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STEELE '39

Surveying This Issue

LESS than ten years ago the transverse fissure, an internal flaw in railroad rails, was the dread of railroad engineers. Today such a flaw is detected before it becomes dangerous by a Sperry Detector Car, and there is a resulting safeguard to life and property. "The Detection of Defects in Railroad Track" presents a clear account of modern methods of flaw detection.

MAN has utilized the principle of the suspension bridge ever since he first stretched a rope across a river. The first real suspension bridge, however, was not constructed until 1801. It was seventy feet long and the wooden roadway was suspended by chains. "Suspension Bridges" explains the developments, both theoretical and practical, which have made it possible to have a single span of over 4000 feet.

ONCE again the honors go to "Howdy" White for his fine photograph which is used as a frontispiece in this issue.

—*R. S. K.*

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The Detection of Defects in Railroad Track

by J. E. Bernhardt, c., '08

Mr. J. E. Bernhardt, the author of this article, was graduated from Rose in 1908. He is at present President of the Rose Tech Alumni Association.

"The Detection of Defects in Railroad Track" deals chiefly with the Sperry method for detecting the arch-enemy of the railroad engineer—the transverse fissure.

All illustrative cuts used in this article were furnished by the Sperry Corporation.

ONLY a few years ago the transverse fissure in rails was the bane of railroad engineers. There were numerous derailments resulting from this cause, yet no one knew how these defects originated in the rail or how they could be found in rail in the track. Today the transverse fissure can be found by testing with Sperry Detector Cars.

The transverse fissure is probably better known as "rail cancer", for this defect, which develops from a tiny nucleus inside the rail, grows as a sub-molecular crack transversely across the rail head and cannot be visually detected until it reaches the surface of the rail. Long before it has reached this stage in its development, the fissure has become a menace to safe transportation. When steel rails leave the mill, they are flawless. In recent years, much research has been made in the effort to produce steel rails in which fissures will never form; progress has been made, but thus far the hidden fissure is still a menace to railroad safety.

Two illustrations of fissures are shown. The smaller one shows a 30 per cent fissure, which apparently grew from a minor fissure within 30 days. The larger of the two represents a fissure which in a very short time will result in the rail breaking. Should there be two such fissures in one rail there is a possibility of the rail breaking at both fissures simultaneously, and as a result, a piece of rail may come out of the track and a derailment could result.

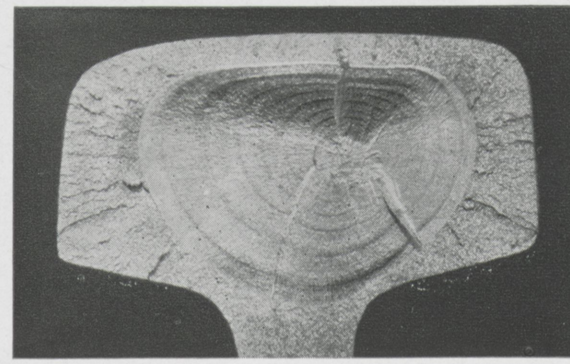
The Detector Car was invented by the late Dr. Elmer A. Sperry, who, prior to his service in the railroad field, had already contributed numerous achievements to benefit mankind, among them the gyro-compass and the gyro-stabilizer in the marine field, and the high intensity arc light so important to aviation. Dr. Sperry also developed the Sperry gyro-track recorder car, a device for recording track unevenness, and while he was so engaged, he became interested in overcoming the menace of the transverse fissure. In 1923 he started intensive research on his problem in his laboratory in Brooklyn, New York, and in 1928 the first Sperry Detector Car was successfully demonstrated. An entirely new principle discovered by Dr. Sperry went into the making of the first successful detector car and is in use today on a fleet of Sperry Detector Cars, which patrol annually thousands of miles of steel thoroughfares in the United States and Canada.

The apparatus for detecting fissures in rails in track is electrical. By passing a current of about two thousand amperes through a rail at low voltage, a magnetic field is set up about the rail head. Whenever an internal flaw is encountered, the axis of the field is changed and the flux becomes distorted. Dr. Sperry found that he could pass a coil above the rail and pick up this distortion which, when properly amplified, could be made to operate simultaneously a recording pen and a paint-gun. Thus, as a Sperry Detector Car cruises along railroad track at a rate of six to eight miles per hour, if a defect is encountered, an ink record is made by a pen moving over a record tape in the recording compartment of the car, and at the same time a paint-gun under the car automatically ejects a bullet of white paint onto the rail at the exact location of the suspicious area. Although the detector car was invented to find transverse fissures, immediately after the first one was demonstrated it was found that splitheads and other rail defects were also detected. Thus the car gave even greater service than anticipated.

Death claimed Dr. Sperry in 1930 before the fleet was completed, but he lived to see his idea at work in the interest of public safety and to establish Sperry Rail Service to build and operate all Sperry Detector Cars. By establishing central control of the Sperry Cars in the Sperry Rail Service organization, complete records kept by experienced detector car personnel have enabled Sperry Research to continue improvements on the entire fleet of cars; during their first decade of service the efficiency of Sperry Detector Cars was thus more than tripled.

The original searching unit, which was comprised of a single row of non-staggered coils, was carried on a rigid mounting. By 1929 an improved flexible mounting was discovered which gave greater accuracy and which found more fissures. In 1932 an improved searching unit with multi-tandem staggered coils was put on the cars with resultant lessening of false indications received during testing and doubling of the number of fissures found.

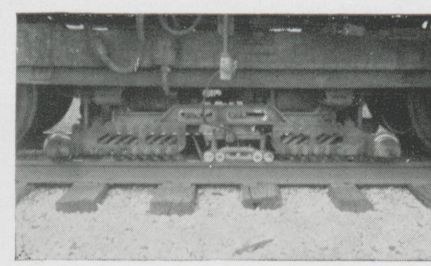
Two typical views of fissures. The one on the right would have broken in a very short time.



Actual testing experience led to the discovery that each face of a transverse fissure constitutes a definite pole. If polarity is properly aligned, fissures of the smallest size can be easily found; but if polarity is opposed to the direction of testing, it is difficult if not impossible to detect the fissure. Testing twice, once in each direction, over a track would take care of this matter of polarity, but this problem was solved by introducing "pre-energizing" on all cars in 1933; an added auxiliary brush and an extra generator set comprise the pre-energizing circuit which aligns polarity, finds fissures otherwise missed, requires only one defect pen, simplifies operation, and increases accuracy in testing. In 1934 an improved paint system, making a shorter mark for each defect, was put on all the cars. Thus the Sperry Research Department, in cooperation with other departments and all field personnel, continues its part in the improvement of detector car testing efficiency.

In testing, the Sperry Detector Car moves over the track at a speed of from six to eight miles per hour; and whenever a flaw in the rail is encountered, two records are made of it, one penned onto the record tape, the other painted on the rail. The recording compartment is at the rear of the car; there, seated at the recording table before the car window, the recording operator watches the track from the rear of the moving car, watches the record tape move over the record table in front of him at a speed proportional to that of the car, and keeps an eye on some twenty-five other instruments within his vision. The record tape is scaled 1/16" to 1' of rail.

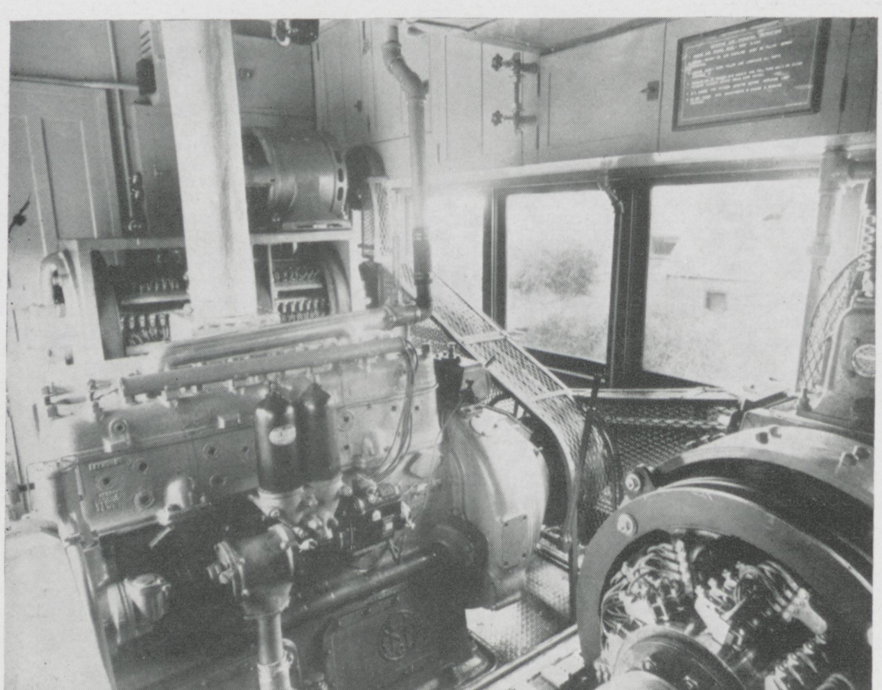
The record made on the tape consists of seven lines. From right to left: line No. 1 indicates mile posts, other land marks, and testing speed of car; line No. 2 indicates defects in left rail; line No. 3 indicates location of rail joints in left rail; line No. 4 gives a visual check on electric current being passed through each rail so that the operator can tell if the testing apparatus is functioning;



Close-up of main brush carriage

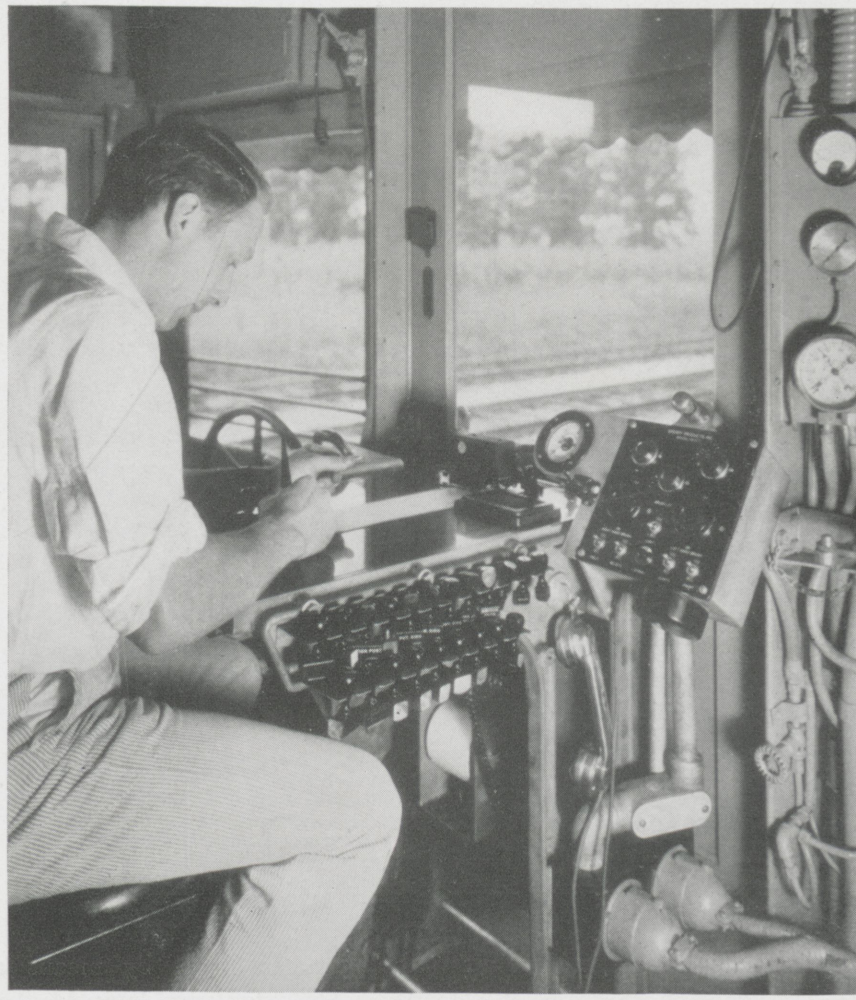
and lines Nos. 5, 6, and 7 give the same record for the right rail respectively as lines 4, 3, and 2 give for the left rail.

When a defect is indicated on the record, the operator looks from the record tape to the rail for the corresponding paint marker as it appears from under the car. If the flaw is of a surface nature, the recording operator stamps the record tape to this effect, and the car continues testing; but if there is no outward cause, the operator signals the driver who is in the driving compartment at the front of the car, and the car is backed up. As the car is backing up, the assistant operator drops off and inspects the rail from the ground. If his inspection shows no external cause for defect and it appears on the second run of the car, the car is stopped and a

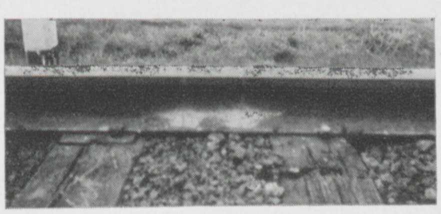


Interior of the generating compartment of a Sperry Detector Car hand test is made. The hand test is made with a delicate meter on the suspicious area marked by the paint spot, and thus the exact extent and nature of the internal flaw is revealed. Should the flaw be an internal fissure, the tape is so stamped and the size of fissure is noted on the tape, this size being denoted by the ratio of area of fissure to total area of rail head. A section crew of the railroad being tested follows the detector car to handle defective rails found, as directed by the railroad representative who accompanies the car during the test. If the defect is shown to be a large fissure, the rail is usually removed immediately and replaced with a perfect one; if not removed it is at least angle-barred, or trains are flagged to pass slowly over it until it can be replaced; if the defect is shown to be a tiny fissure, probably not yet large enough to be dangerous, the rail may be marked for removal at a more convenient time.

All available space beside and above the windows of the recording compartment is covered with instruments indicating to the operator how the various units inside and outside the car are functioning while the test is in progress. Amplifying units are located over the windows at either side of the compartment. "B" batteries for the amplifiers are located in the seats at either side of the compartment directly under the amplifiers. Also at the rear of the car a throttle and airbrake, voltmeter, oil pressure gauge, and an air brake gauge are provided for operation of the car backwards over long distances.



The Recording Compartment of a Sperry Detector Car. This is located in the rear of the car. Note the tape which automatically charts all rails tested.



Two paint marks, each indicating an internal transverse fissure.

All units are self-propelled gas-electric cars, and are built with a galley, dining, lounging, and sleeping quarters for the testing crew. The length of the cars is about 57′; the body is 9′10″ wide. On trials the cars have been run at 60 miles per hour, but 40 miles per hour is placed on them as speed limit in non-testing service. The trailing truck of each car is of Sperry design, being arranged for mounting the main current brush carriages between the wheels on either side. Fully equipped with brush carriages, air cylinders, lifting mechanism, and bus bars, the truck weighs 15,000 pounds. It has two 5′ 9″ axles with 33″ wheels spaced 10′8″ with outside brakes. The truck has a double bolster, straight equalizer bar and a frame fabricated entirely of welded sections. An airbrake system is arranged for straight air operation from either end by means of valves, permitting exceptionally fast operation through the relay valve or for control from the train line if the car happens to be coupled into a train. Emergency application may be obtained by means of conductor's valves and a triple valve. A 16″x12″ cylinder is used, the force being divided to give 100% braking on drive truck and 90% on rear truck. The main air reservoir consists of one 16″x72″ tank, an additional reservoir 16″x36″, and the auxiliary tank 16″x36″; air is supplied by a motor driven air compressor.

The Sperry Car has been designed for operation in sparsely settled territory where it is difficult to secure fuel and supplies. Therefore the following storage facilities were provided under the car: two 250-gallon tanks, one 75-gallon lubricating oil tank, one 25-gallon kerosene tank, one or two coal bins, a battery box holding one 32-volt battery, two sash and screen boxes for carrying the storm windows in summer or the screens in winter, a box for hold-thereby reducing voltage required. In order to conserve space the tanks are built in the form of an archway, permitting the location of a day bed for the cook under the archway of the tank. This bed can be folded up during the day and is then covered by a door. Fire protection is provided by two high pressure fire extinguishers.

The minimum crew consists of a chief operator, an operator, and a driver. An assistant operator or a student operator, or both, may also be included. A colored cook or steward, who takes no part in testing, also is provided for each detector car. During the test a representative of the engineering department of the railroad accompanies the crew, and he determines the handling of each rail found by the car to be defective.

Approximately 75,000 miles of track in the United States and Canada are tested annually by the Sperry Fleet of Detector Cars, and they are finding an average of one transverse fissured rail to every 3.89 miles of rail tested; considering all types of defects—fissures, split heads, etc., the Sperry Cars are locating an imperfect rail for every 1.73 miles of rail tested, or over 57 defective rails per 100 miles of rail. Thus they are greatly contributing to safe railway travel.

The Chicago and Eastern Illinois Railway has, since 1929, been testing all rail in its high speed main track with Sperry Cars. Prior to such testing it had been the practice to remove from high speed track all rail from a heat after three fissures had been discovered in rail from that heat. This practice resulted in the removal of many sound rails. The use of the detector car eliminates the necessity of such wholesale renewals and has resulted in considerable economy in that way.

Of current interest is the fact that every foot of rail in Canada over which the King and Queen of England will travel is being tested with a Sperry Detector Car.

MAKING A HAND TEST.

After a flaw is located, a hand test is made to learn its extent.

ing front radiator cover, and five air tanks—three for the airbrake system and two for the pneumatic control of Sperry equipment. For the detector equipment, lights, and drive there are nine different voltages ranging from 1 to 700. From the generators or motors there are thirty-eight meters and eighteen different electric machines. There are 500 feet of conduit used for the electrical wiring, and there are 200 feet of air piping; 5,706 feet of wire are used for detector equipment and hookup control wiring. There are 370 feet of 750,000-C.M. cable used for conducting current to brush carriages.

One compartment on the car contains the generating equipment for the detector current, roof radiation for the engine driving the generators, storage cabinets for tools, an auxiliary lighting unit, a paint tank, an air compressor, and a work bench and panel boxes for the detector equipment control wiring. The generating set consists of a 150-h.p. engine driving three generators and the air compressors by means of "V" belts. A clutch is provided so that the engine may be started without the generators. The engine is cooled by radiators built into the roof through which air is drawn by a fan having a capacity of 15,000 cubic feet per minute driven by a 5-h.p., 110-v., d-c motor. Current for the main brush carriage is delivered by a 7,000-ampere, 3-volt generator, which has an overload capacity up to 10,000 amperes. The pre-energizing current is delivered from a generator rated 3,000 amperes at 6 volts, having an overload capacity up to 5,000 amperes. A 10-k.w. exciter furnishes current for the fields of the two large generators as well as the 5-h.p. fan motor and various small auxiliary motors used on the car. A two stage air compressor is mounted over the pre-energizing generator. Between the generating compartment and the recording compartment water tanks of 500-gallon capacity are built into the car structure. The water is used on the rail to improve contact of the brushes

Suspension Bridges

by John W. Yaw, c., '39

Because of the fact that suspension bridges are not rigid structures, their design and construction is not generally as well understood by engineers as it should be. Mr. Yaw in "Suspension Bridges" relates the history and development of these bridges from both practical and theoretical viewpoints.

SINCE very early times ropes have been stretched over rivers in order to assist the ferrying of boats, or to carry small parcels across in a suspended basket which was pulled to and fro by a cord attached to it. The next step was for a man to walk across upon the rope keeping his balance by the help of two other ropes hung somewhat higher so that he could grasp them with his hands. Later two ropes were hung side by side and a rude roadway laid upon them, thus forming a narrow foot bridge. In the eighteenth century chains were used instead of ropes and the structure made sufficiently heavy to allow the passage of animals and vehicles. All suspension structures erected prior to the beginning of the nineteenth century were of this rude type; they were few in number, short in span, and very deficient in rigidity.

The first true suspension bridge was erected by James Finley in 1801 at Greensburg, Pa.; it was distinguished from all previous structures by having the roadway nearly horizontal and hung from the chains by vertical rods, while the chains themselves passed over towers and by means of backstays were anchored to the rock. The span of this bridge between towers was 70 feet, its width 12½ feet, and its cost $6000; it was guaranteed, all but the flooring, to last 50 years.

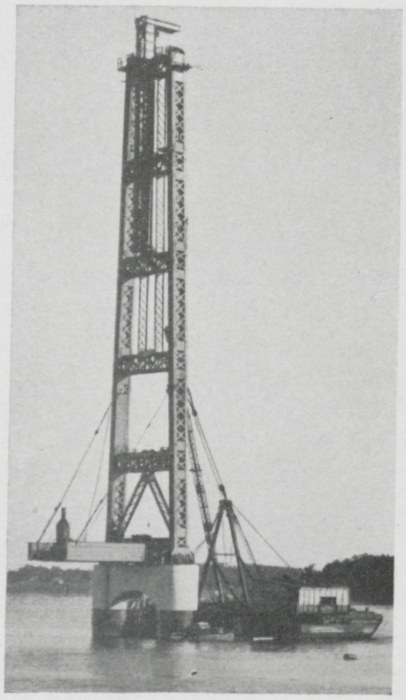
Eight suspension bridges of this type were erected by James Finley and John Templeman prior to 1810; the span length was increased to 148 feet. In 1808 Finley was granted a patent for this system of bridge construction, and the knowledge of it was widely spread by the descriptions given by Thomas Pope in his Treatise on Bridge Architecture, published in New York in 1811.

In these bridges the cables were made of chains, but the fact that iron wire had greater strength was soon recognized. In fact, a foot bridge with iron wire cables, having a 408 foot span, was erected in 1806 over the Schuylkill river, the platform being probably laid on the cables in the old style. In 1814 Telford made investigations and concluded that with wire cables it was possible to build a suspension bridge a thousand feet long. In 1819 Brown built one with 450 feet of span, and in 1826 Telford erected one over the Menai straits with a span of 580 feet; these, however, were chain bridges, the chains in the Menai bridge being made of bars 9 feet long, 3¼ inches wide, and 1 inch thick, united at their ends by coupling bolts. Throughout Europe the suspension system gradually spread as an advantageous one for highway structures of long span. In 1834 a bridge of 870 feet span was erected at Freiburg, Switzerland, the four cables of which were made of wire, 1056 wires being used in each cable.

In 1842 Charles Ellet built a wire suspensoin bridge across the Schuylkill river which had a span of 343 feet; in 1848 he built one across the Niagara river which was used for highway traffic until the completion of the heavier structure by Roebling in 1855. In 1848 he also built one over the Ohio river at Wheeling, which had the great span of 1010 feet. This was blown down in 1854. All suspension structures built between 1810 and 1850 were of the Finley type, the roadway being hung from the cables by vertical rods; to prevent oscillations, however, inclined rods called stays were attached to the roadway at various points and carried to the tops of the towers, while guy rods were run laterally and downward from the roadway and secured to points on the banks of the stream. In spite of these precautions these bridges were subject to violent oscillations in gales of wind and many were destroyed. Even under the passage of ordinary traffic they were liable to great deflections, and it was then generally supposed that the system could not be advantageously adapted to railroad structures.

The Niagara suspension bridge, completed in 1855 by John A. Roebling, marks an epoch in the history of this system, it being the first and only suspension structure which had been built for heavy railroad traffic. The span between towers was 821 feet, the width 15 feet, and it had four cables, each 10½ inches in diameter and made of 7 twisted strands of wire. The upper deck was for railroad and the lower deck was for highway traffic. The distinctive feature introduced was that the roadways were supported by two trusses 16 feet deep, these trusses being hung from the cables by rods. By the use of the truss the stiffness of the structure was greatly increased, this tending to cause a partial load to be uniformly distributed over the cables. This bridge was successfully used for 42 years; in 1880 the wooden trusses were taken out and replaced by steel ones; in 1886 the stone towers were also replaced by steel. In 1897 the bridge was taken down, giving way to the steel arch erected by L. L. Buck.

From the beginning of the twentieth century down to the present



Cuts Courtesy *Civil Engineering*

The Main Tower of a Suspension Bridge.

day there has been much progress in the analysis and design of suspension bridges. The latest suspension bridge to be built is the Golden Gate Bridge in San Francisco, California, with a main span of 4200 feet and two side spans of 1125 feet each. The bridge is 81 feet wide. This structure shows a great deal of improvement over those built in the nineteenth century.

Development of the Analysis and Design of Suspension Bridges

The first studies of suspension bridges were made a century ago by Navier, Rebhan, and others. These studies were made on the behavior of an unstiffened cable, since suspension bridges were not stiffened systematically in those days. For the light wagon loads of those times a braced railing was considered sufficient. However, these studies contained much informative material, especially on the general behavior of the suspension bridge.

After experience had shown that light, unstiffened suspension bridges were neither comfortable for travel nor safe against wind, engineers began to stiffen them. For the short-span bridges built in the early times the attachment of any sizable stiffening girder supplied more than sufficient stiffness. In fact, the girders were so stiff that it appeared to be logical to assume the beam as perfectly rigid. A simple static solution then became possible and was readily established. It formed the basis of the well-known Rankine-Ritter theory.

With the greater use of metallic bridges the effect of temperature variation was recognized in the course of time, and a correction was introduced in the stiffening-truss formulas to allow for the change in temperature. Soon thereafter the elongation of the cables due to change of load also received recognition, and a correction was extended to provide for it.

By that time the study of the elastic behavior of metallic structures had attained a high development and was extended to suspension bridges. The elastic theory, which was then developed, took account of the elasticity of the various parts forming a suspension bridge and forgot the effect of the dead or original load of the bridge. The deflection theory takes this effect into consideration as its basic idea. It has proved that the effect of the dead load or, more precisely the pull in the cable due to it, is of serious importance and sometimes completely controls the design and behavior of the bridge. The elastic theory has outlived its usefulness as a tool for designing suspension bridges.

A clear understanding of the distortional behavior of suspension bridges and of the functioning of stiffening trusses is not as common among engineers as it is generally assumed to be. The fact that, with the exception of suspension bridges, all bridges may be treated as rigid structures rightly leads to directing the attention of engineering students to rigid bridges. The distortions of rigid bridges under live load, wind, and temperature are small enough not to affect the primary stresses of their frames. This does not hold true for suspension bridges. In these bridges the distortion of the structure under live load and other outside forces exerts a marked and determining effect on the stresses in the various members of the combined structure. Suspension bridges, therefore, require a different analytical approach than rigid bridges, and as a result, the considerations covering their design are also quite different.

Stiffening Trusses

Supension bridges in general, even though they have enough strength, are not suitable for carrying heavy loads because the distortions would be too great. To overcome this difficulty the bridges must be so stiffened that they will retain their shape under all load conditions. This is done chiefly by means of the stiffening truss which distributes the load and has rigidity enough to prevent any sizable deformation.

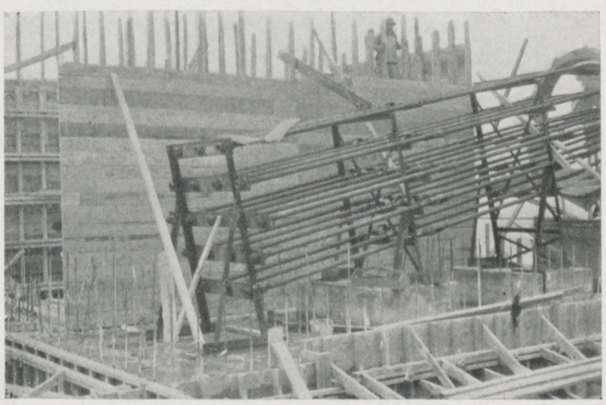
Stiffening trusses are classified as three-hinged, two-hinged, or continuous. This classification is also used to denote the different kinds of suspension systems. These types are just what their names imply. A three-hinged truss is one hinged at each tower and in the center. A two-hinged truss is one hinged at

A partially completed Suspension Bridge.

each tower. A continuous truss is one that is not hinged at any point, but is continuous the length of the bridge. The three-hinged truss is the only one that is statically determinate when used in a suspension system. The two-hinged is one time statically indeterminate, and the continuous truss is three times statically indeterminate. The two-hinged stiffening truss is considered to be the lighter construction and is the common practice. Continuous stiffening trusses have been shown to be uneconomical although they do offer the advantage of increased rigidity.

Problems in the Design of a Stiffening Truss

There are many problems to be considered in the design of the stiff-

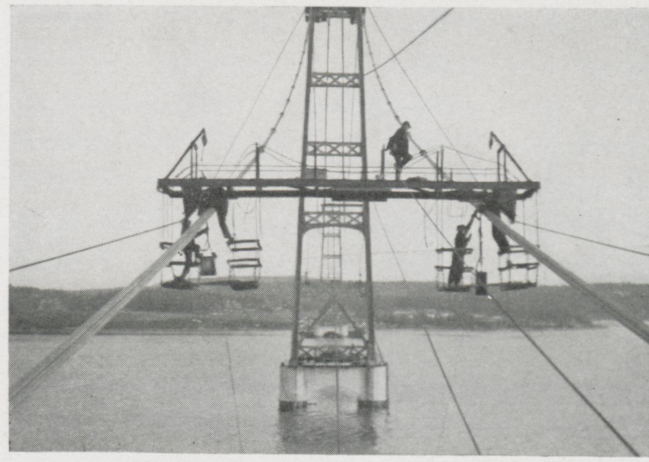


Anchorage Rods Before Pouring Concrete.

ening truss for a suspension bridge. They may be summarized into two important questions: What is the proper degree of rigidity? and how is it obtained structurally?

There are widely varying degrees of rigidity in the stiffening trusses, and it seems that there is much studying to be done along this line in an effort to establish a more uniform and improved practice. However, this is such a complex problem that an attempt to devise formulas or rules of design on a theoretical basis appears fruitless.

In smaller and lighter structures the principle object is rigidity against vibrations or oscillations which may be detrimental to the structure as well as objectional to traffic. There has been no formula based on theoretical grounds from which the required amount of rigidity could be obtained. Deflections have been limited by purely emperical rules set up by experience.



Placing Cable Bands in a Main Span.

As the bridge increases in span and weight, this object becomes less and less important, except in the design of floor systems. Flexibility of the structure as a whole is desirable since it reduces local impact effects and vibrations. The principle purpose of limiting deflections in long spans is to avoid excessive gradients, and to prevent deformations that may result in excessive local bending, distortions, or transverse tilting of the floor.

Grades may need to be considered in construction of a bridge for rail traffic, but deflections will not be of enough magnitude in a well designed structure to cause excessive gradients for highway traffic. The effect of the deflections upon the floor depends so much upon the width, depth, and general arrangement of the floor structures as to require careful study in each individual case.

The present tendency is to make stiffening trusses more flexible. This is because of the fact that, with increasing magnitude of highway bridges, rigidity, as measured by deflections of the structure as a whole, ceases to be important, and flexibility offers material economic advantages besides aiding the designer to make more graceful structures.

Another factor tending to make stiffening trusses more flexible is the abandonment of the elastic theory which ignored the influence of dead weight of the structure in the design of the stiffening truss. This led to wasteful designs, especially in long spans. In the use of this theory the depth of the stiffening truss was taken as 1/40-1/60 of the span. Today stiffening trusses have been built with a depth of 1/168 of the span length and have proved amply rigid.

The Bronx-Whitestone bridge is stiffened by plate girders with a depth of 1/210 of the span length. This bridge has yet to be tested by actual operation, but many authorities think that it will have enough rigidity.

Towers

Suspension bridge towers may be either fixed or hinged at the base; if hinged the cable saddles are always rigidly attached to the top of the tower. If the tower is fixed at the base, the saddle may be either fixed or sliding. In the former case there will be a small difference in the horizontal cable pull at the tower top which will act as a transverse load on the tower, the latter acting as a cantilever beam fixed at the base. Since the tower bending stresses from this source may be considerable, it will usually be necessary to investigate the question of maximum tower deflections.

Stresses to be Considered by the Application of Live Load

Given a suspension bridge and live load W as shown in Figure 1. The broken line shows in exaggerated form the shape the suspension system tends to take. The stresses to be considered from this live load, then, are: additional stresses in cables and suspenders due to distortion and weight of the live load, bending in tower due to increase in the horizontal component of the cable tension, column action of the tower due to increase in the vertical component of the cable tension, and bending and shear in the stiffening trusses and floor system. The solution of these stresses is very complex, especially with the two-hinged or continuous stiffening truss. As the load W moves across the bridge there will be a change of stress in the various parts of the bridge. The floor system will form a very small wave which the load will always be ascending.

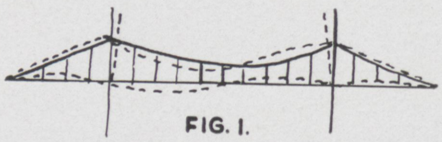


FIG. I.

FIG. 2.

Figure 1 shows the general shape that all bridges with suspended side spans and all bridges of continuous stiffening truss will take under the application of live load. If the side spans are simply supported and the stiffening truss is hinged, the live load will cause the bridge to take the shape shown by the broken line in Figure 2. The live load will also tend to ascend the wave in crossing the main span of the bridge. The stresses to be considered here are the same as before.

Lateral Forces

The stability and lateral stiffness of a bridge depend on its width. General bridge specifications usually prescribe a minimum for the ratio of span to width. Therefore, when the wind pressure on some spans of suspension bridges amounts to more than 1000 lb. per lin. ft. of bridge, the resulting stresses are of a magnitude sufficient to affect the determination of the width of the structure. In addition, as a considerable part of the applied pressure is transferred from the trusses to the cables and thence to the saddles, the design of the towers is also affected. Also, since the lateral deflections are proportional to the sag ratio for a given length of span, the sag ratio, and therefore, the general dimensions of the structure are dependent on the wind stresses. It will thus be seen that the wind stresses play an important part in the design of suspension bridges, and their rigorous analysis is fully justified. An important feature to remember in this analysis is that as soon as the bridge swings out of its vertical plane the effect of the dead and live load comes into action and tends to reduce the horizontal deflections. Consequently, a redistribution of the acting wind load follows until equilibrium is established between all acting forces.

Temperature Stresses

There are no temperature stresses in a three-hinged bridge. In the other types, however, temperature must be considered from the standpoint of its effect on cable tension, shears, moments, and deflections.

Conclusion

Transportation and erection conditions are frequently less difficult for suspension bridges than for any other type of permanent structure. Consequently, the suspension type particularly recommends itself for those locations where these considerations are of prime importance.

The economic ratios of side span to main span are about 1:4 with straight backstays and 1:2 with suspended side spans. Conditions at the site sometimes are the controlling factors governing the length of side spans. The economic ratio of cable sag to span length between towers is about 1:10 with straight backstays and about 1:8 to 1:9 with suspended side spans. The width between centers of stiffening trusses or wind chords should not be less than 1/30 of the span. The depth of stiffening trusses has been discussed previously.

For locations where piers or trestle bents are difficult or expensive of construction, or where requisites of span lengths are such as to necessitate as few piers or obstructions in the profile prism as possible, or where satisfactory rock is not found at convenient locations to receive the horizontal thrust from arch spans, it will be found that a suspension type solution of the problem is frequently surprisingly economical even for short crossings.

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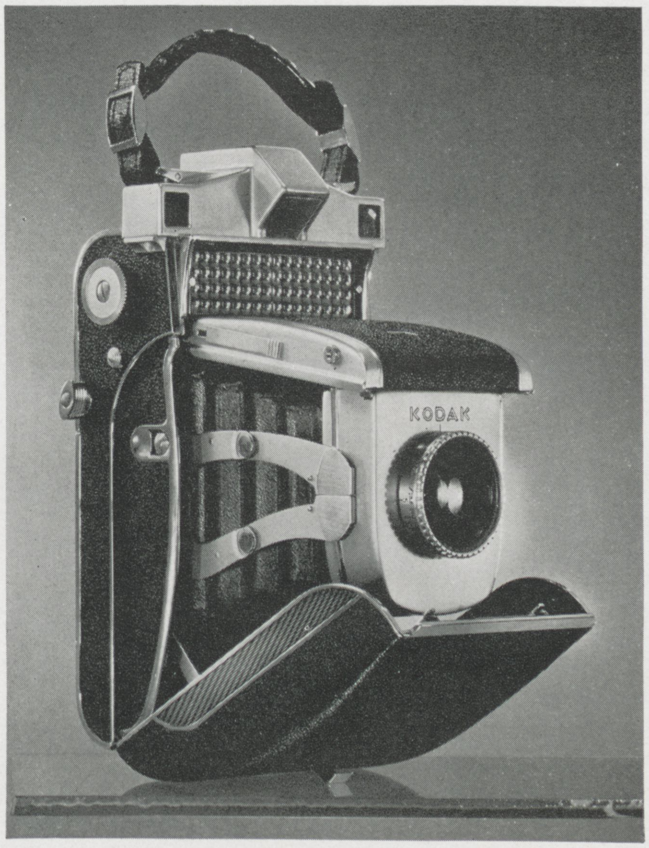


Courtesy *Machine Design*

Research and Development

edited by Lloyd O. Krause, e., '40

Camera With Automatic Exposure Meter

The Eastman Kodak Company has built a new camera that uses a photo-voltaic cell to automatically control the iris diaphragm of the camera. The energy utilized is, of course, very small. There is no material increase in size over that of the conventional camera.

Immediately above the camera lens is a multiple collection lens with a photocell behind it. This multiple lens system is calculated to cover the same field as the camera lens, and so the photocell is affected only by the light that is within the camera range. At the moment that the shutter is released the photocell actuates a galvanometer that is in the lens housing, and the diaphragm is adjusted to give the correct amount of exposure for the given shutter speed, producing a technically perfect negative.

The diaphragm is sensitive, well-balanced, and practically free from friction, enabling the photocell to adjust it readily. The designers of the camera have accomplished the coupling together of the photocell and the diaphragm in such a manner that this adjustment can be realized. The galvanometer dial on the lens housing permits selective readings of light and shadow in any particular scene, just as with the regular exposure meter. For special effects the diaphragm may be adjusted by hand.

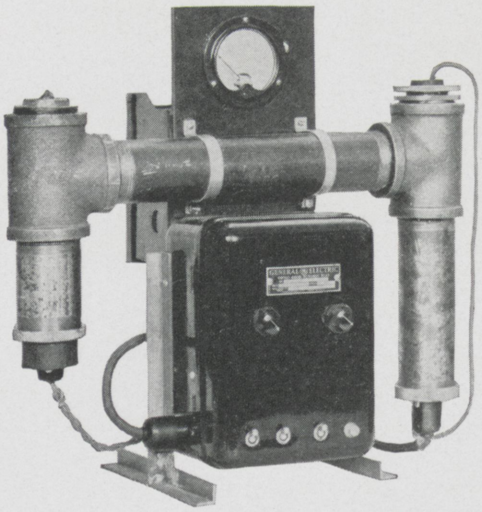
If the shutter speed is changed, the coupled photocell immediately compensates for the change by increasing or decreasing the diaphragm opening. Changes of light on intermittently cloudy days, changes of scene from light to shadow, and changes in shutter speed are instantly equalized. The user may, if he desires, operate the camera by hand to obtain special pictorial effects, such as focusing out poor background.

The present trend is to simplify cameras, and this one is indeed an extension of the trend; for all the user needs to do is focus and shoot.

New Fume Detector Sees Shadows

Because all fumes must obey the basic physical law that any vapor will absorb the same color of light that it emits when excited, they cast shadows. To the human eye, these shadows are, of course, imperceptible. The invisible fumes of mercury can be detected with apparatus recently developed in the research laboratories of the General Electric Company. Mercury vapor is invisible to the human eye, but since its emitted color is blue and ultra-violet, it will absorb these colors. The new device employs a lamp that emits light rich in blue and ultra-violet, and when air containing mercury vapor is passed in front of it, a shadow is cast. This shadow is detected by a photoelectric tube upon which it is directed. The samples of air to be tested are merely sucked through the apparatus. Furthermore, besides detecting the presence of mercury vapor, the device is also quantitative in its operation, because the amount of shadow cast depends directly upon the amount of mercury present. A perceptible shadow is cast by an extremely low ratio of mercury to air. One part of vapor to a billion parts of air will cast a distinct shadow.

There are at present two methods



Courtesy *General Electric*

New Fume Detector which Sees Shadows.

of detecting low concentrations of mercury vapor in the air. One is chemical, the other optical. The chemical method depends upon the reaction of mercury with selenium sulphide, a yellow powder; but this reaction requires hours for low concentrations of mercury. The optical method depends upon the opacity of a vapor to light of the same wavelength that it emits. Thus if ultraviolet light, in the case of mercury, is directed toward a phototube, any mercury vapor that comes between the source of light and the tube will cut down on the amount of light striking the tube, and so cut down on its current emission. The phototube and the lamp are mounted at opposite ends of a 2-inch length of standard pipe, and the sample of gas to be tested is drawn through it. An amplifier tube is placed in the same housing as the phototube. An indicating meter measures the decrease in plate current of this amplifier from the condition of a pure gas sample, so that a current flowing in the meter signifies a reduction in the amount of light and hence the presence of mercury vapor.

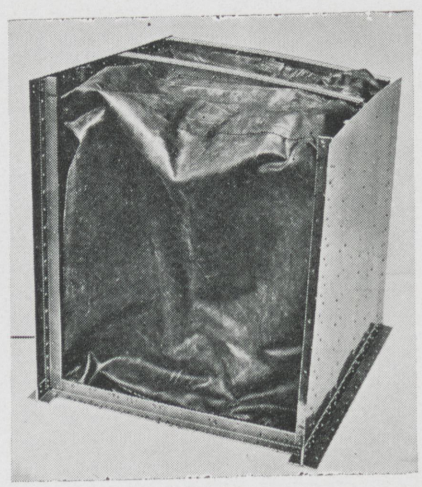
The detector is 10 by 18 by 21 inches, and weighs about one hundred pounds. It is plugged into an ordinary a-c outlet, and all equipment used is standard.

A Fabric Fuel Tank

A new fabric aircraft gasoline tank, developed by the Glenn L. Martin Company, gives promise of being vibration proof, and thus promise of greater safety and reliability.

The "Mareng fuel cell," as it is called, eliminates gas-tight metal tanks. The treated fabric bags are designed to fit in any portion of the plane that is desired, such as the wing or some part of the fuselage. The bags are cut to a size larger than that of the compartment in which they are to be placed, and so do not have to withstand any strain or twisting, the surrounding structure absorbing any strains. The cells thus act merely as static, vibrationless containers.

Government specifications state that any aircraft fuel tank must be



Courtesy *Scientific American*

Fabric Aircraft Gasoline Tank.

able to withstand 15 hours of continuous vibration on a high frequency vibrating table, and no service ever requires more than 25. The Mareng cell withstood 700 hours of vibration unscathed, and to make the test more severe a rocking motion was imparted at the same time.

Another advantage is the near immunity of the cells to bullets. Not that the cells are bullet-proof, but a bullet tends to make a narrow slit in a fabric rather than a clean round hole as in a metal tank. The pressure of the gasoline on the fabric (remember the cell is in a compartment smaller than the size to which it is cut) tends to seal the slit, and so prevent any leakage of gasoline. A Mareng cell was actually pierced on a foreign war front, and the plane, instead of being forced to land, returned to its base 100 miles away. Gas-corrosion of a metal tank need never be feared, for the fabric is absolutely unaffected by gasoline.

At present the tank is perhaps of more military interest than commercial, but it is believed that it will soon stimulate commercial interest also.

Syphillis Bows to Artificial Fever

Research of the past twelve months has developed an improved method for the combatting of such diseases as syphillis, St. Vitus Dance, rheumatic heart disease, some cases of arthritis, encephalitis, cascular diseases, and meningitis. This weapon consists of artificially induced fever produced by short-wave therapy acting in conjunction with medicinal drugs and has tremendous advantages over any previous type of treatment.

Syphillis has been treated with artificial fever for some twenty years. During the last several years some physicians have used mechanically induced fevers, but most of them innoculated actual fever producing bacteria into the body, usually active malaria or typhoid. The great detriment to the latter method, although of course it does produce the desired fever, is that malaria has a mortality of its own, and so the life of the patient may be seriously jeopardized.

Six physicians, working cooperatively, found that the use of mechanically induced fever not only permitted the administration of antisyphilitic drugs such as mercury, bismuth, and arsenic while the patient was being treated, but also that the combined treatment produced greater absorption of the drugs and more rapid results than the former conventional methods. Later complications could thus be prevented because of shortening of the course of the disease.

Patients who failed to give any progressive response to the conventional methods of treatment showed definite and progressive improvement from week to week when treated with combined therapy.

As the temperature of a patient's body climbs from a normal of 98.6 degrees Fahrenheit to higher temperatures around 104 to 105 degrees, the number of white blood cells increase in number, building up resistance to the disease invaders until they are banished from the body. In some cases the heat itself destroys the invading organism, but the increased number of white blood cells has the greater effect, in that these numbers surround the invader, depriving it of food and killing it.

If, while these increased numbers of white blood cells are acting, medicinal drugs can at the same time be administered, a truly effective barrier is set up against the disease. The theory of compound therapy is yet new, however, and it cannot be definitely predicted what the ultimate result will be in each case.

A Synthetic Voice

There has recently been developed by the Bell Telephone Laboratories a new device that actually talks. It was built mostly of ordinary everyday telephone apparatus and was especially designed for use as a novelty at the World fairs of New York and San Francisco.

Courtesy *Scientific American*

The Voder, a machine which creates speech.

The Voder, as it is called, is the first machine in the world actually to create speech. Numerous devices have been built to create a single vowel sound or consonant, but none has actually linked the sounds together into connected speech as the Voder does. A skilled operator, sitting at a seat similar to that of an old organ, can make the machine say anything that he desires. It takes a long time to acquire skill in making the machine talk, usually on the order of a year with three hours of practice a day. This is not quite as long as it takes a human to develop his own natural powers of speech after birth, but it is still a long time. Steady practice continually increases the skill of the operator.

The designers equipped the machine to make two sounds, consonants and vowels. There are two types of consonants, the hiss and the stop. The hiss sounds are made by humans by forcibly passing the breath through the throat, over the tongue and then through the teeth. The stop consonants, such as "k", "p" and "d", are usually formed by some sort of explosive action. The consonants are controlled by a set of keys, and when vowels are desired they are switched in by means of an arm rest switch and are similarly controlled.

Braintwisters

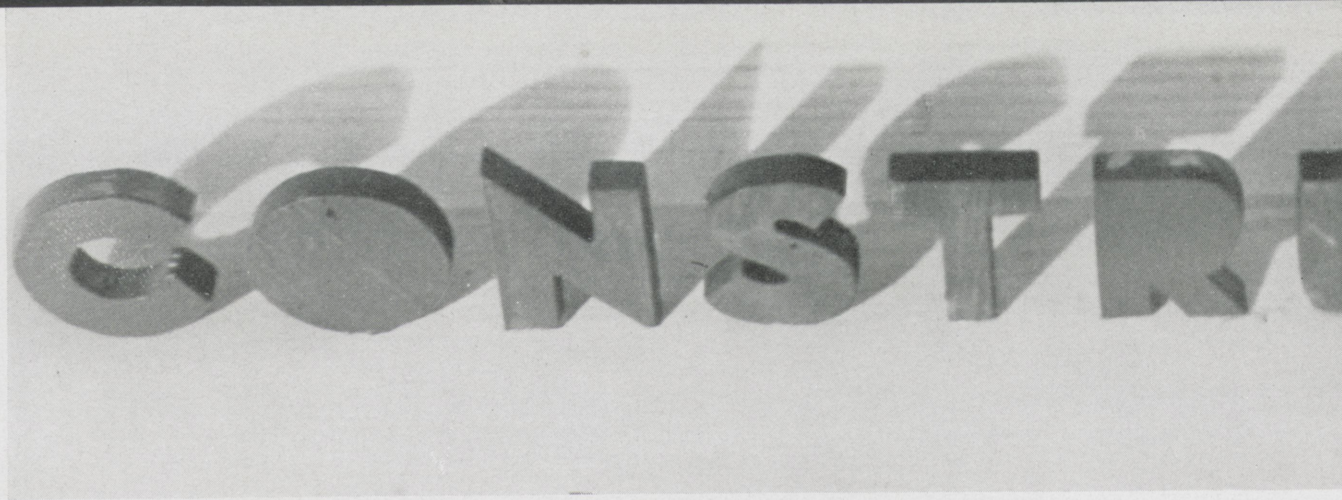
by William A. Reddie, ch., '39

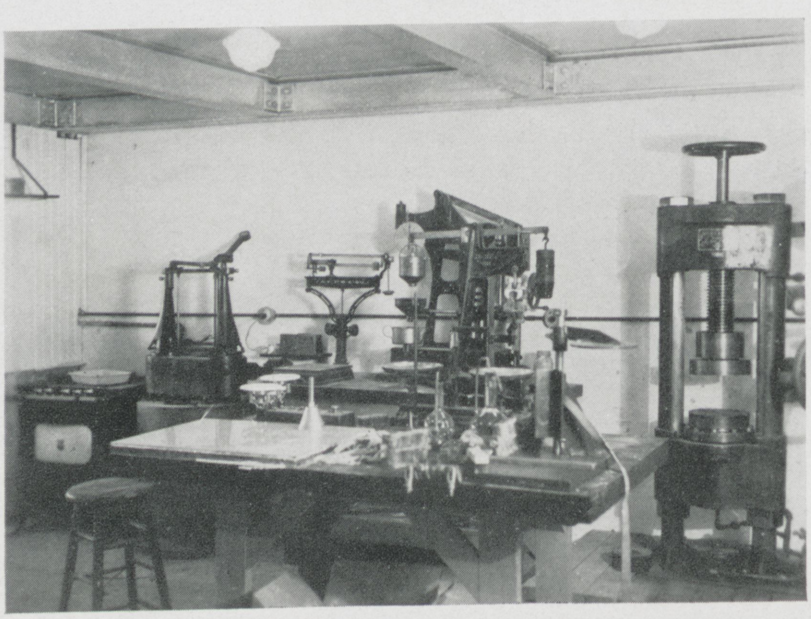
The editor of this column wishes to acknowledge another correct solution of the problem entitled "How's Your Geometry?" which appeared in the January issue. This solution was submitted by Dr. W. D. Crozier of the Physics Department.

An equilateral triangle, ABC, has a tower at each corner, 90 feet, 100 feet, and 110 feet high, respectively. A point within the triangle is located so that the distance from it to the top of each tower is the same. Find this distance and the distances from the point to the three sides, respectively, if the side of the triangle is 100 feet long.

A tree 90 feet in height and situated on level ground is broken so that the height of the stump is equal to the distance from the base of the stump to the point where the top touches the ground. How high is the stump?

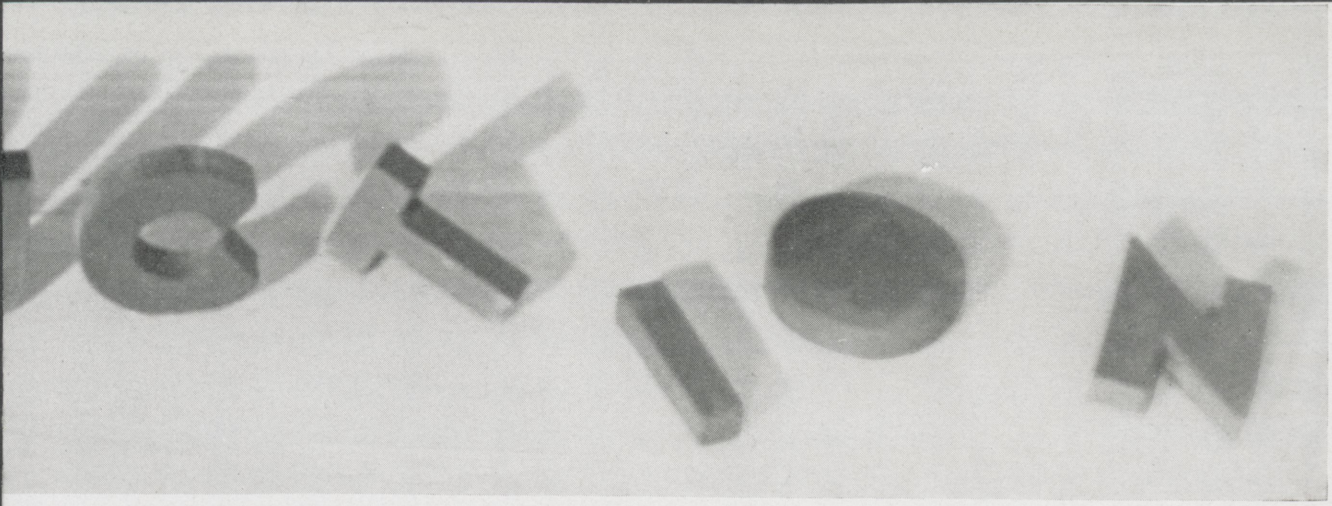
Three men, A, B, and C, bought a grindstone, sharing equally in the cost. The outer diameter of the stone was 30 inches. There was a 4 inch opening at the center for the shaft. How many inches of the diameter must each in turn grind off to realize his share of the stone?

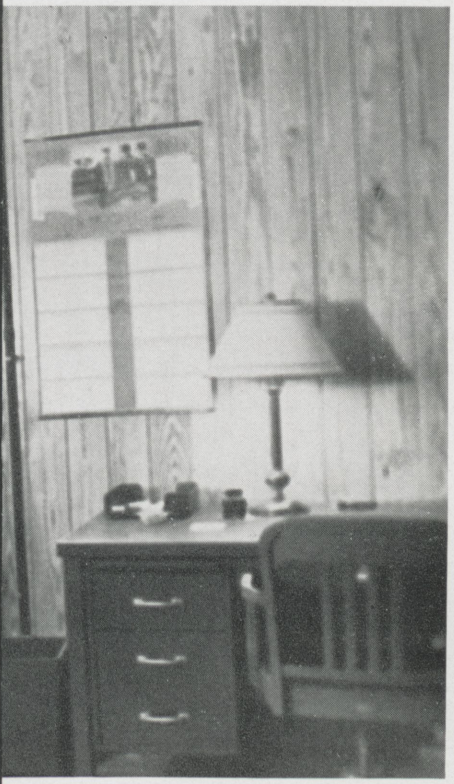




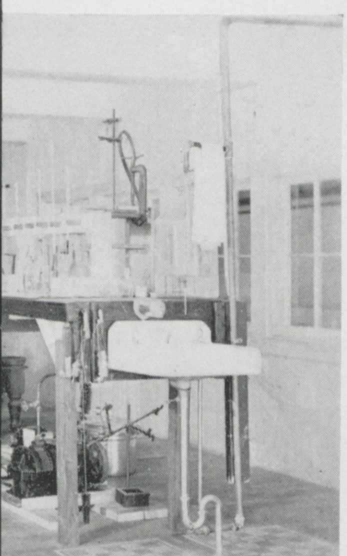
New Concrete Testing Laboratory

New Water Tes





Three Views of the Newly Constructed Technic Offices



Laboratory

Partially Completed Hydraulics Laboratory

THE ROSE TECHNIC

Member Engineering College Magazines Associated

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Do you feel as though you have lost that vital capacity for the full enjoyment of life as it should be lived? Are you becoming short tempered and alienating your friends and mother-in-law? Are your powers of endurance and stick-to-itiveness curtailed, and is the quality of your work becoming poorer and the quantity smaller? Does your appetite vary inversely as the increased size of the bags under your rheumy eyes? Are your social successes marred by imperfections of epidermis or respiration? Are you incapacitated by disorders of the alimentary or nervous systems? Then, friends, if these are symptomatic, come in closer, for herein follows a message which may be of incalculable value to you.

A number of miraculous case histories will not be cited, but seriously, the remedy may be as simple as this: make an accurate survey of the amount of sleep you regularly obtain; if the analysis reveals that you are not averaging 7 to 8 hours in each 24-hour block, the amount required by normal individuals, correct this deficiency immediately. If no improvement results, see your mortician.

All too often we moderns increase the range of our activities at the expense of that period which, after the natural order of things, must be devoted to the restoration to working efficiency of our personal equipment. It is well to remember that old saw, "Early to bed, early to rise . . ." It remains valid. Mr. Winkle may have been an extremist, but he had something there. *J. E. T.*

Comments

Extra-curricular activities and some professors do not seem to mix in perfect harmony. If a college is to perform all of its functions of preparing its students for the world, extra-curricular activities are as much an integral part of its course as the curriculum. Activities are usually given to the men most able to do them, that is, the men with the higher scholastic ratings. That is only as it should be, of course, because some scheduled classes must be missed for activities. Most teachers are more than willing to dismiss students for this work, but some seem to do it grudgingly and with a lurking mental prejudice. Students who participate in these activities should not be given any special consideration because of them, but at the same time they should not have these same activities held against them.

Rose turned in a more than good record for the basketball season just completed, especially for the last half of their schedule. Of the last ten games played they scored eight victories. The entire season's record is the best Rose has had in fifteen years. Congratulations to the team for taking us out of the doldrums and making us again a factor in Indiana athletics.

By the way, speaking of winning teams, have you noticed how the rifle team has been doing? This is also one of the best years they have enjoyed in some time. Almost every week they have turned in a score high enough to win one or two of the postal matches for that week. Probably the win they have the most to say about is a five man, all position victory over the varsity of Indiana University. Their record is impressive this year when you remember that during the firing season last year we only marked up one victory for the entire schedule. The rifle team deserves congratulations too.

The photography we sometimes have displayed on the bulletin board in the hall by the camera club darkrooms certainly lends a cheerful atmosphere to that hall. It is pleasant and resting to hesitate during our rush from one interesting class to another and view some quiet, pastoral scene. Thanks to those who contribute to our temporary relief from the mental strain of acquiring an engineering education at Rose.

E. A. C.

Around The Campus

with Chuck Howlett, e., '41

Camera Club

Tuesday, February 7, the Rose Camera Club met at the University Club in the Hotel Deming to enjoy a series of pictures shown by Mr. Harold O. Wimsett, class of 1911. While at Rose Mr. Wimsett was a member of the Camera Club under Professor Peddle, and since that time he has done much work in photography. At present Mr. Wimsett in his capacity as Locating Engineer for the State Highway Commission of Indiana does much travelling about the state and so has many opportunities for taking interesting and beautiful pictures.

During the past year he has made most of his pictures in color and now has over 900 slides, one of the finest collections of Kodachrome slides in this region. At this meeting, however, he selected about 200 of these to show. The pictures are not prints; but are called by photographers "transparencies", being projected upon a screen.

Mr. Wimsett showed many pictures of engineering importance, such as bridge structures and other road constructions. He also showed nature pictures of sunsets and other scenery. Outstanding among these photographs were a picture of an approaching dust storm and an unusual picture of a rainbow.

The members of the Camera Club and of the faculty who attended the demonstration were much impressed by the work of Mr. Wimsett, and it is hoped that he will be able to return to Rose to show some of his pictures at a school assembly.

There are plans for Dr. Crozier to present the features of amateur photography, including the composition and the proper exposure of the picture; for Dr. Strong to present interesting facts of photographic emulsions and of chemical reactions involved in the development of the pictures; for Professor Hutchins to tell of the use of photography by the engineers of the T. V. A.; and for Dr. Howlett to describe the construction of camera lenses and to show how lenses are chosen to meet various requirements.

Saint Pat's Dance

Saint Pat's day has been celebrated in recent years by the engineering colleges of the country because, we are told, Saint Pat was an engineer. Here at Rose the custom has led to one of the outstanding dances of the year. It is sponsored by the Student Council, and the following have been appointed for the dance committee.

General Co-chairmen—Malcolm A. Steele and Franklin G. Doenges.

Orchestra and Place—Robert P. McKee and Frank G. Pearce.

Publicity — Newspapers — Robert S. Kahn; Posters—George W. Smith and James E. Ducey.

Tickets—John W. Quinn.

Decorations—Malcolm A. Steele, Frank G. Pearce, and Robert D. Parr.

Finance—Stanley R. Craig.

The dance is to be held Friday, March 17, at the Terre Haute Country Club, to the music of Wayne McIntyre's orchestra. Under the influence of the atmosphere of the beautiful South Club the dance should prove to be even more successful than it has in the past.

Technic Staff Meets

Tuesday evening, February 21, the members of the *Rose Technic* indulged in a bit of lighter publication work at a dinner and business meeting held at the Elk's club. The faculty advisors, Professor Herman A. Moench and Mr. Henry C. Gray, as well as the sixteen members of the staff, were present for the occaion. Following an excellent dinner and the solution of a few brain teasers submitted by the faculty members, the business meeting was opened.

Robert Kahn, Editor of the *Technic*, welcomed George Smith as the new Business Manager of the magazine and congratulated Robert Phelps on his promotion to Advertising Manager.

Plans were discussed for the revision of the generally antiquated constitution and for the inclusion of the specific duties of each member in the by-laws. Several constructive criticisms were made of the composition of the magazine as well as of the schedule which is followed in its publication.

Military Training Popular

Students at Rose take full advantage of the elective course offered in military science and tactics, it is shown by statistics included in the Reserve Officer's Training Corps Engineer. The manual states that there are twenty-nine R.O.T.C. engineer units in U. S. colleges. In twenty-one of these colleges the R. O. T. C. course is required for graduation, and in the remaining eight the course is voluntarily elected by the students. Rose ranks first among the colleges where the course is voluntary and fourth among those where the course is required, the rankings being based on the ratio of students enrolled in the R.O.T.C. course to total college enrollment.

The report also showed that in general the engineering training course is gaining in popularity over training courses in the other branches of the service at colleges where more than one unit is established. At such institutions there are 45,084 students enrolled for military training. Of these, 16,556 selected infantry units, 11,219 selected engineer units, 9,519 chose artillery units, the remaining being distributed in smaller groups among the other branches of the service, such as cavalry and coast artillery.

An especial reason for the popularity of the course among students in chemical engineering is that each summer advanced R. O. T. C. members are permitted to attend the chemical warfare school at Edgewood Arsenal, Maryland, about fifteen miles from Baltimore. Rose students who will attend the school this year are Emil G. Christiansen, James E. Ducey, Frank G. Pearce, and J. Edward Taylor.

Many graduates continue R.O.T.C. work and affiliate themselves with the Reserve Officer's Association. The members of this year's graduating class at Rose who will join are Robert J. Burger, Edward A. Coons, Franklin G. Doenges, Robert N. Ladson, William M. Noel, Victor W. Peterson, William A. Reddie, Joseph E. Ross, George W. Smith, Edward O. Spahr, Robert W. Underwood, Richard G. Weldele, and John W. Yaw.

Assembly

Thursday, February 16, the students of Rose heard a very interesting presentation of the theme "The Development of Aviation". The talk was delivered by Colonel H. Weir Cook of the United States Officers Reserve Corps.

Col. Cook began his story of aviation with some of the theories and dreams found in the writings of Leonardo da Vinci and told of the development of aviation from that time through the period of the Wright Brothers' developments and the World War to the present time. His talk was very interestingly supplemented with the exhibition of scale models of the different stages of the airplane.

Having flown during the World War in the same squadron with the famous ace, Eddie Rickenbacker, Col. Cook had access to a vast fund of experiences with which to illustrate his points in the development of aviation. By the use of these humorous and illustrative examples Col. Cook made the assembly as interesting as it was educational.

Honor Point Revisions

The Student Council at a recent meeting adopted a few changes in the Honor Point system of rating. The committee in charge of the investigation of the ratings suggested that the following revisions be accepted:

Freshman Athletic Manager	4
Sophomore Athletic Manager	5
Junior Athletic Manager	6
Senior Athletic Manager	7
Editor, *Technic*	15
Art Editor, *Technic*	10
Campus Editor, *Technic*	10
Financial Secretary	12
(To be awarded in Senior year)	

These ratings were passed upon by the Council and will go into effect next year. The others will remain the same as before.

Radio Club

A great deal of work has been done on the Radio Club room in the past month. It has been painted, and the installation of new wiring has been started. The 160-meter transmitter is to be placed in the club room in the near future.

Mr. Schull has purchased $25.00 worth of equipment by permission of the club. He has made rapid progress on the construction of the new final stage for the 40-meter rig and will have it ready by the time that the mast is completed.

Glee Club

The Glee Club is about to start the busiest portion of its season, and the adviser and officers of the club appreciate the manner in which the men have been attending practice.

At the present time the club is learning some new numbers in preparation for concerts at Glenn on March 10, at Gerstmeyer Technical High School on March 13, at Clinton on March 17, and at Indianapolis over station WIRE on Saturday, March 18, at 4:30 p.m.

A.I.Ch.E.

The Rose student branch of the American Institute of Chemical Engineers held its second anniversary meeting at the Terre Haute House Friday evening, March 10th. Following the dinner, new officers were installed for the coming year. The chapter also presented its annual award for scholastic excellence to Frank G. Pearce.

Dr. Ralph K. Strong then had the pleasure of introducing his friend and one of the most outstanding speakers to appear before the chapter, Mr. Sidney D. Kirkpatrick, editor-in-chief of "Chemical and Metallurgical Engineering." Mr. Kirkpatrick is also chairman of the A.I.Ch.E. committee for professional guidance and of the E.C.P.D. committee for junior engineers. For his address he chose a subject on which he is supremely qualified to speak, "*The Chemical and Metallurgical Awards for Progress in Engineering.*"

The chapter held its February meeting on Thursday, March 9, in Deming Hall. Dr. Arthur Campbell of the Commercial Solvents Corporation was the speaker of the evening. Speaking on "Rubber," his talk was exceptionally good because he was able to present the essence from a large scope of information.

Recent Appointments

Several positions of student importance have recently been filled. They include the joke editor of the *Modulus* and the editor and two associate editors of the *Student Handbook*.

Robert P. McKee will edit the jokes for the *Modulus* this year, the position having been left vacant when David Reifenberg withdrew from school.

Edward A. Coons, President of the Student Council, also announces that Frank G. Pearce has been selected as editor for the *Student Handbook* for the coming year. He will be assisted by Charles A. Howlett and Norman G. Eder, associate editors, in producing the revised handbook, the purpose of which is to familiarize the new students with the school activities.

A.I.E.E.

The A. I. E. E. held an afternoon meeting February 14 at 12:45 p. m. The purpose of these afternoon meetings is to have several members give brief summaries of topics which are of general interest to all of the members.

Mr. E. O. Swickard gave a brief history of the part that electricity has played in medicine. He also explained the principles of operation of the high frequency generator used to induce artificial fever in the body without the use of contacting electrodes, which may cause burns.

Mr. F. G. Doenges talked on the construction and uses of fuses.

Mr. W. V. Louthen then discussed a mechanical speed control for an induction motor. The speed control is operated by centripetal force.

A.S.C.E.

Mr. Carl B. Carpenter, formerly Superintendent of Sanitation for Bloomington, Indiana, now employed at Hammond, has resigned as contact member for the Rose chapter of the A.S. C.E. the distance to Terre Haute being too great for him to attend the meetings of the chapter. The chapter has been fortunate to obtain Mr. Fred Kellam as their new contact member. Mr. Kellam is the engineer of design for the State Highway Commission of Indiana and is also president of the Indiana Section of the American Society of Civil Engineers.

The Rose chapter held its monthly meeting Wednesday evening, February 22, in the rooms of the University Club at the Deming Hotel. Mr. Kellam was introduced, and an interesting program of talks was presented.

Mr. Yaw presented a paper on suspension bridges. The history of the development of suspension bridges was outlined, and the various stresses and deformations found in such bridges were discussed.

Professor E. A. MacLean presented a brief outline covering the steps in bridge construction. Mr. Kellam then related numerous peculiar incidents that he has encountered in the design of structures.

The chapter had as its guests Dr. B. A. Howlett and Mr. T. P. Palmer.

Photo by White

Rose Men in Blue Key (See Fraternity Notes for Details.)

Seated, left to right: Spahr, Kahn, Ladson, and Smith. Standing: Coons, Ross, Colwell, Smilanic, and Underwood.

R.O.T.C.

The following appointments have been made to date in the Rose Polytechnic Battalion:

Cadet Captain: Franklin G. Doenges, Robert W. Underwood, George W. Smith, and William A. Reddie.

Cadet 1st Lieutenant: J. Ewing Ross, Robert J. Burger, Robert N. Ladson, Victor Peterson, Edward A. Coons, and John W. Yaw.

Cadet 2nd Lieutenant: Roy E. Warren, Richard G. Weldele, Randall H. Wise, Edward O. Spahr, and W. Merritt Noel.

Technical Sergeant: Frank G. Pearce, J. Edward Taylor, and Emil G. Christiansen.

Staff Sergeant: Maurice W. Johns, Vernon E. Whitehouse, Maurice W. Cannon, Maurice C. Fleming, Robert H. Colwell, and Norman G. Eder.

Sergeant: Clarence A. Wilkinson, Allen T. Wilson, Earl O. Swickard, and James E. Ducey.

Cadet Corporal: George R. Schull, John L. Combs, John F. Kramer, Fred Wehle, Jr., H. Rolland Buell, Kenneth O. Hambrock, Hugh C. Chapman, John R. Roberts, Edward J. Klecka, John E. Bartmess, Sommers E. Blackman, Allen S. Buzard, Joseph W. Dreher, Charles A. Howlett, Quentin R. Jeffries, Vincent Kautz, Thomas F. Lane, Ross S. Pyle, and William D. Schwab.

1938-39 Basketball Lettermen

Front Row, left to right: Dreher, Smith, Captain Ladson, Forsyth, and Mehagan.
Rear: Keeler, Colwell, Bowsher, Meurer, and Manager McKee.

Sports

edited by

Robert N. Ladson, ch., '39

Rose vs. Earlham

On February 3, 1939, Earlham College came to Rose boasting a good record in the Indiana Conference and a previous win over the Engineers. Despite all this, the Rose cagers roared to a thrilling win in an overtime game by a 37-34 score.

The game opened rather slowly, but before long both teams were using a fast break to advantage. It can truthfully be said that this was one of the fastest games ever seen on a Rose floor. Rose jumped into a 4-3 lead and held a slight edge until near the end of the half when Earlham tied the score 15-15. The half ended at this time with each team having five field goals and five free throws. Meurer led the first half with eight points.

Very soon after the last half opened Rose took a three point lead which it held until near the end of the game. Just before the game ended, Earlham secured a basket and a free throw to tie the game and throw it into an overtime. In this half all the Rose players clicked nicely and defensively held their own.

Entering the overtime, Earlham, still confident of victory, scored immediately and then tried to hold the ball until the final gun. However, Rose would not be denied and Charlie Meurer, freshman flash, scored on a neat fake and dribble-in shot. The score was tied again. As both teams opened up again, Rose grabbed the ball on a fast break and a quick pass to Bowsher netted a field goal. He was fouled on the play and made the shot for a score 37-34. For the remainder of the game Rose held the ball.

This can be considered as the best game of the season as teams seldom reach the heights to which the Engineers rose on this occasion. Colwell, high scoring center, was not playing because of an injured knee and this further hindered the Rose team. Keeler, reserve center, played a very nice game, however, despite his lack of previous experience.

Meurer led the scoring with fifteen points.

Rose vs. N.C.A.G.U.

Following up its victory over Earlham, the Rose team beat the Normal College of the American Gymnastic Union by a score of 28-25. The game was played in the Rose gymnasium on February 8, 1939.

Rose jumped into an early lead and held it for about ten minutes until the long shot artists of N.C.A.G.U. began to find the range. The Rose team definitely did not show the form that was exhibited in the last game and found the basket hard to hit. The players tried hard but could not get going. As a result of the mediocre showing Rose was trailing 15-11 at the half.

As the second half opened, N.C.A.G.U. took the ball and immediately scored. This was the last time they got near the basket for several minutes as the Rose defense began to function more smoothly and the offense began to click. During this basket drive Rose accumulated enough points to tie the score at 19-19. The Engineers, once started, kept up the drive. N.C.A.G.U. kept in the running, however, and with just twenty-five seconds to go the score was 25-25. Rose scored a free throw at this point and then a field goal to put the game on ice.

Meurer again led the scoring with twelve points, and the rest of the scoring was divided.

Rose vs. Milton

On February 14, 1939, Rose began its two game itinerary against Milton College of Milton, Wisconsin. Playing a superb brand of ball, the Engineers took the measure of the Milton team, 41-32.

The game began with Rose gaining a four point lead. They did not hold it very long, however, and the Milton cagers went into the lead. Just after this light rally, Rose again began to score and took the lead, never to be headed. All members of the Rose team scored in this half, and the score stood 25-21 as the half closed.

The second half was much like the first half as far as scoring was concerned, and the outcome was never in question. Rose utilized a fast break to good advantage while Milton played a slow deliberate type of basketball. As the game neared the close, Milton initiated a rally, but Rose stopped it shortly. Rose held the ball most of the last five minutes of the game and won 41-32.

The scoring was evenly divided between Meurer, Bowsher, and Ladson. Colwell broke into the game for a short while, but he was slowed somewhat by his injured knee.

Rose vs. Joliet

Following the Milton win the Rose team traveled farther south for a return game with Joliet College. They played very good basketball for most of the game, but were lax on several occasions and Joliet emerged a winner by three points, 50-47.

As the score indicates, the game was loosely played and both teams scored rapidly. Joliet led most of the first half although Rose led 13-11 at one time. As in the other game with Joliet, Rose experienced trouble in stopping the one-hand shots at which the opposing team was so adept. Joliet led at the half, 27-21.

Rose returned to the floor with increased determination and scored two quick field goals. The whole team at this time was made up of freshmen, and they showed up very well. At one time in this half the score was tied at 35-35, but Joliet again pulled away to a seven point lead. Rose made a feeble attempt at a rally and raised its score four points but still fell short by three points. The score at the end of the game was 50-47.

Bowsher was the star of the Rose team in this game as he scored fourteen points by virtue of seven field goals.

Rose vs. Taylor

On February 17, 1939, Taylor University of Upland, Indiana, came to Rose to renew a two year fued. Having previously beaten Rose, they came expecting to win again, but the fighting Engineers thought differently. When the game was over, Rose had emerged victorious by a score of 41-25.

This game really showed the improvement that Coach Brown's men have made in the past month. Taylor was completely outclassed. Rose jumped into a six point lead as soon as the game began, but Taylor immediately scored six of its own. After Rose again began to score, it was never again headed. The scoring was pretty slow in this half as both teams showed good defensive strength, and the half closed with Rose leading, 15-13.

The second half was merely a repetition of the first, as Rose held the lead. However, the way the game looked the lead was not secure enough to warrant coasting, so the Rose team hammered away at the basket. Colwell returned to the lineup in the second half and flashed his usual form to bother the Taylor team very much. The game ended with the Rose team in front by sixteen points. The final score was 41-25.

Colwell was the big scoring gun with twelve points, but Meurer gathered eight. In this game a freshman newcomer, Mehagan, made a good showing. He is small in stature, but he fights with the best of them.

Rose vs. Shurtleff

Shurtleff College, a newcomer to the basketball schedule came to Rose on February 23 with an excellent season record of seventeen wins and two losses. It expected an easy game but Rose won 31-28 in a very well played game.

The visitors showed a very good brand of basketball in the opening minutes of the game and led for the first fifteen minutes. This lead, however, was never more than two or three points. The Shurtleff team was using a tricky double-pivot type of play and scored rather readily. Rose began to click near the end of the first half and gained a lead of 17-10. This was rather surprising considering the way Shurtleff started, and Rose was determined to hold the lead.

As the second half opened the visiting team came back with a drive to erase the first half lead, but Rose had different ideas concerning this matter. At no time in the second half did the Shurtleff team get closer than three points to the fighting Engineers. Duckels, flashy Shurtleff forward, began to hit the basket and accounted for twelve points during this half. The rest of the team, however, was closely guarded and could not score consistently. As a result of this perfectly played game Rose walked off the floor with a neat 31-28 win.

Bowsher led the scoring for Rose with ten points.

Rose vs. Concordia

For the final game of a very good season Rose traveled to Fort Wayne, Indiana, and played Concordia College of that city. As a fitting windup Rose came away with a 40-33 win.

In one of the roughtest games of the season the Concordia team, striving hard for a win, played very good basketball to hold even with the Rose team. After a fast start, the Engineers settled into a very mediocre performance and allowed Concordia several points. At the half the Rose team was trailing by a 19-18 score.

The game ended with Rose leading, 40-33.

Colwell was the high scorer for Rose with nineteen points. Thus ended a very good season.

At the conclusion of the season letters and sweaters were awarded to the following men:

Seniors: Captain Ladson, Smith, and Forsythe.

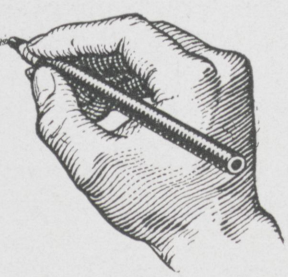
Junior: Colwell.

Sophomore: Dreher.

Freshmen: Muerer, Bowsher, Mehagan, and Keeler.

Manager McKee was also awarded a letter for his services to the team.

Fraternity Notes



Alpha Tau Omega

The Indiana Gamma Gamma chapter of Alpha Tau Omega is very proud to announce the pledging of 16 men of the class of 1942. The men who were pledged are:

Harold E. Bowsher, John Brehany, Edwin E. Gaston, Jack Kennedy, William G. Leedy, Hulit L. Madinger, John G. Mehagan, Earl F. Michaels, Harris E. Murchison, Robert D. Parr, Eugene V. Plock, James T. Rogers, John M. Rotz, Arthur J. Welsh, William E. Worley, and Sam McGurk.

On Saturday, February 4, 15 men and their dates attended the Winter Formal of the Delta Alpha chapter of Indiana University. The dance was held in the chapter house and this dance gave some of the new pledges their first opportunity of attending an A. T. O. function.

On Sunday, February 12, the entire chapter, actives and pledges, attended the Central Christian Church. The active chapter of 35 and the new pledge chapter of 16 made quite a large body of men. A week and a day later the actives and pledges enjoyed their first dinner meeting. The dinner was prepared by Mrs. Srofe, house mother, with the help of the Mother's Club. In the meeting following the dinner Ewing Ross and Frank Pearce were elected to fill two office vacancies until the coming election, which will take place sometime in April.

The first open house in honor of the new pledges was held on Saturday evening, February 11. At this open house the new combination phonograph and radio very satisfactorily proved its worth. The entertainment consisted of dancing, cards, and ping-pong. This open house was well attended, some 35 couples being present at some time during the evening. Refreshments consisted of soft drinks and cakes. The chaperones of the evening were Mr. and Mrs. John Phelps and Miss Helen Mahley and Mr. T. P. Palmer.

On Saturday evening, March 4, the state dance of A. T. O. took place in the Claypool Hotel in Indianapolis. The function was well attended, almost the entire Gamma Gamma chapter of A. T. O. being present for both the banquet and the following dance. This function takes place every year, and it is attended by the four chapters in the state—these being at I. U., Purdue, DePauw, and Rose Tech.

The chapter wishes to congratulate Bob Ladson, captain of the basketball team, for leading the team through one of the most successful seasons in many years.

Sigma Nu

The Beta Upsilon chapter of the Sigma Nu fraternity has been busy reorganizing the Mothers' Club for the chapter. Jack Wilkerson has been in charge of this job, and the first meeting was held on Sunday afternoon, February 26, 1939.

The Sigma Nu wish to congratulate the men who were pledged Sunday, February 5. The new pledges are: King Chalfant, Terre Haute; Jerome V. Lentz, Terre Haute; Edwin A. Martin, Mt. Vernon; York E. McCormick, Batavia, Illinois; Clay W. Riley, Terre Haute; Robert W. Rockwood, Terre Haute; Benjamin K. Sollars, Clinton; Norman J. Tiefel, Brazil; James Van Pelt, Shelbyville; and Dwaine L. Woolsey, Terre Haute.

The new pledges have been having pledge classes under the direction of Richard Mullins. James Van Pelt was elected pledge captain.

The new pledges were guests at the annual pledge banquet held in the fraternity house Sunday, February 5. Following the dinner formal pledge services were held.

On Saturday, February 18, the Sigma Nus held their first open house of the new semester. Plans are under way for the annual pledge dance to be held in March.

Theta Xi

Kappa chapter of the Theta Xi Fraternity takes pleasure in announcing the pledging of the following men at the close of the annual rush season: John O. Bland, Jr., Louisville, Ky.; John H. Bolton, Hamilton Ohio; F. M. Drury, Henderson, Ky.; Eugene E. Hess, Jr., Fort Wayne, Ind.; J. Gordon King, Terre Haute; Eugene R. Kipple, Terre Haute; Frederick Nahm, Jr., Bowling Green, Ky.; John H. Taylor, Buffalo, N. Y.; and A. John Ullrich, Jr., Indianapolis, Ind.

On February 2 the new pledges were the guests of the active chapter at a theater party at the Indiana Theater in pursuance of an annual custom.

The pledge dance was held in the

Rose Gym on Saturday, February 18, with Warren Henderson and his orchestra furnishing the music. Thirty couples were present, including several of our alumni. The chaperones were Mr. and Mrs. Henry C. Gray and Professor MacLean and Miss Mahley.

The chapter is pleased to announce the initiation of Robert A. Young, of Indianapolis, Ind., as a part of the regular active meeting on Monday, February 27.

As previously announced, the chapter has planned a long range program of social events to finish the school year. Committees have been appointed for an open house to be held March 10 and a spring formal which will be held at a later date.

At the regular meeting on February 13 an election of officers for the spring term was held. The new officers are: President, Walter T. Zehnder; Recording Secretary, Ivan C. Frakes; Treasurer, Raymond C. Hogan; House Manager, George C. Harper; and Assistant House Manager, Edward J. Klecka.

Blue Key

The Rose Polytechnic Institute chapter of Blue Key National Honor Fraternity has recently been accorded the highest honor that any chapter can receive.

At the biennial convention held in Indianapolis, Dr. John Clark Jordan, national president of Blue Key, made the announcement. The Rose chapter was voted by the National Executive Council to be the best chapter in the United States. The basis for the award was service to school and community, co-operation with the national officers, variety of activities of members, and method of selection of new members.

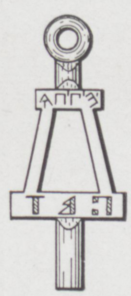
This is, indeed, an honor to the present members of Blue Key, but a great deal of the credit goes to the charter members as well as all members who have been a part of the development here at Rose. The full significance of the award cannot be realized without taking cognizance of the fact that Rose is one of the smallest schools having a Blue Key chapter.

Dr. Prentice is the faculty ad-

visor for Blue Key. The members are Robert Ladson, president; Robert Kahn, vice-president; Edward Spahr, secretary-treasurer; George Smith, corresponding secretary; Ewing Ross, Edward Coons, Robert Underwood, Robert Colwell, and Nicholas Smilanic.

Blue Key is staging a ping-pong tournament at the present time and is sponsoring a dance on April 1, 1939, the proceeds of which will be used to maintain the recreation room.

Tau Beta Pi



Tau Beta Pi held its second semester meeting on February 22, for the election of eligible members from the Junior and Senior classes. To be eligible for membership, a senior must rank in the upper quarter of his class, and a junior in the upper eighth of his class. High scholarship, however, does not insure election to Tau Beta Pi. Quality of character, breadth of interests, and activity in student organizations are important factors.

The students elected were Gaylord Barrick from the Senior Class, and Nick Smilanic and Allen Wilson from the Junior Class. The initiation and banquet will be held in March.

Plans for the annual Tau Beta Pi dance are under way. The dance will probably be held April 29.

Here and There With the Grads

edited by
Nick Smilanic, e., '40

Rose Alumni Active in National Meeting

The Technical Association of the Pulp and Paper Industry, an organization of engineers engaged in the production of pulp and paper, held its annual meeting in New York City February 20 to 23.

At the meeting two papers were presented to the Association, one by Melburn Heinig and one by J. Rex Adams. Both men were graduated from the department of chemical engineering at Rose Polytechnic Institute in the class of 1928. Mr. Heinig, who won the Heminway medal in his class, is junior chemist for the United States Forest products Laboratory in Madison, Wisconsin. Mr. Adams is chief chemist of the Old Colony Envelope Company of Westfield, Massachusetts.

At the meeting each year the TAPPI medal, named after the initials of the association, is awarded to an outstanding member of the industry for "achievements which definitely contribute to the technical progress of the pulp and paper industry." The honors at this meeting were conferred upon J. Newell Stephenson of Gradenvale, Quebec, Canada. Mr. Stephenson graduated from the Massachusetts Institute of Technology in 1909 and then continued his studies at Rose, where he obtained the master of science degree in chemical engineering in 1911.

At present he is the editor of the magazine *Pulp and Paper of Canada.* He is also principal of the Institute of Industrial Arts.

Civic Honors for Rose Alumnus

James T. Jones, '32, of Joplin, Missouri, received a unique honor recently, one which marks unusual participation in the life of his community and recognition of activities generally associated with older men. The Junior Chamber of Commerce presented to Mr. Jones its distinguished service award which is given to "the most outstanding civic worker in the city". In the citation made at the presentation of the golden key to the city, he was recognized for his excellent work in the Junior Chamber of Commerce, of which he had been president, in the Joplin Association for the Blind, in the Red Cross and Community Chest drives, and in other civic organizations.

Mr. Jones is manager of the E. J. Jones Ice Plant of Crane, Missouri, and Engineer for the Empire District Electric Company of Joplin. He was graduated with honors from the electrical engineering course at Rose. Mr. Jones, who made his home in Terre Haute until six years ago, is also a graduate of Garfield high school. Following his graduation from Rose, he was employed for some time at the Commercial Solvents Company. Upon the death of his father Mr. Jones went to Crane, Missouri, to take over the active management of his father's business, the E. J. Jones Ice Plant.

Rose Men Represented at American Engineering Council

The Nineteenth Annual Assembly of the American Engineering Council was held at the Mayflower Hotel in Washington, D. C., from January 12 to 14, 1939. At this annual conclave of engineers a series of interprofessional discussion forums were conducted by the Public Affairs Committee of the American Engineering Council. Each subject was under the direction of one of the several committees of the council.

Alonzo J. Hammond, Rose, '89, Chairman of the Public Works Committee of the American Engineering Council, led the discussion on "Engineering Aspects of Governmental Organization" and "National Planning and The Engineer's' Relation To It." Mr. Hammond, who was the Heminway medal man of his class, is now a consulting engineer in Chicago. He is also a Vice President of the American Engineering Council.

Ralph E. Flanders, Eng.D., Rose, '35, Vice President of the American Engineering Council and Chairman of the Engineering-Economics Committee and H. N. Davis, Eng.D., Rose, '38, participated in the discussion on "Engineering and Economic Factors in The Size of Business." Mr. Flanders is president of the Jones and Lamson Machine Company of Springfield, Vermont. Doctor H. N. Davis is president of Stevens Institute of Technology in Hoboken, New Jersey.

Obituary

Robert J. Schefferly, president of the Quality Foundry & Manufacturing Company, died at his home in Los Angeles on January 2 after a short illness. Mr. Schefferly had been in business in Los Angeles for 20 years. He was born in Mount Clements, Michigan, in 1879. He was an alumnus of Detroit College and was graduated from Rose Polytechnic Institute in 1903. Surviving Mr. Schefferly are his widow, Mrs. Eva Schefferly; a daughter, Mrs. Lindsay H. Sneddon; and a grandson, Richard E. Sneddon.

Births

Mr. and Mrs. Arthur F. Wood announce the birth of a son, William Robert. The baby was born January 15, 1939. Mr. Wood is a Rose graduate of '36, and is now employed by the Link Belt Company in Indianapolis.

What They're Doing

'22 Kenneth L. DeBlois is a structural engineer with the U. S. Corps at Pittsburgh, Pa.

'23 D. L. Mewhinney is a distributor for the Bryant Heater Company in Mount Vernon, New York.

'28 William P. Leake is plant superintendent for the Louisville Cement Corporation at Milltown, Indiana.

'31 Harold Kehoe has a position with the Highway Department of the District of Columbia. He is also attending classes at Georgetown University.

'32 John V. Niemi has taken a position as instructor in electrical maintenance at the Mechanic Arts High School in Evansville, Indiana.

'33 John C. Dalrymple has a position in the Department of Agriculture, Bureau of Engineering, Washington, D. C.

Franklin W. Crawford has a position with the Govro-Nelson Company in Detroit.

Glen T. Lautenschlager is a junior electrical engineer in the Engineering Power and Operating Department of the Indiana Public Service Company at Indianapolis.

'34 Edward N. Ketchum, with the United States Fidelity and Guaranty Company, has been transferred to Denver.

'37 Stephen Koos, with Joseph E. Seagram's and Sons Company, has been transferred to Baltimore.

Hubert Wittenberg, with RCA Radiotron Company, is taking advanced courses at Stevens Institute of Technology.

'38 Robert E. Pearce has taken a position with the Citizen's Telephone Company in Terre Haute.

Merton B. Scharenberg, with the American Can Company, has been transferred to New York City.

Cracked Gas

edited by
John E. Bartmess, m., '41

Saint Pat Says—

Pity the modern girl. Everything that she wants to do is either illegal, immoral, or fattening.

The chief cause of divorce is marriage——.

Even his best friends wouldn't tell him—so he flunked the exam.

Yes, and sometimes the guy that calls himself a big shot at college sends home some mighty weak reports.

A girl is half witted to wear a
dress knitted,
If she happens to be not designed
With curves of perfection
In either direction—
What I mean is before and behind.
No, some are not fitted to wear a
dress knitted;
It clings, and the critical mind
Accepts no acquittal
For too much or too little—
Especially before, or behind.

School days, school days,
Dear old golden rule days,
She was my girl in calico,
I was her bashful barefoot beau,
And I wrote on her slate,
Keep out of the sun, babe, every-
body's looking through your
dress.

—Nebraska Blue Print

Early this fall Ollie was commander of the Z Co. and somehow or other it had gotten off the parade grounds and was approaching the cliff above the rifle range. Poor Ollie seemed to be at a loss for words when Captain Hawkins bellowed: "For God's sake, Spahr, say something, even if it's only good-bye."

"Who ever told that guy he was a prof. He might know it, but be darned if he can teach it. The trouble is that he is too far advanced. Every time he tries to explain something he gets so far off the subject that no one understands anything about it. He oughta go back to the farm, or try teaching a more advanced course. . . .

"Yeah,—I flunked it too."

—How true

First Engineer: "What kind of a dress did Betty wear to the party last night?"

Second Ditto: "I don't know, but I think it was checked."

First Ditto: "Wow! What a party."

—North Dakota Engineer

Excited little boy in washroom of a transport plane: "Gee, Mummy—you can see in here better'n you can see out the windows."

He: "I suppose you dance."

She: "Oh yes, I love to."

He: "Great, that's better than dancing."

—Thanks, Penn State Engineer

Mary Ann: "Don't you love driving?"

Harold: "Yes, but wait until we get out of town."

Teacher: "Who gave us this beautiful school?"

Pupil: "President Roosevelt!"

Teacher: "Who keeps the roads so nice?"

Pupil: "President Roosevelt!"

Teacher: "Who makes the trees and flowers grow?"

Pupil: "God."

Voice from rear: "Throw out that damn Republican!"

Sign in library:

"Only low talk permitted here."

"That is me all over," said Ross as he dropped the TNT.

Co-ed: "I think kissing is childish."

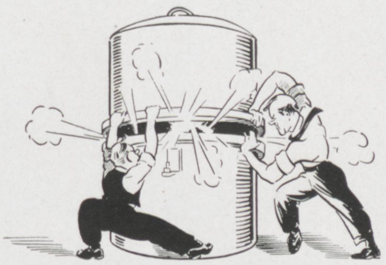
Guy: "So do I, baby."

A British writer says the Americans use poor English. Some of the Scotch they use is none too hot, either.

Many of our engineers are spending a lot of time tinkering with the Misses in their motors.

When the little gal next door asked if she would have a mustache on her lip like her daddy when she grew up, us didn't say. "Very often, dear, I expect."

G-E Campus News



A BIG SQUEEZE

IT TAKES a lot of squeeze to put a 1,000,000-volt x-ray equipment in a container only four feet in diameter and seven feet long, especially when its less-powerful predecessors required a special building 62 feet long, 32 feet wide, and 36 feet high. But recently, G-E scientists applied the necessary squeeze and completed some surprisingly compact x-ray equipment.

Such squeezing naturally involves a few innovations in design. So innovations were introduced. The 11-section x-ray tube was put inside the novel transformer, in the space normally taken by an iron core. Gas having an impressive-sounding name, dichlorodifluoromethane, was used instead of oil as an insulating medium, 100 pounds of this gas doing the work of six tons of conventional oil.

Then the equipment was mounted in the grounded metal container, thereby enclosing the 1,000,000-volt circuit and eliminating the hazard of electric shock. Looking at the apparatus, you note a striking absence of moving parts, for the control of the apparatus is essentially electrical.

The first of the new units will be installed this spring in Memorial Hospital, New York City, providing medical science with another powerful weapon in its constant war on disease.

LIGHTS! ACTION! CAMERA!

IN A specially constructed room alongside the studios of the G-E international short-wave stations, the familiar words, "Lights! Action! Camera!" will soon be heard. For General Electric's new television station at Schenectady is nearing completion.

The television transmitter, perched atop the Helderberg Hills 12 miles outside the city, will be at least 250 feet higher than the station in the tower of the Empire State building, New York. And, broadcasting with 10,000 watts, it will be the most powerful television station in the United States.

There will be—literally—no strings to the transmitter. C. A. Priest, Maine '22 and an ex-Test man, Engineer of the Radio Transmitter Engineering Department of General Electric, has announced that an ultra-short-wave transmitter will be used instead of the usual cable to relay the images from the Schenectady studios to the main transmitter in the Helderbergs.

THE "HOUSE OF MAGIC" BECOMES TWINS

THE world-famous G-E "House of Magic" show has become twins. It had to, for it was placed in the predicament of having to be in two places at one time—the New York and the San Francisco Fairs.

One twin—directed by R. L. Smallman, Calif. Tech '33 and ex-Test man—is already holding court on San Francisco's Treasure Island, site of the Pageant of the Pacific. The other makes its bow April 30, opening day of the New York World's Fair. Its director is W. A. Gluesing, Wisconsin '23, also an ex-Test man.

The thousands of visitors to these Fairs will see such feats of modern magic as a voice-controlled toy train, a magic carpet, zigzagging pictures of sound. They will see the stroboscope, which makes it possible to see the spokes of a whirling wheel just as if the wheel were motionless. They will see a light beam sawed by the teeth of a comb.

However, entertaining as these demonstrations are, they represent far more than mere tricks of modern magic. They symbolize the work in pure science that is constantly taking place in G-E research laboratories—work which is the basis of General Electric's contributions to the world of the future.

GENERAL ELECTRIC

90-126C


THE
RIGHT COMBINATION
FOR MORE
SMOKING
PLEASURE
Chesterfield
CIGARETTES
Chesterfield
THE BLEND THAT CAN'T BE COPIED
THE RIGHT COMBINATION OF THE WORLD'S BEST CIGARETTE TOBACCOS