Winter 1-1909

# Volume 18 - Issue 4 - January, 1909

Rose Technic Staff
*Rose-Hulman Institute of Technology*

Vol. XVIII JANUARY, 1909 No. 4

# THE ROSE TECHNIC

# THE ROSE TECHNIC

Vol. XVIII | Terre Haute, Ind., January, 1909 | No. 4

## THE TECHNIC



TERMS

One Year, $1.00 — Single Copy, 15 cents

*Issued Monthly at the Rose Polytechnic Institute*

Entered at the Post-Office, Terre Haute, Indiana, as second-class mail matter.

At a meeting of the Louisville Tech Club, held on December 29, there were present, besides some twenty regular members, a half dozen undergraduates of Rose, and these men bring in a very favorable report of the club's work. At this meeting a paper was presented by Goodman, '07, on food adulteration. Goodman, who is assistant city chemist of Louisville, gave facts and figures of such value and interest along the lines of milk, butter, and water impurities that a staff member cornered him immediately at the close of the talk and demanded a copy of the paper for The Technic.

This Alumni club gathers in the engineers' and architects' club rooms once a month, bringing in any stray Polys that happen to be in town, and listens to a paper by some member. The paper is followed by a general informal discussion, in which all may present their views on the question of the evening—or on any other that is more urgent. In this way there is kept alive a feeling of interest in old Rose, that is of first importance to the welfare of the institution.

We believe that to this club is due no little credit for the fact that Rose is so extensively known among the three hundred thousand inhabitants of Louisville. There are now sixteen students registered at Rose from this city, and we may expect more in the years to come if this club keeps alive its present spirit.

We do not know just what all the Alumni associations are doing (let's have a letter from you occasionally), but we do know that if they all had the enthusiasm of the one mentioned, R. P. I. would be benefited in many ways; perhaps most especially in receiving the better appreciation of the commercial world.

* * * *

### THOMAS GRAY.

Thomas Gray, Professor of Mechanical Engineering, died on December 19th at his home in Terre Haute. He had been in poor health for some time, but refused to leave his work until a few weeks before the end. It is hardly necessary to say here that this loss comes as a severe blow

to Rose Polytechnic Institute; those who studied under his leadership will feel that they have lost a personal friend, and those of us not so far advanced are still greater losers.

Dr. Gray was one of the foremost scientists in his line in the world. He was a fellow of the Royal Society of Edinburgh, member of the American Society of Mechanical Engineers, a fellow of the American Association for the Advancement of Science, and held the offices of secretary and vice-president of the last-named organization in 1890 and 1891.

He was a brilliant student in Glasgow University, and later took special work under Lord Kelvin. After completing his studies he accepted a position under the Japanese Government in the electrical engineering department of the Imperial University at Tokio. In 1882 he became chief assistant to Lord Kelvin in the work of supervising the manufacture and laying of the system of Atlantic cables. He remained in the service of Lord Kelvin until 1888, when he came to America. Professor Gray is the author of several scientific works, and invented a number of the devices now used in seismological research.

Thomas Gray.

The Board of Managers held a special meeting and adopted the following resolutions:

"In the death of Professor Gray the Rose Polytechnic Institute loses a man of great professional attainments, an enthusiastic and inspiring teacher, a helpful friend and adviser of every earnest student, and so thorough a believer in the Institute and all it stands for, and so wise a leader in the achievement of those purposes, that the successful development of the Institute since his connection with it is largely due to him.

"As a member of the Faculty he gained and held the respect of his associates not only by his fine character, but also by the solidity and wide range of his knowledge, which fairly placed him in the forefront of his profession. He won world-wide recognition as an authority on dynamic and electric engineering by his original investigations and writings. None realize the loss sustained by his death so keenly as those who, during the years of his and their connection with the

Institute, enjoyed the large privilege of his inspiring instruction.

"The present student body, as was the case with their predecessors, found in him a man of large attainments, whose supreme delight it was to impart to them from his own great store a full measure of knowledge of the science concerning which he spoke as one having authority.

"Professor Gray was more than a teacher and investigator of dynamic and electric engineering, gifted as he was in those branches of human knowledge. He was a good citizen, interested in everything of a helpful nature, a believer in civic righteousness, and in all the relations of life a man who stood four-square to the world.

"The heaviest blow is, necessarily, to his bereaved family, whose members sustain in his death a loss that is measureless. This board realizes with sincere sorrow the loss they and it have sustained. To both there is such consolation as comes from the common knowledge that both were sharers of his assiduous care, that he gave to both of his splendid talents without stint, and that they are both joint heirs of his fame as a scientist, as both were beneficiaries of his labor and his love.

"The 1896 *Modulus* contained a brief but appreciative sketch of Dr. Gray's life and work, which this board incorporates in this tribute, and directs to be spread upon its records.

"*Resolved,* That, as a mark of respect on the part of the Institute he served so long, so ably and faithfully, the board sends an appropriate floral emblem for the casket and attend the funeral officially in a body."

Although the president and vice-president of the Student Council were out of town, the remaining members met, made N. A. Bowers, '10, chairman *pro tem.*, appointed a committee to purchase a floral tribute, and drew up the following resolutions:

"WHEREAS, It has pleased Almighty God to remove from us by death Professor Thomas Gray; and,

"WHEREAS, It is fitting that we should give some expression of our sorrow, and that we should pay a last tribute of respect; therefore, be it

"*Resolved,* That we, the members of the Student Council of the Rose Polytechnic Institute, acting in behalf of the student body, do hereby tender our sincere sympathy to the remaining members of the bereaved family, and join with them in grief over our common loss; also, be it further

"*Resolved,* That a copy of these resolutions be sent to that family, a copy to the public press, and a copy to the ROSE TECHNIC."

The Faculty of the school adopted the following resolutions:

"*Resolved,* Having lost by death our honored colleague, Dr. Thomas Gray, the Faculty of the Rose Polytechnic Institute desires to express in his memory the affection and regard in which he has been held by them as a man, an educator, and an investigator.

"In the field of his activities he stood in the first rank, and his loss to the Institute is a wound from which it will not quickly recover.

"He has been an inspiration to all who have come under his influence, and the effect of his influence will be felt wherever the men of Rose are found.

"In the midst of our sorrow we do not forget his bereaved family, and our deepest sympathy goes out to them in this hour of their affliction. It has been ordered that a copy of this resolution be sent them, and that it also be preserved on the records of the Institute."

The Senior Class met and appointed a committee, which selected a floral design and adopted the following resolutions:

"WHEREAS, God, in his infinite wisdom, has taken from us our professor and friend, Dr. Thomas Gray; and,

"WHEREAS, The members of the Senior Class are the only students at present in school who have been under Dr. Gray's personal instruction, and have hence become especially attached to him; therefore, be it

"*Resolved,* That the Senior Class hereby expresses its sincere sorrow for this loss, and extends its heartfelt sympathy to the bereaved family; be it further

"*Resolved,* That a copy of these resolutions be sent to the family and a copy be published in THE ROSE TECHNIC."

The funeral services were held at the residence, and were conducted by the Rev. J. E. Sulger, of St. Stephen's Church. Although the Institute had closed for the holidays two days before, over eighty students attended in a body. The honorary pallbearers were the members of the Board of Managers and the Faculty. Active pallbearers were Pritchard, Curry, Brannon, and Tyler, of '09, and Bareuther and Bowers, of '10.

# AN ENGINEER OF THE RENAISSANCE

By Prof. John B. Peddle.

We are so accustomed to thinking of the science of mechanics as being the development of the last hundred and fifty years or so that we are apt to unduly belittle the attainments of engineers of an earlier period. There is a tendency to assume that their acquaintance with mechanical principles was of the most elementary nature, and that such work as they did was mainly, if not entirely, a matter of rule of thumb. A little reflection concerning the many fine buildings, churches, bridges, etc., which they left should show us that they must have had some better guide than mere thumb rules in making their plans, and it is probable, also, that they had many pieces of apparatus, of which there is no record now, to lighten the labor of construction.

There was, of course, no general knowledge of engineering matters in those days, such knowledge as there was being pretty closely confined to the few masters in the various branches, and, unfortunately, the records of their work have largely perished. It is only here and there that we can find any definite statement of what they did or of their methods.

One of the most remarkable of a group of men who flourished during the fifteenth and sixteenth centuries was Leonardo da Vinci. His popular fame rests almost entirely on his painting, and it is a matter of surprise to most persons to know that he excelled in any other work. As a matter of fact, painting was only one of many different forms of activity in which his genius showed itself. He was, besides, an architect, sculptor, anatomist, botanist, zoölogist, geographer, mechanician, engineer, mathematician, and musician, and the historical records left of him seem to indicate that he stood in the first rank among his contemporaries in all of these subjects.

He seems to have taken an especial pride in his engineering ability, and it is with this phase of his genius that this paper is concerned. In it I wish to give a hasty account of a few of his achievements and inventions.

He recognized the importance of the notebook, and has left an account of his investigations and ideas in a bulky manuscript known as the Codice Atlantico, or Atlantic Code, so named, I believe, from its great size.

Recently the publication of this manuscript has been undertaken, and, while a considerable portion has appeared, I believe it is not yet complete. A résumé of some of the earlier parts of this work appeared in 1906 in the Zeitschrift des Vereines Deutscher Ingenieure, and it is from this source that I have drawn the material for my article.

The account given there is necessarily brief, and it is not always clear whether the descriptions refer to actual machines or are merely his ideas of them. We all of us recognize the vast difference which may exist between the conception of a machine in the inventor's brain and its reduction to practice. Doubtless some of the descriptions found here belong to the first category. Contemporary accounts, nevertheless, agree in crediting him with many practical inventions, and it is said that he was commonly looked upon as a wizard on account of the remarkable results he was able to accomplish without human agency.

He made experiments to determine the laws of friction, and gave the coefficient a general value of one-fourth, though he states that it is different for lubricated surfaces. Considering that the materials he worked with were mainly wood on wood, stone, iron, etc., his results were probably near enough. His experiments lead to the conclusion that friction was independent of the size of the rubbing surfaces. He also investigated the effects of friction in the case of the inclined plane, and thus arrived at a conception of the friction angle. The friction of journal bearings was also studied, and he correctly determines the forces necessary to overcome it when these forces are part of the load. He distinguished four kinds of friction: fluids on fluids, solids on solids, fluids on solids, and the rolling friction of wheels on the earth.

He investigated the strengths of beams and columns by methods based largely on experiment, and while his conclusions are faulty at times, they show in the main that he had some understanding of the nature of the problem. When we know that the first printed book on Algebra, "partly in Latin verse," appeared in 1494, we can understand some of the difficulties under which he must have labored even if he had access to the book, and the marvel is, not that he made mistakes, but that he did not make more.

He states, among other things, that the strengths of beams and columns vary directly with their lengths, and that the loads applied at the middle of various beams of the same section to give the same deflection are inversely as the cubes of the lengths of the beams. He also investigated the effect of changing the position and amount of the load to produce the same deflection, and boasts: "I need only see the load which you hang at the middle of a beam in order to cause a certain deflection, and then you may touch the beam where you will and I will tell you what load must be placed there to produce a like deflection."

In the case of beams fixed at one end and loaded at the other, he decides that the deflection of the loaded end is proportional to the load, and that for beams of different lengths the loads necessary to produce the same deflection are inversely proportional to the cubes of the lengths.

Considering forces acting on levers, he states that two forces will be in equilibrium when they are inversely proportional to the perpendiculars dropped from the center of rotation to the imaginary lines of action of the forces, irrespective of the actual position of the lever arm or crank.

In the line of mathematical instruments, he invented the proportional dividers and an instrument for drawing the parabola. He also describes instruments for leveling and measuring heights, the latter being a sort of inclinometer.

When we come to mechanisms, we find a considerable number of elementary forms described. The worm gear is among them, also gears with roller and pin teeth. One of the latter is shown attached to a flexible shaft, apparently made in the form of a helical spring.

Cranks and cranked shafts figure frequently, of course, in his sketches, and there is also a ratchet device for transforming reciprocating into rotary motion, not greatly different from the one so frequently invented nowadays by men who want to "do away with the inefficient crank."

The lazy tongs is described and its property of multiplying motion referred to.

The right-and-left-hand screw figures in many mechanisms, among them a movement for the wings of a flying machine. In this, by the way, he attempts to imitate the bird, whose wings, he observes, are concaved on the down stroke. He does this by an ingenious arrangement of cords and pulleys, which accomplishes the result automatically.

The gimbals for preserving the horizontal position of the mariner's compass is described. This is essentially the same as the universal coupling, whose invention is generally ascribed to Cardanus at a later period.

In horology he describes a peculiar but practical form of escapement.

The anti-friction rolls, identical with those

used to-day for mounting grindstones, are illustrated in connection with carriage wheels. A somewhat similar arrangement on a large scale is shown for hanging large bells.

Under the heading of motors, Leonardo discusses the proper position of the man in a treadmill, saying that he should not stand inside the wheel near the bottom, as was customary, but on the outside on a horizontal plane through the center, where his leverage is much increased.

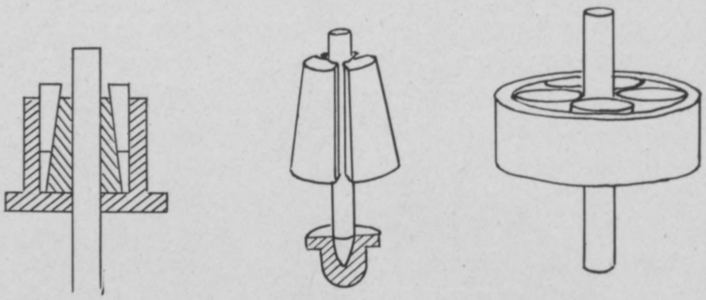


*Fig. 1—Vertical shaft bearings for grinding machine.*

He criticises the ordinary type of overshot water wheel, saying that it spills more than half its water before it reaches the lowest part of the wheel, and shows a scheme of his own, consisting of a wheel with pivoted buckets which remain vertical till they are tripped at the lowest point.

In the way of machine tools, he describes devices for cutting screw threads and tapping nuts. Various rolling mills for sheet gold are shown, with devices for regulating the pressure between the rolls. Turning lathes appear, in some variety, as regards driving mechanism.

He appears to have paid considerable attention to grinding mirrors. The mirrors were usually mounted on a vertical shaft for grinding, and he recognizes the fact that the side pull of the driving belt tends to wear the bearings and cause inaccurate work. He attempts to minimize this as far as possible by a correct arrangement of the belt, and recommends a glass step bearing. For the journal bearing he sketches a three-part conical bush, adjusted by wedges. A roller bearing is also shown for the same place. For grinding concave mirrors he has an ingenious traversing arm to carry the grinding material in the arc of a circle, the arm being actuated by the same mechanism which rotates the mirror.

One machine for plane mirrors has the grinding disk attached to a spur gear, which engages with an internal gear in such a way as to give the disk a combined motion of rotation and translation over the surface of the mirror.

Several varieties of sawmills are illustrated, one for wood having the saw attached to a frame which reciprocates vertically, and is driven by water power. The table on which the timber rests is also power driven. While crude in appearance, it has a practical look.

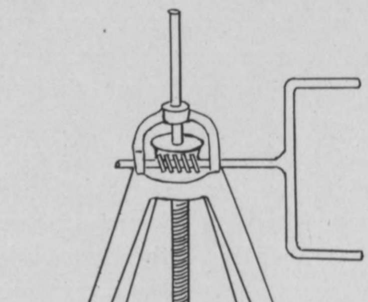


*Fig. 2—Worm-driven screw jack.*

A mill for sawing stone is also shown, and I have heard that mills, in all essentials identical

with those designed by Leonardo, are in use to this day in the Carrara quarries.

Hoisting tackle and machinery in great variety appear among the sketches, and include winches, elevators, cranes, and jacks. In some instances the simple machines bear a startling resemblance to modern apparatus for the same purpose.

A pile driver is shown, with details of the various parts, among the most interesting being the device by which the trip is automatically released from the rope at the top of the stroke. See Fig. 3.

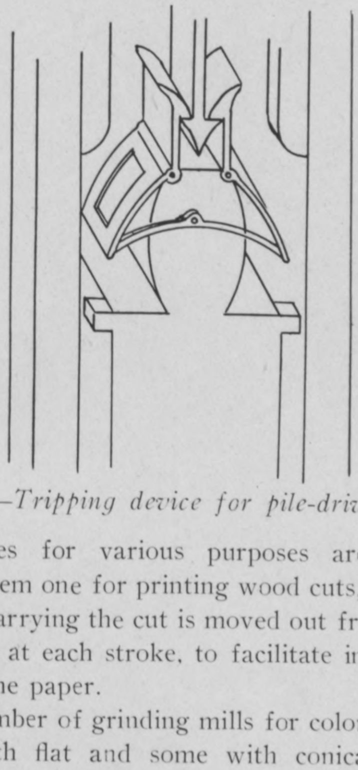


*Fig. 3—Tripping device for pile-driver trip.*

Presses for various purposes are shown, among them one for printing wood cuts, in which the bed carrying the cut is moved out from under the press at each stroke, to facilitate inking and placing the paper.

A number of grinding mills for colors appear, some with flat and some with conical stones, similar to our modern crushers.

He seems to have paid considerable attention to textile machinery, and shows a number of hand and power machines for spinning, and weaving, and shearing cloth.

In this connection a machine for grinding sewing needles is shown. He evidently calculates doing business with it on a modern scale, for he reckons his profits as follows:

"A hundred times an hour, each time 400 needles, makes 40,000 needles per hour, and in twelve hours 480,000. But if we call it 4,000,000 [corresponding to ten machines], this, at 5 soldi

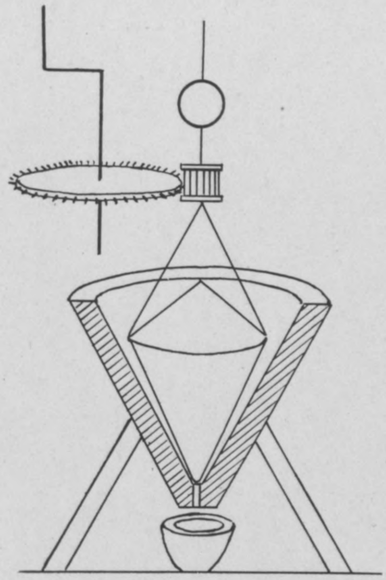


*Fig. 4—Color-grinding mill.*

per 1,000, gives 20,000 soldi, or 1,000 lire per day. If we work twenty days in the month, it amounts to 60,000 ducats a year."

In hydraulics and pneumatics he describes various devices for striking the hour in big clocks, but lack of space prevents more than an allusion to them here. Water-raising devices, including the chain pump, plunger pump, and a sort of

*Fig. 5—Treadmill blower.*

water-lifting wheel, are shown. The latter consists of an undershot wheel containing a number of interior passages shaped to the Archimedean spiral. The water is scooped up in these and lifted to the level of the wheel center.

Blowers and ventilators are shown, some of them with the bellows or other blowing machinery inclosed in a treadmill.

Considerable space is devoted to machinery for cutting canals, and a number of shrewd observations are made as to the methods of securing the greatest economy of time and labor.

He sketches a number of arrangements for pillar and other cranes for lifting the dirt and depositing it on the spoil bank. The motive power for the cranes is obtained by driving oxen up an inclined plane and onto a platform connected by ropes and pulleys to the dirt bucket. As the platform descends by the weight of the ox, the load is lifted and swung into position for dumping. In connection with one of his sketches he shows the inclined plane for the ox replaced by a kind of spiral stairway, so that when the animal steps off the platform on the down trip it will be at the beginning of the incline, instead of having to walk back to it. Leonardo observes: "This stairway is better than the straight one, for when the rise is 4 ells the length on the ground must be 10 and the ascent 14, making 24 in all. The spiral stairs are only the 14. If, therefore, an ox goes up 1,000 times [should be 400 times] a day, he saves 4,000 ells, *i. e.,* one and one-third miles."

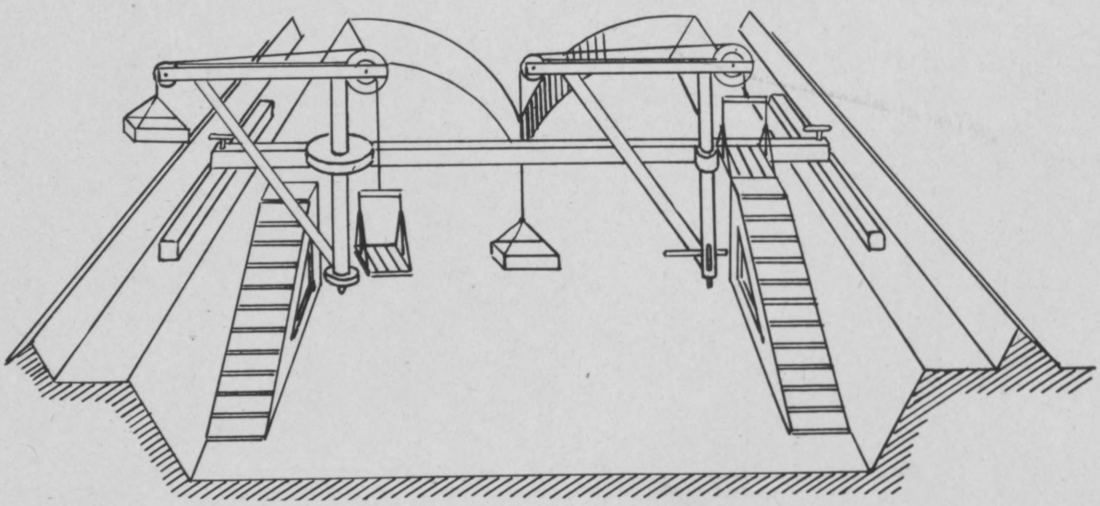


*Fig. 6—Canal-cutting machinery.*

Self-dumping buckets are shown for some cases.

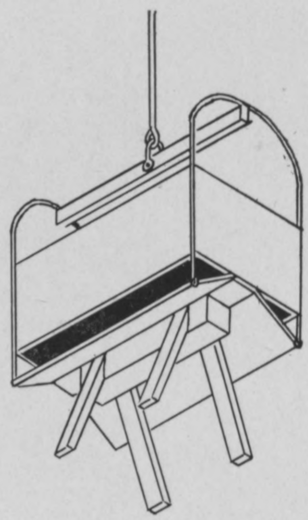


*Fig. 7—Dumping bucket.*

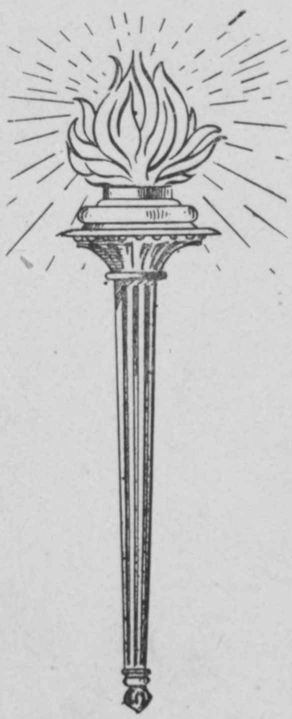
Swinging drawbridges of various designs receive considerable attention.

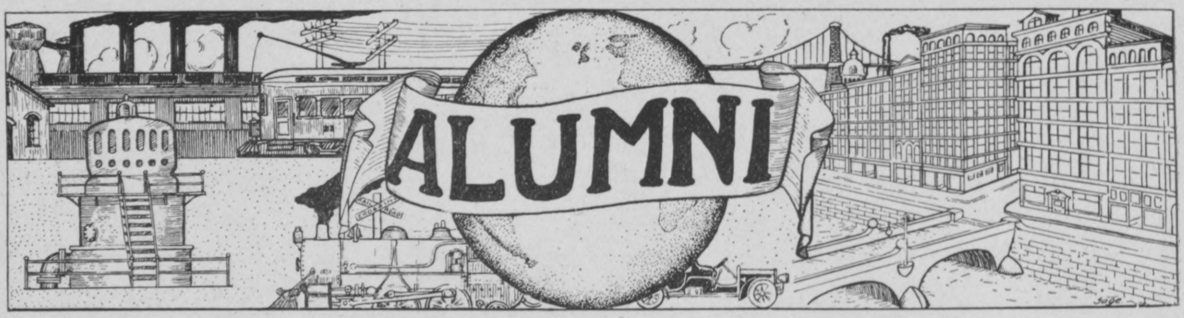
Paddle-wheel boats are much in evidence. In some cases the paddles are driven directly by a simple crank, and in others through a somewhat complicated system of spur and bevel gears.

Leonardo had to have his "shy" at the perpetual-motion problem, and he shows several familiar solutions in which weights are caused to drive a wheel by acting at a large radius on the downward movement and at a short one on the upward.

In looking over this hasty record, which does not pretend to be more than a bare outline of some of his more interesting work, one can hardly fail to be struck by the evident genius of the man. Mistakes and crudities appear, of course, but must be looked upon as inevitable with the limited knowledge and lack of precedent which were offered by the science of the period.

His greatness should not be measured by a comparison with engineering feats which are a commonplace to-day, but by the difficulties he had to overcome and the resourcefulness he showed in doing this. And especially should the quantity of work he accomplished be reckoned in. How he found time to make himself a master of so many branches of learning and craftsmanship and to do so much in each is a question which is only partly answered by referring to his genius.






# NOTES ON LAND SURVEYING IN HAWAII

By Carl B. Andrews, '08.

The writer's excuse for considering the subject of land surveying, which is usually half despised by the college undergraduate, in connection with an article for The Technic, is, that his recent practical experience has been along this line.

Hawaii, as a sub-tropical land, is probably similar in many topographical features to other lands of volcanic origin in the tropics, and experience obtained here should serve well in other countries of similar climate.

Topographical surveys over extended areas which have either been cleared of tropical forest, which is the case with much sugar-growing land here, or on which there is no natural forest growth, as in poorly-watered localities, which yet afford good grazing land, are best made by stadia traverses and sideshots, depending on an accurate network of triangles as a support. The mountainous character of the Hawaiian group of islands gives exceptional opportunities for the location of triangulation stations at commanding points. Comparatively level land is the exception rather than the rule, and many volcanic hills, tufa cones near the seashore, and lateral cones on the slopes of the high mountains, afford prominent stations from which the view extends for many miles, and which are easily located from other stations. The more prominent points have been occupied as triangulation stations of the Hawaiian Government Survey, and sometimes a line between two stations of the government secondary triangulation may be used as a base on which to construct a new system of triangles for the work in hand.

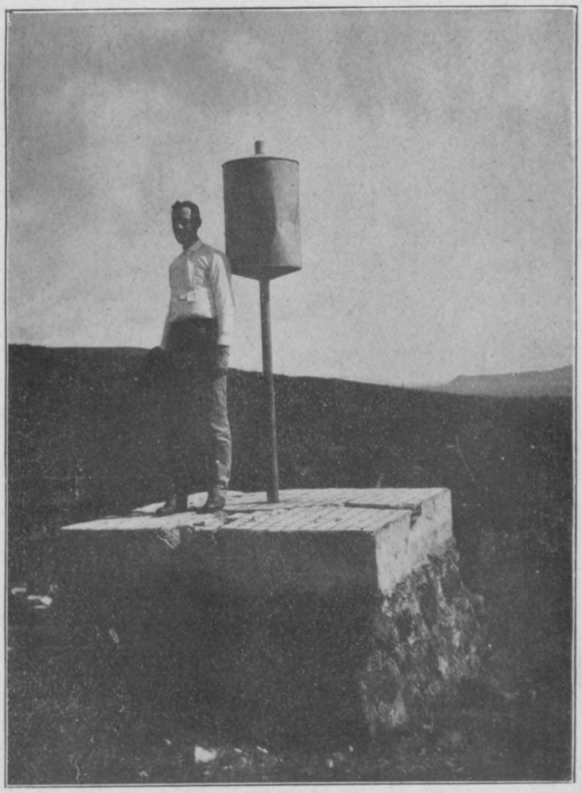
The air of the mid-Pacific is very clear. With a telescope magnifying twenty-four diameters, the targets of the government triangulation stations, which are galvanized-iron drums eighteen inches in diameter, can be readily found and seen up to a distance of ten miles, and in stadia work the conditions of open country and clear air permit of readings of distance up to two thousand feet with an error within five feet. In some localities, such as are occupied by the sugar plantations in the Hilo district of Hawaii, where the sky is generally clouded and there is little wind, long stadia traverses can be made to close with a surprisingly small error. Because of the slope of the ground,

the vertical angle must be read constantly, and in sights to the bottoms of gullies this angle may be as high as 30°.*

In the rainy districts of the islands, particularly the northwest coast of Hawaii, where daily showers are the rule, it is a good plan to carry a waterproof slicker into the field, and where the wind will permit, an umbrella, which may be erected over the transit, is a great convenience, as it allows the work to proceed as long as the rodman can stand the rain, without damage to the instrument.

A transit for use in a seacoast country should have all graduations on solid silver. Whether by vaporization or transportation, salt from the sea is present in the air of such places, and the graduations of a silver-plated circle grow to show a fine green deposit, like moss, along their sides after several years' usage. When there is much hill-climbing to be done, a small, light mountain transit should be used when obtainable. The heavier instruments have the advantages of higher magnification and larger circles, but the disadvantage of weight, which means a great deal in some places, and they are awkward to carry on horseback, which has to be done at times. In case of an accident, a light instrument does not so persistently roll down a declivity as a heavy one, or, rather, it is more likely to be stopped by bushes and weeds. Only recently an experience of possibilities came to the writer, when riding in a spring wagon behind a pair of lively mules, all three occupants of the seat being set sprawling into the road as the result of an accident to a singletree. If the incident had happened ten minutes sooner, the instruments, which were in the wagon, would have had a good chance for a 250-foot roll, and a light box with leather cover and shoulder strap would probably have rolled much less than a full-size and weight transit container.

Surveying of any kind on land covered with tropical forest is attended by difficulties which can only be fully appreciated by those who have tried it. There is even yet an extensive tract of forest in Puna, Hawaii, which is practically unexplored. Some years ago some boundary lines were surveyed through it, but the trails have since grown up, and an exploration by the Hawaiian Mahogany Company, to determine the nature of the forest, was one of an unknown land. A gang of four men can cut a trail about a quarter of a mile per day through this growth, which is im-



Wyllie Trig Station; a station of the secondary triangulation of the Hawaiian Government Survey. The target can be removed when it is desired to occupy the station with an instrument.

---

*It is stated on good authority that on a hillside field of the Onomea Sugar Company, of Hawaii, the laborers stretch a rope down the hill, to which they hold with one hand while hoeing the cane with the other, lest they slip and fall over the cliff at the bottom of the field into the sea. This field was not being worked when I saw it, but the appearance of the land supports the story, the slope being apparently about 45°, and situated above the cliff in which is the Onomea natural arch.—C. B. A.

penetrable to man or domestic animal without clearing. The taller trees are little hindrance, but the undergrowth of small ferns, tree ferns, semitree ferns, banks of brushlike ferns, bananas, and many small trees, bound together by a network of creeping, climbing, and twisting vines, is a barrier which only a cane knife and an axe overcome. The heavy rainfall which occurs in forest regions keeps this foliage dripping with water, as a rule, so that to walk through it for five minutes means a drenching, and one that lasts all day. Gullies, water courses, pitfalls in the lava, and rough lava fields partly decomposed make the way bad underfoot.

Surveying in the rainy district; common-sense protection from the weather.

At best, surveying in this kind of country is unsatisfactory work; every course must be cleared, there are no checks until the traverse is closed, and an outlook over the land is impossible. There is no way of obtaining topography unless the cleared trails are close enough together to permit of interpolation between. It would be a blessing to surveyors on such land if a wireless system of determining azimuth and distance were invented, which would not require the clearing of a line of sight.

One of the conditions which a surveyor must be prepared to meet is the variety of languages in use among the people living in these islands. When a complete party of rodmen and axemen can be taken from the home office, the language question does not become troublesome, but on extended trips to different islands, transportation expense demands that help be picked up on the ground. The Hawaiian language is very simple and easily learned, so that it has become a medium of conversation between English speakers and Japanese and Chinese. The Japanese working class, however, are prone to despise the Hawaiian language, and to talk a more or less execrable pigeon English, which is partly the fault of such English speakers as talk it to them in turn. To such a man the expression "Don't do that" seems meaningless, but when he is told, "No do all same," his comprehension is immediate, and the result is the degradation of the speech of the man who knows better, for the sake of expediency, which quickly develops into a habit if not closely guarded against. It is evident that a knowledge of the language of the people with whom one has to deal is a great advantage, so that many surveyors have attained considerable fluency in speaking Hawaiian, and some in speaking Chinese, both races being land owners. The Japanese very seldom purchase land, but are satisfied to carry on their agricultural enterprises on leased holdings.

The location of boundaries is accompanied by peculiar difficulties, which a brief history of Hawaiian land titles will help to explain.*

---

* The historical information is abbreviated from a paper by Mr. C. J. Lyons.

The ancient primary division of land, the *ahupuaa,* is, in its typical form, a strip at right angles to the seashore, with its fishery and sea beach, its cultivable land, and higher up its forest. A chief held it; not owned it, for he was a tenant at the will of a higher chief, or the sovereign. He, in turn, had tenants at will beneath him, who

Ordinary fair-weather field costume.

owed him military service in time of war and agricultural service in time of peace. The sovereign was considered to own all of the land.

In 1846-1849 a general division of the land took place by the voluntary act of the king, Kamehameha III, and the chiefs. Certain lands were reserved for the king. The common people were awarded fee simple titles to such separate small tracts, or *kuleanas,* as they had previously improved or lived upon, and the chiefs were awarded the better portion of the lands formerly held by them in fief, receiving the portion of the *ahupuaa* not already awarded as a *kuleana.* As residual grantees, they were obliged to allow a right-of-way to each *kuleana* from some public road over their land. There were about eleven thousand *kuleanas* awarded, varying in size from house lots to tracts of a number of acres, many covering two or more separate lots. They are of every conceivable shape.

There is another class of tracts called grants, which were purchased from the Government. *Kuleanas* and grants were awarded by surveyed descriptions, the surveys being magnetic (compass) surveys, each on its own basis, giving generally the names of adjacent owners. There were absolutely no general surveys until the organization of the Hawaiian Government Survey in 1871.

The location of *kuleanas* is often a matter of great difficulty. The original descriptions are in the Hawaiian language, and should be studied on the ground in their original form to ascertain the most probable meaning of the ambiguities and two-synonym words which sometimes are found. If an old resident is living in the neighborhood, his testimony as to boundaries is often invaluable where the *kuleanas* are no longer occupied, so that the boundaries have been lost. Owing to the crudity of the apparatus used in making the original surveys, large errors of closure are to be expected, though some of these surveys are remarkably good, an instance of which is a tract of about forty-five acres near Honolulu, with a perimeter of over six thousand feet length, which closed within forty feet. This survey was made in 1847 by a native Hawaiian with a compass and chain.

For field costume in warm weather there is nothing better than khaki clothing, such as is supplied to soldiers, leggings of the same material, and a ventilated cork helmet. If rain is expected, of course a slicker is to be included, and if snakes are met with the leggings may be of leather. Owing to the slight visibility of regulation khaki at a distance against common backgrounds, it might be as well to provide rodmen with white helmets, which show out like headlights when the sun strikes them. However, this is a detail of minor importance.

## ALUMNI NOTES.

Alumni, please take notice of this page and send in your notes. We receive remarks now and then that this page is deficient in news, and it would be highly appreciated if you would contribute to these columns, as it does not require any literary ability to send in notes. Those who send in the notes do not like to do all the work, and there are only a few who send them to us.

H. L. Watson, '05, is now located in Cleveland, O., as gas engine and steam turbine specialist for the Allis-Chalmers Company, of Milwaukee, Wis. Mr. Watson has been in the sales department at the home office for some time past, and this transfer is another step toward the front.

C. W. Lawton, '06, with the General Electric Company, at Schenectady, N. Y., is first assistant on turbine water-rate tests at the home plant.

Harold McComb, '06, whom we noted in the December TECHNIC as being transferred to Columbus, O., is in the commercial sales department at that place.

R. W. Benbridge, '06, with the International Steam Pump Company, St. Louis, Mo., spent the Christmas holidays with his parents in Terre Haute.

Byron Kelso, '08, has left Terre Haute to work in the Canal Zone on the Isthmian Canal.

J. J. Kessler, '97, was elected corresponding secretary of the St. Louis Chemical Society at the last meeting, in December.

D. D. Wright, '05, with the Westinghouse Electric and Manufacturing Company, in the industrial and power department at Pittsburg, Pa., was seen during the Christmas holidays looking well and happy. He showed the old Poly good fellowship by taking a full half day to exhibit the wonders of the Westinghouse plant at East Pittsburg to a couple of the present Senior Class in Pittsburg at that time.

A. W. Worthington, '06, has been transferred from the Pittsburg Division to the Eastern Division of the Pennsylvania Lines west of Pittsburg. Engineering headquarters in the Allegheny Station, Pittsburg, Pa.

Arrived at the home of H. W. Foltz, '86, on Sunday, December 13th, 1908 (3 A. M.), a girl baby. Foltz now is the happy father of two girls and one boy.

The good work goes on in Indiana.

Edward F. Phillips, 1900, of Artesia, N. M., is in Anaheim, Cal., with his wife and son, for a six-weeks' vacation.

William Hadley, '01, has recently been heard from at Culebra, Canal Zone, Panama.

George T. McCormick, '08, is with the National Cash Register Company, of Dayton, O., as an assistant chemist.

Fred N. Hatch, '06, was in Terre Haute recently for the Vandalia Railroad Company.

Emil J. Fischer, '08, was in Terre Haute shortly before Christmas.

A card from L. A. Touzalin, '04, states that he "started the new year right!"

January 1, 1909.
Arrived
at 214 East Seventy-seventh Street, Chicago, Ill.
Mr. and Mrs. L. A. Touzalin,
a boy—eight pounds.

The Rose Alumni still have the right spirit. Send him to R. P. I.


# MOONSHINING

By E. E. Ferrell, '11.

In the mountainous section of Kentucky, Tennessee, West Virginia, and many other States there lives a peculiar class of people. To the general public they are known as moonshiners. They are called moonshiners from the fact that they ply their trade by the light of the moon. Both State and Federal Governments treat them as outlaws, and in conjunction these two Governments make life a burden for this poor old set of men. The State Government punishes him because he has no respect for any law that may be passed by the legislature regulating the manufacture and sale of whisky. He feels that he is immune from the operation of the law, and from his mountain home mocks at law and order, much to the chagrin of the better element of his commonwealth.

He likewise delights in the violation of the Federal law which has the audacity to ask him to pay a tribute of $1.10 per gallon on all his product. It further asks him to pay a privilege for working at the business.

The loneliness and isolation of his mountain home suggests to his mind some vocation out of the ordinary, and he conceives the idea that he has a right to dispose of his corn in any way he may see fit. If you ask a moonshiner why he makes his corn into whisky he will say: "A man that lives near a railroad can sell his corn without any trouble, or he may grind it into meal and sell the meal. Now, why should I not be allowed to dispose of my corn any way I please? If I choose to make whisky from my corn instead of selling the meal, whose business is it?" and it is a waste of energy and time to try to convince such men they have not a right to make moonshine.

But the Government fails to see things this way, and here the controversy begins. Hence, there is a perpetual warfare between Government and moonshiner. And how difficult it is we shall see hereafter. Uncle Sam, in order to uphold the majesty of the law, has divided his domain up into districts composed of several counties, and placed a deputy marshal to keep up with the moonshiner. He gives that marshal power to collect a posse of men and to go forth and destroy this bane of contention—the wild-cat still. Such a hazardous business of being a posseman is sure to attract some venturesome men.

One who has never seen a moonshiner would, no doubt, expect to see some hideous-looking monster "with horns on his head and hoofs on his feet." But such is not the case. They are men

who would violate no other law than the internal revenue law. They are as honorable in their dealings with their fellow men as any men on earth. They are simply swayed by their belief that they are engaged in an honest pursuit when they make whisky, and there are men who encourage them in the belief.

The primary object of the moonshiner is to put up an article that will produce drunk the quickest. And to do this he uses many artifices. Tobacco is often used freely in the manufacture of the whisky. This kind is styled the "busthead," from the effect that it has on the head. Then there is a kind that has buckeyes in it. This variety will cause a man to do many funny stunts. A man thus drunk is said to be "buckeyed," and does act like a buckeyed calf. Another variety is that which is treated with concentrated lye. This variety makes a man want to fight. It is said that if a drop of this is given to a rabbit it will make him "walk right up and spit into a dog's eye." Men who drink too much of this often "see snakes" right now. Men have been known to betray the location of a still while delirious from the effect of this stuff.

The vigilance of the revenue officers has made it extremely difficult for the moonshiner to obtain sufficient apparatus to embark into the business. He would not dare order an outfit from a factory, for the authorities would watch him and destroy it at once. But here is where he distinguishes himself. Necessity arouses his inventive genius. They make their appliances, and some of the very rudest have been found by the raiders, which look more primitive than those used by the Indian.

The worm of a still is the dearest of all the apparatus, hence it is guarded with the greatest care. It is so fixed in its casing that it can be removed on the shortest notice, and when a still is destroyed the worm is rarely ever found, for the last to leave will take the worm with him. It is always kept in a safe place, for one moonshiner will not hesitate to steal the worm from his neighbor moonshiner.

When moonshiners are at work every precaution is taken to prevent a surprise by officers, and they organize into bands for mutual protection. They practice drills, and have a code of signals which all must understand thoroughly. So perfectly have they become organized that it is now almost impossible to catch the moonshiner in his still. The ring of a bell or the blowing of a distant horn will cause him to hastily decamp, and the usual report of the officers is that the moonshiner had just escaped. The women are of the greatest aid in spreading an alarm. The scream of a woman is a far-reaching signal. If a stranger appears in a neighborhood of this kind, woe unto him if he excites the suspicion of these people. Many innocent men have mysteriously disappeared from these localities.

The location of a still is a matter of the greatest importance. The smoke from a still is the greatest give-away. If the still can be so located that the smoke can not be seen by passers, the location is ideal. Therefore, stills are usually in the most unfrequented spots in the mountains. One thrifty moonshiner built his still in one valley and siphoned the whisky over into another valley, where no one would suspect a still. Stills have been found in cellars under the homes of the moonshiners, where no one would suspect the smoke from it. But the greatest thing to consider is to locate it out of the way of the ever-watchful eye of the marshal. The man who gave the information I have written in this article was once a moonshiner, and knows all the tricks of the trade, and is rarely ever misled or deceived about the location of a still. His band of moonshiners once surrounded a posse of officers and starved them into submission, and paroled them on the condition that they would never come back to that vicinity. He had been a scout in the Civil War, and had gained some military knowledge. Some of the deeds of daring he did during the war would read like fiction. He reformed and entered the revenue service, and is now the most valuable man in the service.

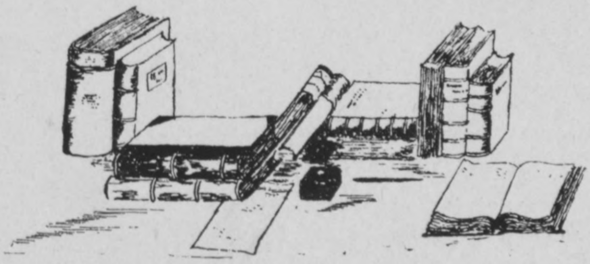
Many are the schemes that they use to deceive him, but he is too wise for them. Very often they

write him anonymous letters to decoy him off. They sometimes write him and sign a woman's name to the letter, and put up a pitiful tale of woe about the operation of the still, saying that her boys are being led astray.

There is always a certain class of people in sympathy with the moonshiner. It is the professional booze fighter. It has become so difficult for him to get his booze owing to the prohibition laws, which even prevent the shipment of whisky into dry territory. If one is destroyed, another springs up as if by magic.

The disposition of his product is an easy matter for the moonshiner. His customers know when to come to his still. They place their jugs where the moonshiner can find them easily, and when they find them again they are already filled with the white liquid. No one is seen to sell the liquor, no one is seen to buy it, hence no one is reported for buying or selling whisky. If the moonshiner ever ventures out to sell his whisky he has always some slick scheme, and is rarely ever caught. He chooses some public day, and sells his stuff only to those whom he may trust. He will carry a load of oats or fodder in which he conceals a pint of whisky, and sells it for twenty-five cents per bundle to the consumer, who has bought it presumably for his horse.

The prohibition laws seem to encourage the manufacture of this moonshine whisky. There are those who must have their dram, and can not get it otherwise. However, in Tennessee laws are becoming more rigid against the liquor traffic. State prohibition has been the subject of the recent political controversy. Prohibition made great gains. The legislature of Tennessee will, no doubt, pass a State-wide prohibition law. This will be the final step in what has been the most fiercely-waged campaign, in which the late ex-Senator Carmack suffered martyrdom for the cause of temperance. Owing to the fact that he was murdered by an agent of the saloon, the good people have become more determined in the elimination of the liquor traffic. The old argument that it is a necessity from a business standpoint has long been disproved. Sober consideration has long since revealed to them that whisky is the "demon that has dug more graves and sent more souls unprepared to judgment than all the pestilences that have wasted life since God sent the plagues to Egypt and all the wars since Joshua stood beyond Jericho."



# ...ATHLETICS...

## BASKETBALL.

### I. S. N. S., 2; Rose, 31.

January 6th was a "Jonah day" for Normal for fair. It was the opening game of the season for each school, and even though our old enemies had been practicing about two months longer than we had, Old Rose had no trouble in trouncing them by the score of 31 to 2. The first half ended 20 to 0 in our favor, and at no time during the session was our goal in much danger. This is the first game in our memory when we calsomined a team during the opening session.

Every man on our team played the game of his life, and we can predict some classy games when we meet some of the stronger teams in the State.

In the second half we changed our line-up, and still Normal could not shove many through the rim. The game was fairly interesting, with all of the one-sided score, and the rooters got good practice for the games that are to come.

LINE-UP.

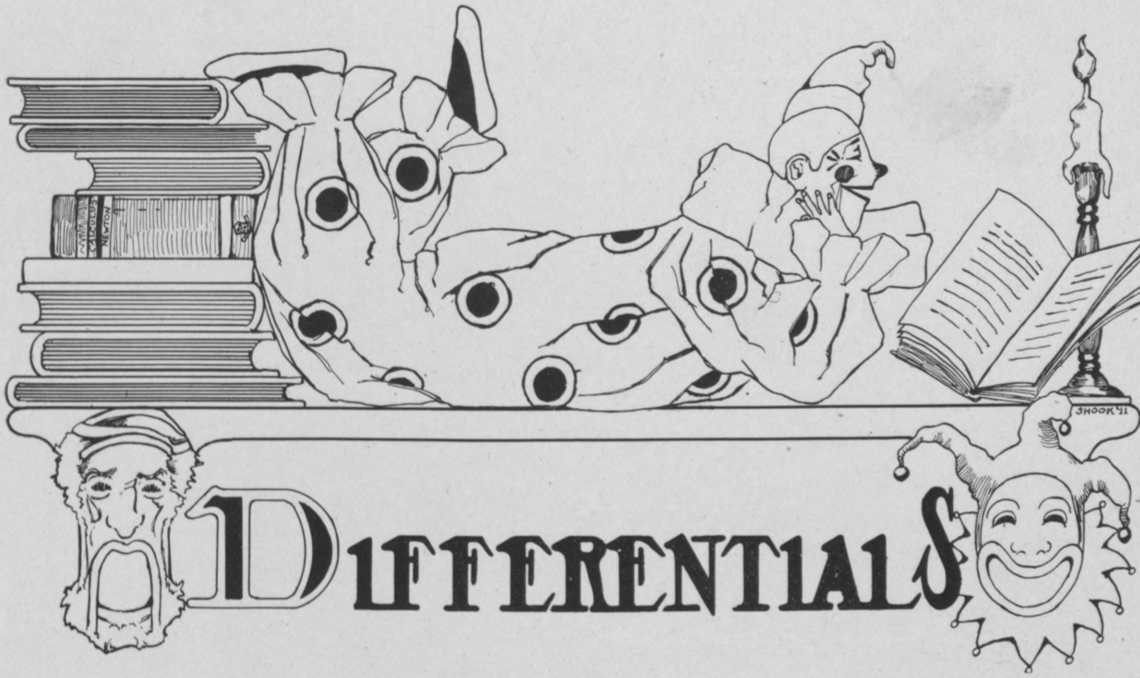
| *Normal.* | *Position.* | *Rose.* |
|---|---|---|
| Shorling | F | Wente, Markley |
| Shoeppel | F | Webster |
| Everett | C | Hoffner |
| Wood | G | Hadley, Standau |
| Laughlin | G | Curry, Offutt |

Summary.—Field goals: Hadley 4, Curry 3, Hoffner 3, Webster 2, Wente, Shorling. Foul goals: Hoffner 4, Hadley. Referee, Kisner. Time of halves, twenty minutes. Score, 31 to 2.

Manager Rockwood has succeeded in scheduling one of the hardest schedules that a basketball team from Old Rose has ever had to buck. Fourteen games are on the list now, nine of which will be played in Terre Haute. Rockwood is still corresponding with the Purdue manager with reference to a game to be played in Lafayette. Negotiations are also on for a contest with Indiana University here. The two big games of the season will be with our old rivals, Wabash, one here and one at Crawfordsville. Now, fellows, we cleaned up with the "Little Giants" in football last fall, and now can't we do it again in basketball? Certainly we can; but to do it, it will take the best playing possible from the men on the team and the support and rooting of the entire student body. Let the Freshmen come down to the Y. M. C. A. and get in on the rooting. Remember, we do the best rooting of all in basketball, and even at that we want to make it better.

The schedule as it now stands is as follows:

Jan. 6—Rose at Normal.
Jan. 13—DePauw at Rose.
Jan. 16—Wabash at Rose.
Jan. 23—Rose at Indiana.
Jan. 30—Franklin at Rose.
Feb. 6—Normal at Rose.
Feb. 9—Rose at Wabash.
Feb. 11—Hanover at Rose.
Feb. 13—Purdue at Rose.
Feb. 19—Rose at Earlham.
Feb. 20—Rose at Butler.
Feb. 23—Rose at DePauw.
Feb. 27—Earlham at Rose.
Mar. 6—Butler at Rose.




# DIFFERENTIALS

### HEARD ON TUESDAY.

Boarding-house Mistress—Well, gentlemen, did you enjoy the turkey we had on Sunday?

Weaver, '11 (star boarder, toying idly with the hash)—Oh, yes. In fact, I think we'll never get through enjoying it.

---

Two '12s were heard indulging in the pastime of telling each other of their admiration and love for one another. Their conversation ran about like this:

"I hate you! I despise you!"

"So do I. Since I have been going with you, honest, I am ashamed to be seen in my own company."

"Ho, as for me, I would rather be alone in a crowd than by myself in your presence."

---

Her Small Sister—Yes, come in, Mr. Washburn; sister's been expecting you.

Washie—How do you know she's been expecting me to-night?

Small Sister—Oh, she's been lying down all afternoon.

### RELIGION VERSUS SCIENCE.

"My dear brethren," said the pastor, "we have with us to-day Evangelist Tumbler. Once he was fallen from grace, but he recovered himself, and now has fallen from disgrace. Before he addresses you on the 'Spiritual Law of Gravity' we will sing 'Dropping, Dropping, Dropping!' "

---

Werst was getting ready to trace a drawing, and Wischy told him to take an eraser and rub a little chalk on the tracing cloth. So Werst spent an hour with a red rubber eraser and a stick of chalk, rubbing it in.

---

Senior—What, is that Trig?

Krieger—Plew says it's Trig.

---

Sproull—And how did Artie Page hold out in his response to the toast, "The Gas Engine"?

Brannon—Oh, as usual, he broke down just after he had it fairly started.

---

"What is the race problem, professor?"

"Picking winners," responded Mac, absently.

HOW CRUEL OF HIM!

Newhart—Doctor, I suffer from rush of blood to the head. What causes it?

Doctor—Nature endeavors to fill every vacuum, you know.

---

A foot-pound of work is the amount of work required to lift a foot twelve inches.—*Ex.*

---

Struck (coming into class)—What is this calculus, or least squares?

---

Say! If you can't bring her to the burlesque, get some one *that can.* "Be a Booster."

---

"Some people always get the cream, while others have to be thankful for about half enough skimmed milk."—*Found posted in the "study" of a Freshman.*

---

It has been reported that Davidson, the "Dewdrop," would make an awful *splash.—At the burlesque.*

---

Rush (in Civil, with his feet on the desk, making an angle of about 45° with the horizontal)—Wish "Mac" would come. But hope he makes some noise in coming.

---

Spoon—How do you subtract on this adding machine?

Smith—Run it backward.

---

Prof.—Conjugate the verb "to be."

Student—Itch (ich) bin.

Prof.—Sit down and scratch!—*Ex.*

---

Miss a meal and see "The National Flower." K. of C. hall, February 5th and 6th.

THAT JUNIOR FRENCH.

Wicky (suspiciously)—Do any of you do this French together?

Watts—I do. I have to do it together because I don't come apart.

---

AT GLEE CLUB.

Freshman—Say, I can't dance in skirts; there's no use trying.

Mrs. Adams—Well, you needn't worry; the length of our skirts will never bother you.

---

The feat of the burlesque—the girls' feet.

---

Dr. Mees, dropping in on an afternoon rehearsal, was invited by an instructor to get a front view.

Dr. Mees—Oh, never mind; I know them all by the backs of their heads.

---

Young Doc Mees "makes up" beautifully as a girl, if it wasn't for his feet. K. of C. hall, February 5th and 6th.

---

First Fresh.—What are you doing here? You haven't any voice.

Second Fresh.—No, but I have a dress suit.—*Exchange.*

---

Strucky (with surprise)—When did you get that problem?

Spoon—Oh, I got that between twelve and bedtime.

---

She—How kind of you to bring these flowers. They are nice and fresh. There is some dew on them yet.

He—Yes, there is a little, but I hope to pay that to-morrow.—*Ex.*


### A New Fuel.

A patent fuel has recently been brought out by a French inventor, designated as "charbonnette." The fuel, it is stated, can be produced for about two-thirds the cost of coal. It lights easily and rapidly becomes incandescent, while at the same time it gives out intense heat and leaves very little ash. It is manufactured in briquets, and its main features are cleanliness in handling and the absence of odor. According to *The Electrical Review*, it is understood that the preliminary tests have been so satisfactory that a manufactory is to be erected.—*American Machinist.*

### The Inventor of the Tungsten Lamp.

A great deal has been written and said about the tungsten filament, and the Germans have received the credit of being its inventors. This, however, is not the case, although we must give them credit for its development. It has not been generally known that a young American, while still in his teens, was the inventor, Mr. Turner D. Bottome, who, by the way, was an exceedingly bright electrochemist, and contributed a number of electrochemical inventions to the world. * * *

In the early part of the year 1887, Mr. Bottome, scarcely eighteen years old, became associated with a lamp company in Harrison, N. J., called the Vitrite Aluminoid Lamp Company. Being a great student, and observing the defects of the filament made by the company with which he was connected, he conceived the idea that the metal tungsten had properties of peculiar advantage for an incandescent-lamp filament, a metal of fairly high resistance, and of very high fusing point. * * * The number of the patent is 401,120.—*J. A. Y., in Electrochemical and Metallurgical Industry.*

### Refitting a Worn Pump Piston.

The chest piston, as it is called, of a Deane pump had, after many long years of service, become so worn that sometimes so much steam would blow past that the valve would become inoperative and the pump would stop. For some reason extra parts of this particular pump were not kept on hand, as was the case with all the other pumps in the plant, so the engineer decided upon a repair of his own. After the plant closed Saturday evening the piston was taken and slowly heated in the forge to a dull red, and then buried in the ashes and left until Sunday morning. Then, taking an intelligent helper with him, the engineer took the piston from the ashes, cooled and cleaned it, and, after several trials, found a way that one end could be made to enter the bored part in the chest.

The end having been entered fairly, with a hickory stick held against the piston the helper

drove it through from end to end. Then the chest was reversed and the piston driven back. This was kept up for about two hours, the sledge being replaced by a heavy hammer and the heavy hammer by a light hammer as the movement of the piston became freer, until it could be easily pushed back and forth with the fingers, when it was thought that it was as good as could well be.

The chest and piston were put back on the pump and tested. The job was perfectly satisfactory in every way. It would seem that the heat to which the piston was exposed had the same effect upon it that superheated steam has on cast-iron fittings; that is, swelled it a little.—*J. L. F., in Power and the Engineer.*

## State Commission.

The Railroad Commission of Louisiana has ordered all steamboats operating in the State to meet the rail rates within the State where such rates are lower than the steamboats' rates. The steamboats are allowed, however, to charge in addition the actual cost of insurance of the freight. Rates between intermediate landings and from towns and cities to landings where no actual railline competition exists need not be reduced on account of short-line rail competition.—*Railroad Age Gazette.*

## Expansion of Valves.

The result of experiments to determine the expansion of valves and fittings in service involving high temperatures are given in *The Valve World.* Three flanges were taken, one of cast iron, one of ferro steel, and one of steel. They were exposed to varying degrees of heat for a period of one hundred and thirty hours, the temperature being less than 500 degrees for eighteen hours, 500 to 700 degrees for ninety-seven hours, 710 to 800 degrees for twelve hours, and over 800 degrees for three hours. The average for one hundred and thirty hours was 583 degrees. The view previously put forth by *The Valve World* was, that cast iron subjected to continued temperatures of approximately 500 to 600 degrees takes a permanent expansion, and does not return to its original volume when cooled. The results of the above-mentioned experiments are stated as follows: Cast-steel flange—no change. Castiron flange—outside diameter increased 19-1000 inch, inside diameter increased 7-1000 inch. Ferro-steel flange—outside diameter increased 33-1000 inch, inside diameter increased 17-1000 inch.—*American Machinist.*

## An Important Legal Decision Regarding Trench Excavation.

The excavation of trenches for sewers and water mains where rock is encountered is often the subject of dispute between contractors and the cities for which the work is done. Even where the terms of the contract are so drawn as to avoid dispute under ordinary conditions, exceptional cases sometimes arise where the character of the work differs so materially from that on which the bids were prepared that an appeal must be made to the courts to determine the respective rights of the parties to the contract. A case of this sort has recently been settled by the United States Circuit Court of Appeals for the First Circuit. The decision is given in 164 Fed. Rep. 593, Gammino vs. Town of Dedham, and is one of the most illuminating statements made from the bench in some time regarding work of this nature.

The contractor undertook to build two sections of a sewer in accordance with the plans and specifications of the town, which stated approximate quantities of the work to be done. The contractor was to be paid different sums per cubic yard for earth and rock excavation at different depths. The approximate quantities were given in detail, accompanied by the following explanation: "The above quantities are not guaran-

teed, and the commissioners reserve the right to increase or diminish the same within 25 per cent. Upon the quantities above given bids will be compared. These quantities will be a part of any contract made for the prosecution of this work, and when referred to in such contracts include each and every part of the same." As a matter of fact, the rock excavation on one section of the sewer was eighteen times the amount estimated, and on the other section forty-three times the estimate. The town contended that the work in rock must be paid for at the stipulated rate, while the contractor claimed that the amount of excavation in excess of 25 per cent. over that given in the specifications was the subject of future agreement, and he claimed a large sum for this excess. The suit was decided against him in the lower court, but in the Circuit Court of Appeals it was decided in his favor and the case remanded for further proceedings.—*The Engineering Record.*

## Repairing a Broken Air Chamber with Portland Cement.

* * * It happened away back in the country, where a water-power plant was being built to furnish electricity to a town farther down the valley.

A Cameron steam pump was on duty keeping the water out of the excavation. By an unlucky swing of the derrick boom, a loaded dirt bucket struck the cast-iron air chamber of the pump, snapping it off just above the discharge connection, putting the pump out of commission.

It was miles to a repair shop, and the prospects of delays were exasperating. Things looked rather dark until the civil engineer in charge of the job offered his assistance.

At his suggestion the broken air chamber was put back into position, and an empty barrel, minus the head and bottom, was placed over it. * * * All holes and openings between the barrel and valve chest were then plugged up with cement sacks and the barrel filled with concrete.

The pump was shut down for a day or two to let the concrete harden. When it was started again it worked along as though nothing had happened to it, and continued on duty until the job was finished.—*American Machinist.*

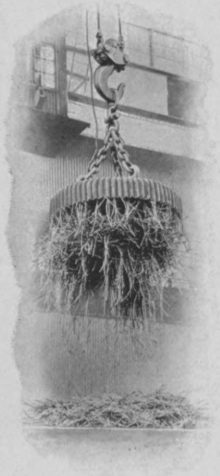
## Test of Gas Engines on Ships.

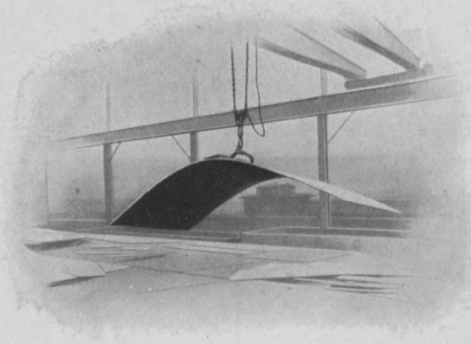
A successful experiment with a gas-driven ship was recently conducted with an old British gunboat of about seven hundred tons, which made a trip of about fourteen miles, demonstrating the applicability of gas propulsion to slow-going ships. The old steam machinery, which was of the usual horizontal triple-expansion type, with two navy boilers, was removed, and replaced by a single-acting gas-producer plant, and five-cylinder engines. The features of the demonstrations were the economy of coal, it being calculated that the consumption of anthracite was equivalent to 0.8 pounds per indicated horse power per hour, while the machinery, weight for weight, was 25 per cent. less than that of the old equipment, and consequently there was a considerable saving in space.—*American Machinist.*

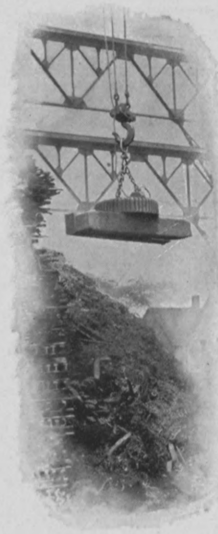
## Wear of Steel Rails.

The wear of rails is being investigated in a very thorough manner on the Harriman lines under the general direction of Mr. J. D. Isaacs, their consulting engineer. Whenever a rail breaks or otherwise fails, the section foreman who detects the failure reports the fact at once to the roadmaster over him on a blank form, which, when filled out, gives complete information regarding the accident and all conditions of the track. When the rail is taken from the track it is marked carefully for identification and sent to the division terminal. At least 10 per cent. of the broken rails are sampled by making borings,

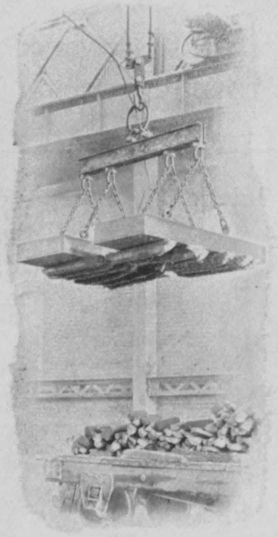
the material removed in this way being sent to the general officer in charge of maintenance, who has it tested. The foremen's reports are summarized in the offices of the division superintendent, and the reports of the latter are transmitted to the maintenance department. The information collected in this way up to the present time indicates that there are more failures of 90-pound rails per one hundred miles of track than of 75-pound and 80-pound rails under the same tonnage, and that about three-fourths of the failed rails contain phosphorus in excess of 0.085 per cent. Cold weather also seems to increase the number of rails that fail. The information collected in this way is so complete in its details that the records of a few years may be expected to furnish a large number of useful facts concerning the behavior of rails.—*The Engineering Record.*

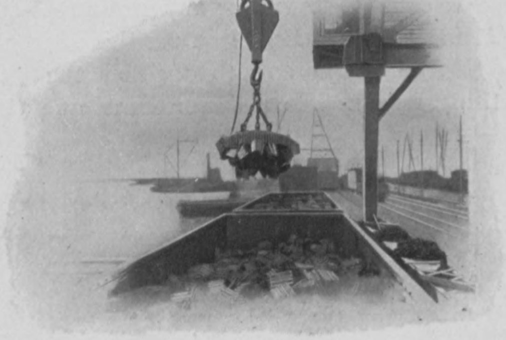


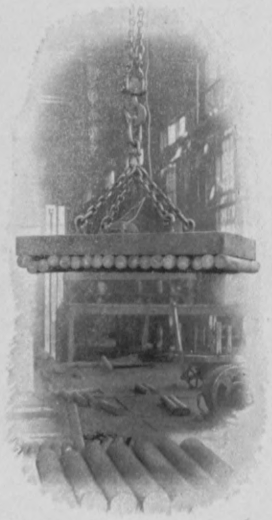












# Barney & Berry Skates

ARE

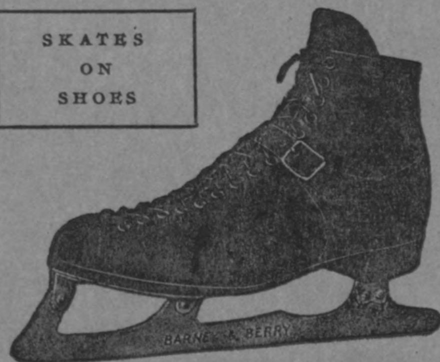
## ACCEPTABLE GIFTS AT ANY TIME

Any vigorous exercise is beneficial to the Student. Witness the elaborate apparatus in our Gyms. No kind of exercise is attended with more enjoyment than SKATING—Roller Skating in a well-ventilated hall, with merry companions and good music, or Ice Skating under the stars, in the clear, bracing air.

Wherever, it is well to be a trifle fussy about your skates. Get good, reliable ones.

We want you to use Barney & Berry's Skates, and you will never apologize to yourself for buying them. See your dealer. Send for Free Catalog (Ice or Roller).

SKATES ON SHOES



**Barney & Berry,** 272 Broad Street SPRINGFIELD, MASS.

---

## A. G. SPALDING & BROS.

The Largest Manufacturers in the World of Official Athletic Supplies

Foot Ball
Basket Ball
Ice Skates
Hockey
Golf

Official Implements for all Track and Field Sports

Uniforms for all Athletic Sports

Gymnasium Apparatus

Spalding's handsomely illustrated catalogue of all sports contains numerous suggestions. Mailed free anywhere

**A. G. SPALDING & BROS.**
NEW YORK CHICAGO

---

## THORMAN & SCHLOSS'

### "GOOD CLOTHES"

AT 1/4 OFF 1/4

ARE THE BEST BARGAINS TO BE HAD IN THIS MAN'S TOWN

See Our $1.50 and $2.00 Shirts at
**98 cents**

50 and 75-cent Four-in-hands at
**35 cents,**
**3 for $1.00**

TAKE A LOOK

**Thorman & Schloss**
668-670 Wabash Ave.

# FOULKES BROS.

**Hatters, Furnishers and Tailors**


. . Selling Agents . .
KNOX, STETSON, HEATH, and many other well known . . . . . Hats . . . . .

**College Hats and Caps Galore**

Manhattan Shirts, Keiser's Barathea

Everything Up-to-the minute in Evening Wear . . . . . . . . .

**FOULKES BROS.**
**Hatters, Furnishers and Tailors**
**631 Wabash Avenue**

---

## FOR HIGH CLASS

# Laundry
# Cleaning
AND
# Pressing

See our Poly Agent
**HARRY MOSBY**

## Hunter Laundering and Dyeing Co. . . .

PHONE S. 257

---

THE
# ENGINEERING MAGAZINE

THE ENGINEERING MAGAZINE publishes the best original articles by the highest authorities on all phases of current engineering progress.

Additional and exclusive features are: a Review and Topical Index to the current contents of nearly two hundred engineering and industrial journals; Current Record of New Technical Books; Industrial News; latest Improved Machinery and new Trade Literature.

Every number is a valuable reference book for every engineer or student of engineering.

Ask for sample copy and descriptive circular.

**THE ENGINEERING MAGAZINE**
140-142 Nassau St., New York

---

# Higgins'

Drawing Inks
Eternal Writing Ink
Engrossing Ink
Taurine Mucilage
Photo Mounter
Drawing-Board Paste
Liquid Paste
Office Paste
Vegetable Glue, etc.


**Are the finest and best goods of their kind**

Emancipate yourself from the use of corrosive and ill-smelling inks and adhesives, and adopt the HIGGINS INKS and ADHESIVES. They will be a revelation to you.

AT DEALERS GENERALLY

**CHAS. M. HIGGINS & CO., Mfrs.**

Branches Chicago and London — 271 Ninth Street BROOKLYN, N. Y.