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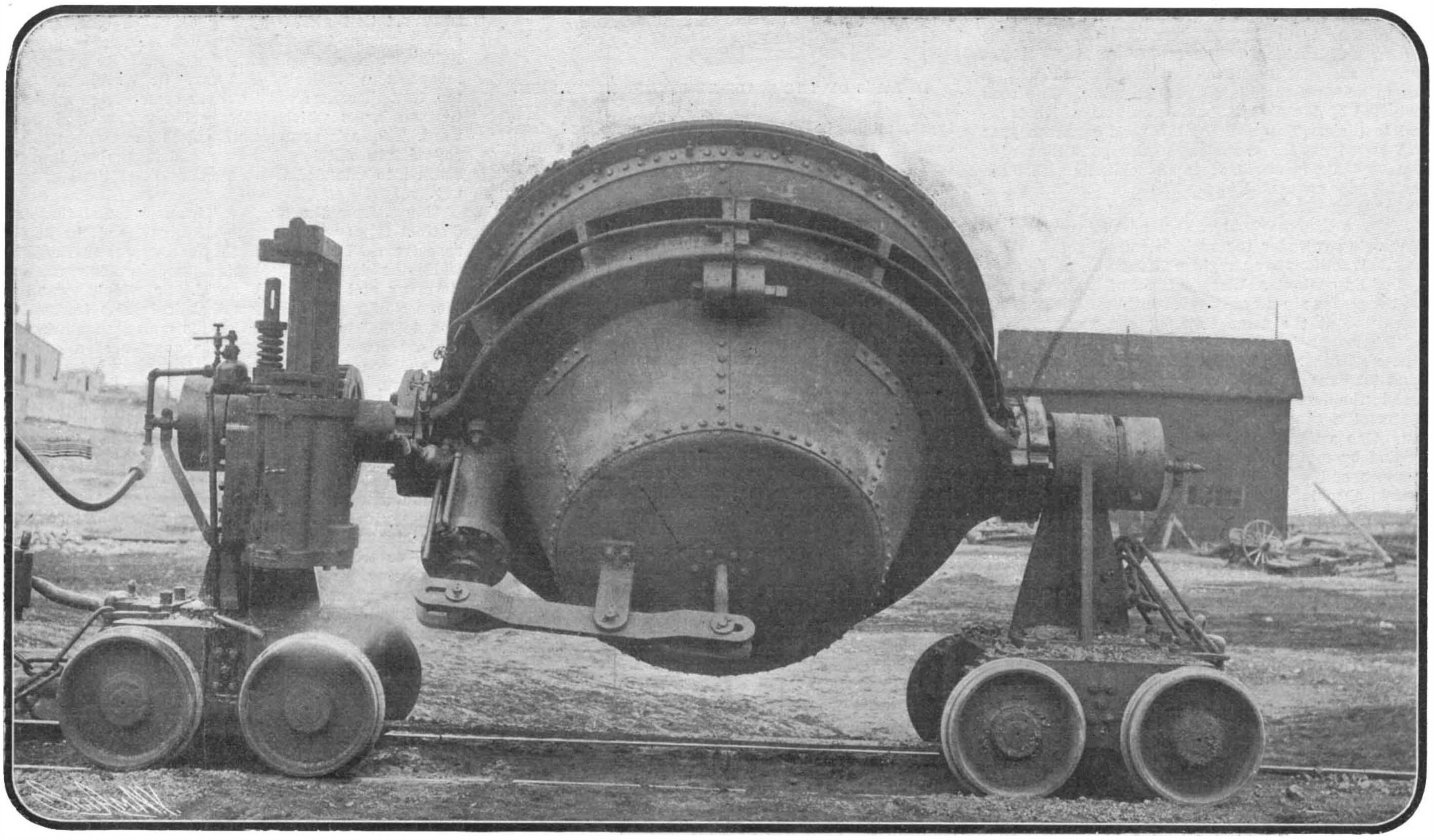
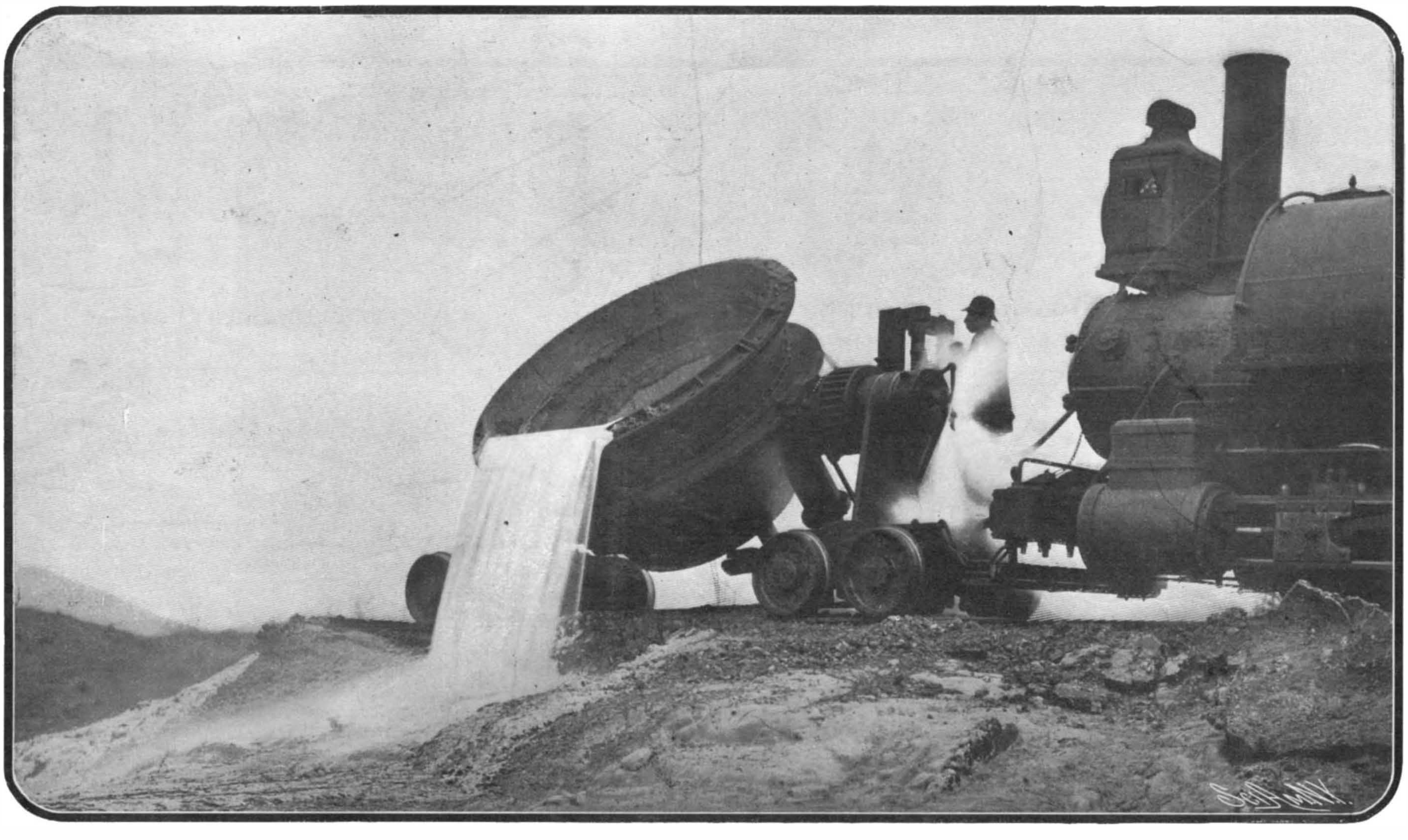


REAR VIEW OF THE CINDER POT SHOWING SCALE-REMOVING MECHANISM.



CINDER POT TILTED BY STEAM POWER TO POUR OUT THE SLAG AND CINDERS.

**STEAM-OPERATED CINDER POT.**

## STEAM-OPERATED CINDER POT.*

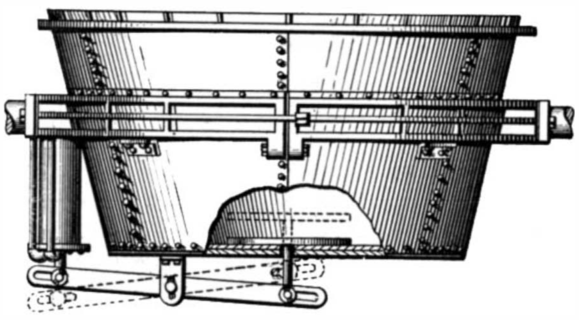
THE ordinary type of slag or cinder pot is dumped by the operation of a hand lever, which tilts the pot through the medium of stepped-down gearing. Obviously, the work is slow and requires considerable expenditure of power. Furthermore, the cleaning of the pot, when it becomes coated with scale, is an exceedingly crude process, and often requires several hours. The scull is first cooled by the use of water, and then the cinders are removed with a pick and shovel. Aside from the expense in time and labor entailed by this process, the use of water in cooling the cinder is very injurious to the pot. With a view to overcoming these objections, the steam-operated pot, which we illustrate herewith, has recently been invented, and its success is proved by its rapidly increasing and already extensive use in a large number of iron and steel plants.

The construction of the improved cinder pot is quite simple. The pot is mounted to turn in brackets secured to the car trucks. On one of the brackets the dumping and cushion cylinders are secured. These cylinders are cast together, and are formed with a guide in which a rack is adapted to move. The rack is actuated by the pistons, having an arm which is secured to them. The teeth of the rack engage a gear wheel keyed on the trunnion of the pot. Steam or compressed air is admitted to the cylinders, through a flexible pipe connected to the boiler of the locomotive used for propelling the car. The steam supply is controlled by a four-way valve. On admitting steam to the dumping cylinder the rack is raised, rotating the pot on its trunnions to an angle of 90 degrees, and dumping it of its contents. When a train of these cars are used, the steam pipes are coupled together, and can all be operated at the same time by one man with no more labor than in operating a single pot. Owing to the ease with which the operation can be performed, the switchman or brakeman on the locomotive can attend to the dumping in addition to his regular duties, and thus the expense of employing a pot dumper is saved. The action of the cushioning cylinder may be regulated by means of a valve on the pipe connecting the upper end with the lower end of the cylinder, and thus checking or increasing the flow through the pipe, as desired. The crust which, after continued use, forms on the bottom of the pot, is quickly removed by a special steam-operated device. In the bottom of the pot is a plate connected to a lever hinged to the pot. The outer end of this lever is secured to a piston working in a cylinder secured to the pot at one side. This cylinder may be seen in our rear view of the cinder pot. On admitting steam to the cylinder the plate is lifted, breaking the crust formed over it, and effectually cleaning the pot. Then the valve is turned, opening the exhaust and admitting steam to the under face of the piston, forcing it down and causing the plate to assume its normal position in the bottom of the pot. The whole operation requires but a minute or two, as against several hours' work by the old process. Since it is not necessary to chill the pot with cold water before cleaning, the pot lining will last much longer than if subjected to the old process. The makers of this cinder pot claim that on a two-furnace plant an actual labor saving of $2,000 per year is made, in addition to the saving in repairs and renewals.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

## MULTI-CYLINDER LOCOMOTIVES.

A QUARTER of a century ago non-compound locomotives having more than two cylinders were comparatively scarce, and, with the exception of one or two types, might be classed as experiments and freaks, even in cases where they were certainly not failures. Compound locomotives with two or more than two cylinders had, for all practical purposes, not made their appearance, although a few attempts to apply the compound principle to locomotives had been made or suggested.



DETAILS OF THE SCALE-REMOVING MECHANISM.

The past twenty-five years, however, has seen many changes in locomotive design, involving in some cases rather striking departures from orthodox practice. To-day there are many multi-cylinder non-compound types in more or less extended use, and undoubtedly successful, while the compound locomotive with two, three, four, and even more cylinders is an acknowledged success, and engines of the various types are being rapidly introduced in ever-increasing numbers in all parts of the world.

No method of classification for multi-cylinder simple locomotives is altogether satisfactory, but the following may be said to be the principal reasons which have caused the adoption of more than two high-pressure cylinders:

1. To dispense with coupling-rods in a four-driver engine.

2. To obtain a more regular turning effect than can be obtained with two cylinders driving cranks at right angles, and to balance the engine.

3. To produce a more powerful engine.

4. To increase the power without unduly loading any one axle, or to provide a sufficiently powerful locomotive for use where the weight per axle is limited or where other conditions restrict dimensions.

5. To provide a "flexible" locomotive, for use on roughly-laid tracks, and on curved lines.

What is believed to have been the first multi-cylinder locomotive ever built was of the first class above mentioned. It was supplied to the Stockton & Darlington Railway by Messrs. Wilson & Co., of Newcastle-on-Tyne, England, in 1827, and had four cylinders, two for each pair of driving wheels. Probably the difficulty of procuring wheels of exactly equal diameters, and a distrust of coupling-rods in those "pre-steel" days, were responsible for such a new departure; but the engine was a failure.—J. F. Gairns, in Cassier's Magazine.

## AERIAL TRAMWAYS AS AN ECONOMIC MEANS OF TRANSPORTATION.*

By STEPHEN DE ZOMBORY, C.E.

IT is not my object to enter into a technical discussion of the subject, but rather to discuss the conditions which warrant the construction of such aids to mining enterprises and those types which will give the most satisfactory results from the mine operator's point of view, as well as some of the many advantages of this system of transporting ores from the mine to the reduction plant.

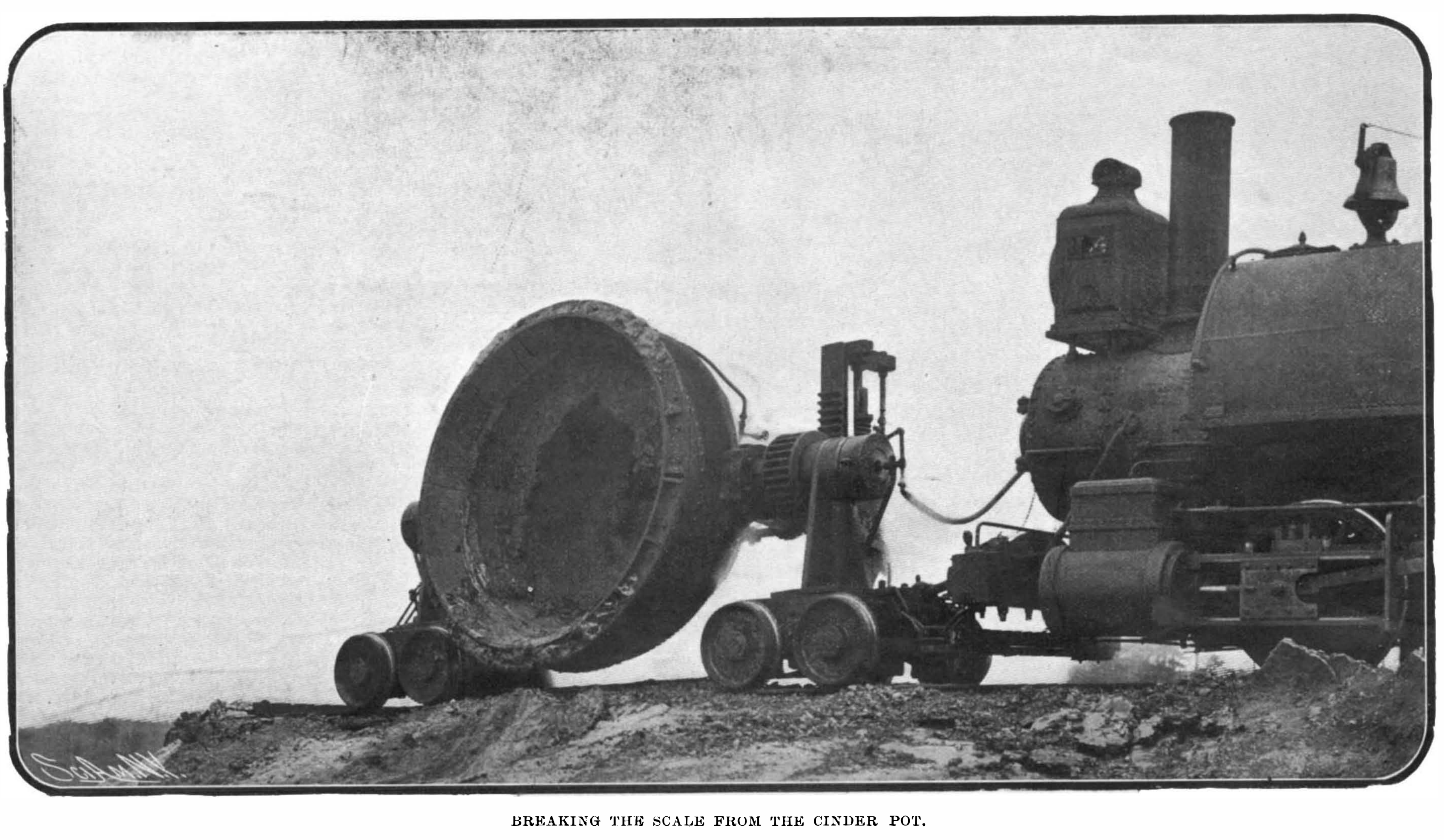
The time is too short to enter into an extended discussion of tramways and their development. As a curious fact we could mention that wire ropes served for transportation methods many centuries past, and research among the ruins of Pompeii have brought to light wire rope, specimens of which are to be seen in museums in Naples at this day. Or I could mention, too, that there are wood cuts in some of the medieval German books which show perfectly developed tramways. The early scenes of this method of transportation passed into oblivion, however, and it was not brought again into extended use until the 40's of the last century.

Almost from the origin of trams we find that two distinct types were known—the single and the double rope tram. The home of the former was in England, while the double rope system is extensively used in Germany and the whole world. So widely spread is the use of rope tramways that it is also interesting to note that in Germany there is a single manufacturing concern which, during the quarter of a century it has been in existence, has turned out over 1,800 tramways.

The experience of the past two or three decades has shown many marked advantages of this type of transportation. Discussing the merits of both the single and double rope types the advantages might be expressed thus:

Undulated profile is of little importance, since these tramways are equally effective on plains or in a very mountainous country. Expensive understructures, viaducts, or trestle work is absolutely unnecessary, the ropes being suspended on wooden towers which are of simple construction, erected at intervals of two or three hundred feet. If the formation of the ground does not permit these distances, it is possible to construct spans of as many as a thousand feet. Deep gulches and ravines, which are effectual barriers to transportation means of other types, offer no obstruction to a rope tramway, and some of the finest tramways in the country have solved just such problems for mine operators. Climatic conditions in no manner interfere with the action of a tramway, permitting the continuous operation in most inclement weather. Thus the heavy expense of keeping mountain roads open during the winter is avoided. Being economical

* This paper was read by the author, an engineer of the Broderick & Bascom Rope Company, of St. Louis, Mo., before the Annual Session of Transcontinental Mining Congress, at Deadwood, S. D., on September 11, 1903.



BREAKING THE SCALE FROM THE CINDER POT.

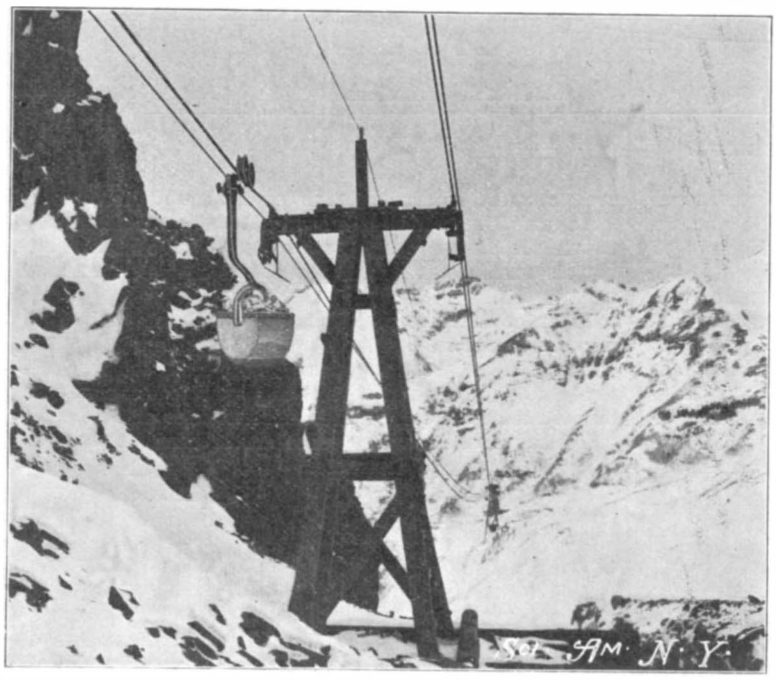
STEAM-OPERATED CINDER POT.

both of construction and maintenance, it proves to be the real friend of mine operators who are operating on even a moderate capital.

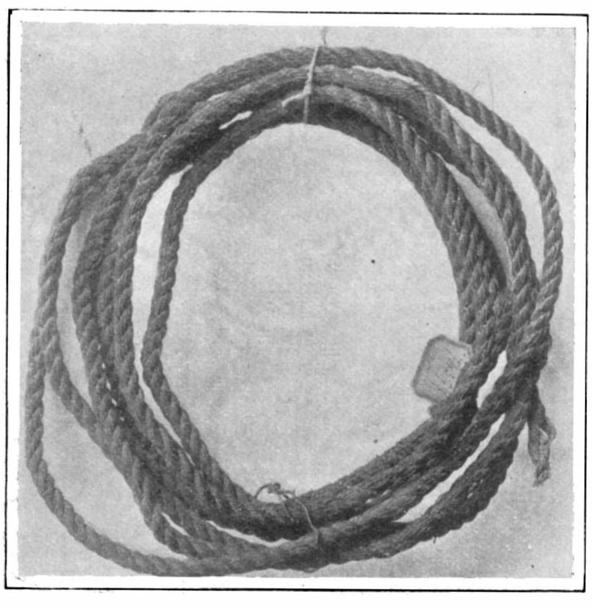
Another marked advantage is the fact that the time occupied in construction is much less than for the construction of other systems of transportation. Especially is this true in mountainous country. The adaptability of the tramway is so great that it will meet the most urgent demands made upon it, and, unlike rail or wagon roads, should occasion demand, the plant can be wrecked and installed in a new location at moderate cost and with a surprisingly short loss in operating time.

In the main these advantages apply to both the single and double rope types. I do not myself feel entitled to condemn either type. Both have their advantages. I only will compare them.

The single rope type being much the simpler in its construction, having less parts has the advantage in being cheap in primary cost and erection. Its principal drawback is that it can convey only a limited amount of material. There are tramways of this system with an hourly capacity of 35 tons, yet these particular tramways did not get beyond the experimental stage and it is not advisable to deliver more than 20 tons per hour. The practical mine operator whose hope and ambition is to vastly increase the output of his mine could hardly consent to install a system which in itself was of so limited capacity. Yet its main advantage, as stated, is its cheapness of construction, a fact which always must be taken into consideration.




A TYPICAL ROPE TRAMWAY.



A ROMAN WIRE CABLE, DUG UP IN POMPEII.

Another advantage of this system is the fact that the strain upon the parts is heavy, with consequent expense of repairs and loss of time in operation, itself no small item in working costs.

THE DOUBLE ROPE SYSTEM,

which is of far more extensive use, is more costly in installation but is always advantageous on account of its capability of increased capacity as occasion demands in the future development and output of a mine. Speaking of capacity, I could mention that there are lines which deliver 250 tons of ore per hour, which is really a tremendous output. This special line has been in almost continuous operation since the fall of 1898, and since its installation its repairs have been of such trifling cost that even its builders have been surprised. Operating costs are low. One Colorado tramway, which traverses a very rough, mountainous country, approximately 10,000 feet in length, is handling ore at a cost of 17.6 cents per ton, with the cost of maintenance 1.5 cents per ton.

These admirably low figures are due to the fact that the systems now being perfected require the services of very few men on the entire line. The addition of automatic devices which perform the work of loading and dumping has gradually decreased the labor costs until now only one or two men are required to watch the loading of the buckets. As is generally understood, most of the double rope tramways which are in operation through the mining districts of the country require no power, being operated by gravity entirely. Even then the power which is produced by the weight of the buckets can be turned into a source of profit, being sufficient to meet demands for ventilating purposes, for the operation of dynamos, for lighting plants, and operating mine pumps, as can be seen in some of the larger western mines.

The division of the strain upon the ropes at this double rope system reduces the repair bills and at the same time renders stoppages less frequent.

Returning for a moment to the matter of automatic systems: There is to-day a tendency to render these tramways more and more automatic in their operation. It is a question in the mind of the trained engineer just what is the limit. What is of more concern to the prospective or actual owner of a tramway? How far can we go in making the tram entirely independent of human control, but then take the risk of the eventualities which are connected with all such machinery?

Reduction of labor costs is always an object in considering operating expenses, but yet it is the opinion of many engineers that it will not be advisable to entirely dispense with it. The aim of the constructing engineer should be to plan a tramway which would be as nearly automatic as is consistent with due regard for the safe conveyance of its traffic.

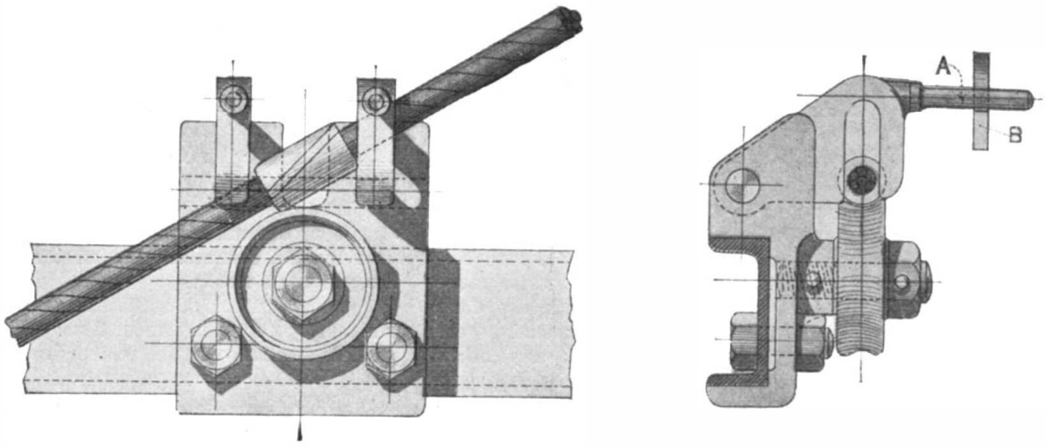
In all the double rope systems which are in general use, the principle of construction is the same. That is, the ropes, pulleys, and sheaves, as well as the other machinery in use, perform their duties in the same general fashion, differing only in design. The difference between the systems is chiefly in the manner of attaching buckets to the rope. Therefore, double rope tramways might be divided into three general types:

First. That system in which a clip or lug-nut is permanently attached to the running rope which drags the bucket suspended on a standing or immovable rope.

Second. That system in which a clutch fastened to the bucket seizes the running rope and remains attached thereto by means of friction. This latter system might be further sub-divided into two classes—one in which the friction is created by an eccentrically operating lever locked and released automatically, securing a constant friction that is independent of the angle which the traction rope forms with the horizontal; second, one in which the clutch exerts friction on the traction rope by a lever on which the weight of the bucket is transmitted. This friction varies with the cosinus of the angle the line forms with the horizontal.

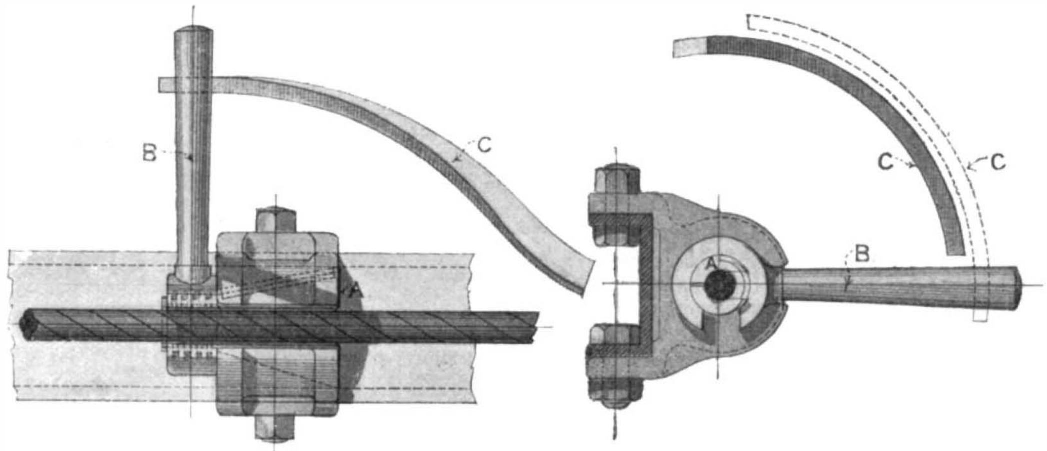
The third and latest development is that system in which the buckets are fastened permanently at certain distances to the traction rope. On this system the buckets are loaded with a walking bin which runs simultaneously on parallel rails above the buckets in the station, loading the same.

It is here impossible to enter again into extended discussion of the merits of these three systems of double rope tramways. As time is drawing to a close, I will only mention some of the most marked differences. The clip system enables us to handle the buckets at exactly the same intervals. This prevents accidents which might result from the failure of laborers to keep the buckets loaded and moving at the proper distances. One marked disadvantage of this type is the fact that the wear on the traction rope is constantly in the same place, thereby weakening the strength of the rope at these points. Shifting the clips from time to time is resorted to in an effort to overcome this difficulty but with a more or less extended loss of time. In the second class this difficulty is not encountered because the grip seldom ever clutches the same spot on the traction rope twice in succession. Slight alterations, also, in the relative positions of the buckets on the rope work no disadvantage in the operation of the second type. To secure an even distribution of the buckets along the line, signals are easily arranged by which the workman is enabled to estimate the proper intervals. With the assistance of eccentrically working friction grip arrangement, all grades can be over-



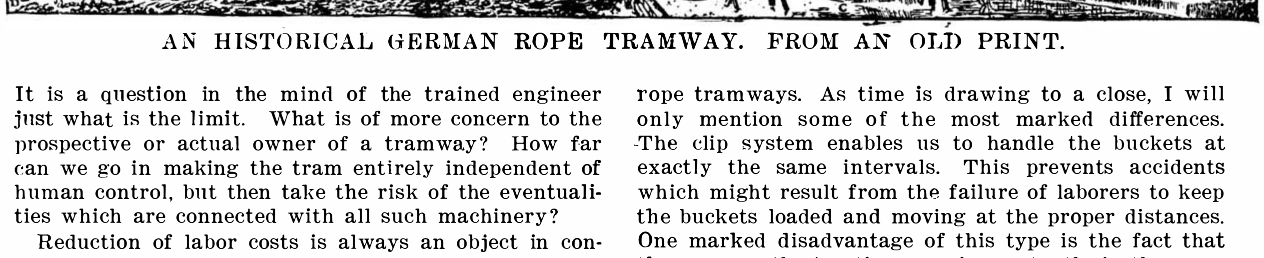

CLIP OR LUG NUT SYSTEM OF FASTENING THE HANGER ON THE BUCKETS.

The two dogs are lifted automatically at the stations by the fingers A, through the medium of the lifting bars B, thus allowing the lug nut either to place itself between them and form the connection of bucket and running rope, or to leave them and disconnect the rope from the bucket.




THE CLUTCH SYSTEM OF HANGING BUCKETS.

The split cone A works in a taper sleeve and is drawn together by the action of the screw in the boss of lever B. This lever is moved automatically at the terminals by the deflection bars C C, which raise or lower it as required, thus releasing or gripping the running rope.




AN HISTORICAL GERMAN ROPE TRAMWAY. FROM AN OLD PRINT.

come, because the friction on the rope is constant and uniform. In the type in which the weight of the bucket is transferred by means of a lever on the clutch and is transformed to friction, the limitation of grades which can be overcome is confined to those not in excess of 45 degrees.

The third system, that in which the buckets are attached permanently to the traction rope, is probably the most promising one, as here the loading as well as the unloading of the buckets is automatic, with corresponding savings in operating expenses. The more or less complicated clip catchers and grips are done away with. It requires buckets of less expensive construction and overcomes any grade that any other system of rope tramways can traverse. This last type of construction is of such recent development that comparatively few plants are in operation in this country. As far as known it renders the most successful service.

And now a word as to the costs of installation of rope tramways. Naturally, the single rope tramway is the cheaper type of construction, but popular opinion is more favorable toward the double rope tramway, as evidenced by the number of that type which have been and are being installed by mine managers. The heavier the traffic to be handled, the heavier and more substantial parts must be used in the construction work. Many other considerations based upon the peculiar conditions which attend the installation of tramways at different mines, must be considered in the individual case. Generally speaking, we are within limits when we say that including all the machinery parts the average price per foot of line constructed may be regarded as ranging from $1.80 to $2 per foot. These figures include the necessary wire cables, towers, sheaves, and buckets. To these figures must be added the construction costs, which vary according to freight rates, prices of timber, labor, and delivery to the point of construction. Very naturally this affords a wide variation in costs, but as an example it might be cited that in Colorado the construction costs would probably be from $1 to $1.15 per foot. Therefore, it is safe to estimate the entire cost of a tramway per foot in this region, where the conditions are approximately the same as in Colorado, at from $3 to $3.10 per running foot.

The rope tramways and their application to mining and manufacturing industries the world over is a subject upon which any engineer might talk for hours. The economies which are effected in all industries in which their use is possible, are so generally recognized that no argument in their behalf is necessary. Every mining man in the West can probably cite examples of mines whose profitable operation without the aid of tramways would not be possible. The time which has been allotted me is now drawing to a close and therefore, in conclusion, let me repeat a poetic tribute to the tramway, the work of a fellow engineer unknown to me, whose beautiful allegory is more expressive than language of my own:

"Nestled silently in the clouds, away up above the timber line, Nature has hidden almost inaccessibly its treasures. Deep down below in a valley stands a reduction plant which day by day with the aid of human genius converts ore into wealth. Reluctant to give up her treasures, Nature wages a constant warfare with man, calling to her aid the snows and ice of winter, altitude, precipice, and ravine. But man won the fight. Two slender wire cables, puny in appearance despite their strength, span ravine, rise over precipice, and scale the heights, disappearing among the clouds. With their aid man has encompassed the defeat of Nature. Silently, unpretentiously, disdainfully ignoring the grumbling of Nature over her defeat and her efforts to overthrow the work of man, the buckets modestly move forward; they are the connecting links between mountain and valley, real private soldiers of the mining industry, always alert, always performing their duty, always obeying their commands and rendering invaluable service in adding to the wealth of the nation."

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**A German engineer** has recently made an investigation of the water power available from the rivers on the northern slopes of the Alps. The total power of the streams in this region is estimated at 6,000,000 horse power, of which about one-half could be utilized for economic purposes. Only about 10 per cent of the available power is employed at present.

## PROPOSED RECONSTRUCTION OF THE BROOKLYN BRIDGE.

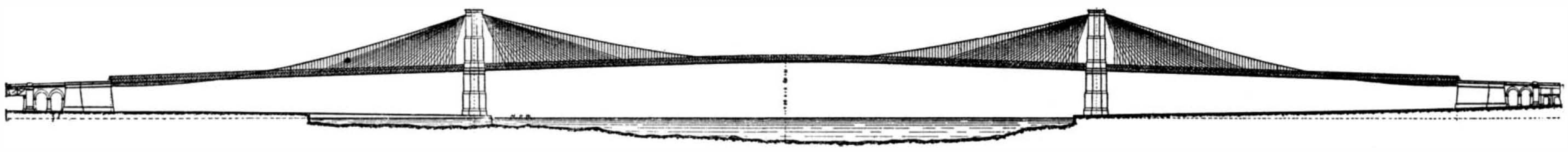
ONE of the last acts of the late Commissioner of Bridges, Mr. G. Lindenthal, before the close of his term of office was to present to the Mayor the drawings, etc., for a thorough reconstruction of the Brooklyn Bridge. We present several plans and drawings of the reconstruction, together with the following report by the Commissioner on the general features of the proposed work:

The present bridge structure was never intended and dimensioned for the traffic it has to bear now. The suspended structure, from anchorage to anchorage about 3,600 feet long, is in a wornout and weakened condition, requiring constant and expensive repairs to keep it safe. The rebuilding of the bridge has become imperative, but must necessarily be deferred until the Manhattan Bridge (located about 1,500 feet north of the Brooklyn Bridge) shall have been completed; which can be done in three years, all the plans being ready for letting contracts.

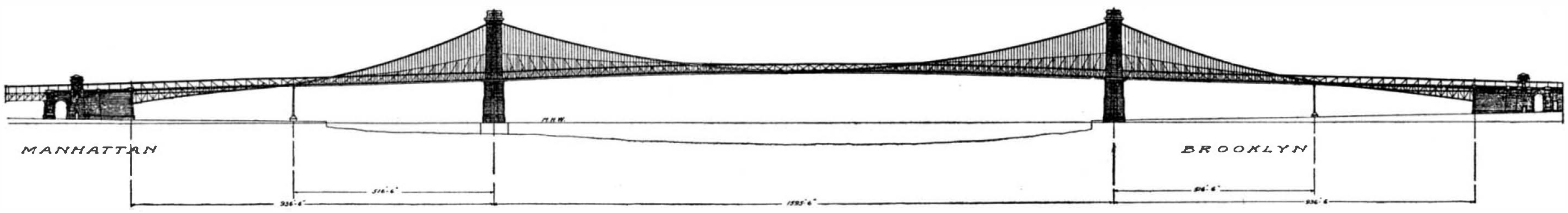
Nothing but the Manhattan Bridge will effectually relieve the over-congested Brooklyn Bridge.

The Williamsburg Bridge (one mile north) is now completed, and would no doubt draw away some passenger traffic from the Brooklyn Bridge if the former were provided with an elevated terminal station between the Bowery and Broadway. The construction of this station rests with the Rapid Transit Commission.

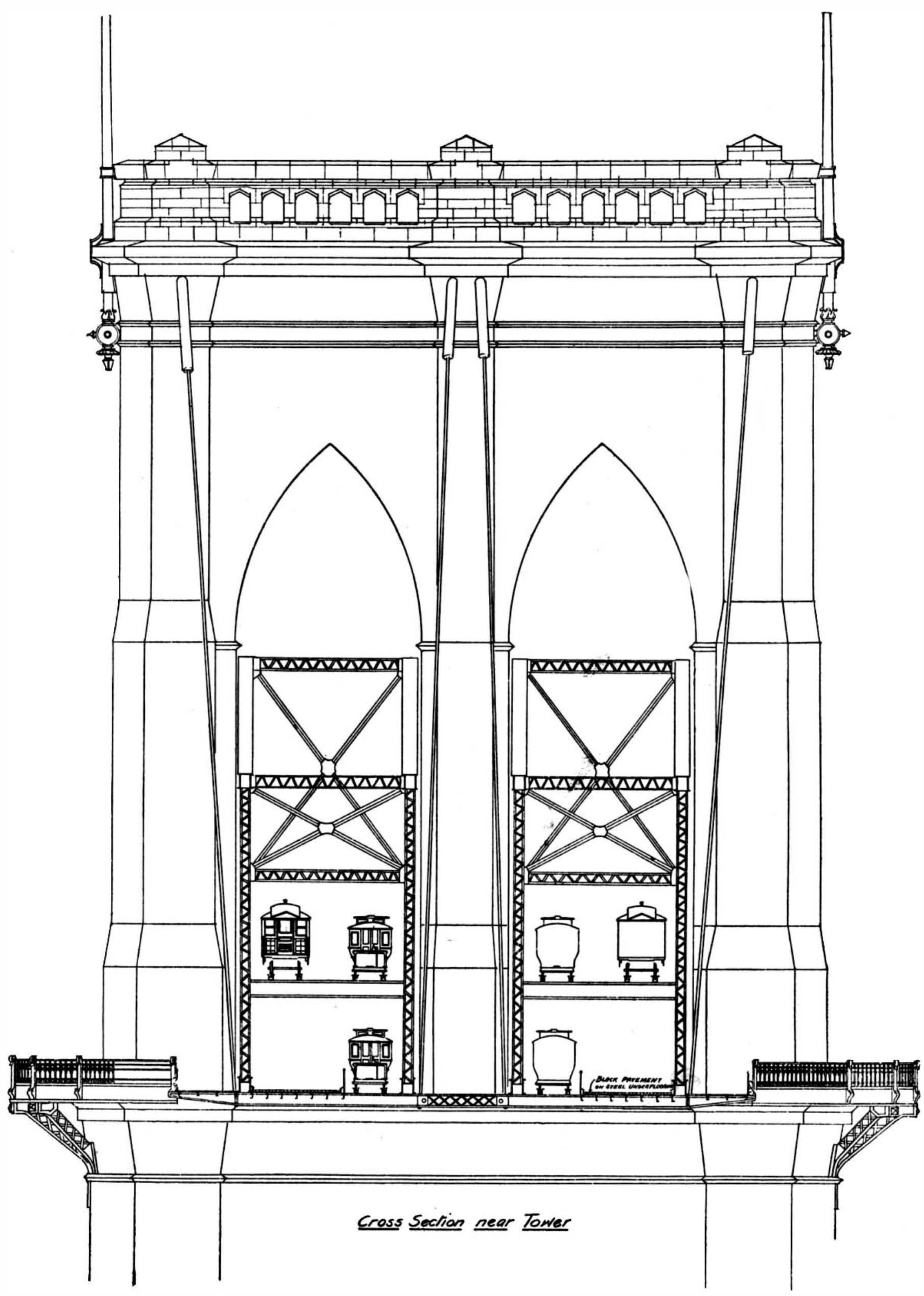
In order that the rebuilding of the Brooklyn Bridge may be taken in hand without delay when the Manhattan Bridge shall have been completed, I have prepared such preliminary plans and specifications as can be used as a basis for more detailed plans and studies, which, as a rule, require considerable time, so that an early beginning is desirable.



SIDE ELEVATION OF THE PRESENT BROOKLYN BRIDGE.




SIDE ELEVATION OF RECONSTRUCTED BRIDGE.




CROSS-SECTION NEAR TOWER SHOWING THE GREAT DEPTH (75 FEET) OF THE STIFFENING TRUSSES.

PROPOSED RECONSTRUCTION OF THE BROOKLYN BRIDGE.

I find it practicable to convert the present old structure with one deck into a new structure with two decks, arranged to accommodate four elevated tracks and two trolley tracks. The latter will be entirely separated from the roadways, each of which will be seventeen feet wide. That will make it possible to run trolley cars over the bridge at twice the speed of the present limit. It means that a pair of trolley tracks on which at present three hundred cars per hour can run, will then be able to accommodate as many as four hundred to four hundred and fifty surface cars per hour, in and out during rush hours. That number is probably the limit of cars per hour that could be drained into the streets radiating from the Brooklyn end of the bridge, without causing congestion of street traffic during rush hours.

Greater relief and more rapid transit must be obtained by elevated railroad trains, for which four tracks are provided, in place of the present two tracks. The capacity of the rebuilt Brooklyn Bridge will thus be nearly doubled for rapid transit, besides restoring to their former width the two roadways for wagon traffic, and adding two promenades for pedestrians. There will also be more space for telegraph wires, postal-tubes and other equipment on the bridge structure.

The accompanying plans show the proposed reconstruction. They comprise not only the rebuilding of the superstructure, but also the enlargement of the anchorages, which, otherwise, would be too light.

It is intended to place stairways and elevators at each anchorage, to make the bridge accessible from the streets below. The stone towers will be somewhat heightened in order to provide a roof for the masonry, and to make the cable bearings more accessible for inspection. At present, the top of the tower is accessible only with great difficulty, and not without danger.

The roadways will be fireproof. They will have a steel channel foundation, with wooden-block paving. Throughout, the structure is intended to be modernized and brought up to a condition where its maintenance (which is now very costly) may be reduced probably by one-half; that is, to the mere painting of the iron-work and the repair of the tracks and wood-block pavement.

The present structure has a capacity of 2 elevated tracks, 2 trolley tracks, leaving two narrow strips of less than 9 feet each on each roadway for truck traffic, and one promenade 15 feet in width.

The live load for which the bridge was originally designed is about 2,000 pounds per lineal foot.

The reconstructed structure will have accommodations on the upper deck for 4 elevated railroad tracks, and on the lower deck for 2 trolley tracks, 2 paved roadways 17 feet each, and 2 promenades each 8½ feet wide in the clear.

| | |
|---|---|
| The present width of the bridge is ........................ | 86 feet |
| The width of the reconstructed bridge will be .............. | 105½ feet |
| The capacity of the new bridge will be ..................... | 11,000 pounds |

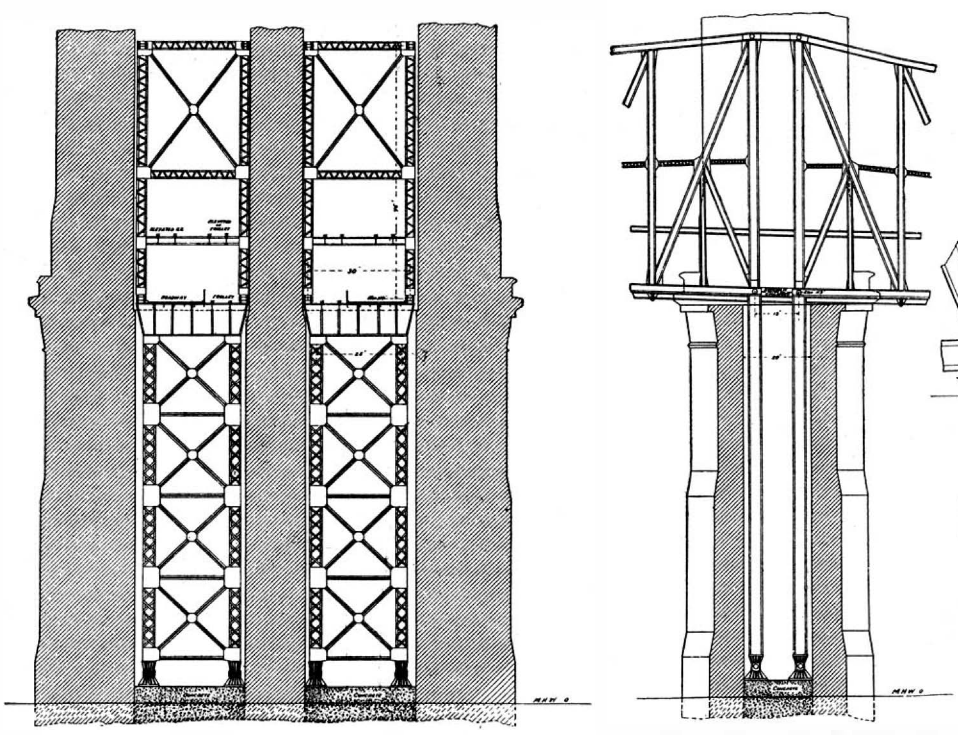
Live load per 1 foot of bridge as follows:

| | lbs. per 1 ft. |
|---|---|
| Two rapid transit trains, at 1,700 pounds | 3,400 |
| Four lines trolley cars, at 1,000 pounds.. | 4,000 |
| Available width of roadways and foot-walks, at 70 pounds per square foot.. | 3,570 |
| | 10,970 |
| Say ................................ | 11,000 |

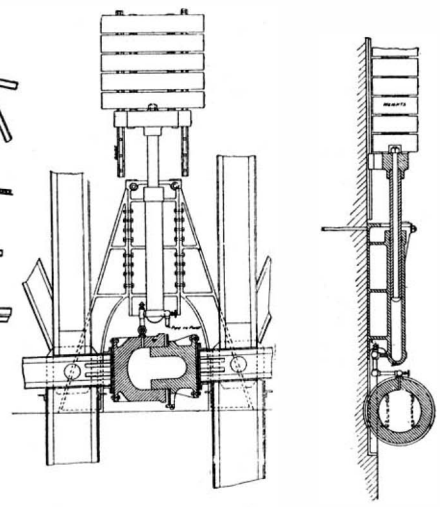
The leading considerations in the laying out of the plan were:

1. No additional cables shall be required.
2. No additional load shall be put upon the top of the towers which would bring a higher pressure upon the masonry than would be considered prudent.
3. The bridge shall be safe under a congested maximum live load wherever it may occur on it between the anchorages. The existing bridge has not been designed for that condition, and would not be safe if a local congestion should occur on it anywhere between anchorages.
4. The weight of the stiffening frames shall not be carried by the cables, which would considerably increase the strain in the latter and reduce the stability of the anchorages.
5. The cables shall carry practically the entire live load and also the weight of the floor construction proper.
6. The stiffening trusses shall carry their own weight and the wind and lateral bracing.
7. In order to make this distribution of dead and live load upon the cables and the stiffening trusses an absolute certainty, the stiffening trusses shall be designed as continuous trusses over the towers, with fixed pier bending moments to be described hereafter.
8. Anchor posts will be placed under the middle of each end span. They will act as anchors for the continuous girders of the middle span, and as supports for the live load on the side spans. The expansion joints will be placed near those anchor posts.

In order to keep the dead weight of the new structure within the lowest practicable limits, nickel steel has been selected for the stiffening trusses. There appears no particular saving in weight in the use of nickel steel for the floor construction, and structural steel will here fully answer the purpose.



SECTIONS SHOWING STEEL PIERS INSIDE TOWERS, WHICH TRANSFER WEIGHT OF TRUSSES DIRECTLY TO FOUNDATIONS.



DETAIL OF HYDRAULIC ADJUSTMENT OF STRESS IN STIFFENING TRUSSES.

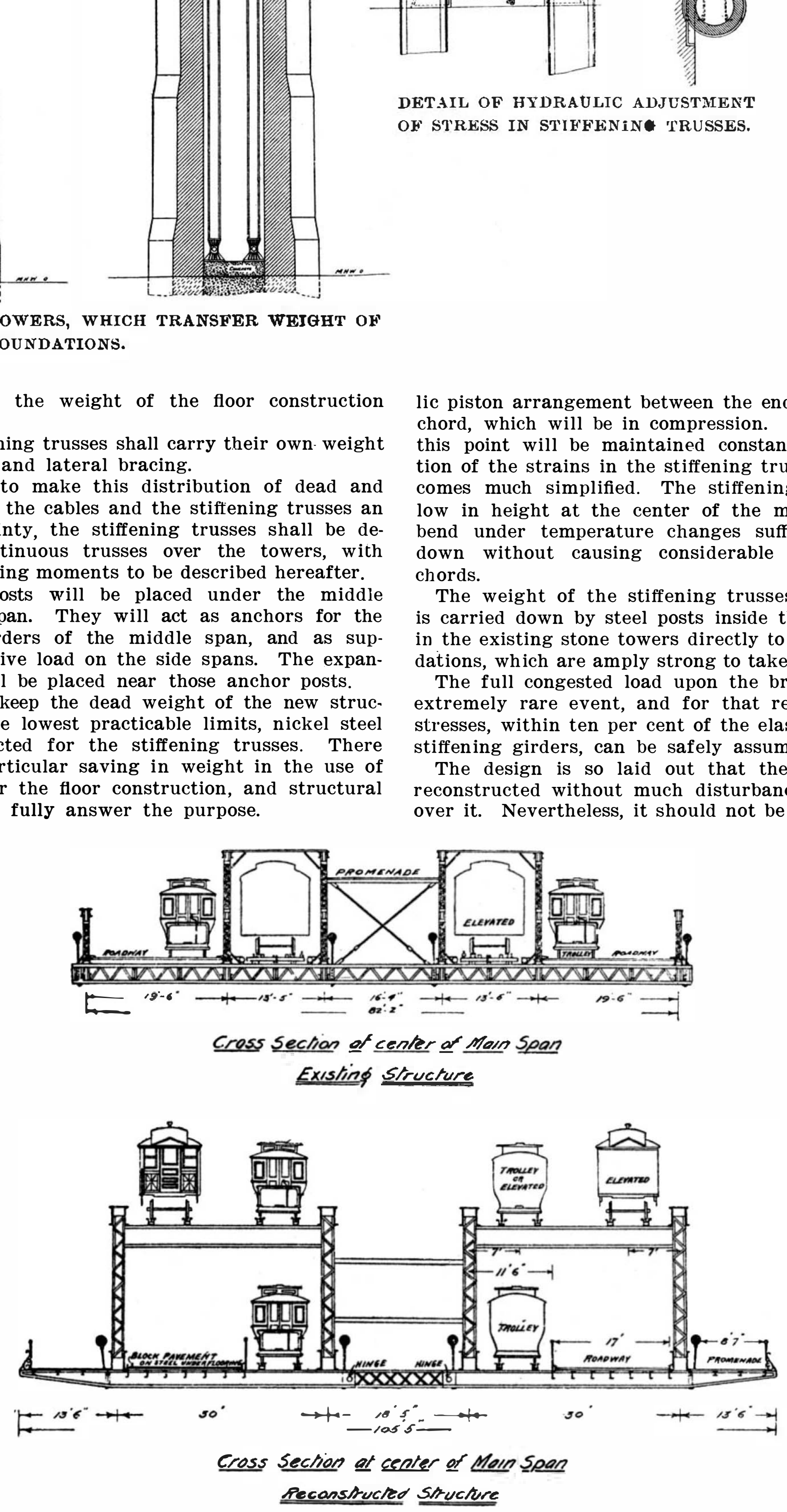
It is desired to use the present suspenders from the cable and to maintain the cables in an inclined or cradled position. The bands around the cables will be replaced with wider ones of cast steel. Each two suspenders—7½ feet apart—shall be connected by a cross connection at their lower ends, to be attached to the floor beams, 15 feet apart. The panels of the stiffening trusses have been divided with that view into lengths of 30 feet each, with two sub-panels of 15 feet. The height of the continuous stiffening trusses will be 75 feet at each tower, reducing to 19 feet at center of main span and at anchor posts.

The constant pier bending moments at the towers in the stiffening trusses will be produced by a hydraulic piston arrangement between the ends of the bottom chord, which will be in compression. The pressure at this point will be maintained constant. The calculation of the strains in the stiffening trusses thereby becomes much simplified. The stiffening trusses, being low in height at the center of the middle span, can bend under temperature changes sufficiently up and down without causing considerable strains in the chords.

The weight of the stiffening trusses at the towers is carried down by steel posts inside the hollow space in the existing stone towers directly to the tower foundations, which are amply strong to take this load.

The full congested load upon the bridge will be an extremely rare event, and for that reason high unit stresses, within ten per cent of the elastic limit in the stiffening girders, can be safely assumed.

The design is so laid out that the bridge can be reconstructed without much disturbance of the traffic over it. Nevertheless, it should not be undertaken until the Manhattan Bridge shall have been completed.




CROSS-SECTIONS OF OLD AND NEW FLOOR SYSTEMS.

PROPOSED RECONSTRUCTION OF THE BROOKLYN BRIDGE.

The stays of wire ropes running over the top of the towers to the present stiffening trusses will be removed, being a troublesome feature and a useless weight on top of the towers. The present wind wire ropes will also be removed. The new trusses and their lateral bracing will effectively sustain any possible wind pressure.

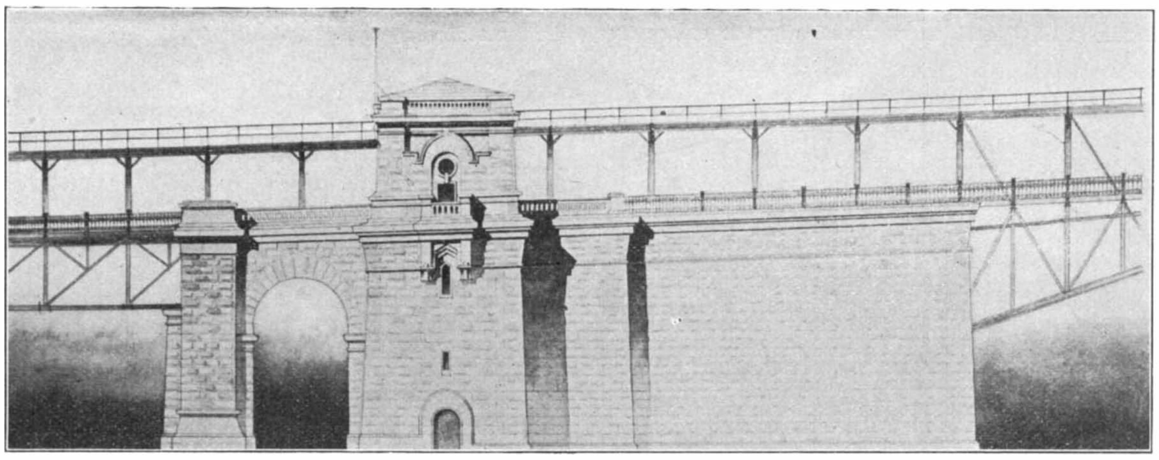
The arrangement of the stiffening girders in the end span is such that the anchor arm extending from the tower meets the anchor arm extending from the anchorages, which shall be constructed as a cantilever.

The anchorages require lengthening to increase the resistance to sliding and to prevent a large increase in the present toe pressure from the increased pull upon the cable. The plans show how this lengthening of the anchorages is to be affected, leaving at the same time room for stairways and elevators at this point.

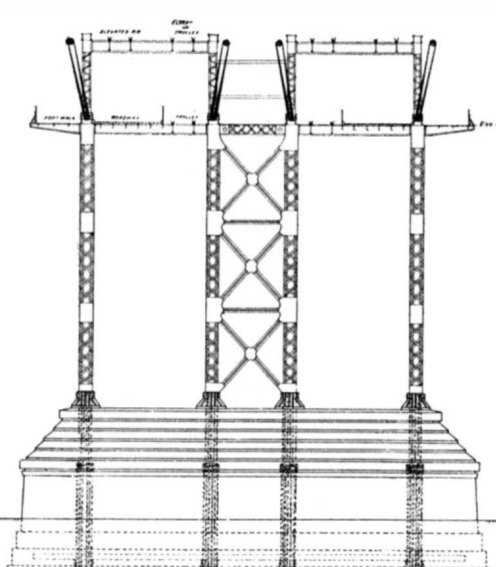
The foundation upon which the anchorages stand is on both sides a fine, compact sand, and so far has proved to be stable and satisfactory. But in order to be quite safe, steel sheet piling should be driven all around the foundation of each anchorage to protect the same against injury from excavation that may happen in the future in its neighborhood, either for the construction of houses, sewers, or water pipes.

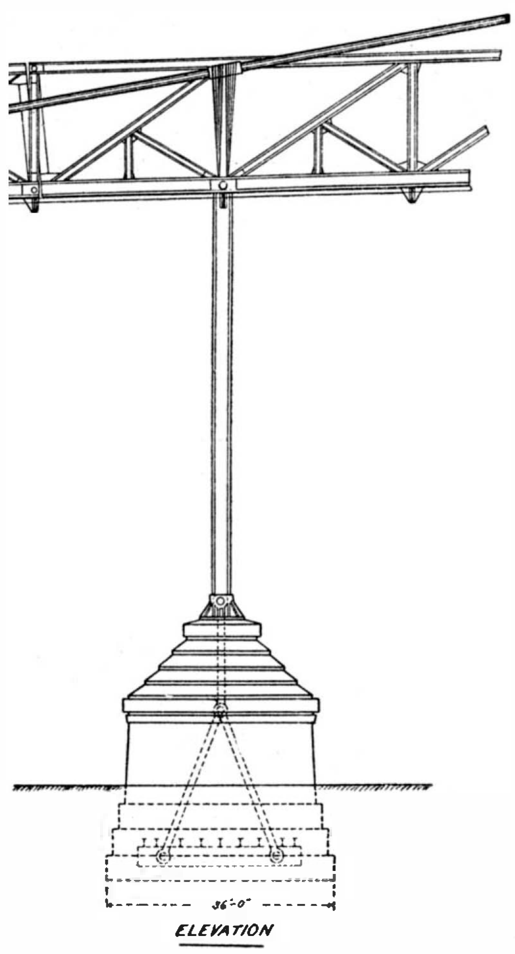
| | |
|---|---|
| An approximate estimate of cost for the work outlined above, from anchorage to anchorage, and including the same, is... | $5,141,000 00 |
| For extending the elevated railroad lines to the terminals at both ends, and repaving the roadways and sidewalks, etc., the same estimate is......... | 357,000 00 |
| This gives a total estimated cost of ........................ | $5,498,000 00 |

GUSTAV LINDENTHAL.



THE ENLARGED ANCHORAGE.




INTERMEDIATE ANCHORAGE OF INSHORE ENDS OF THE STIFFENING TRUSSES.

PROPOSED RECONSTRUCTION OF THE BROOKLYN BRIDGE.

## WHAT ARE THE NEW MACHINE TOOLS TO BE?*

By JOHN E. SWEET.

IT is a fact quite apparent to users of machine tools (and first among them are the machine tool builders themselves) that the new high-speed tool steel calls for a redesigning of our machines if we are to get even a fair share of the ultimate possibilities which the new steel offers. I expect the machine tool builders have already the reply formulated as follows: "You just keep on building engines and leave the machine tool business to us." But that will not quite do. If no one but the engine builders had mixed in the engine business, we would have had no turbine engines, and many of the standard machine tools were originally devised by those who had use for them, rather than by the man who devised things to sell. I think the machine tool builders will admit that the machines must be redesigned; but to the most of them will this mean anything but just to make the driving elements more powerful and the machines stronger, which is as much as to say everything has been all right, and all we need to do is to change the strength and power? But have they been all right or half right?

It can be shown by figures, I suppose (I know it to be a fact by a trial with models), that a complete box is thirteen times more rigid against torsion and four times more rigid against bending than the same amount of material is in the form of side plates and thin cross girts. It is probably from four to eight times more rigid than the cross girt plan in any form, and yet in the case of lathes, the whole business of whose beds is to resist torsion, only one or two builders have had the courage or audacity to adopt the box form.

All planer beds can just as well be box beds with half the cost in patterns and foundry work, and so, too, the tables which are sprung by bolting down work can just as well be box tables four times as strong with the same material, and with a saving of half the cost in patterns and something in the foundry. The whole tendency of the cut is to slide the work endwise of the planer bed; but who has ever tried putting the slots crosswise in a way to offer the greater resistance and prevent the bending of the bed by the peening of the upper surface, as now occurs, which, with the springing by bolting down the work, are the primary causes of cut ways? Some planer and boring-mill cross rails are of box section in the center, but are thinned down at the ends when fastened to the housings. The most of them are three sides of a box only, or one-tenth the strength of a box, where a plain square box straight through is infinitely better and cheaper. Of course, the boxes are not to be proportioned from what is in use now, but from what is to be made to meet the new conditions. To select enough material to meet the new demands and then put the material so that it will be four times more rigid will be something like it. Housings of box section will be just as rigid fore and aft and much more rigid against side strain.

Milling machines of the planer style are constructed like planing machines, seemingly without a thought but that the conditions are identical, while they are not. If the bed of a planing machine and the table were of the same length, the weight of the table and the load over-running the end of the bed would soon wear the top of the bed crowning and the under side of the table concave to fit, and it is to counteract this tendency of gravity to wear them out of true that the beds are made longer than the tables. With the milling machine the load is less, more of it in the middle of the table, because there is less gained by putting on small pieces end to end, and the down pressure of the big cutter always in the middle partially, if not wholly, neutralizes the tendency to wear out of true by gravity. When such a machine has side cutters or a vertical spindle, the pressure is always in the middle, first in one direction and then the other, exactly the reverse from the gravity action, and instead of the side guide of the bed being longer than the table it should be shorter, by just about the same amount as the bed of a planer needs to be longer. Many times the sliding piece and its guides can be the same length and keep straight. The things which do not tend to wear out of true do not wear much, and the things which do wear out of true and have to be refitted are never just right but when new and when so refitted. Where a short block slides on a long guide, if the scraper marks wear out sooner along the middle than at the ends, the ends of the guide need cutting off, however much overrun it gives to the sliding block.

The draftsman dare not make a drawing of an engine crosshead overrunning the guide one-third of its length at each end; the builder would hardly dare to build it if he did, and no user has the courage to take out the guides and cut them off or cut away the surface even when he knows it would be money in his pocket, but it is the thing to do. We find that in the case of a slipper guide, owing to the effect of inertia and momentum giving a twisting action to the crosshead, it is necessary to cut away the guide so that the crosshead will overrun very nearly one-half its length before the scraper marks will show uniform wear. This, of course, is subject to modification according as the center of gravity is higher or lower, or the speed of the engine is greater or less. We are building engines with the crossheads overrunning that way and people buy them.

To get the best out of machines, they not only want to be rigid and true, but the drive needs to be powerful. In this respect a worm gear is about as perfect as can be, or cutting spur gear teeth spiral accomplishes about the same result. What appears as an objection to spiral teeth is end thrust against the shoulders, which does not amount to much, and when the shaft runs in reverse directions and end play in the journals is permissible, the journals keep in much better condition. The mention of a worm gear is like the flaunting of a red rag to some people, but it has its place and a good many more places than it has been used in. The claimed objection is excessive friction and loss of power, but the results do not seem to justify the claim. The most perfect worm gear we have (theoretically) is a screw and nut, and they do waste enormously in friction, and in proportion to what they do they wear out the most of any piece of mechanism. The most imperfect worm gear we have (theoretically) is the Sellers planing machine drive, and yet they never wear out, and hence cannot lose much in friction. In the writer's opinion two of the things which never need to have been invented are the Hindley worm gear and a machine for hobbing worm gear. Experience convinces the writer that a liberal pitch worm skewed round so as to properly mesh with a plain spur gear, or one with the teeth at such an angle as to skew the worm a little more, will run more easily and last longer than the other sort. A machine driven with the worm is positive, and if there is any chatter it comes from elasticity in the spindle or the work itself.

The value of lathes, particularly those used for face plate work, is considerably improved by having large and short main bearings. They should be large to resist torsion and short to resist bending, and the ordinary face plates are ridiculously frail. To get the best of a face plate it should be box section and as large as will swing in the lathe. Owing to the rapid wear of screws the writer is convinced that a precision screw in any lathe used in manufacturing is of no special value over a fairly good one. Wearing the screw in one place while threading a few hundred pieces destroys the precision in a way which no future use will ever correct.

If the designer will analyze every detail he will find that many of the old features were not right to meet the old conditions and not half right for the new. While manufacturing is going to call for many more simple machines—that is, machines to do one thing rapidly and well—the machines which will do a variety of work will be still in demand for the sparsely settled sections of the country, and the colonies will call for the country machine shop as of old. It is the hope of the writer that this tirade will bring out an interesting discussion on machine design and the capabilities of the high speed steel, for that is the object of its presentation.

* A paper presented before the American Society of Mechanical Engineers, New York.

## IMPROVEMENT IN BOILER DESIGN.

IT is a fact that, although boilers are, and have been, designed with a view to convenience of stowage, to strength of the structure, to largely increased heating surface, to lightness, and to other points connected with their use, the best conditions for the transmission of heat have not as yet exerted any marked influence upon boiler design. This is remarkable because an observer, looking at the subject from the outside, must at once perceive that steam generation is primarily and mainly a question of heat transmission.

The difference between water in the liquid state and in the gaseous state (or in the form of steam) is merely a matter of heat. A comparatively small amount of heat suffices to raise the temperature of water from that of the atmosphere to 212 deg. F.; but then 966 B. T. U., or degrees Fahrenheit per pound (heat which becomes latent), must be added to the water before its physical state is changed, its volume as steam relatively to its former volume of water becoming about as 1,600 is to 1. This steam has still the temperature of 212 deg., and although it might be supposed that much more heat, and, therefore, fuel, would be required to produce steam of, say, 300 pounds per square inch pressure, or about 415 deg. F., yet that is not the case,

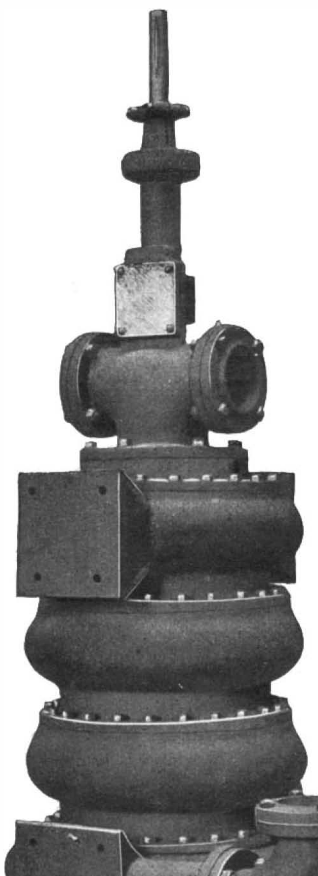
Now, as the combustion of the fuel which furnishes us with this heat cannot take place in contact with the water—in which it is unlike the combustion of the metals potassium and sodium—we are at once confronted with the fact that the heat so yielded must be passed from the outside of some chamber to water on the inside—that is, across some solid medium. That medium is either wrought iron, steel, or copper—most frequently mild steel in ordinary practice; and if we inquire what is its capacity per square foot of surface for transmitting heat, we find that this is practically unlimited, unless interfered with by great thickness or some artificial resistance, such as a coating of scale or oil.

When we turn from this to inquire what is realized in practice with boilers, we find that in the year 1747 an inventor named John Payne, in describing his boiler to the Royal Society of London, announced that he had "rarefied" or turned into steam 90 gallons of water with 112 pounds of coal. This gave an evaporative rate of 8.03 pounds of water per pound of coal; but, unfortunately, we do not know the rate of evaporation per unit of surface.

Present practice with modern boilers rarely exceeds John Payne's result, and, measured per unit of surface, it reveals the astonishing fact that the average evaporation amounts only to from 2½ to 7 pounds, rarely more, and say exceptionally to 10 pounds of water per square foot of heating surface per hour, whereas the writer believes we have solid ground for maintaining that an evaporation of 50 to 80 pounds, and possibly of 100 pounds, per square foot of surface per hour can be obtained in regular practice with suitably designed boilers. Here, then, is a great opening for improvement, and in order to take advantage of it we must make ourselves acquainted with all that can be learned from investigations of the phenomena of heat transmission.—F. J. Rowan, in Cassier's Magazine.

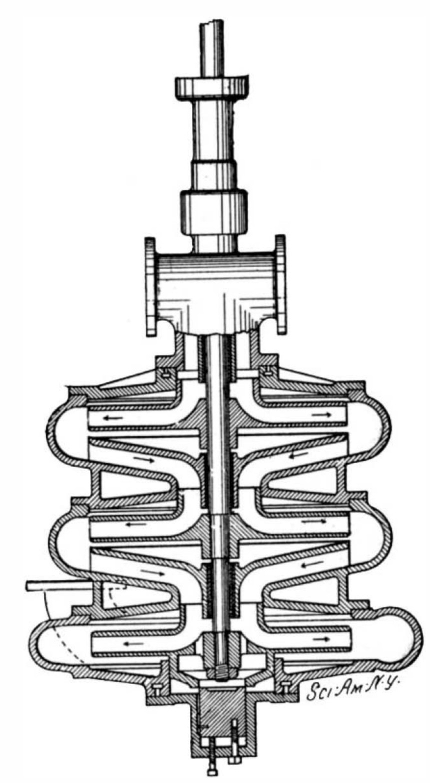
## A NEW CENTRIFUGAL PUMP FOR HIGH LIFTS.

HYDRAULIC engineers and miners have been slow to recognize centrifugal pumps as a medium for delivering water at a height of over 40 feet. Direct-acting steam pumps and geared plunger pumps up to within the last year or so were the only known devices for raising water to high elevations. On account of the heavy expenditures for repairs of direct-acting pumps, owing to excessive wear on the piston and valves, caused by muddy or gritty water, there has been a long-felt need by engineers for an economical pump that could be adapted for any quantity of water at heads ranging from 100 to 2,000 feet. Such a pump is now provided by the invention of Mr. Byron Jackson, of the Byron Jackson Machine Works, San Francisco, Cal. The invention provides a series of high-pressure centrifugal pumps for raising and forcing water by increasing pressure in successive steps, using the centrifugal impactive and cumulative forces set up by two or more rotating runners mounted upon the same shaft. The invention also covers an improved adjustable automatic balance for end-thrust on the shafting and casing sections inclosing suitable curved waterways between the discharge of one runner and the entrance of the next in series. In our illustration we show a vertical pipe of series centrifugal pump, and also a diagram of the pump in section, which reveals its construction. The pump, it will be observed, comprises a series of cylinders, mounted one above the other. Runners of the inclosed type are operated in the upper part of each cylinder. In the lower portion of each cylinder, immediately below the runner, is the casing, in which are the curved waterways adapted to conduct the water from the discharge ports of one runner to the entrance of the next in the series. The waterways are formed by curved vanes, which divide the space between the bottom of the cylinder and the upper wall of the casing into a number of spiral channels leading in toward the center. An annular flange formed on the top of the casing fits snugly over a flange depending from the runner above. The vanes in the casing have practically the same curve and direction as those in the runners.



FOUR-STEP SERIES HIGH-PRESSURE CENTRIFUGAL PUMP.

The operation of the pump is as follows: The pump being filled with water, the impelling runners are driven at a suitable speed to discharge water at the desired head. Rotation of the runner acts to suck in the water at the center and force it out by centrifugal action into the cylinder, whence the water is forced through the waterways to the runners below, finally discharging from the pump with a pressure equal to the sum of all the series of pressures. It is known that the suction and discharge pressure in the centrifugal pump is unbalanced on the two sides of the inclosed type of impellers, and that this inequality of pressure amounts approximately to the number of inches of area of the suction inlet multiplied by the pounds pressure of the total head pumped against. This pressure, however, is never equal to the discharge pressure, which is always varying, depending on the head, and may be more in one side of the runner, depending on the central position of the runner; the greatest pressure per inch being greatest on the side having the greatest clearance between runner and pump case, because of skin friction on the side of runner, producing a pumping effect. To compensate for this varying pressure, caused by the end travel of the pump shaft, changing the clearing space between the sides of the pump case and the runner, a plug is provided, which is movable in the pump casing in line with shaft and port. This plug has a sliding fit with the walls of the latter, and is adapted to be advanced or retracted to enter the port or be withdrawn therefrom, according as it is desired to allow more or less back-pressure water in chamber, to enter the runner again for the purpose of restoring or maintaining equilibrium.



SECTION OF A SERIES CENTRIFUGAL PUMP.

The pump is designed for raising water to heights ranging from 100 to 2,000 feet, and will maintain an efficiency of from 70 per cent to 84 per cent. It is adapted for raising muddy, gritty, sandy water, as well as clear water, without injury to the pump, there being no valves whatever in the pump to wear out.

These pumps are past the experimental stage, for they have already been put into service and given remarkable results. The "four-step" pump shown in our illustration is designed to deliver 450 gallons per minute operating against a total head of 500 feet.

## CONTEMPORARY ELECTRICAL SCIENCE.*

BLONDLOT'S N-RAYS.—After having found that the new kind of light is also contained in an Auer burner (see The Electrician, vol. l., p. 1010, and vol li., p. 236), R. Blondlot studied a number of other sources of radiation, and found that the new obscure rays are also contained in the radiation from a plate of silver or talc heated to redness, and in an ordinary circular gas flame burning without a chimney. He concludes that these rays, though invisible, are of frequent occurrence, and proposes to call them N-rays, after the Nancy University, where they were discovered. He also announces that a small electric spark is not essential for their detection, since the essential thing about it is a small mass of incandescent gas. This is also furnished by a very small gas burner, which acts equally well as a detector, but is not suitable for discovering polarization. It brightens whenever N-rays impinge upon it. That this brightening up of one flame by another has not been noticed hitherto is due to the difference produced in the luminosity of a larger flame not being very evident. The author has found that a screen of calcium sulphide exposed to sunlight shows a notable increase of phosphorescence under the influence of N-rays. This furnishes a good means of detecting them.—R. Bondlot, Comptes Rendus, May, 25, 1903.

RADIO-ACTIVITY OF ORDINARY SUBSTANCES.—Radium is at least 100,000 times more active than uranium, and uranium is 3,000 times more active than the most common active material among ordinary substances. But R. J. Strutt believes that a slight amount of radio-activity is associated with all solids, and that the so-called "spontaneous ionization of air" is due to a slight activity of the walls of the vessel containing it. To test this view, he experimented with a glass cylinder closed at one end by a plate of glass cemented on, which could be removed so as to introduce linings of different materials. He found rates of leakage varying from 3.3 scale divisions per hour in the case of tinfoil to 1.3 in the case of glass coated with phosphoric acid. In platinum the rate of leakage for different samples was 2.0, 2.9, and 3.9 divisions per hour. Thoroughly oxidized copper showed a rate about three-quarters that of polished copper. The author tried the absorption of the radiation by air at different pressures. To do this he determined the pressure at which an increase of pressure produced no increase of leakage, thus showing that all the radiation was absorbed. No such limit was reached with zinc, but with tin it was reached at 10 inches in one sample, and 20 inches in another.—Hon. R. J. Strutt, Phil. Mag., June, 1903.

ELECTROSTATIC DEFLECTION OF RUTHERFORD RAYS.—T. Des Coudres has succeeded in deflecting the positive Becquerel rays, sometimes called Rutherford rays, and in thus establishing beyond doubt their positive character and comparatively large mass. Their magnetic deflection has already been accomplished by Becquerel himself, who found, curiously enough, that there was no magnetic dispersion. This marks a distinct divergence from Wien's canal rays, which show all kinds of velocities. But Becquerel's observation is fully confirmed by the author, and it therefore seems that the positive ions emitted by radium bromide have a single definite velocity and mass. The electrostatic deflection was produced with the aid of a central station supply at 110 volts. A deflection of about 1 millimeter was obtained, with an exposure of 80 minutes and a radium preparation not exceeding 8 milligrammes in weight. The figures obtained by micrometer measurement and calculation were: $mu/e = 2.56 \times 10^5$. From this the author deduces, with the aid of the magnetic deflection, the value $u = 1.65 \times 10^9$ for the velocity, or about one-twentieth of the velocity of light, and $e/m = 6.4 \times 10^3$, thus showing that we have to do with masses of the atomic order.—T. Des Coudres, Phys. Zeitschr., June 1, 1903.

IONIZATION OF AIR BY WATER.—F. Himstedt has found that air supplied by a water-spray pump possesses a considerable conductivity. That this conductivity is not due to its moisture is proved by conducting it through phosphoric acid, which leaves the conductivity unimpaired. That it is not the ordinary waterfall electricity is proved by conducting it through earthed copper wool, which also leaves the conductivity unchanged. These observations led the author to suppose that the conductivity of Elster and Geitel's "cave air" is due to the fact that the air is pressed through interstices between moist particles of sand and earth. On pressing air through moistened glass, wool, coke, or sand a similar ionization was, in fact, observed, and not on pressing it through paraffin oil or benzol. The same sample of water could be used indefinitely, with the same result, and oxygen and carbon dioxide were similarly ionized by it. The author accounts for this ionization by referring to the high ionizing power of water for metallic salts, and supposes that water has a similar ionizing power over gases. The ionized molecules might emerge in an ultra-chemical sheath of water which would gradually liberate them. The conductivity may be destroyed by cooling to the temperature of liquid air.—F. Himstedt, Phys. Zeitschr., June 1, 1903.

* Compiled by E. E. Fournier d'Albe in the Electrician.

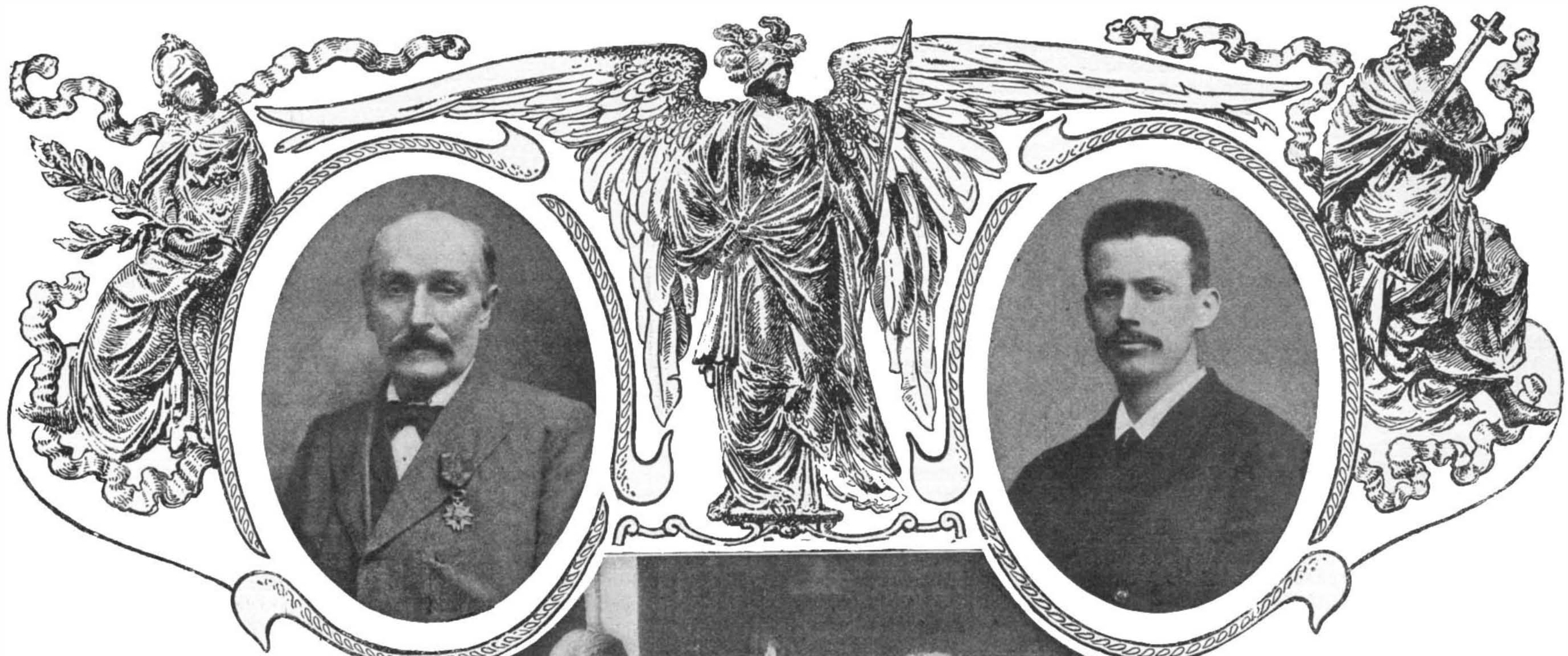
**There are 125,144.14 miles** of main and feeder wires reported by the Census Bureau for both private and municipal stations in the United States. Of this total, 109,805.23 miles, or 87.7 per cent, are reported by private stations and 15,338.91 miles, or 12.3 per cent, by municipal stations. The mains and feeders for underground circuits measure 8,124.26 miles, or 6.5 per cent of the total, and the overhead circuits 116,976.35 miles, or 93.5 per cent. Comparatively few stations have a record of the actual length of the wires strung and ready for service, but the amounts reported are careful estimates prepared by, or under the direction of, the management of each station. In several instances it has been found that electric light stations supply current to electric railway companies, and that, in the majority of such cases, the railway companies own the main and feeder wires over which this current is supplied. There are, however, 199.75 miles of mains and feeders for electric railway service owned by the central stations.

## THE WINNERS OF THE NOBEL PRIZE.

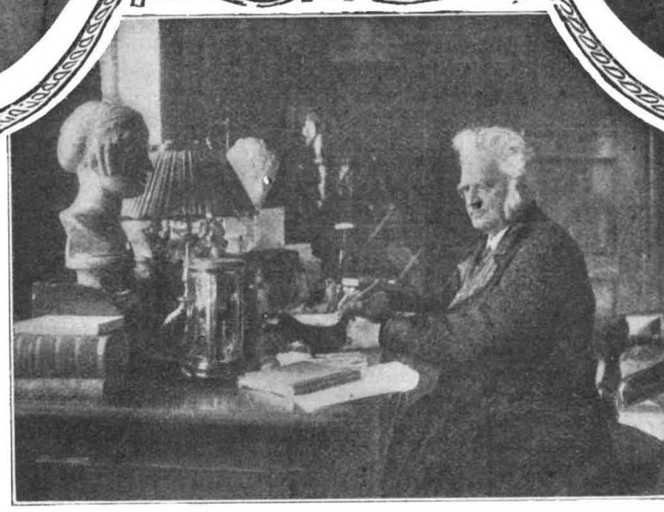
THE Academy of Stockholm has awarded the Nobel prize for chemical science to M. and Mme. Curie and to Henri Becquerel. The recipients are to share the prize. Nearly three years have passed since the names of M. and Mme. Curie have come before the public as the discoverers of radium. Scientific research in the field of radio-active substances has been deemed of such importance that the Curies have been made laureates of the Institute of France, and awarded the Davy medal, one of the highest recognitions of merit which it is possible for the Royal Society of England to confer. The work of M. and Mme. Curie has been based upon the experiments with the radiations discovered in 1896 by Henri Becquerel. It is, therefore, a rather happy decision to award the Nobel prize in chemistry to M. Becquerel and M. and Mme. Curie.

Henri Becquerel is a member of the Institute and professor at the Museum of Natural History. He is a grandson of the illustrious physicist Becquerel.

M. Pierre Curie conducts a course of lectures at the Sorbonne and is professor of physics and chemistry at the Municipal School. Mme. Curie, who is a Pole by birth, is a doctor of science, and professor at the Normal School of Sovres. Mr. William Randall Cremer M.P., received the Nobel prize for work on behalf of international arbitration. Prof. Finsen was likewise honored for the discovery of the light cure which bears his name. Our pictures are taken from the London Illustrated News and L'Illustration.

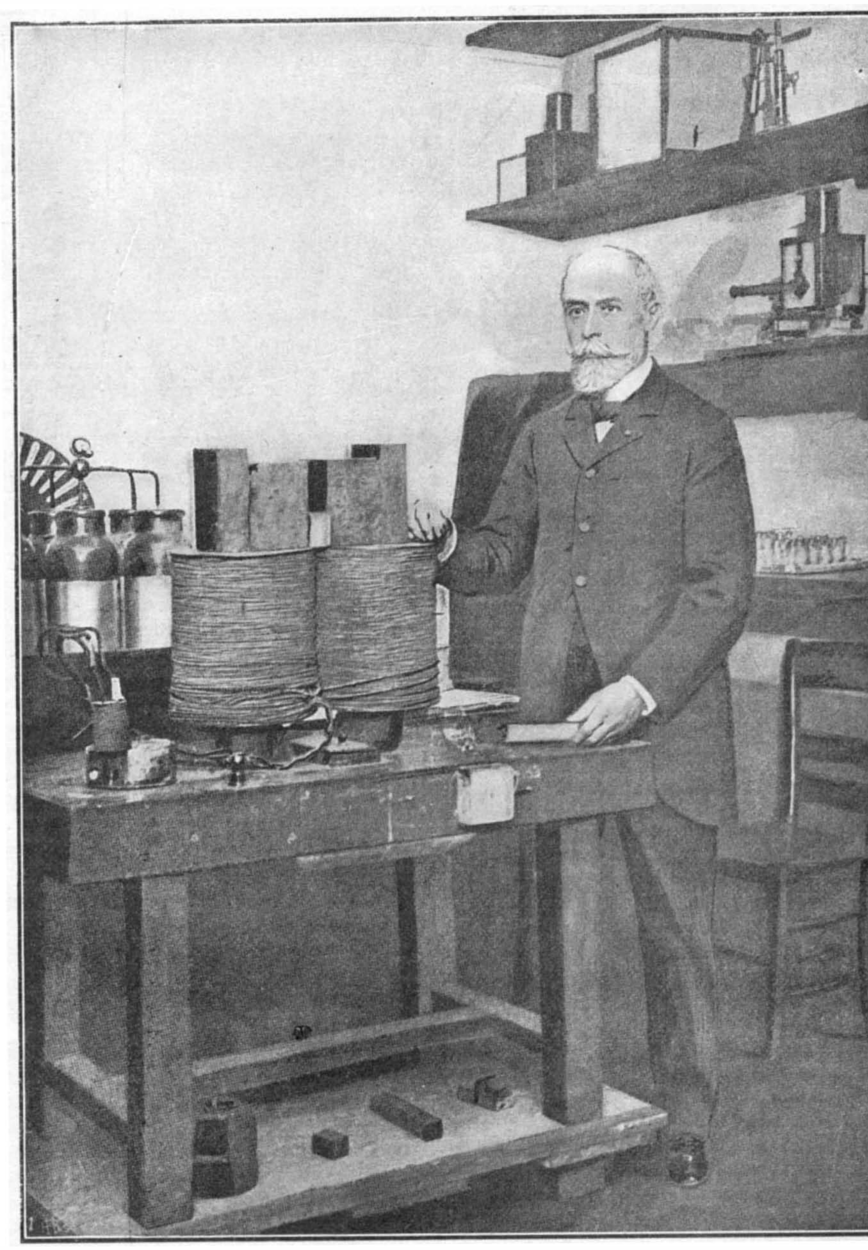


MR. CREMER. PROF. FINSEN.



PROF. BJÖRNSEN.

M. AND MME. CURIE, JOINT DISCOVERERS OF RADIUM, IN THEIR LABORATORY.



PROF. HENRI BECQUEREL, THE DISCOVERER OF BECQUEREL RAYS.

THE WINNERS OF THE NOBEL PRIZE.

## TACT AND TASTE IN ANIMALS.

By AUSTIN FLINT.

THE word *tact*, in the title of this article, has a wider meaning than touch. In human physiology, it is common to recognize a number of subdivisions of impressions made on what are called sensory nerves—such as pain, titillation, heat and cold, pressure, simple contact and touch. The sense of touch usually is described by itself as depending upon peculiar little organs at the ends of nerves; these being prominent in certain parts, but not existing in the general integument. These touch-corpuscles abound in the skin of the pulps of the fingers. In the space of one-fiftieth of an inch square, on the forefinger, more than a hundred have been counted. The intelligence of man enables him to cultivate the appreciation of touch to a degree of exquisite delicacy—wit-

ness the facility with which the blind read, passing the fingers over raised letters. It is related that Giovanni Gonelli, a blind sculptor, modeled excellent likenesses, though guided entirely by the sense of touch. The blind learn to recognize individuals by feeling the face; and it is said that they have been known to become proficient in conchology and in botany.

It does not appear that any of the special senses in the lower animals are susceptible of education; but in the animal scale, the sense of tact, as a rule, becomes specialized from the lower to the higher orders. "In the lowest organisms we have a kind of tactual sense diffused over the entire body." (Tyndall.) Still, there is reason to believe that some nocturnal animals are superior to man in the development of the tactual sense. The few facts I have recited seem sufficient to justify the use of the word tact, instead of touch, as applied to the tactile, or tactual sense in the inferior animals. In many animals, particularly those low in the scale, the sense of tact seems to serve for their protection and apparently for no other purpose; in man, on the other hand, the word tact is often understood to express a mental sense—a quick perception or discernment, rendering one able to say or do the proper thing required by circumstances, and having no reference to the sense of touch.

Many zoöphytes—animals closely resembling plants, such as sea anemones and certain hydroids—appear to have an acute sensibility; and their soft parts contract promptly when touched. This, however, does not depend upon any special organ or organs; and it persists in separated parts so long as they retain life. In many insects, as in the common house-fly, the sucking proboscis presents an enlargement at its end, which serves as a tactile organ. The antennæ serve the same purpose; and some insects are provided with minute tactile hairs. Spiders, mites, and ticks have a pair of legs in front which probably are used as tactile organs, and not in locomotion. Most annelida are provided with tentacles and tactile antennæ. The articulata have mobile hair-like processes, attached to the ends of nerves, which serve as tactile organs. In mollusks, the parts not covered with the shell are distinctly sensitive. Many fishes have special tactile appendages to the skin, as the barbels (soft or rigid), which are like fingers about the mouth, the tentacles about the head, and some parts of the ventral fins. In some birds nerves go to the covering of the beak and terminate in bodies resembling the tactile corpuscles of man. These structures have been described in the parrot, duck, pigeon, flamingo, and many other birds. In parrots, what appear to be tactile corpuscles exist on the tongue and the lower surface of the claws.

In following the specialization of tactile organs, ascending in the animal scale, it is seen that tact, in the lower orders, is a sense which contributes almost exclusively to their means of protection and preservation. In most mammals, however, specialization of function is more distinct; and it approaches the perfection of anatomical and physiological development of what is known in man as the sense of touch. The statement that tact in the lower animals cannot be improved by training or education may be applied as well to the senses of sight, hearing, and smell. In man, education of the special senses is largely, if not entirely, a mental process. We learn, by study and practice, to recognize slight differences and nice peculiarities in visual, auditory, olfactory, gustatory, and tactile impressions; and we obtain thereby exact information. This is intellectual; and it involves an accurate appreciation of impressions, to be attained only by special training and study. In the lower animals, the organs of special sense are adapted to their simple requirements and natural environment. In some domesticated animals that have long existed under the protection of man, certain of the special senses, indeed, appear to have deteriorated. Wild cattle avoid poisonous herbs which domesticated cattle will eat; the sense of hearing is more acute in wild animals than in domestic animals of the same species; and other examples of this kind might be cited.

The adaptation of the tactile sense—using this term in its widest signification—to requirements of animals in their natural or wild state is practically exact. It is invariable that in mammals, prehensile parts are provided with special tactile nerves and often with special nerve-endings. The hands and feet of apes and monkeys (*quadrumana*, or four-handed) are like the hands of man; prehensile tails are endowed with the tactile sense; the forefeet of cats, raccoons, and some rodents are hands, so far as the tactile sense is concerned; the lips of horses and cattle are tactile organs, and so is the nose of the canine genus; the long nose of the mole is exquisitely sensitive to tactile impressions; and this is true of hedgehogs, armadillos, shrews, tanrecs, and other insectivorous mammals.

Many mammals possess so-called tactile hairs, endowed with acute sensibility, situated in various parts. The mustache of the seal is a tactile organ. Curious experiments have been made upon cats, showing the uses of the sensitive hairs (*vibrissæ*) about the mouth. In 1823, Broughton put a kitten, with its eyes bandaged, in a sort of labyrinth. The animal readily found its way out. He then cut off the mustache and repeated the experiment; when the animal was unable to avoid obstacles and to find its way as before this mutilation.

About the end of the eighteenth century, Spallanzani, and afterward Jurine, made extended experiments on the flight of bats. It is well known that these animals fly about freely in profound darkness, never striking against the walls of caves or rooms in which they may be confined. It was the same when the eyes were securely closed; but Jurine found that the flight became uncertain when the ears, as well as the eyes, were bandaged. A modern explanation of these curious facts was afforded by anatomical investigations (Jobert, 1871), in which it was found that on the inner surfaces of the wings of bats, and on the skin of the external ear of bats, rats and mice, as well as of some other animals of the same genus, are small hairs connected with the very abundant nerve-fibers distributed to these parts, which probably are sensitive to currents of air. It is easy to understand how such an arrangement of sensitive hairs would enable bats to avoid obstacles, even in rapid flight.

Investigations into the sense of tact in the lower animals present, of necessity, great difficulties; for we are often unable to understand the phenomena which follow the stimulation of sensitive parts, and to distinguish between what may be simply tactile impressions and impressions of pain. Man, on the other hand, when the subject of experiments, can describe what he feels. It is in this way that students of human physiology have been able to recognize, throughout all regions of the general surface, distinct spots, or areas, irregularly distributed and inter-commingled, from which different impressions are appreciated. In man, in addition to the exquisitely sensitive tactile organs in the pulps of the fingers, there are spots sensitive to contact, others sensitive to cold and not to heat, some sensitive to heat and not to cold, and some sensitive to pain. Physiologists describe these as contact spots, cold spots, heat spots, and pain spots, their relative number differing in different parts of the skin. In number and extent, the pain spots predominate, and the heat spots are the least.

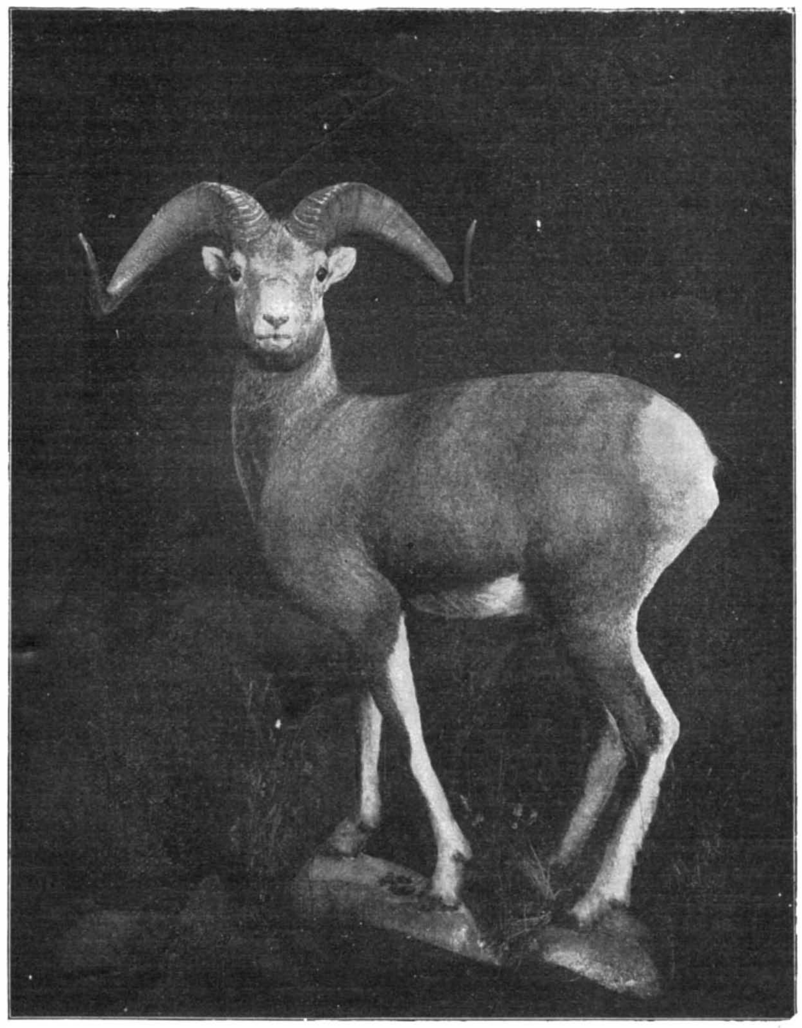
It is difficult, even in the human subject, to draw a definite and exact line of distinction between the sense of taste and the sense of smell. As regards anatomical structure, however, the division is sufficiently plain. There is quite a restricted area in the mucous membrane of the posterior nares which contains special olfactory cells—the end-organs of the olfactory nerves; and the mucous membrane of the tongue, soft palate and fauces contains peculiar end-organs connected with the nerves of taste. The special character of the sense of taste really depends more upon the properties of the gustatory nerves than upon the nature of the substances that make an impression on these nerves. The chief difficulty is to determine what substances, called sapid, attack the sense of taste alone, and what attack the sense of smell as well as the sense of taste. It is difficult also to eliminate substances that attack only the nerves of general sensibility.

In describing the sense of taste, physiologists usually divide savory substances into: 1, sweets; 2, acids; 3, bitters; 4, salines. Savory impressions, however, have an infinite variety; but savory substances are almost always odorous as well. So-called flavors are regarded simply as odors. It is not my purpose to discuss the sense of taste in man; but there is little to be said regarding this sense in the lower animals.

It is probable that insects are endowed with the sense of taste; and it is well known that bees, flies, and many other insects are attracted by sweets, even when these substances have no odor. Comparative anatomists have found taste-organs in the tongue of the frog. Many fishes have no tongue; but it is thought that in the subcutaneous canal-system—which produces a slime that covers the surface of some fishes—little cup-shaped cells, connected with these tubes and abundantly supplied with nerves, enable them to recognize certain qualities of the water in which they swim. Snails and other mollusks prefer certain kinds of food, and the same is true of worms and leeches; but it is probable that they are attracted through the sense of smell rather than of taste. All mammals possess nerves which correspond to the gustatory nerves of man; and all are endowed with the sense of taste. Some pampered domesticated animals are, indeed, exceedingly dainty in their feeding. It is thought that the sense of taste is but little developed in birds, particularly when no taste-organs are found in the tongue.

The senses of taste and smell undoubtedly protect wild animals against poisoning by noxious plants. Monkeys will not touch poisonous berries and fruits. The wild herbivora will not eat poisonous plants. Cuvier observed that a certain ganglion (spheno-palatine), connected with the gustatory nerves, is much larger in the herbivora than in carnivora, and thought that this enabled the herbivora to distinguish between wholesome and poisonous plants; but this idea is not generally accepted.

As regards the inferior animals, it may be said that the sense of taste—associated with the sense of smell—when it exists, is important largely in contributing to the selection of nutritious and appropriate food.—Our Animal Friends.



STONE'S SHEEP.

## STONE'S SHEEP.

In the upper part of the Stikine Valley in British Columbia, H. A. Stone discovered a black sheep of a new species. The animal inhabits the northern limit of the Rocky Mountains of British America. Its beautiful coat is dark colored, and is characterized by many black markings. The illustration which we present of the animal is taken from the United States National Museum Report.

## THE INDIA RUBBER CLIMBING PLANT OF FRENCH CONGO.*

The flora of Congo has been recently enriched by numerous new caoutchouc plants, most of which are imperfectly known through incomplete descriptions of plant collectors. Moreover, the study of the latex of these plants not having been made on the spot, specialists are not able to verify their botanic characteristics by the coagulated substances sent to them, so that great uncertainty prevails in regard to the value of the plants as producers of rubber. The German botanist R. Schlechter, the envoy in 1899 and 1900 of the Wirtschaftliches Committee to Western Africa, has furnished, by his study of the production, the harvesting, and the preparation of caoutchouc, more exact but still incomplete information. The aim of the present communication is to point out some new facts observed by the Chari-Tchad in their journeyings in Congo.

We agree with Schlechter that the only climbing

* Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from the French of M. Aug. Chevalier. Paper presented to the Académie des Sciences.

plant of French Congo yielding caoutchouc that is utilized by the natives to any extent belongs to the *Landolphia Klainii*.

We think that the description of this plant given by H. Hallig de Wildeman refers, not to a single species, but to several confounded under this name. We have so far observed three very distinct forms, characterized especially by the shape of their fruits, which are large and nearly spherical, and from 10 to 20 centimeters in diameter.

The fruit of the first is somewhat mammilated on top, and presents in the upper part ten depressions separated by protuberances; the base is tapering. The leaves, lanceolate and pointed, are 10 centimeters in length, and 3 centimeters wide. This plant was raised in the Libreville garden from seed gathered near the Gaboon.

The second kind bears a fruit round at the top and tapering at the base, making it pear-shaped. The oval, lance-shaped leaves, round at the base and terminating in abrupt points, are from 12 to 15 centimeters long, and 5 centimeters wide. We found this plant at Toumba (Belgian Congo), near the railway line from Matadi to Leopoldville.

The third variety has a fruit which is almost spherical, but very slightly tapering at the base. Its leaves are long and lanceolate at the base, with crisp, wavy edges, measuring from 20 to 22 centimeters in length, and from 5 to 5.5 centimeters in width, that is, four times as long as they are wide. This plant grows at Stanley Falls.

The three varieties of the rubber plant were under our observation too short a time to decide on their specific value. The germination of the seeds of all these climbing plants takes place constantly under very remarkable biological conditions, which no observer has previously recorded.

At maturity, the fruit, like that of all the Eulandolphia, is formed of an exocarp, having a close and resistant sclerous coat enveloping the soft cellular parts and the seeds, which number from 20 to 70.

When the fruit ripens, generally in the course of July, it is detached by its own weight and falls to the ground, where it is quickly attacked by insects. The termites, which were not able to overcome the too resistant sclerenchyma, penetrate the fruit and devour the soft pulp parts; these are replaced with moist earth. The seeds, whose corneous albumen protects the germ, are spared. In the close cavity of the exocarp, surrounded with earth, they germinate in a few days. The young imprisoned plants are impoverished, lengthen out in growing, and wind several times around the interior of the cavity. Usually, they are not freed from this prison until atmospheric agents or animals have broken the carapace. Then the roots strike into the ground, the stems shoot up and develop their leaves, and the termites seek a shelter elsewhere.

Thus the *Landolphia Klainii* forms clusters around the parent plant. Most of these young plants perish in the deep shade of the forest, but the strongest fasten their tendrils to the trees, and when they have reached the bright light at the extreme ends of the branches, then, and only then, do the plants thrive and develop normally.

## THE GEOLOGICAL SOCIETY OF AMERICA.*

THE sixteenth winter meeting of the Geological Society of America took place at St. Louis, December 30, 1903, to January 1, 1904, in connection with the annual convention of the American Association for the Advancement of Science. The sessions took place in the Central High School, under the chairmanship of the president of the society, Mr. S. F. Emmons, of the U. S. Geological Survey. The society was welcomed to St. Louis by Prof. J. A. Holmes, chief of the Department of Mines and Metallurgy at the Universal Exposition to be held this year in St. Louis. The reports of the council and the officers of the society showed its usual satisfactory condition, although the membership shows a net loss of two. There are now 254 fellows on the active list, aside from the eleven new names added at the St. Louis meeting. The fourteenth volume of the official bulletin of the society was completed during 1903. It is a volume of about 600 pages, comprising valuable articles in the several branches of geologic science. The book is illustrated with 65 half-tone plates and 43 line drawings, making it one of the most attractive volumes ever issued by the society. Thirty-nine papers were listed in the programme for the St. Louis meeting, but ten of them in the absence of their authors were read by title only. Three fellows have died during the past year: J. P. Lesley, for many years State geologist of Pennsylvania; W. C. Knight, professor of geology in the University of Wyoming; and Peter Neff. Memorials of these were presented by Profs. J. J. Stevenson, E. H. Barbour, and H. P. Cushing.

In his presidential address President Emmons took up the subject: Theories of ore deposition, historically considered. This treatise was a concise summary of the stages through which the discussion of the important question as to the origin of ores has passed from the earliest times to the present. Agricola collated many facts which have been enormously added to since, and several conflicting theories have been propounded. Werner, Hutton, Sandberger, Posepny, and others have proposed epoch-making theories, while the numerous practical investigators now living have done much to establish some of the old theories and disprove others, without proposing much that is absolutely new.

According to the scheme followed by the council in arranging the programme, the papers offered were classified under eight subdivisions of the general subject of geology, areal, palæontological, petrographical, physiographical, historical, physical and structural, glacial and stratigraphical, which begin the programme of a meeting in rotation. The areal papers came first this time, and the list began with one by Dr. O. C. Farrington, of Chicago, entitled "Observations on the geology and geography of western Mexico." This paper described a journey from Durango westward to Vantanas across the plateau of the western Sierra Madre. The plateau exhibits a comparatively unbroken surface, rising gradually from an altitude of 6,000 feet at Durango to about 9,000 feet farther west. Then it slopes toward the Pacific, and is deeply dissected by streams. The evidence obtained shows that the divide has a geologically rapid movement eastward. The region is for the most part comparatively arid, although on the western edge of the plateau extensive forests occur. The rocks are largely eruptive. The Cerro Mercado, or Iron Mountain, is in the region, and an area of remarkable erosion forms known as the "City of Rocks."

Prof. C. H. Hitchcock, of Dartmouth College, contributed a paper on the Ammonoosac district of New Hampshire, in which he gave the results of recent studies in a region which he has been investigating for several years. This district is the only part of New Hampshire which yields fossils. These are now known to belong to the middle portion of Upper Silurian age. There are several masses of grasses, protogene, diosite, and hornblendite, which were formerly held to be metamorphosed sedimentaries, which the author now considers of igneous origin. The numerous fractures in the "auriferous conglomerate," a widespread formation, indicate that the whole region is a mosaic composed of faulted fragments or blocks.

In discussing the nickel-bearing rock of Sudbury, Ontario, Prof. A. P. Coleman, of Toronto University, stated that field work carried on during the past two years had proven that the eruptive rock accompanying the ore has a continuous outcrop inclosing an oval area forty miles by sixteen in extent. The bed is in reality a sheet of rock from one to three miles thick, forming a boat-shaped basin with intrusive contact with the rocks both above and below. Most of the ore seems to have separated by gravitation from the igneous mass while still molten, but part has been deposited by circulating waters. The ore bodies are found along the more basic outer edge of the oval and along dikelike extensions of the eruptive rock. One mine alone contains several million tons of ore.

Dr. Samuel Weidman, of the University of Wisconsin, called attention to the fact that the occurrence of the mineral fayalite in igneous is much more widespread than has been supposed. The decomposition of this mineral gives rise to the production of much magnetic iron oxide. It also alters readily to serpentine, and thus loses its density. Prof. U. S. Grant, of Northwestern University, gave a paper on the methods adopted by the Wisconsin Geological and Natural History Survey for the 1903 field work in the lead and zinc district of the State. The topographic and geologic mapping were carried on at the same time by the same individuals on large-scale maps, which are expected to give important results in working out the details of the relations of the ore bodies to the structure of the district. Prof. A. R. Crook, of Northwestern University, described the molybdenite mine at Crown Point, Washington, which furnishes the largest amount of the mineral of any of the localities in this country. Twelve tons were obtained here in 1902. The mineral occurs in a quartz vein two to three feet thick in granite. The granite is barren of molybdenum, hence the ore in the vein apparently is not the result of lateral secretion.

Prof. W. M. Davis, of Harvard University, gave a preliminary description of the physiography and glaciation of the western Tian Shan Mountains in Turkestan. The studies were made during the past year by himself and Mr. E. Huntington, of Cambridge, Mass. The existing ranges of the Tian Shan Mountains result from the elevation and greater or less dissection of a more ancient mountain system that had been previously subdued or worn down to small relief over a large area. The elevation of the old-mountain region was accomplished in part with moderate deformation, in part with strong blockfaulting. The mountains show much glacial erosion, which is still continuing, sharpening the peaks. Not less than five glacial epochs were determined, all characterized by true mountain glaciers, there being no confluent ice sheets.

Prof. W. H. Hobbs, of the University of Wisconsin, in a paper on the tectonic geography of southwestern New England and southeastern New York, discussed the important elements in the architecture of the earth's crust within that province, as a result of extensive surveys made for the U. S. Geological Survey. A number of "key areas" were selected having regard both to the intricacy of their structure and to their distribution within the province and studied with much detail. The structural elements characteristic of the individual areas were then compared and their relationship to the broader structural lines of the province as a whole considered. The essential facts were set forth by means of maps projected upon the screen.

A second paper by Prof. Hobbs, entitled "The lineaments of the eastern United States," was an extension of the investigation into the tectonic geography of portions of New England and vicinity, with a view to determining whether structures found to characterize that province are common to the larger regions as well. The materials of the study have been the topographic maps of this region and the published works of other geologists, the methods of examination and the point of view being, however, new.

The author finds that there have been two great control lines, one running N. 48 deg. to 50 deg. E. and the other N. 85 deg. W., which have influenced deeply the drainage and topography of the region.

The next paper was upon the existence of a pre-glacial peneplain in the driftless area of the Northwest. In this paper Prof. U. S. Grant gave the results of studies carried out by himself and Prof. H. F. Bain. These authors find that in southwestern Wisconsin and adjacent portions of Illinois and Iowa there is a well-developed peneplain cutting across part of the Maquoketa shales, the whole of the Galena, Trenton, St. Peter, and Lower Magnesian and terminating to the north in a sharp scarp developed in the soft Potsdam sandstone. The peneplain rises gradually to the north. Above it are the so-called "mounds" capped with Niagara limestone and forming monadnocks left in the dissection of an older peneplain. Below it the streams have cut valleys with sides of simple continuous slope. The valleys are arranged in normal dendritic fashion. Streams heading outside the area show terraces of glacial-derived material and their tributaries show commonly a low terrace developed by silting up of slack water. The peneplain represents the last great period of baseleveling before the oncoming of the glaciers. It was followed by one of sharp downward stream-cutting which continued apparently with but slight interruption through the Pleistocene to the present.

Dr. E. O. Hovey, of the American Museum of Natural History, followed with three papers upon St. Vincent, Martinique, and Guadeloupe. He described with the aid of numerous lantern slides the striking erosion phenomena which have developed upon the first two of these islands in the coating of dust and ashes deposited by the recent eruptions. Then he showed photographs illustrating the growth of the wonderful spine of Mont Pelé, which was such a prominent feature of the volcano last winter and spring. In the paper upon Guadeloupe photographs were shown to substantiate the author's idea that the Grande Soufrière of that island was a "cumulo-volcano" which had passed through the same history as that through which Mont Pelé is now passing. These topics have been treated by the same author in the SCIENTIFIC AMERICAN SUPPLEMENT for July 11 and December 5, 1903.

In a paper upon "Domes and dome structure in the High Sierra," Prof. G. K. Gilbert, of the U. S. Geological Survey, said in part: "In many dome-like granite hills the rock is divided into plates by curved joints approximately parallel to the surface. Some observers call the structure exfoliation, others regard it as an original structure of the granite. Under one view the surface forms determine the structure; under the other the structure determines the surface forms. A study of the High Sierra of California in the summer of 1903 has led the author to accept the former view, and to believe that the forms of the parting planes are conditioned by the forms of the topography. As to the cause of the phenomenon the following hypothesis is advanced. Formed deep within the crust, the granite was initially subject to compressive stress, which was balanced by internal expansive stress. As the unloading involved in subsequent denudation reduced the compressive stress, the unbalanced expansive stress caused strains which eventually resulted in exfoliation."

Dr. F. P. Gulliver, of Southboro, Mass., presented the results of continued studies upon the shore lines of Nantucket Island. The plane table surveys by the author of the foreland of Miacomet, at Surfside, show that the sands have built out some 1,500 feet in the last forty years at one of the most exposed portions of the island, while extensive cutting back has taken place both east and west of this foreland. At Smith Point the shoreline is rapidly moving to the north.

"The new geology under the new hypothesis of earth origin" was the title of an elaborate discussion by Prof. Herman L. Fairchild, of the University of Rochester, of the geologic bearings of the planetesimal hypothesis advanced by Prof. T. C. Chamberlin at the Denver meeting of the American Association for the Advancement of Science in 1901. The present paper made a brief comparison between the new conception of the genesis of the earth and that known as the nebular hypothesis of Laplace, to show how the old theory had failed to explain phenomena and had been a hindrance to the progress of geologic science. Some of the topics discussed were: Origin of the atmosphere; origin of the ocean; volcanic phenomena; source of hydrocarbons; geologic climates; diastrophic movements; life on the earth.

Mr. G. D. Louderback, of the U. S. Geological Survey, presented a paper on "The Humboldt region; a study in Basin Range structure," in which the fact was brought out that the upper beds in the region are volcanics which were originally level upon folded rocks. The fault structure, which is shown by physiographic considerations, is oblique to the general trend of the range. The drainage on the east side of the range is consequent on this faulted structure, while the drainage of the west side is inconsequent on the folded structure. These observations amount to a demonstration of the "revised basin structure" first proposed by Clarence King, which is that the region was first folded and then lifted, tilted, and faulted.

Mr. Charles R. Dryer, of Terre Haute, Ind., in a paper on the western Finger Lake region of New York State between Canandaigua Lake and the Genesee River, said in part: "The northward slope of the Allegheny plateau is here trenched by deep, narrow valleys, four of which contain small lakes, while a fifth is lake-

* Specially reported for the SCIENTIFIC AMERICAN SUPPLEMENT.

less. These valleys are similar in general character to those of the larger Finger lakes, but bear peculiar relations to one another and to the east-west Cohocton Valley. In several cases the head of a minor valley opens broadly into the side of a major valley but a few hundred feet above its floor, thus sustaining the relation of a headward hanging valley. These are thought to furnish criteria for estimating the amount of differential deepening by ice erosion. The main valley heads are blocked by massive terminal moraines and overwash plains. The steep valley slopes are broken by rock terraces which support well developed marginal moraines. Pitted or morainal deltas indicate the existence of high-level marginal lakes. Transverse passes and high level longitudinal valleys are choked for many miles with morainal deposits terminating in an overwash plain. Some of the principal ridges present drumlinoid profile, while their lateral slopes were greatly over-steepened. The phenomena indicate that during the late Wisconsin period the region was occupied by a complex system of distributary and intercepting ice streams, to which the present depths and sharpness of the valleys are chiefly due."

Prof. H. L. Fairchild gave a paper in which he argued a slight amount of glacial erosion in western New York from the meager glacial deposits between the great terminal moraine and the drumlin area along the Mohawk River, and from the apparently slight action upon the rocks in this area. Another paper by Prof. Fairchild brought out by means of a series of comparative photographs the diminution and retreat of the glaciers of the Alps which has taken place within recent years.

In a paper upon the Iroquois Beach in Ontario, Prof. A. P. Coleman, of Toronto University, stated that the result of field work carried on for several years had traced the old glacial beach from Hamilton to Havelock, where it seems to cease to exist. The highest level is 498 feet above Lake Ontario, or 744 feet above the sea. Northeast of Colburn the beach is split up into parts, and at one place the highest is 80 feet above the lowest; but southwest to Hamilton the beach is practically a unit, and the same is true on the south shore to Niagara River. It is believed that the evidence obtained proves that Iroquois Water was a lake with an ice barrier to the northeast and that it was not an arm of the sea.

The mooted question as to the origin of the extensive loess deposits of the Missouri Valley was discussed in two papers. The first was by Prof. George Frederick Wright, of Oberlin University. This author finds direct evidence of the agency of water in distributing the loess in: (1) The relations of the loess to the main valleys of the Missouri and its larger tributaries; (2) the existence of distinct laminæ, at a height of 180 feet above the river at St. Joseph, which are very clearly of water origin; (3) the new light shed upon the glacial occupation of the region by the discovery of northern drift on the south side of the Missouri River forty miles beyond the boundary which has heretofore been assigned to it; (4) considerations which show the doubtful character of the conclusions drawn from the fossil shells found in the loess; (5) calculations showing the reasonableness of the supposition that at the close of the Iowan stage of the glacial period there were periodical floods each summer sufficient to cover the whole region occupied by the great body of the loess.

The other paper upon the loess took a very different attitude regarding the question. This was by Prof. B. Shimek, of Iowa University, and discussed the fresh-water shells which occur in the deposits. The author began with a review of the available literature in which reference is made to the occurrence of fresh-water shells in the American loess, with a discussion of the significance and weight of such testimony, showing that as yet no well authenticated cases of the occurrence of fluviatile shells, at least in original loess, are known. Then followed a statement of the author's own extensive experience in the study of loess mollusks, which shows that land shells greatly predominate, and that only such fresh-water forms as inhabit temporary small ponds and streamlets occur in the loess, and these in relatively small numbers. The distribution of living forms in the Mississippi Valley is the same as that in the fauna of the loess. The conclusion is that the deposits were built up mainly by wind under conditions similar to those which prevail at the present time.

Other papers as read were by Prof. C. F. Marbut, of the University of Missouri, on "Recent studies in the physiography of the Ozark region in Missouri" and "Farther study of Ozark stratigraphy;" by Dr. E. R. Buckley, State Geologist of Missouri, on "A system of keeping the records of a State geological survey;" by Dr. David White, of the U. S. Geological Survey, "Notes on the deposition of the Appalachian Pottsville;" by Prof. J. E. Todd, of Vermilion, South Dakota, on "The Benton formation in eastern South Dakota."

At the same time with the meeting in St. Louis the Cordilleran section of the society met at the University of California, Berkeley, and listened to the following programme: "A detail of the geology of the Joplin, Mo., district," by W. S. T. Smith; "The fauna of the Lower Miocene of California," by John C. Merriam; "The Miocene deposits of the southern Coast Ranges of California," by F. M. Anderson; "A cross-section of the Coast Ranges of California in the vicinity of Mount St. Helena," by V. C. Osmont; "Glaciation in Central South America," by W. G. Tight; "The geographic development of the Bolivian plateau," by W. G. Tight; "The geomorphogeny of the Upper Kern Basin," by Andrew C. Lawson.

The officers elected for the ensuing year are: President, Prof. J. C. Branner, of Stanford University; vice-presidents, Prof. H. S. Williams, of Yale University, and Prof. Samuel Calvin, of Iowa State University; secretary, Prof. H. L. Fairchild, of Rochester University; treasurer, Dr. I. C. White, State Geologist of West Virginia. The next meeting of the society will be held in Philadelphia beginning Wednesday, December 28, 1904.

## ENGINEERING NOTES.

**An ingenious tool** has been designed by Mr. Charles Simmons, of London, for boring in mines and quarries. This appliance consists of an iron upright or spreader bar, about 9 feet in height, attached to which is a small cylinder. Through this cylinder an ordinary 2-foot drill is passed, the latter being maintained in a rigid position by a powerful spring and grip lever. A foot pedal working in conjunction with a piston causes the drill to revolve. The "drillibite," as it is called, is capable of use in mines and quarries under varying conditions at a great economy of time and money, one man being able to carry out the same amount of work as hitherto achieved by two.

**To care properly for a pump** one must understand its mechanism and the principles involved which cause it to lift water. In mine pumps there are two sets of valves, known as suction and discharge valves; if either set of valves are out of order the efficiency of the pump will be decreased. The surface of all water exposed to the air has the pressure of the atmosphere upon it; therefore if one end of a tube be closed by a valve and the other end lowered into water it will be possible to cause the water to rise in the tube by drawing the air out of it. The plunger of the pump, by creating a vacuum in the suction pipe, draws the water up until it passes into the pump through the suction valves. If the suction pipe is not air-tight, or if the suction valves leak, the plunger cannot draw water, from which it follows that the efficiency of a pump depends much upon the suction mechanism, and that must be made air-tight so that no air enters the suction pipe from above the valves. To illustrate this principle, draw water into a glass tube with the mouth, from a tumbler, and slip the finger tightly over the end of the tube in the mouth. The water will stay in the tube even though it be lifted out of the tumbler. The moment the finger is removed and air allowed to enter the tube from above, the water flows out from below. A similar phenomenon occurs when the suction valves or the suction pipe of a pump leaks. The theoretical capacity of a pump is the volume of water displaced by the plunger multiplied by the length of the stroke; but the theoretical capacity is never realized, and falls short from 20 to 40 per cent, according to the quality of the pump. This loss arises from the lift and fall of the valves, from inaccuracy of construction or leakage, and sometimes from there being too much space between the valves and plunger.—Mines and Minerals.

**In a recent British patent** (No. 7778, of 1902) R. A. Hadfield, of Hecla Works, Sheffield, described a method of increasing the resistance to compression offered by steel of different kinds when subjected to pressure, such method consisting in heating the steel, whether in the cast or forged form, and either directly or after being annealed, to a temperature of not less than about 850 deg. C. and up, it may be, to, say, 1,100 deg. C., depending upon the amount of carbon in such steel and the degree of stiffness it is desired to impart thereto, after which the steel is allowed to cool in air, or in a suitable non-conducting material such as sand, or it may be in the heating furnace. Another more recent invention of Mr. Hadfield's (No. 25,973, of 1902) describes an improved method in order to still further increase the hardness or stiffness of the steel, and improve the quality thereof. The steel is first heated in the manner described in his former specification to a temperature above 850 deg. C. or thereabouts, and it may be up to from about 1,000 deg. C. to 1,150 deg. C., according to the hardness desired, and is then allowed to cool down either completely, say to the temperature of external atmosphere, or only partially, say to about 300 deg. C. to 400 deg. C., after which it is reheated to a temperature of from about 500 deg. C. up to 720 deg. C., and then allowed to cool. The harder the steel is required, the lower should be the reheating temperature. The tougher the steel is required, the higher should be the heating temperature. For example, to obtain a harder kind of steel, the reheating may be carried to about 600 deg. C., and to obtain a tougher steel, the reheating may be carried to about 680 deg. C. A temperature of about 725 deg. C. should not be exceeded or the steel will become too soft and lose its stiffness or resistance to high compression stress. Temperatures between about 725 deg. C. to 850 deg. C. should therefore be avoided or the desired stiffness will not be obtained. The complete cooling of the steel after the preliminary heating may be effected in the furnace, but preferably in the open air, or it may be in suitable non-conducting material such as sand. When only a partial cooling of the steel is to take place this may be effected in the furnace, but preferably in the open air, the steel on reaching a temperature of from about 300 deg. C. to 400 deg. C. being put back into the furnace, and subjected to the further reheating treatment hereinbefore described. The final cooling may be effected in any convenient manner, as, for example, in one or other of the ways hereinbefore mentioned. The invention is specially applicable to the treatment of hard nickel chromium steel for use in the manufacture of armor-piercing projectiles.

## ELECTRICAL NOTES.

**Electric arc lamps were first used commercially,** to a limited extent, in 1876, but the first central electric light station supplying current to such lamps was not installed until 1879. Incandescent lamps were introduced commercially during 1880 and 1881, and the first central station commenced operations in 1882, but during the interim a number of isolated lighting plants had been installed for lighting buildings and vessels. The electrical industry had not developed sufficiently to be enumerated at the census of 1880. The first information appears in the reports of the census of 1890, but as statistics are presented only for the central stations and isolated plants in New York State and the central stations in the District of Columbia and the city of St. Louis, no comparisons can be made to show the growth of the industry in the entire country.

**For all classes** of central electric light and power stations 1,390 waterwheels are reported in operation. Of this number, 113, all but 1 of which are operated under private ownership, possess a stated capacity of 1,000 horse power and over. The smaller size of waterwheels predominates, and wheels having each a stated capacity of 500 horse power and under form 85.4 per cent of the total number installed. Their horse power, however, forms only 39.7 per cent of the total horse power. Only 8.1 per cent of the waterwheels have a stated capacity of 1,000 horse power and over, but their total stated horse power forms 47.2 per cent of the total for all classes of waterwheels. But 82 waterwheels are reported in stations operated under municipal control, and of this number 80 have a stated capacity of 500 horse power and under.

**The smaller type of engine** appears to predominate in all central electric stations, as the number of engines having each an indicated capacity of 500 horse power and under forms 91.9 per cent of the total number of engines, and their horse power 61.5 per cent of the horse power of all engines, while the number of engines having an indicated capacity of 1,000 horse power and over forms only 3.4 per cent and their horse power 24.4 per cent of the total. These proportions, however, are much more pronounced in municipal than in private stations. Only 0.4 per cent in number and 2.9 per cent of the horse power capacity in municipal stations are reported for engines having an indicated capacity of 1,000 horse power and over, while 90.7 per cent of the horse power in use in the same class of stations is reported for engines of 500 horse power and under.

**Of the total amount,** $11,635,509, reported as the cost of fuel consumed during the year by central electric stations, $10,189,685, or 87.6 per cent, is reported by stations operated under private ownership, and $1,445,824, or 12.4 per cent, by those operated under municipal control. Of the total amount reported by private stations as the cost of fuel, 85.9 per cent represents the cost of coal and 14.1 per cent the cost of all other fuel. Next to coal, crude petroleum is the most important variety of fuel, its cost in the private stations forming 6.9 per cent of the total cost of all fuel. The cost of crude petroleum consumed by the stations in California alone amounts to $515,820, and by those in Texas $128,087, leaving only $77,931 for all other stations. In stations operated under municipal control, coal forms 82.6 per cent and all other fuel 17.4 per cent of the total cost of fuel.

**It is probable** that engineers are the most important class of wage-earners in American central electric light and power stations, as regards both the number employed and the character of their duties. It appears that in the private stations 43.4 per cent of the engineers receive less than $2 per day, as compared with 52.6 per cent in the municipal stations. The prevailing rate of pay for this class of employes is from $1.50 to $2.49 per day, and 56.1 per cent of the number in the private stations are included in this group, as compared with 60.2 per cent in the municipal stations. There is a marked excess in the proportions at the higher rates in the private stations, and a corresponding excess in the proportions at the lower rates in the municipal stations. The lower rates of pay for municipal stations may be due in part to the fact that the stations are comparatively small, and the wages are controlled by the amount of business and the responsibility of the positions.

**Exclusive of "power purchased,"** "incandescent lamps" is the largest item of cost in the supply account of the electric light stations operated in the United States under private ownership, forming 13.8 per cent of the total cost of all supplies, while in the case of municipal stations the largest item next to "freight paid" is the "cost of carbons for arc lamps," representing 15.4 per cent of the total cost. The cost of hoods and miscellaneous supplies for arc lamps, amounting to $27,218, is included in the $1,853,544 reported as the cost of "all other materials." A small number of central stations are engaged in the production of electric current for distribution to other stations and are classed as distributing stations, but they also generate power to a limited extent. There are 136 stations that report the purchase of electric current costing $1,300,925; 71, the purchase of water power costing $210,619; 95, the purchase of steam power costing $296,831; and 1, the purchase of power generated by gasoline engines costing $240. There are 85 stations which rent the use of water for the operation of water wheels, paying $322,144 for the same, and a number report amounts aggregating $460,011 as paid for water to generate steam.

[Concluded from Supplement No. 1462, page 23425.]

## STABILITY TESTS FOR NITROCELLULOSE AND NITROCELLULOSE POWDERS.*

By Albert P. Sy, M.S., Assistant Chemist, Ordnance Department, U. S. Army, Frankford Arsenal.

### THE NEW TEST, 115 DEG. C.

From one to four whole pieces of powder are weighed on a watch glass and heated for eight hours in an air bath regulated to 115 deg. C. (+ or — 0.5 deg.); the sample is then taken out, allowed to cool in a desiccator and weighed. This is repeated for six days, at the end of which time the total loss of a powder must not exceed 8 per cent.

A specially-constructed air bath is used for obtaining a uniform temperature. The apparatus, shown in Figs. 5 and 6, consists of a double-walled, sheet copper oven like the water ovens in general use, except that the new oven has the inner bottom slightly V-shaped (Fig. 6, *d*); this effectively prevents bumping. Between the walls the oven is filled (about two-thirds full) with a mixture of xylol and toluol in such proportion that when the mixture boils, the air in the oven has a temperature of 115 deg. C. A reflux condenser prevents the evaporation of the xylol-toluol.

In developing the new test a great deal of experimental work was necessary (credit is due Capt. Dunn for suggestions and aid in this work). The points to be decided were: 1. Does decomposition increase as the temperature increases? 2. Does a bad powder decompose more rapidly than a good one? 3. Which is the most suitable temperature for the new test?

Decomposition increases with the temperature. Experiments soon showed that a bad powder decomposes much more rapidly than a good one. Decomposition at 100 deg. C. is very slow; at 110 deg. it increases, but requires too much time to show a decided difference between good and bad powders. At 115 deg. decomposition is still further increased, and big differences are shown between good and bad powders in a reasonably short time.

Experiments were made at 120 deg.; at this temperature powders decompose more rapidly than at 115 deg., but the difference between a good and a bad powder is not as great, all powders decomposing more or less rapidly.

Although it is desirable to shorten the time of a test, yet it is undoubtedly of greater value the nearer the temperature approaches that of ordinary conditions of storage and handling.

Experiments were made to shorten the time of the new test by sealing the samples in tin boxes and thus effecting decomposition under pressure and determining the combined effect of heat and pressure.

The weighed samples were sealed up (soldered) in small tin boxes and then exposed to 80 deg. and 100 deg. C., opened at regular intervals and weighed. At 80 deg. decomposition is slow but considerably greater than if heated in the open. At 100 deg. (sealed) decomposition proceeds quite rapidly, being almost as great as at 115 deg. in the open. Further experiments are to be made along this line of testing.

After applying the new test to a large number of powders it was found to give more reliable results than any other test now in use. It has the following advantages:

(1) The powder is tested in its *natural condition*, the same in which it is stored or used.

(2) It shows *all* products of decomposition; the older tests show only *acid products*, or only nitrogen as in the Will test.

(3) It shows the decomposition of *nitro-compounds other* than nitrocellulose which are often present in a powder, and also shows the *effect of this decomposition* on the powder itself.

(4) It shows the effect on the stability of a powder of added substances (for masking stability); the effect of volatiles; handling and working which may set up local decompositions; traces of nitrating acids; decomposition due to saponification by water, alkalies, carbonates, etc.

(5) It shows *quantitatively* the progress of *all* decomposition.

(6) The test itself as well as the apparatus used is simple and not subject to variations like the old tests.

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**Prof. H. H. Turner**, F.R.S., of Oxford, in a communication presented to the British Association dealt with the interesting problem, whether any of the "new" stars had previously been known as faint stars. Our information about the historical examples of new stars was too scanty, he stated. The Nova Persei had, after its discovery, not been traced on Pickering's charts; but longer exposure might have revealed it. The Nova Gemini was discovered this March at Oxford. Exact measurements of the object and other stars in that portion of the sky on plates obtained at the Yerkes Observatory, and by Max Wolf, at Heidelberg, differed slightly, so that he had come to the conclusion that the identity of the new star with a faint old star was doubtful. That morning he had, however, received a letter from Prof. Barnard saying that there was a minute star close to the Nova. Prof. Turner added that it would be necessary in settling such questions to go down to stars of the 15th and 16th magnitudes; it was noteworthy that new stars had almost all been found in or near the Milky Way, presumably at very great distances.

* From Journal of the United States Artillery.

## DAIRYING AT HOME AND ABROAD.*

By Henry E. Alvord, Chief of the Dairy Division, Bureau of Animal Industry.

### INTRODUCTION.

To those engaged in dairy farming in the United States or interested in this industry, and who have given no particular attention to dairying in other lands, it may be interesting—in some degree instructive and perhaps encouraging—to compare the means, methods, and practices of the dairy in Europe with those of our own country. For this purpose it may be assumed that the conditions under which dairying is conducted in America are well understood by the reader. The several breeds of cattle best adapted to the dairy, their history and characteristics; the average dairy cow and the most approved methods of housing, feeding, and caring for her; that most important and delicate operation of milking; the care of milk on the farm with modern appliances; the making of choice butter and the shipping of market milk—all these matters are familiar in their detail and have been made the subject of popular publications. Issues in the Farmers' Bulletin series and other bulletins of the Department of Agriculture cover this ground thoroughly. The practice and general problem of the milk supply and milk service of large towns and cities, while less familiar to dairy farmers generally, is better known to a different class of men; but, interesting and important as the subject is, it is not proposed for special presentation in this paper. Cheese making has so nearly ceased as a farm or domestic industry and has been so generally transferred to the factory, that this branch of dairying is a comparative novelty to most American dairymen of the present day. This will therefore be referred to, although in very general terms. On the other hand, it may be assumed that the scenes and circumstances of dairying in the Old World are familiar to comparatively few, and that the opinions of one who has recently studied them in person will be accepted kindly and at their face value.

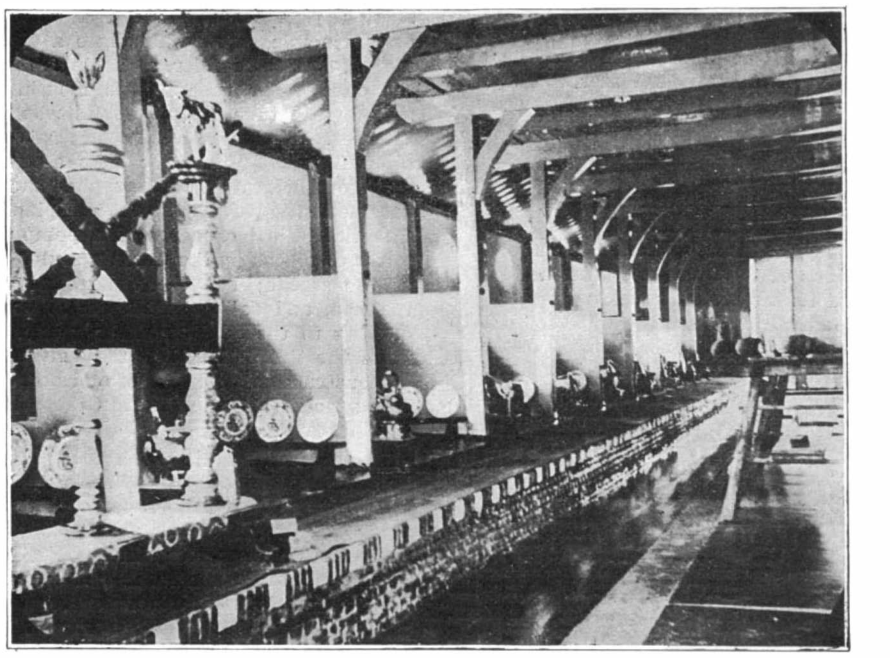
### DAIRY CATTLE IN THE UNITED STATES.

Dairy cattle constitute the foundation and all-important factor of the industry. We have no dairy cattle of our own in America; we have adopted those originated in and brought from other countries. Even our "native" or "common" stock, or "scrubs," are but mongrels of the breeds of another continent. It is impossible to estimate the debt of the dairy farmers of this country to the breeders of Ayrshires and Guernseys and Holstein-Friesians and Jerseys, in their native lands. These are the four races of cattle upon which mainly rest the present and future prosperity and progress of dairying in America. Yet we must not forget to note the blood of the good old milking strains of Shorthorns as an excellent foundation upon which to build up profitable dairy herds. It is needless to enlarge upon the good qualities and characteristics of these distinctively dairy breeds, but it is worth noting that all of them have improved upon our hands. It may not be that the average quality of any of these breeds as they now exist in the United States is above the average of the same race upon its native pastures, but in all of them there are now on this continent animals superior to the best on the other side of the Atlantic. The breeding and management have been so good here that the cows imported and their descendants have made indisputable records as dairy performers, excelling any known in the countries from which they came. Personal observation has convinced us that we now have dairy cattle in the United States so good that nothing can be gained beyond the fancy or satisfaction in new blood by further importations from Ayrshire or any part of Great Britain, the Channel Islands, or the Netherlands.

### COUNTRIES TO BE LOOKED TO FOR IMPROVEMENT OF DAIRY HERDS.

We may very properly inquire, however, whether there are cattle in other countries which would improve our dairy herds or be a valuable acquisition to the variety we now possess. Although others may hold different views, it is the belief of the writer that the only countries to which any attention can profitably be given, in this connection, are Denmark, France, and Switzerland. The first named furnishes the best example in the world of dairying as a national specialty, of rapid development, and of present high average production and excellence. Here we find the Red Danish cattle to be the standard stock, and very satisfactory business cows they are, of a pronounced dairy type. But they lack uniformity, except in color, particularly in udder development and other dairy points, and in the show ring the very best of them could not hopefully compete with the best of any one of the four leading dairy breeds of this country. As dairy performers they are good, but not remarkable; the best yearly records the writer has seen show an average production of 8,000 to 8,800 pounds of milk per cow, in herds of 11 to 19 animals of all ages, with an average fat content of about 3¼ per cent, an equivalent of 290 to 325 pounds of butter per year. A very celebrated herd of 70 cows averaged 7,150 pounds of milk a year. In Jutland there is a distinctively dairy race of sharply defined black and white markings in appearance reminding one of Holland cattle, and still more of Brittanies, although between these two races in size. They are very attractive cows, of rather less than medium size, and excellent milkers. Both these races of Danish cattle may be credited with being economical producers; yet none of them are wanted here, for superlative excellence seems to be lacking on the one hand, while on the other they appear predisposed to tuberculosis and very generally tainted with this insidious and dread disease.

France is a dairying country and possesses a large number of so-called breeds of cattle. One can hardly say "different" or "distinct" breeds, because they seem to be largely of common origin locally differentiated and belonging to geographic districts, along the borders of which they blend in a perplexing way. Nearly all of them are what would be called in this country "dual-purpose" cattle. France prides herself upon producing all her own beef, and depends largely upon oxen for farm labor. With few exceptions her cattle are bred primarily for labor, to ultimately become (poor) beef, and dairy quality is at least a secondary consideration only incidental in some of the breeds. Fine veal is a specialty in France, so that cattle which produce large, thrifty, quick-growing, and easy-fatting calves are particularly sought and are highly profitable. There are but three races of French cattle which seem to deserve consideration as dairy stock. Near the Belgian border, in French Flanders, there is a large, rather rangey cow of a pronounced dairy type and a generous and profitable producer of a medium quality of milk. These "Flamandes" are of a solid dark-brown color, sometimes reddish, and often almost black. They carry no spare flesh, have shiny coats, indicative of health, are good feeders, active, and docile. In size they are above the average, and in some respects suggest the milking Shorthorns. These cattle very justly won the sweepstake prize for dairy animals at the live-stock show of the Paris Exposition in 1900. But it is said that, although rugged enough at home, they become delicate and always deteriorate rapidly when moved away from the comparatively small district in which they had their origin or development. This accounts for the Flamandes being so little known elsewhere. In Brittany are found the pretty, active, little black and white cattle of marked dairy characteristics, producing often an astonishing quantity of milk for their size, rich in butter fat. This is a true breed, a good one of its kind, and an old one. Its blood undoubtedly entered largely into the foundation stock of the highly-prized Jersey; yet it is a race of even smaller size, some strains really diminutive. For the United States they are too small for anything but playthings. In many respects, markings excepted, they remind one more of the



INTERIOR OF COW STABLE, HOLLAND. (IN SUMMER.)

* From Year Book of Department of Agriculture.

French Canadian dairy cattle, which have lately come into prominence, than of anything else in America. Normandy has long been noted for its dairying, and the breed of cattle carrying the provincial name has a great reputation in France. The choicest of this race is the "Cotentin" strain, to be found pretty near the coast, from Cherbourg well down toward Brittany. In color they are red, brown, and white, spotted and patched, from two-thirds white to brindle. The best of them are large-framed, big-boned, coarse, homely creatures, fleshy, without finish or good beef form, lacking in uniformity, and generally devoid of the most highly-prized dairy characteristics. They have udders of all shapes, but few really good ones; yet some are capacious, and good cows average 8 to 10 quarts of milk a day for nine or ten months, or 5,000 to 6,000 pounds per year. It requires at least 12 quarts of milk in the winter and 14 or 15 in the summer to make a pound of butter. The annual butter product is, therefore, 200 to 225 pounds per cow; ordinarily 100 pounds a week from 20 cows, rising at times to 125 or 130 pounds. A few specimens of this breed have reached America and found favor in some quarters. But after some time spent in Normandy and an examination of many noted herds, they were decided to be a mixed, irregular, rough-looking lot of cattle, with no indications of economic dairy quality, and hardly attractive as "dual-purpose" animals. Careful comparative trials of dairy cows made in France have proved the "Normandes" to be inferior in every respect to the Brown Swiss.

The cattle of the several cantons of Switzerland noted for their dairying differ mainly in color and name. The Bernoise, Fribourgeoise, and Simmenthal cattle are all spotted, and have yellows, reds, and browns mixed with white in varying degrees and an infinity of patterns. Those with red or yellow spots usually have light muzzles and switches, while black noses and tails accompany the brown and black spots. The Schwyz breed, better known as the Brown Swiss, has been established in the United States for about thirty years. All of these Swiss cattle are exceedingly coarse boned, large framed, and heavy. They are exceedingly active for their size, famous mountain climbers, but carry a great superfluity of flesh for dairy animals, hardly compensated for by their performances at the pail. The Simmenthals are the largest, and by some preferred for milch stock, but unbiased judges generally give the Brown Swiss first place for dairy purposes. In America the last-named race has included cows which have made famous records in milk and butter production; but, as a whole, all Swiss cattle must be here regarded as of the "dual-purpose" kind, and this means that they are not expected to add much to the value of our dairy stock.

HOUSING AND CARE OF DAIRY COWS.

In the housing and general care of dairy cows no foreign country shows, as a rule, in general practice, any methods or conditions better than those of America. The average conditions everywhere are bad enough, with opportunities for very great improvement; but such improvement is being made as rapidly in this country as anywhere. Nowhere else is there a better appreciation of the importance and economy of abundant room, light, air, dryness, comfort, and cleanliness for cows. One hears much of the close relations between the dairy cows and the families of their owners in Holland and Switzerland, connecting apartments, under the same roof, etc.; but the stables which are seen in summer converted into conservatories and rooms for weaving and cheese curing are the exceptional and show places. Even the best of these, when visited in midwinter, with the cattle in place, are often found dark, close, ill ventilated, crowded, and unsanitary in many respects, although frequently kept clean. The construction of cow stables generally in the dairy regions of the Old World is of a substantial kind, but with little regard to light and ventilation, convenience of arrangement, or ease in cleaning. The labor necessary to keep them in decent condition would be regarded as impossible in this country. The cow houses of Denmark average the best of all in Europe, but they are no better in any respect than the average of those in the distinctively dairy districts of this country, and there is here far more regard for economy of labor in management. Danish stables are generally kept clean—probably cleaner than in America—but at the cost of a vast amount of very cheap labor. In other countries, as well as Denmark, much attention is paid to cleaning the cow stables, but the conclusion has been forced upon us that this is done more from an appreciation of the value of all farm manurial matter and the fixed habit of saving it than from any knowledge or intention of cleanliness as of prime importance in dairying. This is especially shown by the fact that cows are milked in just about as careless and uncleanly a manner in Great Britain and all over Europe as, it must unfortunately be confessed, is the common practice in the United States. The very general use of women as milkers in all foreign dairy districts is a decided advantage; they are gentler and cleaner than men, and vastly better than the average farm laborer, who does all sorts of work during the day. Much attention is being given, especially in England, to perpetuate the custom of employing women instead of men for milkers, and to maintain the efficiency of milkmaids; the popular public milking contests at the dairy shows are useful and commendable. Many parts of Europe have the additional advantage of keeping the cows in the fields continuously the greater part of the year and milking them in the open air. This practice does much to insure clean milk and pure products.

FEEDING DAIRY COWS.

Very skillful feeding may be observed in many of the dairying districts of foreign countries. The owners seem to know how to obtain the maximum product from their cows with the minimum expenditure of forage. From Norway to Italy and from Ireland to Siberia, dairymen, including the poorest peasants, do not hesitate to buy concentrated cattle foods when necessary to supplement home supplies; the purchases are made judiciously, and the feeding is equally so. But this skillful practice is almost all based upon "the rule of thumb," learned of sire by son, and passed from generation to generation. We believe that, at the present day, there is much more general knowledge of the differences and comparative value of feeds and of correct principles of feeding in this country than anywhere else, Denmark not excepted. And yet there is probably more careless and wasteful feeding of dairy cattle and animals of all kinds in America than anywhere else in the world.

THE CARE OF MILK ON THE FARM.

The care which is given to milk on the farm where produced, whether it is to go to a milk market or to be made into butter or cheese, with the location, construction, and arrangement of dairies or milk rooms, their equipment and management, show great variety and lack of uniformity in every country. The good, the bad, and the indifferent are common to all. Good milk rooms, well located, thoroughly built, shaded, cool, and well kept, are not hard to find in any dairy district. Construction is heavier and more durable in Europe; convenience and ease of management are common in America. Excepting Denmark and Sweden, no country compares with America in the general appreciation and use of cold water and ice in the care of milk. The almost entire absence of refrigeration in France, and the general ignoring of the value of cold in dairying, is truly astonishing. In the matter of dairy appliances and equipment, the United States is surpassed by no other country, although Denmark and parts of Great Britain stand about as well.

THE CITY MILK SUPPLY AND SERVICE.

The business of transporting, caring for, and distributing milk for consumption in its natural state and for household purposes seems to be in every possible stage of development in different parts of the world. Cows or their substitutes are driven through the streets and milked at customers' doors in British India and the West Indies. Milch goats are managed in the same way even in the best streets of Paris and of Rome. The milk service of villages and small towns is conducted in an exceedingly crude, yet often picturesque, manner in some of the oldest dairying regions of Europe. In Scotland, Holland, Denmark, and Switzerland milk is still carried in wooden vessels and retailed from them in towns and cities. The local milk service in similar places in the United States is often poor enough, with little regard for care or cleanliness, but nowhere as crudely performed. In most of the big cities of Europe there are large market-milk establishments, admirably conducted. There are fine ones in London, better in Copenhagen, and the biggest and best of all in Berlin. Paris probably has the poorest milk service of any of the large cities. There was a time, not many years ago, when a few foreign milk-supply establishments far exceeded in many respects the best of like character to be found in America. But at the present time, although some of these European milk companies do a larger business and have more extensive and costly plants, it is the opinion of the writer that we have in the United States a considerable number of establishments for city milk supply which are superior in many respects. Some might be named, in several different States, which are better than anything in Europe in their buildings and equipment, the efficiency of their management, and in the purity and high average quality of milk and cream served to their customers. Nowhere in the world is the important business of milk supply and milk service making such rapid and commendable progress as in the United States.

It is well worthy of note that at a special show of perishable dairy products held as an annex to the Paris Exposition, in July, 1900, just outside of the city limits, where French producers had every opportunity of exhibiting their goods in the best possible shape (although under unfavorable local conditions after reaching the exhibit), there was a large collection of natural milk and cream. But the only samples of these products, aslolutely free from chemical preservatives and uncooked, which were sweet and palatable after noon of the exhibition day, were from dairies in New York and New Jersey, then eighteen days from the cow! There was also in the United States dairy exhibit natural milk and cream from a farm in central Illinois, in bottles exactly as sent daily to Chicago families, which was only very slightly acid, although twenty days old. It had kept sweet until the day before this show, and even later it was better than the best normal French milk only twelve to twenty-four hours after milking.*

The American products had been preserved solely by cleanliness and cold; and the statement may be ventured that no milk-supply company in Europe could duplicate this performance.

BUTTER MAKING AND BUTTER MARKETS.

In butter making and the butter markets of the Old World an American dairyman may find many interesting features, but very little that is really instructive and worthy of adoption in this country. Private dairies make choice butter in Great Britain, the Channel Islands, Belgium, Denmark, and Sweden, and to a rather less degree in parts of Germany, France, and Switzerland. In Holland butter is now so commonly adulterated and the spurious article so often passed as the genuine that the product of that country has lost its commercial standing. In nearly all other parts of Europe laws restricting and regulating "margarin" in all its forms, are strict and fairly well enforced, although there is a laxity at times in some countries. Such was the case in France during the last exposition period. The fact that fresh Normandy rolls sell at the very highest price in the London market must be recognized, and superior butter is made elsewhere in France in limited quantity; yet the average quality of French butter is not high, as a whole; it should be classed at best as second-rate. Belgium is a grade higher, while Germany, Switzerland, and Italy are lower. Sweden and Finland may be placed still higher, and Denmark easily holds the position of honor. The high rank of Danish butter, due full as much to most remarkable uniformity as to superior quality, results from the general adoption of the associated or creamery system of manufacture (upon the co-operative plan), and the active aid of the government in criticism, instruction, and supervision, amounting almost to control. Creameries are nearly as successful in Sweden and Finland. Those in Belgium, and especially in Luxemburg, are of more recent origin, but meritorious in management and production. Creameries lately established upon Danish models, and rapidly multiplying in Russia and in Ireland, are doing well, but their product ranks in quality next below those already mentioned. There are several hundred comparatively new creameries, mainly co-operative, in France and Germany, but they are of lower grade, although showing steady improvement. In considering the world's supply of factory-made or creamery butter, the excellent and increasing product of Australia and of Canada must be mentioned, both ranking but little below Danish in quality, and Argentina and Siberia are new producing territories which will make themselves felt in the near future.

In the United States there are many private dairies that make butter as fine as any in the world, and the same is true of our best creameries. The best American creamery butter is quite the equal of the best Danish, but there is no such uniformity of product, and a greater proportion of it is inferior in quality. This results from the wide extent of territory and variety in climate and local conditions which affect the 8,000 or more creameries, and the still greater differences in methods and management. There is ample room for improvement in American creameries, but the only foreign country from which they can profitably learn is Denmark. The best creameries there are models of cleanliness and good order and systematic management. They have also taught their patrons to properly care for the milk and deliver it at the factory in prime condition. The control of bacterial growth, the practice of pasteurization, and the use of artificial as well as natural cultures and ferments have been advanced well toward perfection by Danish creamerymen. All of this tends to insure the clean, mild, and delicate flavor and wonderful general uniformity which characterize Danish butter. Yet, these results are largely accomplished in Denmark through an attention to detail and an expenditure of labor which would appal an American creamery manager. It is not an uncommon thing for six or eight persons to be constantly employed there through a day of long hours in turning out a quantity of butter which is ordinarily made in this country by a man and a boy, who have all their work finished daily at 3 or 4 o'clock in the afternoon.

CHEESE MAKING.

Cheese making is a branch of dairying in which it is impossible to draw any close comparisons between the methods and results in this country and those abroad. For the production of large quantities of cheese of uniform excellence it is believed the American factory system, common to the United States and Canada, is superior to anything elsewhere, and more systematically and economically conducted. The average Cheddar cheese of the Cheddar Valley itself, of Somersetshire in general, and of the best producing districts of England and Scotland, are no better than those of New York and Wisconsin and the best of Canada. In variety and fancy cheese this continent cannot yet attempt to compete with the Old World. If one would learn the bottom facts about making any of the famous specialties in cheese he must go to the locality where they originated, and where alone, often within very narrow limits, they are still made in perfection. This applies to the English Stilton, the French Roquefort and its close kinsman, the Italian Gorgonzola, the Edam and Gouda of Holland, the Gruyère and Emmenthal of France and Switzerland, the Parmesan of Italy, and the Camembert, Brie, Neuchâtel, and hundred and one other small and soft and high-flavored varieties of France and other parts of Europe, including, of course, Limburger.

FAIRS AND MARKETS.

In several foreign countries there are "fairs" and

* These circumstances have been stated in substantially the same language, during a speech in the Senate of France, by a senator who was president of the international jury on dairy products at the Paris Exposition, and by another person in a report to the National Agricultural Society of France.

markets, some only annual or occasional and others frequent and periodical, which afford novel scenes to an American. Although curious and entertaining, with many features which are commendable when local conditions are considered, there is little about these commercial methods or systems which could be advantageously adopted in this country. As examples of these unique dairy markets may be mentioned the great mart or butter exchange of Cork, Ireland, the daily auction sales of butter at the Central Markets of Paris, and the market days in many little towns and villages in Normandy, when the wives and daughters of the farmers and peasants assemble by the hundred in the parks or along the streets and sell their "mottes" of butter, often aggregating several tons a day in a single village, to the representatives of those immense blending-butter factories in the Isigny district of La Manche. The cheese fairs at Frome, England, and Kilmarnock, Scotland, and the street markets at Alkmaar, Hoorn, and Utrecht, Holland, are similarly interesting in connection with cheese.

CONCLUSIONS.

The foregoing facts and conditions as to dairying in the Old World apply mainly to countries (and districts in them) where dairying has been for several centuries one of the leading agricultural industries, if not the principal one. American dairying has been developed wholly within one century, and all of its notable progress has been within fifty years. The comparisons made show that there is little for us to learn from foreign countries to improve our dairying. Our cattle are far better adapted to their special work and more economical as dairy animals than any of the European breeds not common here. As a rule, they are better housed, fed, and cared for, with greater economy of labor, although in many instances foreign dairymen are exceedingly skillful feeders. The rents which are almost universally paid for farms in all the foreign countries named would be regarded as impossible in this country; on the other hand, hired labor for farm and dairy costs there but a fraction of what it does here. In dairy utensils and equipment ours are superior, and our methods are more generally founded upon principles which are understood and known to be correct. Butter is more economically produced in the United States, and so far as the product of the creamery system is concerned, it is of higher average quality than that of any other country except Denmark; the same cannot be said, however, of the farm dairy butter of this country. Europe offers a very much greater variety of cheese, including some of unsurpassed reputation, and a much more general appreciation of this product as an article of food prevails abroad. Notwithstanding the excellence of much of the European cheese, the facilities and processes of making and curing are comparatively crude. The factory system of cheese making as at present organized and conducted in America exhibits greater economy, equal skill, and more intelligence. In the important business of making milk for market, and all through the different grades of milk service, the United States is well abreast of Europe. This is true, not only in comparing averages, but, as already stated, our best establishments and most approved practices are superior to the best elsewhere in production, quality, purity, preparation, transportation, and delivery.

While too much cannot be said in praise of the industry, frugality, and thrift of most of the dairymen of Europe, a close comparison leads one to feel that the conditions of this industry in the United States are decidedly more satisfactory in almost every particular.

## GEOGRAPHY IN THE UNITED STATES.*

By W. M. DAVIS.

FOR twenty years past our section has acknowledged in its name an equal rank for geology and geography, but not one of the vice-presidential addresses during that period, or indeed since the foundation of the Association, more than fifty years ago, has been concerned with the subject second named. I propose to depart from all precedents, and, even though geologists may form the majority in this gathering, consider the standing of geography among the sciences of the United States—how it has reached the place it now occupies, and what the prospects are for its further advance. As early as in 1851 there was a section of geology and physical geography, and another of ethnology and geography, in the American Association, but that classification did not endure. Once only, in 1853, did geography stand by itself as a sectional heading, but at many meetings physics of the globe and meteorology had places to themselves. Through the 60's and 70's geography was sometimes coupled with geology, but the latter more often stood alone or with palæontology, and it was not until the Montreal meeting of 1882 that Section E was definitely organized with the title that it now bears.

During the fifty-three years of the life of the Association there have been but ten papers delivered on the geography of foreign lands, and even geological essays on foreign regions have been few in number. Much valuable geographical work in our own domains has been done by our members, but the results have not been published in the proceedings of the Association. In spite of the geographical work done by State and national geological surveys, the Weather Bureau, the Coast Survey, and other public and private organizations, we have not made great contributions to the full-fledged science of geography. There are few steps toward scientific geography of greater value than good maps, but for the geographer to stop with the production of good maps is as if the botanist were to stop with the collection of dried plants.

Geography has suffered greatly from being traditionally a school subject in its educational relations; the subject as a whole has been almost everywhere omitted from the later years of college and university training, although certain of its component parts have received some attention in college years. Again, geography as a whole leads to no professional career outside of school teaching; it is perhaps chiefly on that account that our colleges and universities can give little time to it. Finally, there is not to-day in this country an organized body of mature geographical experts at all comparable in rank to the bodies of physicists or of zoologists which are organized into effective working societies; in the absence of such an organization geography suffers greatly for the lack of that aid which comes from mutual encouragement among its workers. How can we remove these impediments of low educational rank, no professional career, and no professional organization?

Physical geography is slowly winning a more respected place than it has ever had among the subjects on which examinations are set for admission to college. Commercial or economic geology is destined to attract increasing attention from mature teachers and nearly mature students. The general geography of various parts of the world must receive more and more consideration in our colleges in the century that opens with the outgrowth of our home country. Just as soon as mature teachers of mature geography can make their lectures of value to the young men of today, who are to be the leaders of enterprise to-morrow, place will be found for geographical courses in our higher institutions of learning.

The study of geography is not likely soon to lead to a large, independent career, but it may be made useful in many careers. It will be made particularly serviceable to a class of men that is now of small but increasing numbers, namely, those who travel about the world seeking fortune, entertainment, or novelty.

The third impediment to the maturing of geography, namely, the absence of a society of mature geographical experts, is the fault of the experts themselves. Such a society, in which membership shall be open only to those whose interests are primarily geographical and whose capacity for geographical work has been proved, would be of the greatest aid to the science.

Close scrutiny of what is commonly called geography will certainly be beneficial in bringing forward the essence of the subject, and in regulating irrelevant topics to the background; but it is not to be expected that any precise agreement will soon be reached as to what constitutes geography strictly interpreted. Opinions on the subject, gathered from different parts of the country, even if gathered from persons entitled to speak with what is called "authority," would probably differ as widely as did the nomenclatures of the leading physiographic divisions of North America as proposed in a symposium a few years ago, but if careful consideration and free discussion are given to the subject, unity of opinion will in due time be approached as closely as is desirable.

As a contribution toward this collection of opinions, let me state my own view: The essential in geography is a relation between the elements of terrestrial environment and the items of organic response; this being only a modernized extension of Ritter's view. Everything that involves such a relationship is to that extent geographic. Anything in which such a relationship is wanting is to that extent not geographic.

The location of a manufacturing village at a point where a stream affords water power is an example of the kind of relation that is meant, and if this example is accepted, then the reasonable principle of continuity will guide us to include under geography every other example in which the way that organic forms have of doing things is conditioned by their inorganic environment. The organic part of geography must not be limited to man, because the time is now past when man is studied altogether apart from the other forms of life on the earth. The colonies of ants on our Western deserts, with their burrows, their hills, their roads, and their threshing floors, exhibit responses to elements of environment found in soil and climate as clearly as a manufacturing village exhibits a response to water power. The different coloration of the dorsal and ventral parts of fish is a response to the external illumination of our non-luminous earth.

The word "arrive" is a persistent memorial of the importance long ago attached to a successful crossing of the shore line that separates sea and land. It is not significant whether the relation and the element that enters into it are of easy or difficult understanding, nor whether they are what we call important or unimportant, familiar or unfamiliar. The essential quality of geography is that it involves relations of things organic and inorganic; and the entire content of geography would include all such relations.

A large library would be required to hold a full statement of so broad a subject, but elementary text-books of geography may be made by selecting from the whole content such relations as are elementary, and serviceable handbooks may be made by selecting such relations as seem important from their frequency or their significance. The essential throughout would, however, still be a relation of earth and life, practically as Ritter phrased it when he took the important step of introducing the causal notion as a geographical principle.

Thus defined, geography has two chief divisions. Everything about the earth or any inorganic part of it, considered as an element of the environment by which the organic inhabitants are conditioned, belongs under physical geography or physiography. Every item in which the organic inhabitants of the earth—plant, animal, or man—show a response to the elements of environment, belongs under organic geography. Geography proper involves a consideration of revelation in which the things that belong under its two divisions are involved.

The validity of these propositions may be illustrated by a concrete case. The location and growth of Memphis, Helena, and Vicksburg are manifestly dependent on the places where the Mississippi River swings against the bluffs of the uplands on the east and west of its flood plain. The mere existence and location of the cities, stated independently of their controlling environment, are empirical items of the organic part of geography, and these items fail to become truly geographic as long as they are stated without reference to their cause. The mere course of the Mississippi, independent of the organic consequences which it controls, is an empirical element of the inorganic part of geography, but it fails to become truly geographic as long as it is treated alone. The two kinds of facts must be combined in order to gain the real geographic flavor.

Geography is therefore not simply a description of places; it is not simply an account of the earth and of its inhabitants, each described independent of the other; it involves a relation of some element of physical geography to some item of organic geography; and nothing from which this relation is absent possesses the essential quality of geographical discipline. The location of a cape or of a city is an elementary fact which may be built up with other facts into a relation of full geographic meaning; but taken alone it has about the same rank in geography that spelling has in language.

A map has about the same place in geography that a dictionary has in literature. The mean annual temperature of a given station and the occurrence of a certain plant in a certain locality are facts of kinds that must enter extensively into the relationships with which geography deals; but these facts, standing alone, are wanting in the essential quality of mature geographical science. Not only so; many facts of these kinds may, when treated in other relations, enter into other sciences; for it is not so much the thing that is studied as the relation in which it is studied that determines the science to which it belongs.

I therefore emphasize again the broad general principle that mature scientific geography is essentially concerned with the relations among its inorganic and organic elements; among the elements of physical and of organic geography; or, as might be said more briefly, among the elements of physiography and of—let me confess to the most indulgent part of this audience that I have invented a one-word name for the organic part of geography, and have found it useful in thinking and writing and teaching; but inasmuch as ten, or at the outside twelve, new words that I have introduced as technical terms into the growing subject of physiography have given me with some geological critics the reputation of being reckless in regard to terminology, it will be the part of prudence not to mention the new name for organic geography here, where my audience probably consists for the most part of geologists.*

There can be no just complaint of narrowness in a science that has charge of all the relations among the elements of terrestrial environment and the items of organic response. Indeed, the criticism usually made upon the subject thus defined is, as has already been pointed out, that it is too broad, too vaguely limited, and too much concerned with all sorts of things to have sufficient unity and coherence for a real science. Some persons indeed object that geography has no right to existence as a separate science; that it is chiefly a compound of parts of other sciences; but if it be defined as concerned with the relationships that have been just specified, these objections have little force. It is true indeed that the things with which geography must deal are dealt with in other sciences as well, but this is also the case with astronomy, physics, chemistry, geology, botany, zoology, history, economics.

There is no subject of study whose facts are independent of all other subjects; not only are the same things studied under different sciences, but every science employs some of the methods and results of other sciences. The individuality of a science depends not on its having to do with things that are cared for by no other science, or on its employing methods that are used in no other science, but on its studying these things and employing these methods in order to gain its own well-defined object. Chemistry, for example, is concerned with the study of material substances in relation to their constitution, but it constantly and most properly employs physical and mathematical methods in reaching its ends.

Botanists and zoologists are much interested in the chemical composition and physical action of plants and animals, because the facts of composition and action enter largely into the understanding of plants and animals considered as living beings. Overlappings of the kind thus indicated are common enough, and

* Abstract of the address delivered by Prof. Davis as the retiring vice-president and chairman of Section E (geology and geography), American Association for the Advancement of Science, at St. Louis, December 28, 1903.

* The new term is "ontography."

geography as well as other sciences exhibits them in abundance. It may be that geography has a greater amount of overlapping than any other science; but no valid objection to its content can be made on that ground; the maximum of overlapping must occur in one science or another—there can be no discredit to the science on that account.

Geography has to do with rocks whose origin is studied in geology; with the currents of the atmosphere whose processes exemplify general laws that are studied in physics; with plants and animals, whose forms and manner of growth are the first care of the botanist and the zoologist; and with man, whose actions recorded in order of time occupy the historian, but the particular point of view from which the geographer studies all these things makes them as much his own property as they are the property of any one else.

In view of what has been said let me return to the close scrutiny that I have urged as to what should be admitted within the walls of a geographical society. We will suppose the geography of Pennsylvania is under discussion; as a result there must be some mention of the occurrence of coal, because coal, now an element of inorganic environment, exerts a control over the distribution and the industries of the population of Pennsylvania. But the coal of Pennsylvania might be treated with equal appropriateness by a geologist, if its origin, its deformation, and its erosion were considered as local elements in the history of the earth; by a chemist, if its composition were the first object of attention; by a botanist, if the ancient plants that produced the now inorganic coal beds were studied.

Furthermore, it would be eminently proper for the geologist to make some mention of the present uses to which coal is put; or for the chemist and the botanist to tell something of the geological date when coal was formed, if by so doing the attention of the hearer could be better gained and held, and if the problem at issue could thereby be made clearer and more serviceable. So the geographer is warranted in touching upon the composition, the origin, the exploitation of the Pennsylvania coal beds, if by so doing he makes a more forcible presentation of his own problem; but if he weakens the presentation of his own problem by the introduction of these unessential facts, still more if he presents these unessential facts as his prime interest, he goes too far.

The point of all this is that students in many different sciences may have to consider in common certain aspects of the problems presented by the coal of Pennsylvania; but that each student should consider Pennsylvania coal in the way that best serves his own subject. The scrutiny that I have urged would therefore be directed chiefly to excluding from consideration under geography the non-geographic relations of the many things that various sciences have to study in common, and to bring forward in geography all the problems that are involved in the relations of the earth and its inhabitants.

The things involved in the relations of earth and life are the common property of many sciences, but the relations belong essentially to geography. It would be easy to point out topics in text-books and treatises, in the pages of geographical journals, and in lectures before geographical societies, that would not fall under any division of geography as here defined. In many such cases, however, the topics might without difficulty have been given a sufficiently geographical turn had it been so desired or intended; the topics might have been presented from the geographical point of view, so as to emphasize the essential quality of geographical study, had there been a conscious wish to this end.

But in other cases, the subjects presented belong so clearly elsewhere, or are treated so completely from some other than a geographical point of view, as to fall quite outside of geography; for example, a recent number of one of our geographical journals contained an excellent full-page plate and a half-page of text on the "Skull of the Imperial Mammoth," with brief description of its size and anatomy, but with nothing more nearly approaching geographical treatment than the statement that the specimen came from "the sands of Western Texas."

In all such cases it is open to question whether close scrutiny as to inclusion and exclusion has been given; and while the policy pursued by many geographical societies of generously accepting for their journals many sorts of interesting articles has something to commend it in the way of pleasing a mixed constituency, it is nevertheless open to the objection of not sufficiently advancing the more scientific aspects of geography.

Blades of grass and mammoth skulls are very good things, if crops of hay and collections of fossils are to be gathered; but they are in the way of the growth of the best corn and of the publication of the best geographical journals. Let no one suppose, however, that the audiences in geographical lecture halls or the readers of geographical journals need suffer under the scrutiny that is here urged regarding lectures and articles.

There is, even under the strictest scrutiny, an abundance of varied and interesting matter of a strictly geographical nature; few if any sciences are richer than geography in matter of general interest. There is, indeed, some reason for thinking that the real obstacle in the way of applying close scrutiny in the way here recommended is the difficulty of obtaining high-grade material presented in an essentially geographical form. Inasmuch as this difficulty arises from the relative inattention to geography as a mature science, it is the business of geographical societies to remove the difficulty.

## TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

**How to Build up and Increase American Trade.**—The American firm which seeks to conquer foreign lands has an important lesson to learn and would better study it carefully and thoroughly before making the attempt to introduce its goods.

In striving to build up foreign trade the fact must not be lost sight of that the people must be addressed in their own tongue; thus not only correspondence, but catalogues, pamphlets, circulars, and all advertising literature should be printed in the language of those to whom it is addressed. Talk to the Russians in the Russian language; French should be used in France, German in Germany, Spanish in the South and Central American republics, Mexico, and Spain, Portuguese in Brazil, etc.

Never solicit foreign trade without literature printed in the native language of the people whose trade you desire.

The American catalogue is usually an exquisitely beautiful brochure, the product of the best talent, science, and skill in the printing world; but to be effective it must be understood.

It is hardly to be expected that even the most intelligent foreigner will trouble himself to have a translation made of American advertising matter unless he has a very special reason for so doing—a case which very seldom occurs. What he sees in his own language he will very readily understand. But how about foreign moneys, weights, measures, capacities, and the like? Foreigners can not be expected to be posted in these technical matters.

It is impossible to get a footing in foreign countries without hard work. You must "go after it." The catalogues used should be of individual character, designed to meet the special conditions that are to be met, and to tell the foreigner in his own language all that can be told about the goods offered for his consideration. The minutest details are of importance. The matter of foreign correspondence is also important. Each letter should be made clear and explicit and no essential detail forgotten, leaving no loophole for misunderstanding.

Remember well, when considering these things, that different terms are used in various countries to express the same meanings. When you tell a man in his own language about things no misunderstanding is likely to occur.

American manufacturers, I am happy to report, have in recent years more closely studied foreign countries, particularly South America, to discover markets for their wares; and when they have found conditions favorable they have, after strictly observing local requirements as relates to license and securing the necessary protection of the trade-mark laws, promptly entered this remunerative field or essayed to educate an indifferent public to new desires.

It is, or at least it ought to be, much easier to supply a foreign people with what they want than with what we think they ought to have. It should not be forgotten that advertising in the local papers has been the valuable key which in either case has unlocked the strong door of prejudice or utter indifference, and the publicity attached to this process has not only aided largely in securing the coveted market for the article advertised, but has also helped to create a market for other American goods.

Thus every article of merit which the United States sends to foreign markets and properly and systematically advertises makes it easier for each succeeding effort. We have built up here a strong and steadily growing demand for our food products. If people eat our cereals and find them superior, they can be much more easily induced to try our coal, shoes, wares, furniture, implements, etc. Just so long as we continue to send superior goods to foreign markets will our exporters find public opinion and individual judgment more and more inclined to seek Yankee goods.

Every American advertising success abroad stimulates a wider range of exports and makes the way smoother and easier for all concerned.

I have seen this United States consulate equally as crowded by local merchants seeking information as the office of a famous advertising agent. All the leading trade papers in every line of business are received here, carefully classified, and placed ready for immediate reference. By this complete system of filing the export and trade papers I can at once give a list of American houses dealing in or manufacturing the goods required.

I have pointed out as best I can the peculiar needs of this locality; the likelihood, or the reverse, of probable markets for different lines of goods; the pitfalls to be avoided; the pathways to be followed. There is yet plenty of room here for men who can build, command, and hold trade.

One other error our exporters make, which probably costs them thousands each year, is their practice of lettering the bales and cases containing their goods in English. I have often seen at the custom-house here boxes, etc., labeled, "Fragile; handle with care." Or, in other cases, "This side up, with care." Now, as a matter of fact, we might as well expect a stevedore in New York to read the labels on a Chinese tea chest as to ask the men who handle foreign goods in this port to read English. It gives them trouble enough to decipher their own language when plainly printed. Consequently, when the bale, package, or case enters the steamer at New York, all warnings, caution, or advice printed upon it might as well be done in uncial Greek as in English.—K. K. Kenneday, Consul at Para, Brazil.

**Fighting the American Petroleum Trade in Germany.**—An inquiry has been received by the Solingen Chamber of Commerce from the Chamber of Commerce at Giessen as to the effect of the establishment of the German-American Petroleum Company's tanks at Solingen upon the wholesale and retail dealers of petroleum, and also as to the manner in which the petroleum is sold by the company. Through this inquiry the fact seems to have been established that the German-American Petroleum Company has attempted, by means of its tanks, to monopolize the local market, but thus far has not been entirely successful, because quite a number of the local wholesalers, although at great sacrifice to themselves, have steadily opposed the company. The sales of the German-American Petroleum Company to the retailer are effected by means of street tank wagons, and the retailer is supplied with petroleum-measuring apparatus free of charge, which, however, is kept locked by the company, thus compelling the retailer to use the company's oil. The German-American Petroleum Company makes no sales directly to the consumer.—Joseph J. Langer, Consul, Solingen, Germany.

**Commercial Duties of German Consuls.**—The commercial diet of Germany, which is the central board of all German chambers of commerce, has applied to the Imperial Chancellor for a list of those German consulates which would furnish commercial information, credit rating of business firms, etc. In his reply, the chancellor stated that though all the German consuls are instructed to name the firms in their districts with whom it might be desirable to form business connections, and to furnish all other proper information, yet no general instructions can be issued to require consuls to give an opinion on the credit rating or responsibility of firms doing business in their districts. It must be left to the judgment of each consul whether he deems it in conformity with his duty to furnish information of this kind to German inquirers; therefore no such list as asked for by the commercial diet can be supplied.—Simon W. Hanauer, Deputy Consul-General, Frankfort, Germany.

**German-Egyptian Trade.**—In his annual report the Austro-Hungarian consul at Alexandria writes of the growing trade of Germany with Egypt, largely due to the direct shipping facilities by the German-Levant Steamship Line. German exporters receive bills of lading at any railroad point in Germany on consignments for any port in Levantine countries. The freight rates of this line are also lower than those of the Austrian lines. In consequence thereof many Austrian export firms in Bohemia now ship via Hamburg instead of by Trieste, when expediting consignments for Mediterranean countries. The consul also states that articles of German manufacture are now sold in Egypt which were formerly supplied by other countries.—Simon W. Hanauer, Deputy Consul-General, Frankfort, Germany.

**American Trade in the Dominican Republic.**—Minister W. F. Powell writes from Santo Domingo, September 16, 1903, that importations from the United States into the Republic have increased more than 25 per cent during the past ten years in certain classes of textile goods. Americans have almost complete control of the market for shoes, having supplanted the French in the sale of this article. The trade of Germany and England in the finer classes of textile goods surpasses that of the United States. Germany leads in bric-a-brac and cutlery and France in the finer classes of goods and perfumery. The United States has a monopoly of the provision market in the Republic. The greater part of Dominican exports go to United States markets.

**American Glass Goods in England.**—A firm of silversmiths and platers write me that "American glass goods—such as jams, butter dishes, etc.—suitable for mounting in silver are selling on the English market," and they have been told that these American goods "are remarkably cheap and good, and better than the Austrian goods, of which they buy a large quantity." This firm asks if I "know the address in England of this American firm." I do not know the address.—Marshal Halstead, Consul, Birmingham, England.

**Typewriters to be Admitted Free Into Peru.**—Minister I. B. Dudley sends from Lima, September 12, 1903, copy of a law admittting typewriting machines into Peru free of duty. They have heretofore, Mr. Dudley notes, paid a duty of 40 per cent *ad valorem.*

### INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

**No. 1836. December 28.**—*Trade Opportunities in Abyssinia—American Shoes in Germany—New British Standard of Weights—British Agriculture.

**No. 1837. December 29.**—*Market for American Food Products in Germany—*Berlin as a Market for Food Products—Mines, Railways and Commerce in China—Lace Industry of France—Acid-proof Rubber Goods—Training Customs Officers—New Danish Trading Company—American Competition in Germany—From Paris to Peking by Rail—American Steel Rails for Turkish Railroads—Influence of Automobiles upon Country Life—Cotton Crop of 1902 and Cotton Industry in Russia.

**No. 1838. December 30.**—Macaroni Wheat in Foreign Markets.

**No. 1839. December 31.**—*Suggestion to Exporters to South America—Modification of Cuban Tax Laws—Need of Chambers of Commerce Abroad—Power Signaling on British Railways—New Damask Jacquard Loom.

**No. 1840. January 2.**—Drawbacks to American Trade in Central France—Austrian Railway Freight Rates on Imported Products—Suppressing Malaria in Austria—American Fruit in Belgium—Foreign Commerce of France—Trade Suggestions for South Africa.

Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

## TRADE NOTES AND RECIPES.

**To Solder Steel.**—The preparation is composed as follows: Borax, 3 parts; colophony, 2 parts; pounded glass, 3 parts; steel filings, 2 parts; carbonate of potash, 1 part; powdered soap, 1 part. The whole is fused in an earthen or iron pot, poured upon a cold plate, and bruised and powdered after cooling.—Science Pratique.

**To Clean Wall Paper.**—To clean wall paper, the dust should first be removed by lightly brushing, preferably with a feather duster, and the surface then gently rubbed with slices of moderately stale bread, the discolored surface of the bread being removed from time to time so as to expose a fresh portion for use. Care should, of course, be taken to avoid scratching the paper with the crust of the bread, and the rubbing should be in one direction, the surface being systematically gone over as in painting, to avoid the production of streaks.—Drug. Circ.

**A Hint as to Tools.**—The hardness even of annealed steel increases the labor necessary to the proper preparation of the tools used in the goldsmith's trade, etc. It will, therefore, not be without interest to the users as well as the fashioners of those tools to learn a process by which the tool steel may be rendered as soft as copper.

Take some beef bones and pound them to a fine powder; with a like quantity of clay and a small amount of calf's hair and water; mix it up to a stiff paste. With this paste smear the tool-steel tolerably thick on all sides, and place it between two fire-pans. Wire the pans well together, fill out the depressions with more of the clay and bone mixture, and place them in the fire, where they must be brought slowly to a red heat. When removed, place the combination in the ashes to gradually cool off. After they are cold remove the pans and the baked clay, and the steel will be found to respond to the file as nicely as copper.—Neueste Erfindungen und Erfahrungen.

**Soldering Liquids and Fats.**—1. To the ordinary zinc chloride, prepared by digesting chips of zinc in strong hydrochloric acid to saturation, add one-third spirits of sal-ammoniac and one-third rain water, and filter the mixture. This soldering liquid is especially adapted to the soft soldering of iron and steel, because it does not make rust spots.

To solder zinc, the zinc chloride may be used without any spirit sal-ammoniac.

2. The so-called "Müller soldering liquid" is prepared by mixing 1 part of a solution of phosphoric acid with 1 to 1½ parts of 80-per-cent spirits of wine.

3. If the above are not within the reach of the user, a serviceable soldering liquid may be formed by mixing together 1 part of lactic acid, 1 part glycerine, and 8 parts of water.

4. Soldering fat or grease is commonly a mixture of resin and tallow with the addition of a small quantity of sal-ammoniac. It is particularly adapted to the soldering of tinned ware, because it is easily wiped off the surface after the joint is made, whereas if resin were used alone, the scraping away might remove some of the tin and spoil the object.

5. The following is a well-tried recipe for a soldering grease. In a pot of sufficient size and over a slow fire melt together 500 grammes of olive oil and 400 grammes of tallow; then stir in slowly 250 grammes of resin in powder, and let the whole boil up once. Now let it cool down, and add 125 grammes of saturated solution of sal-ammoniac, stirring the while. When cold, this preparation will be ready for use.—Neueste Erfindungen und Erfahrungen.

**Action of Fertilizer and Soil upon the Burning Qualities of Tobacco.**—Quite some time ago Nessler, of Karlsruhe, ascertained that the burning qualities of tobacco depend pre-eminently upon the amount of chlorine (cooking salt) and potash it contains. The richer the tobacco is in chlorine, other things being equal, the more it chars and the worse it burns; on the other hand, the more potash it contains the whiter will be the ashes and the longer it will continue to glow when once lighted. Since the ash constituents reach the tobacco from the soil, the combustibility is decreased by fertilization with substances rich in chlorine, and increased by manures rich in potash; hence no tobacco should be grown on soils containing much cooking salt. Fertilizers rich in chlorine are privy manure, dung-water, ordinary potassium, superphosphate, kainite, potassium chloride.

The researches recently conducted by Nessler have demonstrated that tobaccos from sandy soils contained an average of 0.29 per cent of chlorine, and those from heavy soils 0.92 per cent. If it is taken for granted that the various fields are manured in the course of the year with approximately the same fertilizer, the only explanation of the above fact may be found in the supposition that the highly soluble cooking salt and other chlorides are washed out of the sandy soil, while they remain in the heavy soils. Tobaccos grown on light soils contained on an average 2.8 per cent of potash, those grown in heavy soil only 2.4 per cent; hence were somewhat richer in potash than the latter. Consequently there is no reason to suppose that potash is also washed out from light soil similarly to cooking salt. Soils which have produced a tobacco rich in chlorine without having been manured with fertilizers containing much chlorine should not be used for tobacco culture. On others purified potash-magnesia with little chlorine should be buried when first plowing in spring.—From the German of L. Dürr in Neueste Erfindungen und Erfahrungen.

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