Louisville U. at Terre Haute.
Feb. 7—Earlham at Terre Haute.
Feb. 14—Franklin at Terre Haute.
Feb. 18—Wabash at Terre Haute.
Feb. 20—Louisville Y. M. C. A. at Louisville.
Feb. 21—Louisville U. at Louisville, Ky.
Feb. 25—Earlham at Richmond, Ind.
Feb. 28—Franklin at Franklin, Ind.




Hansen: "What do they put the holes in the top of the stack for "

Lord Howe: "To let the smoke out."

---

"Jojo" (in Joubert): When will Epsilon be larger, when the current is rising or smalling

---

"Waggie": "Which is greater, specific heat at constant pressure or constant volume "

Cox: "Constant volume."

"Waggie": "Why "

Cox: "Because."

---

Hansen: "We have this damn electricity this morning, don't we "

Lancet: "What kind of electricity "

"Dutch" Moore: "He said damp electricity. Must be hydro electric.'

---

Newhart (in French): "Let's review, professor, it kills time."

Faurot: "That's about all you do anyhow, isn't it "

TERRIBLE LAMENT.

I can not sing the old songs,
The young folks would object.
I can not sing the new songs
And keep my self-respect.

—*Judge.*

---

Mr. Coles: "Now tell us something about the dipping machines. What did you think of them, Shanks "

Shanks: "I was favorably impressed by several of them; but I didn't like the way they smeared the enamel over their arms, and one of them had red hair."

---

First Freshman: "Gee! I got three tens and they didn't cost me even a moment's worry."

Second Freshman: "You're no more successful than I am. I didn't work my own problems either."

First Freshman: "Yes, but I didn't even furnish the paper."

Up at Michigan a course of courtship and love-making is to be offered open to all. "Kiss me, kid, I need the credit," suggests the university daily.—*Exchange.*

---

Hoberg: "They serve such bad beer there."

Harris: "Rats! There isn't any bad beer. Some is just better than others."

---

### After the Football Game.

The football game was over and at the parlor grate,
A maid and a long-haired youth were lingering rather late.
They talked of punts and drop kicks, but found it rather tame,
Till Cupid put his nose guard on and butted in the game.
Quoth he, "It's mighty funny if I don't arrange a match."
So he lined the couple up and made them toe the scratch.
The youth was growing nervous 'neath the weight of new-found bliss,
And he kind of thought the scrimmage ought to end up with a kiss;
He charged upon the center, he tackled left and right,
And the way they held that chair for downs was simply out of sight;
He tried an osculation, just an amateur affair,
But lost it on a fumble, and instead it struck the air.
Then as he landed on her ear he heard the maiden say,
"You penalized for holding, Jim, likewise for offside play."
With set teeth he tried another, this time succeeded fine,
For he scored an easy touchdown on the crimson two-yard line.
And as they sat there by the grate, communing soul to soul,
The parlor door swung open and—her father kicked the goal.

*Wisconsin Cardinal.*

Gadberry (to girl at Stamping Mill): "How would you like to take a ride in my electric "

Mr. Coles—"Elmer! I'm astonished! You should have your taste cultivated along other lines."

---

### The Rodman.

"What is that, mother?" "The Rodman, my child.
His footsteps are weary, his accents are wild,
His hair, how disordered! His eyeballs how blear!
And see where his necktie hangs under his ear."

Rod up there! Hold her steady!! Go down the hill!!
7.8 cut 2.2—No, begosh, it's a fill.
Half the roadbed, 13+ the slope 1:1;
No. it's 1½ though, as sure as a gun.
Well that makes—let's see—Oh! stick her in there.
It'll do. Perhaps the contractor will swear.
But no difference: we're the big dog in this fight
No matter what's wrong, just swear it's all right.
A contractor don't know a beefsteak from a bone.
Now pick up your tools, and let's pull out for home."

*—By J. H. K. B., Engrg. News.*

---

"It's easy to see through that girl."

"Yes, when the sun is shining!"—*Exchange.*

---

### At the Breakfast Table.

Daughter: "Hey, Bo, pass the axle grease."

Mother: "Cut out that crumby slang, you little rough neck."

Father: "That's a heck of a way to set the kid, Snooky Ookums."

Daughter: "Whis-keybubbles."—*Exchange.*

---

A query from an electrical:
Will 2,000 volts kilawop?

"You will have to take more exercise," said the physician.

"That shows the doctor may be wrong," said the visitor. "Exercise! Why, I'm one of the leading tango dancers."—*Exchange.*

---

The electric light bug buzzes this in our ear:

A young man to the lady he is escorting: "May I put my armature disposal?" Swat!—*Exchange.*

---

Considering all that is to be seen in the streets these days, it certainly is h— to be near-sighted. —*Sun Dial.*

---

An agricultural prof says the best environment for calves is silk stockings.—*Exchange.*

---

SULPHUROUS.

Fair Maid (learning to smoke): "How do I light this match My foot isn't big enough."

Tutor: "Scratch it on your—er—er—let me light it."—*Jack o' Lantern.*

---

Don't make fun of her split skirt, men. The same queen noticed your high school pin and rubber collar only yesterday.—*Wisconsin Sphinx.*

---

HE'D RISK IT.

"She has the prettiest mouth in all the world."

"Oh, I don't know! I'd put mine up against it any time."—*Michigan Gargoyle.*

---

OR A WINDY DAY.

Mother: "Ethel, are you saving anything for a rainy day "

Ethel: "Yes, mother, I never wear my silk stockings around the house."—*Cornell Widow.*

---

## NEWS OF OTHER COLLEGES

One hundred and three Freshmen have reported as candidates for the wrestling team at Boston Tech. This squad will be cut to sixty men and divided into ten classes.—*Exchange.*

FIRST COLLEGE PAPER.

"The first college paper, says the Harvard Crimson, "was not established by the oldest university, but by one of her later sisters, Dartmouth. There appeared in 1800 at that institution a paper called the Gazette, which is chiefly famous for the reason that among its contributors was Dartmouth's most distinguished son, Daniel Webster. A few years later Yale followed with the Literary Cabinet, which, however, did not live to celebrate her birthday. It was not until 1810 that Harvard made her first venture in journalism, and then Edward Everett with seven associates, issued the Harvard Lyceum.—*Exchange.*

---

Charges have been brought before the student council that money was paid for votes in class elections at Michigan.

---

The Sorority Council at Illinois has decided against the use of the tango and other new steps at student dances.—*Exchange.*

---

After examination by a physician, it was found that 80 per cent of the men students at the University of Missouri have curvature of the spine.

---

At the University of Chicago those who cheat are ostracized socially—a very good plan to make the honor system more effective.—*Exchange.*

---

A Senior of the University of Chicago was thrown into a tank for appearing without a mustache.—*Exchange.*

---

FRATS NOT EXTRAVAGANT.

The Graduate Magazine, publishes in connection with the University of Kansas, states that the average allowance given each member of Greek letter fraternities is $43.00 per month. The article shows that many members work their way through college and that the general scholastic standing is good.—*Exchange.*

An agitation against gambling in the Freshman class at the University of Virginia has resulted in 600 upper-classmen unselfishly pledging themselves not to play poker with the innocent Freshmen. Edgar Allen Poe ruined his collegiate career at Virginia in his first year by gambling, and possibly the university wishes to keep possible embryo Poes in college.

---

At Allegheney the Freshmen girls are required to wear regulation hats. The hat is dark green with a little yellow knob attached on the side.

---

The Seniors at Ohio Wesleyan rejected by a large majority of two votes the proposition to wear mustaches and carry canes.—*Exchange.*

---

Two silver loving cups are offered at Illinois University to the organization and individual who submits the best jokes and roasts for use in the annual Illio.—*Exchange.*

---

STUDENTS PUT BAN ON "BOOZE."

Freshmen at the University of Wisconsin are prohibited to enter a saloon upon penalty of being canned by the student conference. Upper-classmen are to enforce the rule.—*Ex.*

---

DePauw University was presented a Christmas gift by an unknown donor of $5,000 to be used toward the building of a new gymnasium. —*Exchange.*

---

Radcliffe and Simmons College girls are said to have taken up the fad of wearing monocles. —*Exchange.*

---

Oregon—The university has decided to try the experiment of training its football players throughout the entire college year. During the winter and spring the candidates will be required to practice three hours under the direction of the head coach. Football, wrestling boxing, basket ball and general gymnastics will constitute the training.—*Exchange.*

According to statistics, 80 per cent of the fraternity men at the University of Montana are working their way through college. It is claimed that 78 per cent of the men engaged in college activities are supporting themselves.

---

Columbia's mining engineering students are to have their own mine for practical work in the future. C. E. Hodge, of Roxbury Station, Conn., has leased extensive mine workings which have been unused for years, to the university for $1 a year for the purpose of giving students instruction in mine surveying to reopen and extend the workings and to establish a camp and erect temporary or permanent buildings and remove the same. As the mine is within fourteen miles of Camp Columbia, the summer school for engineers, it will be readily available and of great advantage. The mining engineer will be able to carry on their practical work without going far afield. Columbia hopes that in time the mechanical engineers will have a shop of their own fitted with all modern appliances.—*Exchange.*

---

It is estimated by the authorities at the University of Wisconsin that the amount of money spent by students of that university for alcoholic drinks totals up more than $20,000.

---

Freshmen girls at Wisconsin must wear green buttons. This plan is being tried this year for the first time. It is thought it will enable the girls to become better acquainted.—*Exchange.*

---

Fraternity and boarding house stewards at Ohio State University, have combined to resist the high cost of living. This week an organization has been formed whereby the stewards are to buy jointly the foodstuffs.

---

Nevada is the only state in the Union that does not send a student to Yale. Twelve foreign countries are represented.—*Exchange.*


## PROGRESS IN 1913

THE first number of *Power* for January, gives the following interesting account of the great progress that was made along engineering lines in 1913. It is of special interest to note that last year gave us the largest water power plant in the world, the largest steam turbine unit yet built, the lowest steam consumption of a non-condensing engine, the largest direct current generator, the first American locomobile, the largest gas engine in America, the largest turbine-driven centrifugal pump, the lowest steam consumption of a prime mover and the largest steamship.

Large is the word best suited to point out the tendencies of the year. In nearly every branch of the field units have been installed which are greater in capacity or size than ever before, and from all indications it would appear that present achievements have only whetted the appetite of manufacturer or user for a continuation in the same direction. The wonder of yesterday is only commonplace today and the future promises marvels up to the physical or efficient limits.

Early in the year the Inverness Railway & Coal Co. of Inverness, Cape Brenton Island, ordered a Nordberg Corliss duplex double-drum hoisting engine, 34 and 34 by 72 in., designed to pull a 41,000-lb. load up a 10,000-ft. incline of 16 deg. at the surface and 35 deg. at the bottom. From the standpoint of rope stress and length of cable the hoist is thought to be the largest ever built, although a number of hoists with larger cylinders have been installed.

In Pittsburgh, a De Laval centrifugal pump having a rated capacity of 100,000,000 gal. per 24 hours against a total head of 56 ft. was ordered for the Ross pumping station. This is reported to be the largest steam-turbine-driven centerifugal pump in this country. Two immense Bethlehem Steel Co. pumping engines of the vertical triple-expansion high-duty type have been put in service at the new Mission Street station. Each pump has a capacity of 7,000,000 gal. per 24 hours, against a head of 495 ft.

The Mesta Machine Co. has built for the Gary works of the United States Steel Corporation, a 44 and 76 by 60-in. twin-tandem-compound geared reversing engine weighing 1000 tons and capable of developing the enormous output of 25,000 hp.

In boilers, those at the Delray station of the Detroit Edison Co. still hold the record for output and square feet of surface. Nominally they are rated at 2350 boiler horsepower on a basis of 10 sq. ft. of heating surface. It has been found possible to carry for an hour on a single unit, a load of 11,000 kw. In the Conners Creek station to be installed on Belle Isle, it is planned to use the same type of boiler with equal heating surface, but with the furnace modified so that it will be possible by forcing to continuously carry the enormous load of 13,-

300 kw. on one boiler. During the year a number of large boilers have been installed but none of them has over half the heating surface or steaming capacity of those at the Delray station.

Other large units of their particular type are a 5000-hp. gas engine, a 25,000-kw. alternating-current generator, a 3750-kw. direct-current machine, a Le Blanc jet condenser capable of condensing 150,000 lb. of steam per hour and a 10,000-hp. turbine at Keokuk, weighing 1,000,000 lb. The magnitude of the unit last named is measured in weight rather than in capacity as there are several hydraulic units developing twice the power.

### Steam Turbines.

It is in the steam-turbine field that the most rapid development has been made in the capacity of a single unit. Not long ago a 20,000-kw. unit was considered the last word in turbine design. During the year a unit of this size and one having a capacity greater by 5000-kw., have been installed and advance reports state that orders have been placed for four 30,000-kw. units and one having a capacity of 35,000-kw. In these larger sizes it is of interest to note that all are horizontal machines, even at the Fisk Street station of the Commonwealth Edison Co., of Chicago, where all of the previous units, aggregating 120,000-kw., are of the Curtis vertical type.

Naturally these giant units call for large auxiliaries. The condenser for the 25,000-kw. turbine mentioned above has 39,300 sq. ft. of tube surface which will condense 300,000 lb. of steam per hour, and the condenser for the 20,000-kw. unit has 35,000 sq. ft. With the former unit the usual air pump has been replaced by the kinetic air-ejector for the first time in this country. A small gain in vacuum means a great deal on so large a turbine and the operation of the new apparatus will be watched with interest. Temporarily the generator is the largest alternating-current machine in the field, and in connection with the plant there is an open feed-water heater having a capacity to heat 300,000 lb. of water per hour from a temperature of 65 to 130 deg.

Before passing from this station it may be of interest to state that a steam rate of 11.25 lb. per kw. hr. at the normal rating of 20,000 kw. is expected of the larger unit. This betters by a little over one-half pound the remarkable rate obtained some two years ago on a 6000-kw. Parsons turbine in the Dunston power station of the Newcastle-on-Tyne Electrical Supply Co.

In the smaller turbines the Terry Steam Turbine Co. has developed a multistage machine of the return flow type and the De Laval Co., a velocity stage turbine consisting of two or more regular De Laval wheels with a row of reversing blades between each pair. The mixed-pressure turbine has been given considerable attention. With its two sets of nozzles it will run with equal efficiency on high- or low-pressure steam and can be operated independently of the unit on which it depends for its supply of exhaust steam. In this feature it is an improvement over the usual exhaust-steam turbine.

During the last few months Europe has not been standing still. Ferranti in England has built a turbine of 3000 kw. capacity which runs on 9.4 lb. of steam per kw.-hr., or about 7.5 lb. per i.hp.-hr. LeBlanc in France is advocating a return to single-stage turbines running at very high velocities made possible by the new high-tensile strength steels. Schmidt, the superheater man, is making experiments with very high pressure and temperatures that promise results for steam comparing favorable with those of the internal-combustion engine.

### Engine Progress.

In reciprocating engines there has also been advancement. Perfection of design and construction has resulted in some remarkably low steam rates and the use of superheated steam in an engine of the poppet-valve type has made possible a rate of 15.24 lb. per i.hp.-hr., noncondensing. The old reliable and efficient Corliss is still in the field and will be for years to come, but the tendency is away from this standby of two generations and toward the high-speed en-

gine and some of the recent importations from Europe built on the Lentz and Unaflow principles. This year also seen the first American locomobile which, on test, has developed an indicated horsepower-hour on 9.65 lb. of steam and 1.51 lb. of Holwick coal.

A number of rotary engines and so-called rotary air-pumps have "seen the light" and there has been a new design of triplex pump in which cams take the place of cranks in producing the reciprocating motion.

### Electrical Advancement.

Perhaps the most important new development during the past year in the electrical field was the half-watt nitrogen-filled tungsten lamp brought out by the General Electric Co., as a result of several years work by Dr. Irving Langmuir. There has been little change in generators and motors except in the size of the former to keep pace with the increasing capacity of steam turbines. The largest alternating current generator installed during 1913 was a 25,000-kw. machine at the Commonwealth Edison Co., of Chicago, although still larger ones have been ordered, and the largest direct-current machine, having a capacity of 3750-kw., was installed at the Canal Road plant of the Cleveland Electric Illuminating Co. For alternating-current transmission, 150,000 volts still remains the upper limit, work on the Big Creek Development in California, at which this is employed, having progressed steadily during the past year. In direct-current transmission, however, a bold step was taken in the decision to employ the Thury system at 90,000 volts to transmit 20,000 kw. from the Trolhattan Falls in Sweden to Copenhagen, Denmark.

### Water Power.

The two most notable hydroelectric developments which were formally put in operation during the past year in this country are the Mississippi River Company's plant at Keokuk, Iowa, and the Hales Bar Plant on the Tennessee River. The former is notable chiefly because it will ultimately be the largest single water-power development, aggregating about 300,000 hp., although the immediate plans call for only 150,000 hp. The Hales Bar plant, although designed for only 44,000 kw., possesses a number of unusual features and was completed only after eight years of labor, during which a chain of unforseen difficulties were encountered, making the initial cost greatly exceed that estimated.

Work on a number of smaller hydroelectric developments has been started and several of the existing systems have been extended. Among these may be mentioned the Appalachian development on the New River, Va., consisting of five plants, aggregating 75,000 hp., two being already completed; the New England Power Company's developments on the Deerfield River, four plants being completed and a fifth under construction; a 12,000-hp. plant on the Coon Creek Rapids near Minneapolis; the Turner's Falls development on the Connecticut River; and in the Pacific Coast states extensions to the systems of the Washington River Power Co., the San Joaquin Light & Power Co., and the Pacific Gas & Electric Co. The last named company now has sixteen plants, steam and water power, totaling about 300,000 hp. In Switzerland construction has been started on a 5312-ft. head plant which holds the record as the highest head thus far to be developed.

### The Gas Engine.

Among special applications in the gas-power field, Professor Hopkinson's method of cooling gas engine cylinders by direct injection of water onto the piston and exhaust valves, has attracted widespread attention. Dr. Low, in England, is still experimenting with his internal-combustion engine into which coal is fed directly. In the original design, tubes containing coal extended across the explosion chamber, the gas being driven off from the coal by the heat surrounding the tubes and drawn into the chamber. Spiral conveyors extended through the tubes and by their rotation urged the coal forward. In the later design these conveyors, which lost their rigidity under the high temperature, are abandoned, and the pipes made larger and ver-

tical so that the coal feeds forward by its own weight.

The installation of Humphrey gas pump for the Metropolitan Water Board has been completed and is now in operation. Last summer, also, marked the installation of the 5000-hp. gas engine (the largest in this country) at the plant of the Ford Motor Co., Detroit. The first Diesel locomotive was also completed by Sulzer Bros. of Winterthur, Switzerland, and put in service on the Prussian-Hessian State Railway.

In last year's review we called attention to a number of semi-Diesel engines that were being advanced by American manufacturers. The past year has seen several well known American firms take up the building of heavy oil engines of the regular Diesel type.

### Refrigeration.

During the year the refrigerating field has been given a number of new tables on the properties of ammonia. Perhaps the best of these was the set issued by the Engineering Experiment Station of the University of Illinois. More accurate experimental work than has been conducted in the past may render necessary some revision of the tables, but within the limits of practical working they may be safely accepted as standard.

The Bureau of Standards at Washington has been making some interesting tests to determine the latent heat of ice, and have found that a value of 143.5 B.t.u. per lb., instead of the 144 B.t.u. now used in this country, is approximately correct. The bureau is to continue its good work. Apparatus is now ready for making tests on the resistivity of insulation, and there will also be some work on the properties of ammonia and perhaps some of the other refrigerants commonly used. Pennsylvania State College now has a large thermal testing plant and in the past year has been testing some of the standard forms of insulation. Accurate standards have been badly needed in the refrigerating field so the work now under way should prove of immense benefit. The Third International Congress of Refrigeration held recently in Chicago afforded Americans the opportunity of a generation. Engineers from twenty different countries met and discussed topics of pressing interest and a more uniform and concentrated effort in advancing the art is to be expected as a direct result.

### Marine Tendencies.

On the high seas nothing of any great import has come to pass. The quadruple-screw turbine-driven Hamburg-American liner "Imperator," with 62,000 hp. for driving her propellers and 203,000 sq. ft. of boiler-heating surface was put into service. The 20,000-ton collier "Jupiter" of the United States Navy also went into commision. She is equipped with a high-speed Curtis turbine, the first of a type, and the reduction in speed for efficient propeller operation is accomplished electrically. The turbine drives a 5450-kw., two-pole generator which supplies current to two 2750-hp., 36-pole motors, so that the ratio of reduction is practically 1 to 18. Test data from this ship may possibly have some influence in reconverting navy officials to turbine populsion.

Oil fuel is fast becoming a question of urgent importance to the navy. Last year 30,000,000 gal. were used and in the near future it is likely that this amount will be increased over fourfold. Within the last month Secretary Daniels has recommended that the navy secure its own oil wells and do its own refining. A constant supply at a low cost would then be assured and the exclusive use of oil might be adopted with reasonable security.

### Engineering Societies.

Among the various engineering socities in this country the American Society of Mechanical Engineers has had a very successful year. The attendance is increasing, more papers of a high standard are being presented and the standing committees are doing excellent work. The old question of flanged fittings was up at the annual meeting. The committee had formulated a compromise with the manufacturers which would do away with the dual standard, but a vote before the society as a body resulted in laying the matter over until the next meet-

ing. At the invitation of the Verein deutscher Ingenieure, 300 members and friends of the society attended the spring meeting of the German society at Leipzig. The visitors were taken all over Germany in a special train, their entertainment including fifteen formal banquets and receptions, fourteen lunches and collations, twelve concerts and lectures, and special performances and ten excursions by rail or boat.

### Boiler and Flywheel Explosions.

Boiler accidents and explosions in this country for the first six months of the year total 234, in which are included stationary, marine, locomotive, portable and heating boilers. Those killed number 68, and 234 were injured. Assuming that the last six months will duplicate these figures, the totals for the year will be 468, 136 and 468, respectively. Besides there were three economizer explosions, killing six and injuring twenty. There were also a number of steam-pipe ruptures, air and elevator-tank explosions, cylinder-head breaks, etc., which in the Hartford Co.'s compilations are usually included under the broad head of "boiler explosions." With these items included, the records for 1912, in which the same order as before, give 537, 278 and 392. That the number of heating-boiler explosions was particularly large would indicate that more attention should be given to the inspection of this type of boiler. The flywheel explosions totaled about fifty for the year, and from the records of the first eight months the death list should be about twenty, with serious injuries to thirty more.

### License and Inspection Laws.

Year after year the list of fatalities reaches this same high limit or perhaps exceeds it, and relief from this inexcusable slaughter cannot be expected until every state in the Union has stringent license and boiler-inspection laws which are intelligently enforced. There has been agitation in quite a number of the states, but the net results appear to be an engineer's license law for California, a boiler-inspection law for Indiana, revised laws for Montana, a license law for New Jersey, and new boiler regulations for the province of Ontario. With the aid of the National License Committee of the National Association of Stationary Engineers other states will no doubt soon fall in line, and the recent adoption of standard boiler specifications by the National Association of Tubular Boiler Manufacturers should also help on the side of safety.

### Blazing the Way.

Appropriations for the fiscal year ending June 30, 1915, asked by the Bureau of Mines, indicate that it is to continue on an increased scale its valuable work relating to fuel and mines. Of this $135,000 is to be devoted to fuel testing, $10,000 for the equipment of a testing plant and $30,000 for investigating petroleum and natural gas.

At last it would appear that some attention is to given to the achievements of science and industry. The land is full of libraries, there are museums of natural history and art, but there is nothing worthy of the name to record and exhibit the "milestones" in engineering development. Steps have recently been taken to found a group of museums in New York City. "The Museum of Peaceful Arts," which will consist of twenty buildings costing $30,000,000 and requiring two to three million per year for maintenance. It will be divided into branches of electricity, steam navigation, safety appliances, mechanical arts, mining, architecture and other subdivisions of equal interest and usefulness. The idea is splendid and if carried through to completion, will result in great good to the fields represented.

### Isolated Plant vs. Central Station.

Much in the same way as in previous years, the central station and isolated plant are carrying on their fight for supremacy. It is becoming evident to both sides that there is a field for both, and that the decision placing a plant in either must be based on accurate records and statistics fair to both sides. Probably the most comprehensive test ever conducted is that just completed by representatives of the City of New York and the Edison Co. The plant in the Hall of Records has been the scene of ac-

tion, and for a full year a complete plant test has been under way. Complete operating data will be available for all seasons of the year, and upon these figures it will be decided whether the city is to continue to generate or buy its current. That municipal operation of a power plant is practical and that efficient results may be obtained in such a plant has again been shown in Pasadena. The sixth annual report on this plant, published in our issue of Oct. 28, contains some interesting facts.

### The Honor Roll.

Among the men honored in the mechanical field were George Westinghouse, who wasa awarded the Grashof medal; Prof. H. K. Onnes, of Leiden, given the Nobel prize in physics, and Prof. A. Werner of Zurich, the prize in chemistry. The following men were elected as presidents of the various engineering societies in this country, relating to the field: James Hartness, president of the American Society of Mechanical Engineers; C. O. Mailloux, president of the American Institution of Electrical Engineers; Joseph B. McCall, president of the National Electric Light Association; James R. Coe, president of National Association of Stationary Engineers; John F. Hale, president of the American Society of Heating and Ventilating Engineers; Henry Torrance, Jr., president of the American Society of Refrigerating Engineers.

### Necrology.

Those of prominence who passed away during the year just closed were the following: Victor Hugo, manager and chief inspector of the St. Louis department of the Hartford Steam Boiler Inspection & Insurance Co.; John Fritz, famous in the steel industry; Dr. C. G. P. de Laval, inventor of the turbine and separator bearing his name; William Henry White, a professor of naval architecture and originator of the modern battleship; W. H. Fletcher, vice-president of the Consolidated Iron Works; Philip H. Diehl, founder of the Diehl Manufacturing Co.; Victor Dwelshauvers-Dery, a distinguished sicentist noted for his researches into the properties of steam and its action in the engine cylinder, and his work for the advancement of engineering education; James Tangye, one of the Tangye brothers so well known in English mechanical circles; Samuel L. Moyer, first vice-president and general manager of the Lunkenheimer Co.; Francis M. Rites, inventor of the inertia governor bearing his name; Horatio A. Foster, author of the "Electrical Engineer's Pocket Book" and chief appraiser for J. G. White & Co.; Horace Greeley Burt, ex-president of the Union Pacific R. R. system and late chief engineer of the Chicago Association of Commerce Smoke Abatement Committee; Stephen D. Field, inventor of an electrical elevator and electrical devices relating to telegraphy; Bernard Schuchardt, head of the well known firm of Schuchardt & Schutte; Anthony N. Brady, president of the New York Edison Co. and a number of other corporations; Eugene O. Reuleaux, general superintendent of the American Rotary Valve Co.; Dr. Rudolf Diesel, famous through the invention of the engine bearing his name; William Cary Seldon, a consulting mechanical engineer who had much to do with the early development of steam navigation in the United States Navy; George C. Karme, secretary of the Hills-McCanna Co.; John F. Ensign, chief of the division of locomotive-boiler inspection of the Interstate Commerce Commission; Edwin T. Moore, secretary and treasurer of the Coatesville Boiler Works; Charles Tellier, familiarly known as the "father of refrigeration"; Edgar Penney, president of the American Society of Refrigerating Engineers in 1908; A. J. Frith, associate professor of mechanical engineering at Armour Institute, Chicago.—*Power.*

---

## SUSPENSION BRIDGES AND CANTILEVERS.

Their Economic Proportions and Limiting Spans. Second Edition Revised, by D. B. Steinman, C. E., Ph. P., Professor of Civil Engineering at the University of Idaho. Cloth, 4x6 in., 185 pages, 4 plates. New York, The D. VanNostrand Company. 50c Net.

THIS text was originally written to supply some data on the relative adaptability and the limiting and economic spans of the cantilever and suspension bridges, of which data, according to the author, there was a scarcity at the time of writing.

In the second edition, the analytical studies of the two types of bridges and the results of the investigations have not been changed. However, "the text of the introductory chapter has been revised to permit a modification of nomenclature and definitions whereby the distinction between the theoretical and practical limits of span has been more sharply drawn." The book has also been revised in other places with the idea of making certain parts clearer and the bibliographies and references and tables of bridges noteworthy for length of span or other features of interest have been added to and brought up to date. "Four folding plates showing the elevation and cross section of suspension bridges and cantilevers ranging in span from 1,000 to 3,000 feet, have been inserted to illustrate the designs described in the text."

The first chapter is devoted to the introduction and a statement of the problem and proposed method of investigation. The problem, as the author states it, is to determine "the limiting spans or the longest spans that can be designed, the maximum spans, or the longest spans that can be built, the economic spans or the longest that it would pay to build and the span of equal cost for the cantilever and suspension types of bridges." His solution is "to prepare designs and estimates of a wide range of cantilevers and suspension bridges and to deduce laws of variation of weight and cost with length of span." At the end of the chapter is a table of notable suspension bridges giving name, date, location, engineer, span, rise, etc.

The second chapter is devoted to a study of suspension bridges in general and treats the relative advantages of wire cables and eye bars, advantages and disadvantages of braced cable type of suspension bridge, the economic ratio of rise to span, the minimum and economic depths for the stiffening truss, and finally ends with a bibliography on suspension bridges.

Chapter three is devoted to the design of three suspension bridges of different spans and concludes with an estimate of the cost of the three designs.

Chapter four is given over to the conclusions for suspension bridges which he arrives at from the three designs and also to the construction of semi-empirical formulae for the weights of sion bridges, the cost of suspension bridges, the maximum span for cable spans and for suspension bridges, the cost of suspensian bridges, the economic span, and finally the author's conclusion as to the limiting economic span for suspension bridges.

Chapters five, six and seven take up and treat the cantilever bridge in much the same way that the suspension bridge is treated in the preceeding chapters. There are also several pages devoted to tables of notable cantilever bridges and bibliographies on cantilevers.

In the last chapter the author makes his final comparisons and conclusions on the two types of bridges.

The whole subject is stated in a clear, concise and well organized manner and should be an interesting and instructive work to those interested in bridges of these types.

—K. E. L.

---

## ELECTRICITY TO OPERATE THE PANAMA CANAL.

THE machinery for operating the gates, dams, fender chains, pumps, etc., will be electrically driven; the ships will be towed through the locks by powerful electric locomotives, and electric energy will be utilized entirely for the permanent machine shops, for the dry-dock, for the coal-handling plant, for wharf cranes, and for a number of other purposes. The locks and near-by towns will be electrically lighted, and the relocated Panama railroad will possibly be electrified. Two large power stations and many miles of transmission circuits will be required for the generation and transmission of the power to more than one thousand electric motors which will be required for the operation of the canal. The water power is obtained from the Chargres River water

shed; Gatun Lake, having an area of 165 square miles, offering excellent storage facilities. A 7500-kw. hydro-electric generating station, which will supply the power under normal conditions, is being built at the spillway of the Gatun dam. The present steam-turbine station at Miraflores, which has been used during the construction of the canal, will, however, be retained and held in reserve to tide over either shutdowns or low-water periods of the Gatun station, the intention being to tie together the two plants by a high-tension transmission line. Besides the above, hydro-electric power will be extensively used for lighting purposes along the canal, and possibly in connection with the fortifications which are being planned.—*Engineering Magazine.*

---

## CONCRETING.

By W. J. Potter.

Successful concreting may be divided roughly into two main parts, the proper combination of elements making the whole and the proper handling of this mixture to best carry out the purpose intended. These main heads are divided into many subdivisions, each of which like the parts of a machine, have definite importance in the perfection of the whole. While as in a machine, a poor part may do the work intended, yet it will not do as much work or of the same quality as a perfect part. So, in concrete working, an operation may do the work intended, but the whole will not be as perfect as it might if this component part or operation does not harmonize with the general tone of the work. Thus no matter how perfectly materials have been mixed, the properties thereby gained may be lost in placing, if, for instance, the materials are dropped for a considerable distance, or again, if after being deposited, they are not worked or puddled.

Taking up the first question, that of mixing we have the most important phase, the determination of proper proportion. Engineers differ as to the proper method of measuring material. Some men favor quantity measure, advancing the theory that what is lost in actual quantity is made up in time saved. Machine measures are arranged on this principle. Just at present, the mechanical weight measures have not been perfected sufficiently to admit of practical value upon small jobs. Taylor & Thompson assert the supremacy of measure by weight, advancing economy of material as supporting their argument.

The next point in importance is the consistency of the mixture. This is brought about only by the most thorough mixing. The consistency giving best results in re-inforced concrete is such that the mass will move slowly in and around all obstructions. In ordinary mass, concrete should be jellylike, so that it quakes readily when being worked. Concrete congealing before its being placed and worked indicates that the cement is too rapid and mass must be hardened under water. Dry concrete well mixed and tamped is available at shorter notice nad stands severer tests; but the danger lies in the dry pockets, which weaken the mass, admit water, and later show in form of pocks, when near a surface subject to hard usage. Occasionally, where a too wet mixture is used, the light ingredients do not flow around the stone and when boarding is removed, the mass has a honeycombed appearance, with the further disadvantage of crumbling unless patched.

Cement is the binding agent in concrete; neither the stone nor sand is of value till bound by some adhesive agent. Mixing by hand, the sand and cement should be mixed first, both ingredients being dry and then applied to the granolithic grit. There are several rule-of-thumb methods concerning the period at which water is to be applied and the best method is a matter of opinion. In my own case, I believe in well mixing the sand and cement and then adding water, and finally the stone. The oftener the mass is turned the better the lighter ingreditnets will move about and attach themselves to the heavier. The idea is to have the binding force so disseminated throughout the mass that each particle of cement will exert its influence upon a foreign substance, and hence gain the maximum binding efficiency. This highest effectiveness is gained before the water

or stone has been added to the mass. Sand and cement will affiliate better when dry. They will take the water better when together and insure more perfect plasticity without dry powdery cement spots.

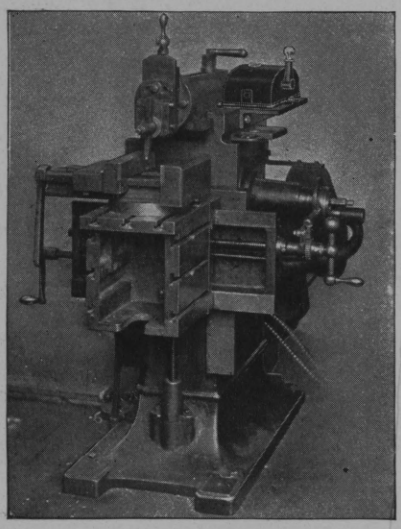
The relative importance of machine versus hand mixing is a question largely determined by circumstances. Where it is a question of small jobs with time as an influencing factor, the old hand method is better. Labor is cheap, the plant (an iron sheet) inexpensive, and transportation a minor factor. However, on large jobs, where the material is heavy, the need of accuracy imperative, the mixing and measuring by machine is far superior to hand work. It produces better concrete, is more economical and pays for itself in wages and time saved.

In distributing, the chief object is to produce a mass of uniform consistency. Dump cars on rails, in carrying on large operations, are of great economy, permitting rapid and thorough working where the distance from dump car to forms is not very great. A fall of five feet will disarrange the particles of mixed concrete, and will force stones to the bottom without their having sufficient adhesive element to bind properly, besides expending more material than necessary or practical. Only very wet concrete can stand much of a drop without disarrangement and even then the results do not justify such a method. A trough running from the dump cars to the form will distribute material evenly and gently without disturbing the relative consistency of the mass, and without destroying any of the advantages gained by thorough mixing of component parts. Ordinary concrete will run on an incline of one in seven, or even one in nine. In placing the concrete it should not be laid deeper than ten inches without ramming. Of course this thickness varies according to the consistency of the material, and the degree of wetness. The method of scattering and working the mixture in thin layers as soon as it is placed in forms, is more advantageous than placing a great depth before working, or delaying the working of material until it has started to stiffen.

The thoroughness with which the material has been tamped or settled has the greatest influence on the ultimate strength and appearance of the finished product. When the concrete has been sent with a rush into the forms, like any liquid or glutinous mass, it takes air particles with it, and because of its nature the air bubbles which are formed do not come readily to the surface. The mixture must be worked over and settled. These small air bubbles in the puddling combine on contact and when sufficiently large, rise to the surface and liberate the air. Air has great elasticity and when compresed is capable of keeping the lighter materials of concrete at bay till the hardening of the latter leaves an air cell, which is a defect leading to greater defects. I have found it of great advantage to work over the materials when laid, with a garden fork or spade. Care must be exercised when puddling not to exert a force too great for the containing forms. A yield in the latter leaves an ugly bulge which is not alone unsightly in itself, but spoils the appearance of a large stretch of the work. Foot tamping with a spade, to allow cement to ooze outside of the rock center and form a smooth facing surface, is liable to strain the forms likewise. Light material in making the latter, or loose carpentry in their construction affect the looks of the finished whole and gives it the appearance of bungling.

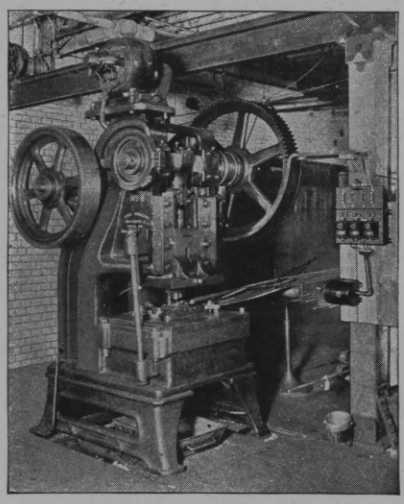
The chief object in ramming a dry mixture is to compel uniform distribution of the cement under and around the rock particles. In tamping the very wet mixture blows are light, just strong enough to force out the imprisoned air. In this operation we have the finishing touches to the job. There are many types of tamping irons, answering the same purpose, their use being a matter of opinion. No hard and fast rules can be laid down in finishing off the job. Local conditions vary and affect the work. Best results are gained by the observation of all established rules, and where conditions are unprecedented, then by the application of the engineer's ingenuity.—*Railway Engineering and Maintenance of Way.*

# THE ECONOMY OF CONVENIENCE



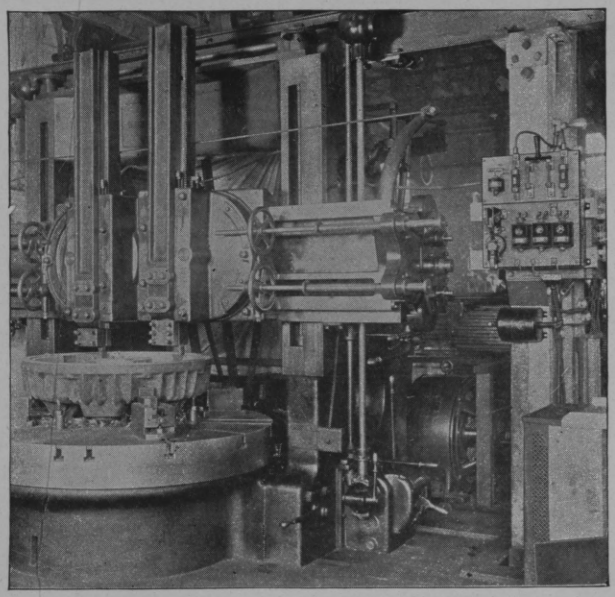
Motor Driven Shaper Equipped With an E. C. & M. Automatic Controller.

It cannot be doubted that convenience of control greatly increases the output of motor driven machinery. E. C. & M. Automatic Controllers were designed with this thought constantly in mind. By their use a motor driven machine can be started, stopped or reversed in the shortest safe amount of time, and all of this can be done by manipulating one handle.



Motor Driven Punch Press Equipped With an E. C. & M. Automatic Controller.

On a motor driven machine tool, for instance, the E. C. & M. Automatic Controller may take the place of a hand operated motor starter, a clutch and a friction foot brake. It assumes the duties of all these parts and does this with wonderfully increased facility and rapidity. WRITE FOR BULLETINS.



Motor Driven Boring Mill Equipped With an E. C. & M. Automatic Controller.


THE ELECTRIC CONTROLLER & MFG. CO.

NEW YORK-50 CHURCH ST. CLEVELAND, OHIO CHICAGO-1417 MONADNOCK BLK.
PITTSBURG-1539 OLIVER BLDG. TORONTO-1222 TRADERS BANK BLDG. BIRMINGHAM-827 BROWN-MARX BLDG.

# HERZ'S

# FOR

# BOOKS

Vol. XXIII FEBRUARY, 1914 No. 5