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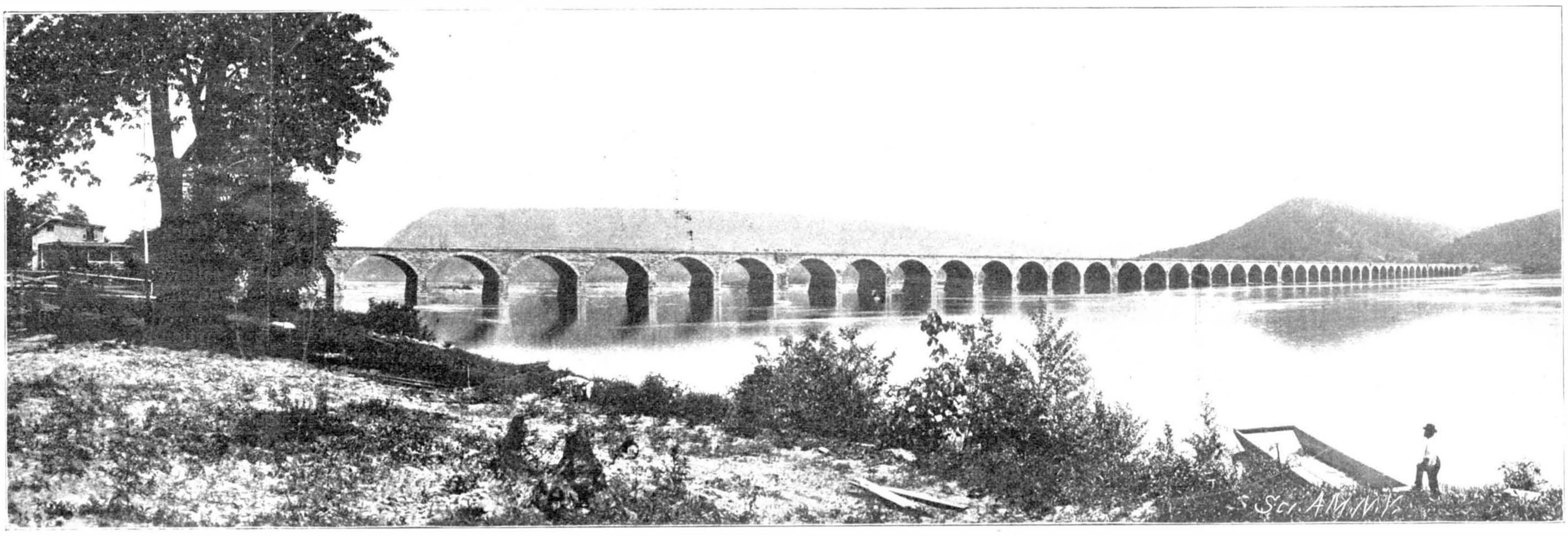
THE FOUR-TRACK STONE ARCH BRIDGE OF THE PENNSYLVANIA RAILROAD ACROSS THE SUSQUEHANNA RIVER.

In tracing the history of the United States railroad system, it is interesting to note the change which has taken place in the materials of construction. Notably is this the case in the department of bridge construction, which, in a country intersected by rivers and waterways of the great size, depth, and turbulence of current that are frequent in this country, is of the very first importance. The development of our railroad system commenced and was under full headway long before the introduction of Bessemer steel had rendered it practicable and economical to erect all framed engineering structures in that material. As a matter of fact, we were pushing our railroads, north, south, east, and west, with feverish activity, at a time when even the earlier materials of metallic bridge construction, cast iron and wrought iron, were limited in quantity and high in cost; and had it not been for the abundance of fine, straight-grained timber that was available, it would have been necessary to cross some of the more important streams by ferriage, or by some other means of transport than by long-span bridges supported on piers in midstream.

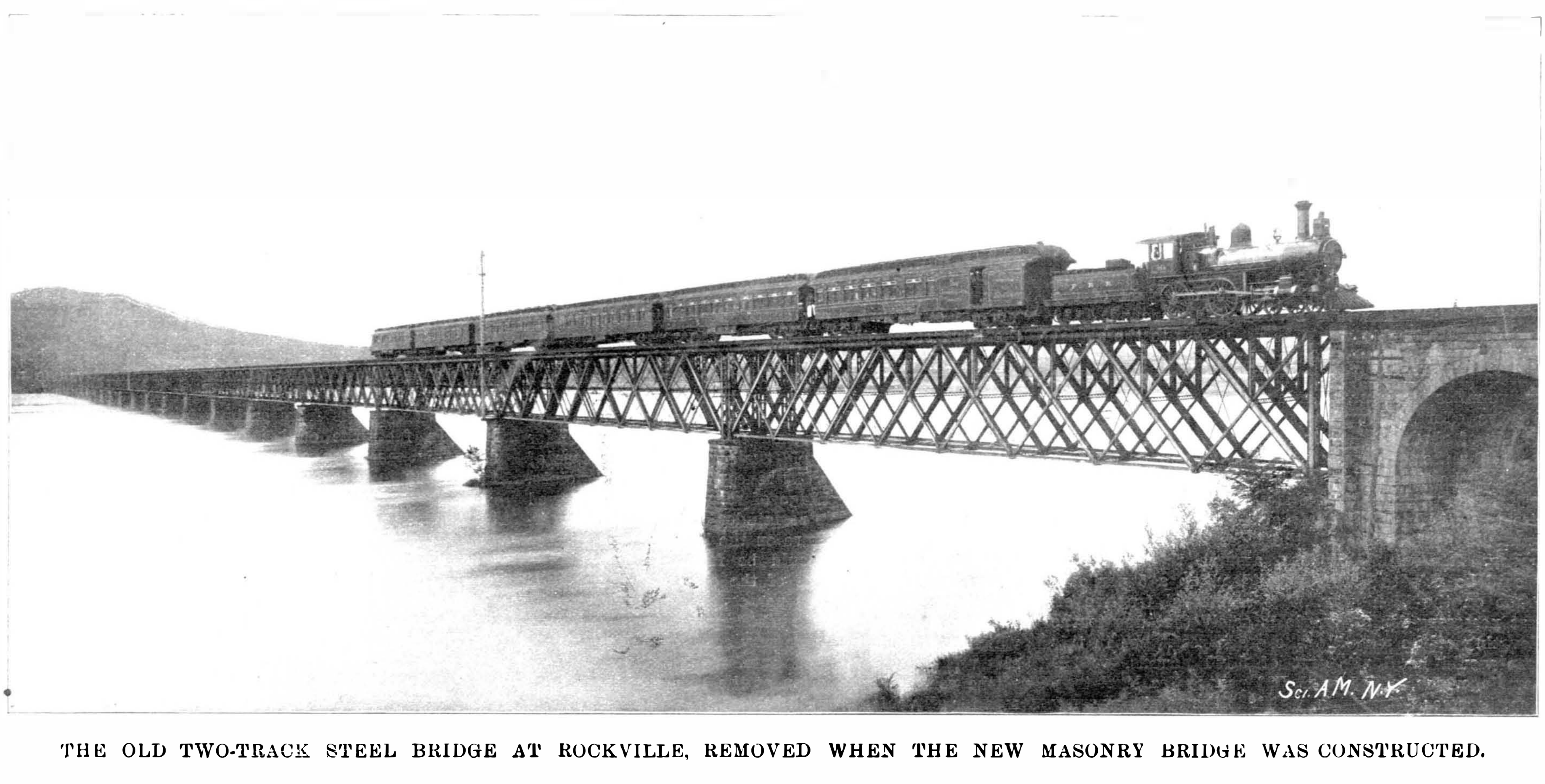
The existence of a large supply of suitable timber, and the invention of that most admirable form of framed bridge known as the Howe truss, solved the problem; and by the use of pile or crib wooden piers, with an abundant use of gravel filling and broken stone riprap, our early railroads were carried successfully over the larger rivers and streams. Gradually, as the railroads grew richer and traffic demands became heavier, the Howe truss gave place to the wrought iron, or combination of cast and wrought iron, bridge, many of these being of a most complicated and, in many cases, of a purely experimental type. Then, in due course, followed the steel truss, with its longer spans, more scientific design, and greater durability. The steel truss, of course, is still with us, and always will be; but the latest phase of development in bridge construction is the tendency, as far as possible, to substitute masonry in place of steel bridges. One of the most active roads in the prosecution of this policy is the great Pennsylvania system; and of the many substitutions which they have made, none is so interesting as the removal of the old Rockville steel bridge over the Susquehanna, shown in our illustration, and the substitution of the magnificent masonry structure, whose life should be as lasting as nature itself.

The steel bridge was a structure notable for its capacity and great length. It had a total length between abutments on either bank of 3,682 feet, which was covered by twenty-three spans of 160 feet. These trusses measured 22 feet in width and 19 feet 7 inches in depth between chord centers. They were of what is known as the double triangular type, and the bridge carried two railroad tracks.

The great increase in the travel on the road necessitated the provision of extra tracks, and it was decided to build a new four-track, all-masonry bridge, parallel with the steel bridge, and remove the latter when the new structure was completed. The dimensions of the stone bridge are as follows: Total length between abutments, 3,791 feet; width out to out of parapets, 52 feet. The arches have a rise of 20 feet and a span of 70 feet, and the total cubical contents of the masonry is 100,611 cubic yards.



NEW FOUR-TRACK MASONRY BRIDGE OF THE PENNSYLVANIA RAILROAD COMPANY ACROSS THE SUSQUEHANNA RIVER. TOTAL LENGTH, 3,791 FEET.



THE OLD TWO-TRACK STEEL BRIDGE AT ROCKVILLE, REMOVED WHEN THE NEW MASONRY BRIDGE WAS CONSTRUCTED.

[Concluded from SUPPLEMENT No. 1478, page 23683.]

SOME DATA ON THE COST OF OPERATING AUTOMOBILES FOR COMMERCIAL PURPOSES.

By HIRAM PERCY MAXIM.

OF the three other motive powers, the one which demands our attention first, and is most promising, judging by its wonderful development and its evident latent possibilities, is the gasoline. Starting in at the birth of the automobile movement, with relatively nothing to build from, it has, in pleasure vehicle service, swept entirely beyond all of the other motive power systems put together, until to-day probably 90 per cent of all the automobiles in use in the world are propelled by it. This fact, taken in connection with the contemporaneous rapid development of the gas engine in stationary practice, where it is becoming a competitor of steam, even in the largest units, is most suggestive.

The gasoline pleasure vehicle to-day, in its best form, is a very reliable piece of apparatus for its particular service. Its engine, when given occasional skilled attention, is entirely trustworthy. Any one of several engines available on the market to-day could be started in the morning, and so far as its operation was concerned, or its reliability, could be counted upon to be found running at night, and without having required any attention in the meantime. With occasional skilled attention we know that this could be repeated day in and day out.

This engine, in pleasure vehicles, is connected to the driving wheels of the vehicle through a system of gear reductions, any one of which may be selected according to the speed or torque required. These gear reductions constitute what we call the gear change. They exist in three forms. In one, the different gears are bodily thrust into and out of mesh with each other. In another, they are always in mesh, but are carried in planetary arrangement and brought into service by retarding part of the system. In the other a separate friction clutch engages whichever gear reduction is wanted.

The first of these requires skill and attention to operate if damage is to be avoided, is almost 100 per cent efficient, and is very light and small even when there are four gears ahead and one reverse. The second requires no skill to operate, cannot well be damaged, but has the disadvantage of being complicated when more than two gears ahead are used, and is very wasteful of power on any but direct engagement. The third requires no skill, is equally efficient on all gears, but is usually bulky and more expensive than either of the others. While all of these systems are used in considerable numbers, the first mentioned predominates in the heavier weight vehicles. The necessity for skill is not objectionable where the owner of the vehicle does the driving, and where his usual aim is to keep it in good order. Anyway, the necessity for this skill is overbalanced by the ability to get several speeds and still have a small bulk and light weight. In a business wagon it is doubtful if these conditions would prevail. It certainly would be a question if the ordinary driver would always be skillful, would always have the good condition of the vehicle more at heart than finishing his day's work and getting home to his supper, than if the owner, who paid the bills for the maintenance expense, would much care whether or not the gear change gave several speeds and yet was small in bulk and light in weight. From bitter experience with the electric business wagon, it would seem distinctly not.

In considering the gasoline business wagon, therefore, it would appear that one of the things we could expect as necessary would be the individual friction clutch change gear system. Friction clutches are old and thoroughly understood, so that, assuming them as used in connection with a modern type of gasoline engine, we can get a very close idea of what a 2,000-pound, a three-ton, and even a five-ton vehicle would have to be.

From our knowledge of the electric wagon, we know that in a 2,000-pound vehicle, each pound of vehicle parts proper, namely, everything other than actual battery and motors, will carry about one and three-quarter pounds of combined load and motor apparatus. The load being 2,000 pounds, and assuming an engine and transmission weight of 1,000 pounds, which should be ample, the combined load for the vehicle parts to carry becomes 3,000 pounds, which, with two men, may be taken as 3,300 pounds. On the one-and-three-quarters pound basis, this means that the total weight of the vehicle with load would be something around 5,180 pounds. It probably would be very close to the actual figure. Again, we find from our electric experience that to propel a relatively small vehicle at a speed of twelve miles per hour, on a level, good road, requires a tractive effort, or push, at the rim of the driving wheels of about 16 pounds per thousand. This would mean, for the 5,180 pounds weight, 83 pounds tractive effort at the tires. Now, from our gasoline touring car experience, we know that it is highly desirable in practice to be able to take fair grades on the high gear. It would probably be all the more so on a business wagon. We will, therefore, assume that a wagon should be able to take its full load up a 5 per cent grade on the high gear. The additional tractive effort necessary for the grade is solely that due to the elevating of the weight. The grade resistance in this case would be 5 per cent of 5,180 pounds, or 259 pounds, which, added to the 83 pounds for level traction, becomes 342 pounds, which is the total necessary tractive effort to mount a 5 per cent grade having a good surface.

The engine necessary to give this tractive effort depends upon the speed at which it is to run. Since a light business wagon would never have to exceed a speed of eighteen miles per hour, it would be safe to allow a speed of 900 revolutions per minute for twelve miles per hour, which would be 1,350 revolutions per minute when running at its maximum of eighteen miles per hour. Taking 36-inch diameter wheels, this means a gear reduction on the high gear of 8 to 1. The engine torque would then have to be one-eighth of the axle torque, plus whatever losses there were in the transmission. The axle torque (torque being considered the twisting effort at a point 12 inches from the center) being 515 pounds if the tractive effort is 342 and the wheel diameter 36 inches, and the transmission losses being not over 12 per cent, the motor torque becomes 515 pounds $\times$ 1.12 $\div$ 8 = 72 pounds.

At 5 inches stroke we know that it is easily possible in engines, as we build them to-day, to get two pounds torque from each square inch of cylinder area. Assuming two cylinders as most suitable for a commercial wagon, each one must give one-half of the 72 pounds torque required, or 36 pounds. If each square inch gives 2 pounds torque, the number of square inches required is 36 $\div$ 2, or 18. A 5-inch cylinder has an area of 19.6 square inches, so that it is plain that two cylinders 5 inches diameter by 5 inches stroke will give a little more torque than enough.

We are then at once able to judge what the wagon will have to be. Its engine would be a two-cylinder 5 inch by 5 inch, preferably opposed, to give steady turning effort and balance, and its transmission individual friction clutches. The number of the latter would depend upon the maximum tractive effort the wagon would ever have to develop. From our experience, we know that this maximum is about twelve times the level full load. From the engine we have assumed this would mean a gear reduction of about 24 to 1. The high gear being 18 to 1, and the lowest it would ever have to have being 24 to 1, it is seen that four gear reductions would be ample and that there would be enough for practical purposes.

The total weight of the wagon without load would be 2,000 pounds less than the total 5,180, which would make it approximately 3,180 pounds. The probable price of such a vehicle and its probable maintenance of expense are now all that is required to enable us to compare it with the electric wagon.

It would be probable, judging from pleasure carriage prices, that a two-cylinder 5 by 5-inch engine and a three or four-speed clutch transmission on a business wagon of the class usually called for in the 2,000-pound capacity, could not be made and sold profitably for less than $2,250. This is assumption, but is probably not far wrong. From this basis, and the weight which we know, we are now able to fairly closely arrive at all maintenance charges but one. This one is the repair and depreciation on engine and transmission. The other elements of maintenance expense, judging from existing electric wagon expenses, would be the following: Tire maintenance, fuel and lubricant consumption, vehicle repairs, depreciation, and interest. Generous tires on a vehicle of this weight would be 3-inch ones. The cost of these would be approximately $164 a set. We could expect their mileage to be the same as those on the electric. This was nine thousand miles. If we take the same service for a gasoline vehicle that we did for the electric vehicle, the yearly mileage will be 8,640, which brings the rubber tire charge to $157 per annum.

The fuel consumption we can get at by the known weight and our experience in power consumption on electric vehicles. We know from this experience that the power required in average service for 1,000 pounds in a wagon of this class is about 53½ watt hours per mile. The average loaded weight being something about 4,000 pounds, the power per mile would be 214 watt hours. This is .28 horse-power hour. Taking thirty miles per day, this amounts to 8.4 horse-power hours per day for actual running.

In the gasoline machine there would be an element of idle running, and a generous allowance for this would be 25 per cent of the working power consumption, which would bring the total to 10.5 horse-power hours per day. We know that we should get a horse-power hour out of one and a half pints of gasoline, which, in this case, would make a daily consumption of 1.97 gallons. Allowing 15 cents per gallon, this is 30.2 cents per day for fuel, which, on the basis of 288 working days per year, comes out roughly at $87 per year.

From our touring car experience, it is safe to take the lubricating oil cost at about the same as the fuel cost, which seems strange, but nevertheless represents about average conditions. A charge per annum for both fuel and lubricant on this basis would be $174.

Separating out the engine and transmission repair and depreciation accounts makes the part coming under vehicle repair very nearly the same as in the case of the electric. The only difference is the electric motors. Since the same percentage of repair has been allowed upon these as upon the remainder of the vehicle apparatus, the percentage figure on the lesser value that the gasoline parts have would be fair. The percentage figure was 4. The price of the engine and transmission is approximately 40 per cent of the value of the vehicle; 4 per cent on the vehicle parts would be $37.37, which represents what we may count upon for essentially vehicle repairs per annum.

The vehicle depreciation at the 10 per cent uniform rate for all vehicles would be $125.16, while the interest at the uniform rate of 5 per cent would be $111.50.

This leaves only the engine and transmission repair and depreciation accounts. The value of these parts is taken at $834.40. From our experience in gasoline engines, the friction clutches in our best pleasure vehicles, when regular attention is bestowed upon them, require about the same repairs and suffer about the same depreciation as the usual run of similar apparatus. Ten per cent of the price of the apparatus is a generous figure for this. This would make the repairs equal to the depreciation, which ought to be safe. The two amount to $166.88 per annum, and conclude the items of maintenance expense as we have estimated them for a 2,000-pound gasoline wagon. Summarized, they are as follows:

Tire repairs	$157.00
Fuel and lubricant consumption	174.00
Vehicle repairs	50.00
Vehicle depreciation	125.16
Interest	112.50
Engine and transmission, repairs and depreciation	166.88
Total	$785.54

Or 9.12 per vehicle mile, where the corresponding electric with Exide batteries is 12.61. The estimate, if Edison battery were used, is 11 cents, and if Manchester box batteries are used, is 10.93 cents. Aside from any consideration of the relative conveniences or inherent peculiarities of the gasoline system, the latter, if built on modern lines, would seem to promise to be cheaper to maintain by some 27½ per cent. This is a very important matter and must sooner or later make itself felt.

In a three-ton gasoline wagon and a five-ton gasoline truck the situation is equally interesting. In so far as the practicability of either of these vehicles goes, there would not be the slightest question of even a five-ton truck, if a one-ton wagon is practical. In fact, a five-ton gasoline truck would probably have less disadvantages on the score of weight and handling qualities than the electric five-ton truck. Furthermore, the speed of heavy trucks must necessarily be low as things exist to-day. Coming down with the speed comes down with the horse-power, so that the engine dimensions by no means go up in proportion to the weight of the truck over the weight of the touring car.

Taking the three-ton truck and allowing two pounds for the wagon parts constant, ten miles an hour for the level full load speed, fifteen pounds per thousand for the level tractive effort, 36 inches for the wheel diameter and 800 revolutions per minute for the normal engine speed, the size of the engine works out as two cylinders 5¾ inches diameter by 7-inch stroke. This is seen to be by no means a large engine, and yet, on a conservative allowance, it will develop enough torque to drive a three-ton truck with a load up a 5 per cent grade on the high gear.

Taking a fair price for such a truck as $3,000 and the tires as 4-inch, the elements of maintenance expense on the same basis as that followed for the 2,000-pound wagon would be the following:

Tire repairs	$242.00
Fuel and lubricant consumption	280.00
Vehicle repairs	65.28
Vehicle depreciation	163.20
Interest	150.00
Engine and transmission repairs and depreciation	217.60
Total	$1,118.08

Or a cost to run the vehicle per mile of 16.1 cents, which is 8.05 cents to haul a ton a mile. In the corresponding electric truck with Exide batteries, the figure is 23.26 cents per vehicle mile, and 11.63 cents ton mile; the estimate of the Edison battery, 20.47 cents for vehicle mile and 10.23 cents for the ton mile, while for the Manchester box battery the estimate is 20.36 cents for vehicle mile and 10.18 cents per ton mile.

Thus the gain over existing conditions, aside from relative inherent peculiarities, is a gain of some 30 per cent for this gasoline truck over the corresponding electric truck operating under existing conditions.

In the five-ton truck the constants allowed are 2.50 for the vehicle parts, weight 1,850 pounds for the engine and transmission weight, seven miles per hour for the level full speed (electrics are satisfactory at 5½), 14½ pounds per thousand tractive effort, 36-inch diameter wheels, and 800 revolutions per minute for the engine. The size of the engine cylinders on the basis of two of them works out as 6-inch diameter by 7-inch stroke, which will be seen to be only slightly larger than those for the three-ton wagon. This is, of course, due to the decrease in speed.

The power of the engine for even this heavy vehicle will be seen to be lower than we frequently use on high-powered touring cars. Therefore, we might expect no difficulties from carburetion, starting, or cooling. In fact, the engine conditions should be considerably easier on account of the greatly decreased fluctuation in speed.

On the basis of a fair price for such a vehicle being $3,400, and the tires being 5-inch, the elements of expense worked out as the other vehicles have been worked out appear as follows:

Tire repairs	$262.00
Fuel and lubricant consumption	320.00
Vehicle repairs	73.20
Vehicle depreciation	183.00
Interest	170.00
Engine and transmission, repairs and depreciation	244.00
Total	$1,252.20

This means a vehicle mile for 21.8 cents and a ton mile for 6.25 cents, where, under existing conditions,

the vehicle mile of the electric was 30.57 cents and the ton mile 8.74 cents respectively. The estimate for Edison batteries was 26.75 cents and 7.64 cents for the vehicle mile and ton mile respectively, while with the Manchester box batteries it was 26.55 cents and 7.44 cents respectively for the vehicle mile and ton mile. The gain is over 28 per cent in the case of existing vehicles with Exide batteries.

This completes the comparison. Aside from the inherent peculiarities of the gasoline system, preventing its entering the field at present monopolized by the electric, there would seem to be good reasons for believing that it will be cheaper at least than the best that we have in sight for the electric. This is a very important matter, for, even if the gasoline engine's peculiarities in the way of odor, heat, and possible fire, prevent its ever becoming a real competitor of the electric, it does, however, open up at once the great field of suburban freight transportation which the electric cannot hope to enter and which is already calling loudly for some kind of a motor vehicle. In the opinion of the writer, the time has arrived for us to expect to see the gasoline commercial wagon and truck emerge from the gasoline touring car just as the electric commercial wagon and truck emerged from the electric phaeton and brougham. The business wagon would probably have to be different in transmission, or gear change, from the existing touring car. Yet, as has already been pointed out, this difference is not without the bounds of what has already been developed and perfected. And, furthermore, if a practical 2,000-pound capacity gasoline wagon is possible, there is no reason why a five-ton capacity truck should not be also.

This brings us to the question of the status of the other two motive powers, steam and combustion. In the light of what has been accomplished with the gasoline engine, and what there is indication that the latent possibilities will be, it is difficult to look upon either the steam or the combination systems as other than temporary expedients to be used only until the gasoline appears. The demand for something of greater mileage possibilities than the electric has been pressing for some time, and it is but natural that the adherents of steam should have entered the field with steam engines and boilers, while the adherents of the electric control and transmission entered with the electric generating outfit in place of the storage battery. Both of these being built from detailed apparatus which was already fairly developed, a much shorter time was necessary to produce practical operating vehicles than was possible with the gasoline.

I personally look upon this as the reason of being for the existing steam lorries in England and the gasoline combination systems in this country. In the case of the former, the question of fuel has of course had an influence, but in the case of the combination, it has not. I say, therefore, that it seems likely that the very near future will see developed in this country what will probably be the greatest of all automobile production—the vehicle of unlimited possibilities, if we but give it the road to run on—the gas engine truck.

ELECTRICITY AS A MOTIVE POWER FOR AUTOMOBILES.*

ANOTHER form of electric propulsion being used abroad quite a little is known as the trackless trolley where an electric automobile minus the storage battery, takes its power from a pair of overhead wires. It is rather surprising what flexibility of travel such a machine possesses. It is not confined to a patch immediately below the wires but can wander quite a way each side and get along through traffic quite readily. As a feeder to regular trolley lines or in locations where traffic will not at once bear the expense of track installation, this system offers a ready solution to the transportation problems. We are sure to see it used quite a good deal in the future.

Just lately another system has been brought to the front and the first equipment is now being installed. It is primarily an electric train for traveling over common roads and hauling heavy merchandise long distances. It consists of a forward or pilot wagon carrying a gasoline engine of large power, and a dynamo; and of several trailers each equipped with a pair of electric motors getting their power from the dynamo up forward and being controlled from the cab as it were. It is comparatively cheap to construct, ought to be cheap to maintain and should give good results in many instances. The actual horse-power required at the rim of the wheel would be much in excess of that required on steel rails, but fuel is one of the smallest items of transportation. Interest on investment and sinking fund largely exceed it generally.

The most frequent question of the intending purchaser is: "What will it cost to run the machine?" This is a question about which there is a deal of misunderstanding. Hastily drawn conclusions, or conclusions drawn from incomplete data are too often applied to the general question. This is a dangerous proceeding regarding any new thing, and the automobile is no exception.

One man will tell you with great glee that his machine did not cost him a cent except for current for the entire season. Another will tell of a depleted bank account and no satisfaction to balance it. Consequently, the average individual forms a very unpleasant opinion of all men's veracity, and a very decided opinion of the uncertainty of the automobile.

Now the facts are these: Of two identical equipments, operated under similar conditions in the same town, one is expensive to operate and the other inexpensive. There is just one cause for this—the care given to the vehicle and the way it is operated; in other words, the personal equation. The same results are seen in the wear and tear on horses. But we have become callous to the dumb animal's maltreatment, and pass it by. Why some purchasers spend from one to three thousand dollars for an electric carriage containing a battery and one or two electric motors, and then blissfully jog along, giving the vitals of their investment but very scant attention, is a mystery. But they do it right along. They seem to think the thing ought to look out for itself and come around to their office and demand attention when needed. The fact that the whole affair is so quiet and docile and does not "holler" and squeal when neglected, results in further abuse. Very soon the owner becomes a pessimist and the automobile gets blamed *per se*. The same general principle applies to the steam and gasoline automobile, but in each of these cases the evidence of mechanism is so apparent, there are so many reciprocating parts to rattle if they get loose and bearings to squeak if not oiled, that the owner is compelled to give them attention for his own peace of mind. Some one ought to invent an attachment to a storage battery to hit the operator over the head every third time he exhausts his battery down to the last gasp, or does some equally foolish thing.

One need not forsake his family and his friends and move into the stables, but he must get to understand it, to know its limitations, to know how to avail himself of its advantages, before he can get satisfactory results.

Let me simply emphasize the absolute necessity of a complete understanding between the man and the machine to get good results. Some owners and operators have scarcely a bowing acquaintance with their machines.

Turning now to the strictly commercial automobile, a high order of intelligence cannot be hoped for in the operator, and hence the machine must be made to withstand its punishment on the road as it comes along. Care at the stable, however, is just as imperative as in the case of pleasure craft.

The success of the commercial automobile depends upon two main points, first, adequate equipments; second, intelligent inspection and care. The trolley car or the locomotive receives no attention on the road, but upon its return to the barn or road-house, it is watched with extreme care. So it must be in the case of their comrade, the commercial vehicle, if success is to be expected.

In the electric vehicle there are only three vital organs, the battery, the motor, the tire. Automobile builders have sometimes yielded to the demand for low initial cost and have "skimped" on these items. Result: short life, great expense of operation, and dissatisfaction. There is a certain safe load that a Pullman car axle can carry continuously with safety. Increase this load seriously and greatly reduced life of the axle results. Similarly, a given storage battery can do a certain amount of work continuously at a reasonable maintenance expense. Overload it and the length of life comes down and the cost runs to prohibitive figures. Just so the 3½-inch tire may fail in a few months with a bad showing of may be ten cents a mile as tire cost, while the 4½-inch tire would do the same work at not over one cent a mile. It is difficult to impress this fact upon intending purchasers, but the company which refuses to under-equip its vehicles will win in the long run. The public must look further than initial investment and realize that a little increase in initial investment may buy an insurance against short life and high operating expense. It certainly cannot be challenged that a man is exhibiting good judgment if he puts $2,500, instead of $2,000, into an automobile, if he can reduce his operating expenses per mile 50 per cent.

The popular tendency toward lightness in automobile construction is all right, if it does not go too far. But like such tendencies, the pendulum is apt to swing too far. And as regards battery and tire equipment on commercial automobiles, the pendulum has undoubtedly swung too far and some good people have been hit by it. There are now, however, indications that the customer is coming to his senses, and there is a chance for good conservative engineering to make itself felt and not be negatived by enthusiastic and sometimes not over-scrupulous sales management.

The other element of importance in this consideration is care of the vehicle at its home station. Intelligence must be exercised here, and the company which places the care of its vehicles in the hands of some Jehu who knows a positive from a negative plate only while the tag is still on, will soon join the disgruntled minority who believe the electric automobile is a snare and a delusion. Delivery wagons can be built and are usually so built that the teamsters formerly employed can be transferred to the automobile and get along all right with little or no experience. The man in charge of the vehicle, however, he whose duty it is to keep the batteries in shape, and give them the regular attention they require, he must have brains and practical experience with batteries and motors. He need not be a retired college professor or even the possessor of an S. B. But he must know what he is about. As you have been told all about batteries, I cannot attempt to tell you what to do to them to make them a fair return on their investment. I can simply emphasize again the fact that too small battery, tire, and motor equipment means failure, and that adequate equipment coupled with adequate attention means success.

To figure the total cost of operation of electric automobiles requires that a great many items be reconsidered. They must be grouped and condensed as follows:

A. Interest on original investment.
B. Depreciation.
C. Cost of maintenance.

Interest on investment is a simple matter. Depreciation is not so easy. Correctly to get at this matter we must first understand that battery and tire items are not included here as they are charged off under maintenance. This leaves only the motors, controller, and the general wagon proper. It can be shown that these bear a fixed ratio to each other, and their rate of depreciation is fairly well known from past experience.

Maintenance includes current repairs to the battery and renewals of plates, after which the battery is as good as new. This is why the battery may be said to suffer no depreciation.

It includes also tire repairs and the renewals of worn parts, at which time the tire is also as good as new.

Also general repairs to the wagon proper. This is a well-known percentage from past experience. Also cost of charging current. This can be closely calculated.

Thus it can be shown that by a suitable dissection of the elements of an electric, we can practically deduce a formula which can be made to read in the form ax by cz. We cannot stop now to go into the full detail of such a formula. The cost may be reduced to two bases, the cost per vehicle mile and the cost per ton mile of merchandise hauled. Attention is directed to two peculiar facts. The cost per vehicle mile increases directly with the size of the vehicle. The cost per ton mile decreases at first rapidly and then slowly as the size of the vehicle increases, until at about five tons capacity would seem to lie the economical limit of the size of the storage battery electric truck. It appears that for general delivery purposes, where the expense of operation can be figured by the owner, only on the basis of vehicle miles, the load being too small or irregular to estimate closely, a small machine is best and most economical; while for the general transportation of merchandise in heavy work, the larger the unit up to about five tons capacity, the better.

On the score of efficiency there are two ways of looking at the question. First, how much do different systems cost? and second, what is the comparative satisfaction they give? One might do its work at a slightly less cost in actual dollars and cents, but it might be so obnoxious as to be unbearable. While another at a higher figure might prove satisfactory all around. There is absolutely no data available as to the relative cost of different systems for commercial vehicles, nothing but electricity having been used enough to yield any data.

Some two years ago the Automobile Club of America held a fifty-mile non-stop endurance run in which the amount of gasoline and water used by the contestants was accurately reported. One electric was entered, and from the performance of these three types under similar conditions, the actual cost of the power used can be figured fairly closely. Figuring the cost of gasoline at the time at 10¾ cents per gallon in barrel lots; lubricating oil for both gasoline and steam engines at 30 cents per gallon; and current for the electric at 4 cents per kilowatt hour, we have the following table of relative costs reduced to a common basis of moving 1,000 pounds one mile:

Steam, using flash boiler	.52 of a cent.
Gasoline, average of all contestants	.42 of a cent.
Electric	.50 of a cent.

It will thus be seen that on a basis of converting dollars directly into horse-power at the rim of the wheel, the electric is intermediate the steam and the gasoline. This, of course, considers only the one item of fuel supply.

* A lecture delivered before the Boston Y. M. C. A. by H. W. Alden, of the Electric Vehicle Co., Hartford, Conn.

CARBON WOOL.—MM. Constant and H. Pélabon describe a variety of filamentous carbon obtained in the process of carburizing fatty oils for the purpose of manufacturing coke. It is not formed in the recuperative furnaces, but only in the old open furnaces. In these, the admission of the air required for combustion is made in the combustion chamber itself. The gases, therefore, burn within the chamber, and all the flames are concentrated toward an opening in the upper wall. Near that opening, the furnace has a much higher temperature than elsewhere. It is there that the deposits of filamentous carbon are found. Every fiber of the "carbon wool" is attached at one end to a piece of coke, and the general direction of the fibers is that of the blast. Some of the fibers are gray, and others are black. Examined under the microscope, the gray fibers are generally cylindrical, and appear to be covered with a varnish, like the coke to which they are attached. Some of the fibers appear as if made up of a number of cones threaded upon each other, but there is no trace of crystallization. The black threads are covered with projections often arranged very regularly. They usually appear to be made up of rings. The authors counted six rings on 1-10 millimeter. The thickness of the fibers varies from 3-100 millimeter to 15-100 millimeter, their length from 5 centimeters to 8 centimeters. Chemical analysis shows them to be made up of pure carbon.—Constant and Pélabon, Comptes Rendus, November 2, 1903.

A POWERFUL GASOLINE LOCOMOTIVE.

By the English Correspondent of the SCIENTIFIC AMERICAN.

THE high standard of efficiency to which gasoline motors have been developed has resulted in their being utilized of late for tractive purposes on steel rails. There are many instances where steam is expensive and electricity is not available, and where, owing to the work being insufficient to justify the employment of either of these systems of propulsion, the gasoline motor is peculiarly adapted. There is also the additional advantage that a motor of this type is always ready for instant use, and, when not running, it incurs no expense for maintenance.

A gasoline motor of this type and for this class of work, illustrations of which are shown herewith, has recently been designed and constructed by the Maudslay Motor Company, of Coventry, England, for the City of London Corporation, to be used for the purpose of hauling freight cars over the track that connects the municipal meat market with the trunk road of the London, Brighton, and South Coast Railroad.

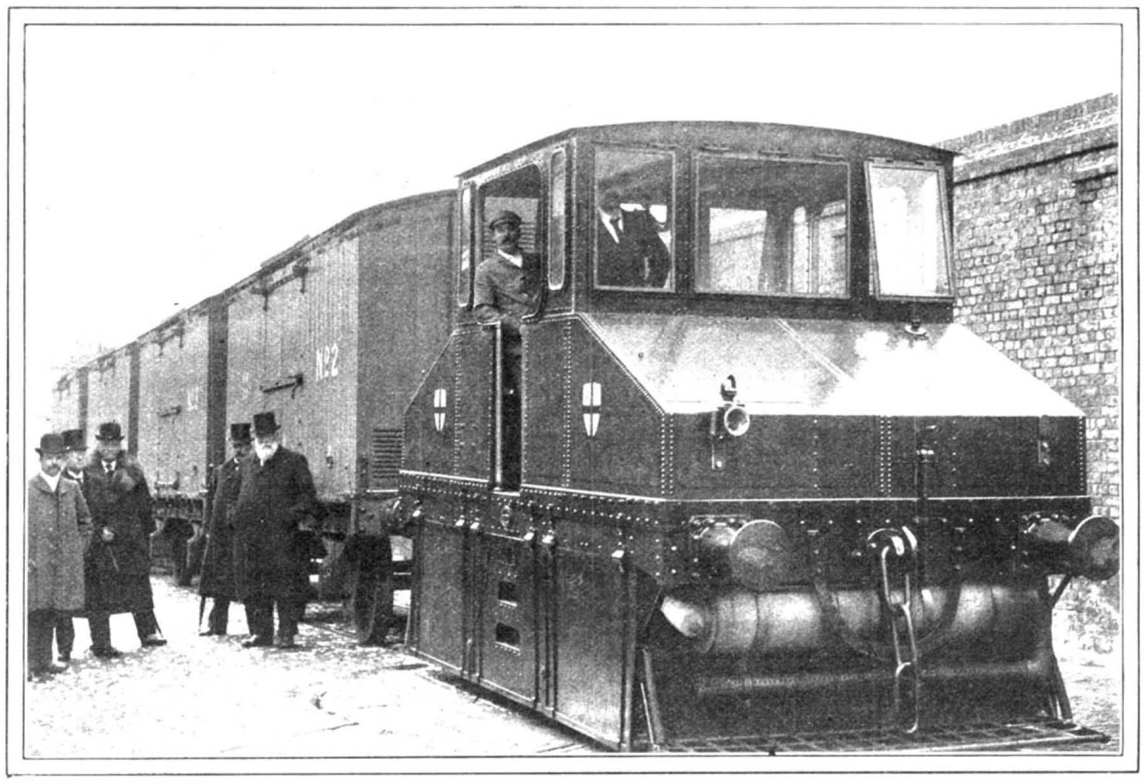
The locomotive, as will be seen, resembles the ordinary electric locomotive in appearance, the engine and mechanism being fully inclosed, to comply with the Board of Trade requirements. The motor is of the Maudslay standard type, having three vertical cylinders, each of 9 inches bore by 9 inches stroke, and it is capable of developing 80 horse-power on the brake, at 450 revolutions per minute. The ignition is of the high-tension type, with accumulators and coil. The locomotive is provided with gasoline and water tanks of sufficient capacity to carry fuel and water enough for a whole day's work. The motor is water-cooled and is supplied with tubular radiators having a large area; while, in order to insure complete cooling, especially when traveling at the minimum speed with the maximum load up the heaviest gradients, a fan is also fitted to the crank shaft. In order to facilitate starting, an auxiliary, single-cylinder, 8 horse-power motor is used to turn over the engine, which is also equipped with compression relief cams.

The class of work fulfilled by this tractor is especially arduous. The maximum load hauled consists of four cars, weighing, when loaded, approximately 50 tons. The track traversed is of standard gage, and extends partly through the streets and the markets. Some stiff gradients have to be negotiated, the maximum being 1 in 36. The locomotive is geared to travel at a slow speed, two speeds forward and reverse of 2½ and 5 miles per hour, respectively, being fitted.

The braking facilities are adequate. These consist of ordinary hand brakes and Westinghouse air brakes for emergencies. In addition, there is also a sand-distributing apparatus to facilitate progress when the streets and track are wet and slippery. The weight of the locomotive complete is about 12 tons.

In the official trial carried out before the Board of Trade officials, the cars hauled by the locomotive were filled with stones, to bring them up to the contracted load of 50 tons. The locomotive hauled the loaded cars over the system with perfect ease, and demonstrated that it could have hauled a heavier load, and at a greater speed than that required. The trial included stopping and restarting with the full load upon the heaviest gradients, and in every instance this was accomplished with complete ease and efficiency. The ease also with which the locomotive was controlled and reversed was very noticeable.

The experiment is being closely followed, for there are many instances extant in Great Britain similar to this, wherein a gasoline motor would be more economical, reliable, and altogether more suitable for haulage purposes, and in which cases the gasoline locomotive will doubtless supplant the existent systems of haulage. For this class of work, it has a wide future, owing to its immunity from breakdown, facility of handling, convenience in working—dispensing as it does with coal or other fuel, steam, and live rails or wires—and low cost of maintenance. Furthermore, the initial expense is much lower than either with steam or electric locomotives, as no expensive plants have to be installed.



GASOLINE LOCOMOTIVE HAULING FOUR LOADED FREIGHT CARS WEIGHING FIFTY TONS AT A SPEED OF FIVE MILES AN HOUR.

EIGHTY-HORSE-POWER MAUDSLAY GASOLINE LOCOMOTIVE FOR USE IN HAULING FREIGHT CARS ACROSS LONDON.

RUSSIAN RAILROADS REPORT.

THE official report for the Russian railroad system has been recently published for the year 1900, giving a series of figures which show the cost of operation and the extent of the traffic upon these lines. The Russian system, exclusive of Finland, but including the Asiatic lines, had a total length of 33,040 miles at the end of 1900, of which 4,680 miles lay in Asia. Of this, 22,490 miles belonged to the government and 10,510 miles to private companies. Double track railroad extends for 6,230 miles. The increase in length over the preceding year is 1,870 miles. In 1880 the government owned but 40 miles of railroad and private companies had 13,880 miles, but in 1891 the state possessed 6,580 miles and the companies 11,470 miles, not including the Trans-Caspian, of which 880 miles is operated by the war department. The new roads and branch lines which were opened in 1901 amounted to 1,990 miles, and at the end of that year there were 4,160 miles in construction in the Russian Empire and 1,570 on the East China system. The capital engaged at the end of 1900 (not including the Finland system) was $2,403,000,000, of which $2,300,000,000, or about 96 per cent, represents the government's share. In this total the Asiatic lines (Central Asia, West and Central Siberia, and Oussouri) figure for $185,000,000. The cost per mile is from $23,900 to $31,800. As regards the rolling stock at the same date, it is represented by 12,337 locomotives; 14,275 passenger cars (including 1,647 of the fourth class) giving 497,435 places; 1,376 cabs; 289,436 freight cars (including 20,398 tank cars) having a capacity of 3,800,000 tons. The number of postal cars is 527.

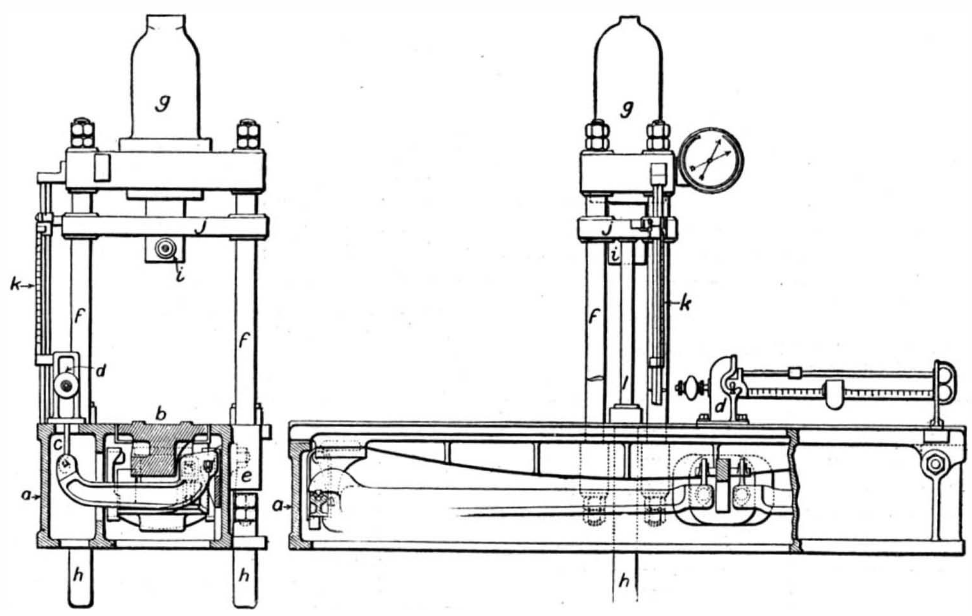
As to the methods of firing used on the locomotives, 2,354 use wood for heating; 4,336 employ naphtha or residues; 5,647 use soft or hard coal. According to the official tests which are made every year, the calorific yield of 1 cubic yard of wood is the equivalent of 190 pounds of naphtha or residues, 290 pounds of English coal, 360 pounds of Silesian coal, or 300 to 480 pounds of Russian coal (according as it comes from the Donetz, Ural, Poland, Caucasus, or Moscow), or 640 pounds of peat. On an average, a ton of anthracite costs $3; naphtha from Russia in Europe costs $7.20, and from Russia in Asia $5.40; wood costs 24 cents per cubic yard. The consumption of combustible per 1,000 miles per locomotive is 23 tons of anthracite, 15 tons of naphtha, or 90 cubic yards of wood. The cost in these three cases is respectively $62, $70, and $56. On the Central Asia system naphtha is used exclusively on the locomotives (except three, which use wood). The Siberian lines have 282 locomotives using wood, 493 with coal, and 181 with naphtha.

As to the traffic upon the Russian railroads, the number of passengers carried amounts to 104,000,000 (including 2,700,000 in Asia) representing about 7,000,000,000 passenger-miles. The freight figures at 160,000,000 tons (5,000,000 tons in Asia), or 27,000,000,000 ton-miles. Of the total, the baggage represents 2 per cent; separate packages 7.2 per cent; military transports 6.6; railroad material 18.5. On an average, one passenger travels 77 miles (in Asia 280 miles), while a ton of freight travels 6,360 miles. The increase of traffic over the preceding year is 11 per cent for the passengers and 13 per cent for freight. The traffic has more than doubled since the year 1891, when it reached 48,000,000 passengers and 72,000,000 tons freight. As to the personnel engaged on the Russian lines in 1900, there were 360,414 higher employes and workmen in permanent employ, representing 4.8 per mile. The total number includes 33,520 employes for the general administration; 116,663 for the maintenance and inspection of the lines; 151,335 for the traffic and telegraph; 58,896 for traction and material, besides 211,875 workmen employed by the day.

A large pumping engine, installed at the Waihi mines in New Zealand, is described in a recent issue of Engineering. It is of the Cornish cycle type, with compound cylinders, and a beam transmitting power from connecting rods to pump rod. Its high-pressure cylinder is 60 inches in diameter with 6 feet stroke and its low-pressure cylinder 110 inches in diameter with 12 feet stroke. The ratio of cylinders is thus 6.7 to 1. The stroke of the pump plungers is 12 feet and the pump plungers are 23 inches in diameter. The first plunger set is placed at a depth of 700 feet from the surface. The engine is designed to raise 1,500 gallons per minute from a total depth of 1,550 feet. To raise this quantity the engine works at 7 strokes per minute, developing 730 horse-power. The rocking beam, built of steel plates and angles, is 48 feet long, 8 feet deep at the center, and weighs 50 tons. The two bearings of the center shaft are each 22 inches in diameter and 24 inches long. The engines were constructed from the designs of Mr. Henry Davey, M. Inst.C.E., of London.

HYDRAULIC SPRING-TESTING MACHINE.

WE were recently asked to visit the works of the West Hydraulic Engineering Company, at Luton, in order to inspect a new hydraulic spring-testing machine which this company has just designed and constructed for the Madras Railway Company. This machine is illustrated in the accompanying engravings. It contains several ingenious devices which are well worthy of attention. Its general design, together with that of its pump, is well shown here, the engravings giving cross and longitudinal sections. It will be seen that the machine consists of an oblong cast iron box *a* at the bottom, in which are arranged the system of levers, on which is hung the testing table *b*. A rod *c* is brought up from the system of levers to the steelyard *d*. Bolted into strong steel lugs *e* cast near the center of the length of the oblong body of the machine are four circular steel uprights *f*, to the tops of which is bolted the bottom plate of the hydraulic testing cylinder *g*. This cylinder only works in one direction, that is to say, it only forces the ram *i* down for testing purposes. In order to raise the ram after the test is over, two additional and smaller hydraulic cylinders *h* are cast in the body of the machine. These cylinders work the draw-back rams *l*, which are attached to the crosshead *j*, which runs on and is guided by the uprights *f*, and which is also attached to the ram *i*.



HYDRAULIC SPRING TESTER.

Practically any type of spring used on railways can be tested with this machine. As shown in the engraving, there are two roller carriages on which the ends of the spring under test may rest. This is one method; another is by means of shackles and links. This is shown by the apparatus lying in front of the testing machine. It consists of two screws with threads of different hands at either end, and can be mounted on the upper side of the body of the machine. By turning the hand wheel shown on the left, the spur wheels turn the screwed bars equally, by which means the shackles can be adjusted to any required distance apart, and the links to any angle. This is of importance, since the inclination of the links affects the stiffness. Should it be necessary to test a helical spring, then an apparatus with a ball bearing head is placed on the table under the ram and a round bar of steel run through the center of the spring, so as to prevent the pieces flying should the spring break when under test.

In use the machine registers the amount of compression which a spring has suffered under given pressure. To bring this about, a scale *k* has been put upon a vertical bar attached to the side of the machine and to the base of the testing cylinder. This scale can be adjusted to suit each spring as it is tested, and the ram as it goes down takes with it a pointer which slides upon the scale, remaining when the ram is withdrawn at the point it reached during the compression. The actual method in testing a spring is as follows: First of all is read the weight of the spring under test on the steelyard. Then the latter is weighted in accordance with the compression which it is desired to put on the spring. Then the ram and crosshead are lowered by the action of the pump until the former just touches the spring without compressing it. This is taken as the zero. The screw holding the rule bar is slackened, and the pointer brought to zero. The rule is then raised on its upright until the pointer touches a small tappet on the crosshead. The screw of the rule bar is then again tightened. As the spring is compressed by the further action of the pump, the pointer is carried down by the tappet, and when the ram is removed, remains in the position it has reached, when the steelyard shows that the requisite pressure has been applied. With an arrangement of this kind it is, of course, unnecessary to make any calculations, since in each case zero is started from.

This machine could, of course, be worked off an hydraulic supply main; but in the present instance a special pump has been provided, and this, too, is interesting. It is shown at the right hand of the testing machine, with its controlling lever placed so that the operator can work it and at the same time observe the steelyard, pressure gage, spring, etc. The pump is worked by belt on to the pulley shown. In the hub of the pulley there is a cone friction clutch which either the raising or depressing of the starting lever puts into gear, the action being the travel of a pin in a helical slot. The starting lever also performs two other functions, namely, the opening and closing a valve leading to the compression cylinder, and the opening and closing of the valve leading to the draw-back cylinders. Of course, if one of these valves is open the other must be shut, and *vice versa*. The method devised for working is ingenious. When the lever is horizontal, as shown, neither valve is open, nor is the pump being worked. By either raising or lowering the lever, one or other of the valves is opened and the pump started to work.

The whole plant is well and strongly made. We had the opportunity of seeing it in operation, and could observe how easily it was manipulated. We understand that it is constructed to work up to a pressure of 15 tons on the spring.—Engineer.

CONTEMPORARY ELECTRICAL SCIENCE.*

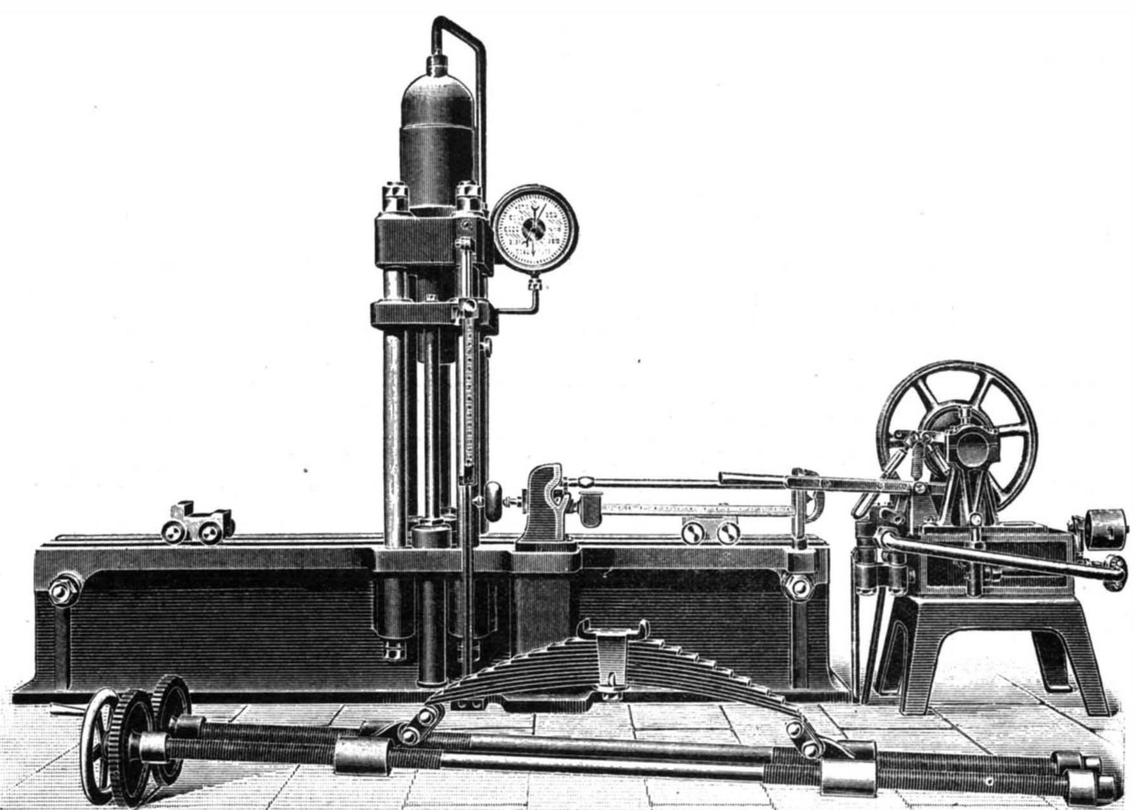
N-RAYS.—R. Blondlot has made several further discoveries in connection with his N-rays. Hitherto, the only fact noticed was that they increased the luminosity of a small flame or electric spark. But the author has now found that they also enhance the reflecting power of bodies. He mounted a band of paper vertically and illuminated it with light from a small flame inclosed in a box provided with a vertical slit. An Auer burner was inclosed in a chimney provided with a vertical slit closed with aluminium foil. It was then found that the brightness of the paper was considerably enhanced by allowing the N-rays to fall upon it, and was reduced on cutting them off by means of a lead screen. The same observation was made on viewing the reflection of a luminous slit in a polished steel knitting needle. This shows that regular reflection is also affected by the rays. It was confirmed by observing the reflection in a bronze mirror and in the polished face of a quartz crystal. But in the latter case it was found that the rays had no effect when they fell vertically on the face of the crystal. All these effects require an appreciable time to appear and disappear. Though an effort was made to discover some effect of the rays upon refracted light, no success was achieved in that direction. The author has recently found that the Auer burner may be advantageously replaced by a Nernst lamp without a glass. A 200-watt lamp shows the phenomena with sufficient clearness to be visible even to the untrained eye.—R. Blondlot, Comptes Rendus, November 2, 1903.

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

INFLUENCE OF FIELD UPON MAGNETIC SUSCEPTIBILITY.—A. Heydweiller finds that within small variations of field intensity the change in the susceptibility of solutions of iron and manganese salts is inappreciable, but that when the fields range from 0.1 to 40,000 C. G. S. units variations are distinctly traceable. In ferric chloride they are slight, in ferrous and manganous chlorides they are somewhat greater, and in the sulphates the variations attain as much as 30 or 40 per cent. As regards the theory of molecular magnets, it must be concluded that complex molecules are formed in these salts.—A. Heydweiller, Ann. der Physik., No. 11, 1903.

PRESSURE WITHIN THE SPARK.—In the year 1882 Dewar executed some measurements of the pressure within the electric arc by perforating the electrodes and connecting the interior with very delicate manometers. He found that the positive carbon was under a constant pressure of about 2 millimeters of water, whereas the negative carbon showed sometimes a positive and sometimes a negative variation of pressure. Early this year, Mitkewitsch measured the ratio e/m and v for the electric arc, and found a far-reaching analogy between the arc and the Crookes tube. This analogy has since been extended to the spark by C. Baumgart. He passed sparks between two electrodes inclosed in a glass bulb, one of them being a rod provided with a micrometer screw, while the other was a brass tube mounted in a position facing the rod. The brass tube had an aperture 0.5 millimeter in diameter. All the results point to two streams of ions, both of which exert a pressure upon the electrode on which they impinge. But the pressure of the positive ions upon the cathode is by far the greater of the two, and sometimes amounts to over a millimeter of water. The longer the spark, the less is the pressure. The ratio e/m appears to be of the order 2×10^6, and would indicate positive ions. The pressure on the electrodes is, of course, independent of the pneumatic pressure within the spark, which, according to Haschek and Mache, lies between 10 and 50 atmospheres.—C. Baumgart, Phys. Zeitschr., November 1, 1902.

PHYSIOLOGICAL EFFECT OF ZINC IONS.—S. Leduc has found a marked effect of an electro-deposition of zinc upon the growth of hair. He applied two electrodes of 10 sq. cm. surface to the ends of a space 10 cm. by 6 cm. on the shaven skin of a rabbit, contact being made by means of hydrophil cotton impregnated with a 1 per cent solution of zinc chloride. He passed a current of 10 milliamperes for 40 minutes. At the end of that time nothing was seen at the cathode, but at the anode there were a number of small white circles, showing that the zinc had penetrated into the skin. In about eight days these circles peeled off. The zinc having been introduced on July 10, the hair on the place of application of the anode showed a decided growth on the 20th, the hair on that place growing much faster than that on the other shaven surface. On August 3 the hairs were 5 mm. or 6 mm. long, and on August 10 10 mm. long, whereas on the other parts of the shaven surface, including that under the cathode, growth was insensible. The surface where the zinc had been introduced was marked out by a thick fleece of gray hair on a buff background. A similar



RAILWAY SPRING-TESTING MACHINE.

introduction of chlorine, and, in another experiment, of potassium, exerted no action on the growth of hair. —S. Leduc, Arch. d'Electr. Med., October 15, 1903.

[Concluded from SUPPLEMENT No. 1478, page 23682.]

PURIFICATION OF POTABLE WATER BY MEANS OF OZONE.*

By DR. GG. ERLWEIN.

(Chief electro-chemist of Siemens & Halske, Berlin.)

FOR the sake of completeness I should like to supplement my description of the Paderborn and Wiesbaden works by showing a plan of the little Siemens experimental ozone water-works at Martinikenfelde, which have become known in the scientific world by the experiments conducted there on pathogenic bacteria by the Imperial Health Office and by Koch's Institute, and which I will mention again later. This establishment also deserves notice because it is a typical ozone establishment for surface water, and perhaps also because it furnishes a model for the technical equipment of the ozone works erected in Germany.* It consists of three divisions: (1) a quick-filtering department in which the Kroehnke rapid filter of the Allgemeine Staedtereinig. Ges. of Wiesbaden is used, (2) a sterilization tower constructed as I have already described, and (3) the ozonizers with their accessories. The plant has been erected for sterilizing ten cubic meters per hour. Water from the Spree of very bad character, previously freed from matters in suspension, has been treated day and night for a considerable time. The bacterial and chemical results, on which I shall make a few remarks presently, are now well known from the published reports.

To study the results obtained thoroughly, the firm of Siemens & Halske have, during several months, been experimenting upon water from the Spree in the small ozone works at Martinikenfelde just described, these

* Paper read before the 43rd Annual Meeting of the Deutscher Verein von Gas- und Wasserfachmaennern, held in Zurich, Switzerland, 1904. Translated for the SCIENTIFIC AMERICAN SUPPLEMENT.

* A complete description of this plant has been published in the SCIENTIFIC AMERICAN SUPPLEMENT.

A'. OPERATING EXPENSES FOR OZONE PLANTS TREATING 2,000 AND 200 CUBIC METERS PER HOUR RESPECTIVELY. WORKING DAY, ABOUT 12 HOURS. (SUPPLEMENTARY TO A.)

	Steam power.	Steam power.	Producer-gas power.
Quantity treated per hour	2,000 cubic meters.	200 cubic meters	200 cubic meters
Total quantity treated per year.	9,000,000 cubic meters	900,000 cubic meters	900,000 cubic meters
Power required per hour	275 h. p.	45.5 h. p.	45.5 h. p.
Total power per year	1,237,500 h. p. hours.	204,000 h. p. hours	204,800 h. p. hours
Annual working expenses:			
(1) 4% Interest	650,000 @ 0.04 = 26,000 marks	200,000 @ 0.04 = 8,000 marks	200,000 @ 0.04 = 8,000 marks
(2) 3% Sinking fund	650,000 @ 0.03 = 19,000 "	200,000 @ 0.03 = 6,000 "	200,000 @ 0.03 = 6,000 "
(3) Cost of fuel	$\frac{1,237,500 @ 1.35}{100}$ = 17,000* "	$\frac{204,800 @ 2.7}{100}$ = 5,530† "	204,800 @ 1.4 = 2,900‡ "
(4) Wages and repairs	= 12,500 "	= 5,470 "	= 5,100 "
	75,000 marks	25,000 marks	22,000 marks
Cost per cubic meter of water:			
(1) % Interest	$\frac{2,600,000}{9,000,000} = 0.3$ } 0.5	$\frac{800,000}{900,000} = 0.9$ } 1.6	$\frac{800,000}{900,000} = 0.9$ } 1.6
(2) 3% Sinking fund	$\frac{1,950,000}{9,000,000} = 0.2$ +	$\frac{600,000}{900,000} = 0.7$ +	$\frac{600,000}{900,000} = 0.7$ +
(3) Cost of fuel	$\frac{1,700,000}{9,000,000} = 0.2$ } 0.3 pfennig	$\frac{553,000}{900,000} = 0.6$ } 1.2 pfennig	$\frac{290,000}{900,000} = 0.3$ } 0.9
(4) Wages and repairs	$\frac{1,250,000}{9,000,000} = 0.1$	$\frac{547,000}{900,000} = 0.6$	$\frac{510,000}{900,000} = 0.6$

* Consumption of coal, 0.8 kilogramme per horsepower hour; cost of coal, 170 marks per 10 t.
† Consumption of coal, 1.6 kilogrammes per horsepower hour; cost of coal, 170 marks per 10 t.
‡ Consumption of anthracite, 0.61 kilogramme per horsepower hour; cost of anthracite, 230 marks per 10 t.

BACTERIOLOGICAL RESULTS.

Ozone Experimental Works, Martinikenfelde.

A. SIEMENS & HALSKE.

Date.	Number of Bacteria before ozonization.	after ozonization.	Species of Bacteria.	
10.11.01	53,500	0		Ordinary Spree and Aqueduct Water.
11.12.01	108,370	10		
15.12.01	110,147	2		

B. IMPERIAL HEALTH BUREAU (Ohlmüller-Prall).

Date.	before	after	Species	
27.3.01	44,230	25		Ordinary Spree and Aqueduct Water.
	85,400	24		
9.5.01	20,530	4		
	43,400	4		
27.4.01	9,700	6		
	25,003	10		

C. IMPERIAL HEALTH BUREAU (Ohmüller-Prall).

Date.	Number of Bacteria before Ozonization.	after, ordinary	after, pathogenic	Species of bacteria.	
	38,330	8	0	cholera	Ordinary Spree and aqueduct water infected with cholera germs and boiled water infected with typhus germs.
	16,590	9	0	typhus.	

D. ROYAL INSTITUTION FOR INFECTIOUS DISEASES (Koch). (Proskauer, Schüder.)

12.3.02	600,000	0	Cholera.	Water infected with pathogenic bacteria.
14.3.02	600,000	0	Cholera.	
18.3.02	600,000	0	Coli.*	
25.3.02	600,000	0	Typhus.	
2.4.02	600,000	0	Typhus.	
27.3.02	600,000	0	Dysentery.	

* Not pathogenic.

Publications with complete tables:

A. Purification of Potable Water by Means of Ozone, by Dr. Gg. Erlwein, Journal of Gas Lighting and Water Works. 1901. No. 30-31.

B. Treatment of Potable Water with Ozone, Drs. Ohlmüller and Prall. Reports of the Imperial Health Bureau, Book XVIII, Vol. 3, 1902.

C. Idem.

D. The Destruction of Pathogenic Bacteria in Water by Means of Ozone by Siemens & Halske's System, Prof. Proskauer and Dr. Schüder, Journal of Hygiene and Infectious Diseases, by Koch & Flügge. Vol. 41. 1902.

TABLE A. DAILY OPERATION, ABOUT 12 HOURS.

Comparative Cost of Different Methods of Purifying Water.		I. Sand Filtration.		II. Ozone Plant Without Filtration.		III. Ozone Plant With Filtration. a. Surface Rapid Filter.			III. b. Rapid Filtering Machine.		
A. Supplying Crude Water, etc.											
		Data.	Marks.	Data.	Marks.	Data.		Marks.	Data.		Marks.
*Installation Expenses	Exclusive of Purchase of Land.										
*Cost per Cubic Meter of Water Supplied.	Interest and Sinking Fund.										
	Working Expenses.										
B. Purifying Water.											
		Data.	Marks.	Data.	Marks.	Data.		Marks.	Data.		Marks.
†Installation Expenses	Exclusive of Purchase of Land.	2,000 Cubic Meters per Hour.	2,400,000	2,000 Cubic Meters per Hour. Machines 100% Res.	650,000	Ozone Plant as under II.	2,000 Cubic Meters per Hour.	650,000 + 600,000	Ozone Plant as under II.	2,000 Cubic Meters per Hour.	650,000 + 300,000
		200 Cubic Meters per Hour.	300,000	200 Cubic Meters per Hour. Machines 100% Res.	200,000		200 Cubic Meters per Hour.	200,000 + 80,000		200 Cubic Meters per Hour.	200,000 + 60,000
† Cost per Cubic Meter of Treated Water.	Interest and Sinking Fund.	Interest 4% and Sinking Fund 2% on Invested Capital.	1.6 to 2.0 Pfg.	Interest 4% and Sinking Fund 2% on Invested Capital.	0.5 to 1.6 Pfg.	Ozone Plant as under II.	Interest 4% and Sinking Fund 2% on Invested Capital.	0.5 + 0.4 to 1.6 + 0.53 Pfg.	Ozone Plant as under II.	Interest 4% and Sinking Fund 3% on Invested Capital.	0.5 + 0.23 to 1.6 + 0.46 Pfg.
	Working Expenses.	2,000 Cubic Meters per Hour. 9,000,000 Cubic Meters per Year. 0.1 m. Filtering Speed. Cleaning Filter and Lifting Work for 1 m. Pressure Height.	0.35 to 0.43 Pfg.	2,000 Cubic Meters per Hour. 9,000,000 Cubic Meters per Year. Steam Power. 4 m. Pressure Height.	1.3 to 1.2 and 0.9 Pfg. Respectively.	Ozone Plant as under II. 4 m. Pressure Height.	2,000 Cubic Meters per Hour. 9,000,000 Cubic Meters per Year. 1 m. Filtering Speed. Cleaning Filter and Lifting Work for + 4 m. Pressure Height.	0.3 + 0.26 to 1.2 + 0.32 and 0.9 + 0.32 Pfg. Respectively.	Ozone Plant as under II. 4 m. Pressure Height.	2,000 Cubic Meters per Hour. 9,000,000 Cubic Meters per Year. 1 m. Filtering Speed. Cleaning Filter and Lifting Work for + 3 m. Pressure Height.	0.3 + 0.20 to 1.2 + 0.30 and 0.9 + 0.30 Pfg. Respectively.
		200 Cubic Meters per Hour. 900,000 Cubic Meters per Year. 0.1 m. Filtering Speed. Cleaning Filter and Lifting Work for 1 m. Pressure Height.		200 Cubic Meters per Hour. 900,000 Cubic Meters per Year. Steam Power. Gas Power. 4 m. Pressure Height.		Ozone Plant as under II. 4 m. Pressure Height.	200 Cubic Meters per Hour. 900,000 Cubic Meters per Year. 1 m. Filtering Speed. Cleaning Filter and Work of Lifting + 4 m. Pressure Height.		Ozone Plant as under II. 4 m. Pressure Height.	200 Cubic Meters per Hour. 900,000 Cubic Meters per Year. 1 m. Filtering Speed. Cleaning Filter and Lifting Work for + 3 m. Pressure Height.	
		Total Cost	1.95 to 2.43 Pfg.	Total Cost	0.8 to 2.8 and 2.5 Pfg. Respectively.		Total Cost	0.8 + 0.66 = 1.46 to 2.8 + 0.85 = 3.65 and 2.5 + 0.85 = 3.35 Pf. Respectively.		Total Cost	0.8 + 0.43 = 1.23 to 2.8 + 0.76 = 3.56 and 2.5 + 0.76 = 3.26 Pf. Respectively.

* Exclusively Cost of Supplying Water and Lifting Work necessitated thereby.
† Exclusively Cost of Purifying Water and Operating Expenses.

Building Plots Requisite for a 2,000 Cubic Meter Plant:
(I) About 25 000 Square Meters. (III) a 4,200 Square Meters.
(II) About 1,200 Square Meters. b 3,300 Square Meters.

Imperial Health Bureau.

E. Pathog. Bacteria Lab. Ozon. Apparatus.

Species of Pathological Bacteria.	Number of pathogenic bacteria per cubic centimeter before ozonization.	after ozonization.	Sterile Spree and aqueduct water.
Cholera	16,351	0	" "
Typhus	39,050	0	" "
Coli	30,600	0	" "
Cholera	45,170	0	Ordinary Spree and aqueduct water.
Cholera	43,890	0	

Publications (E):
Treatment of Potable Water by Means of Ozone, by Dr. Ohlmüller and Dr. Prall in the Proceedings of the Imperial Health Bureau. Book XVIII. Vol. 3. 1902.

In the Ozone Works at Wiesbaden-Schierstein.

F. KOCH'S INSTITUTE.

a. Date.	Number of Bacteria before ozonization.	after ozonization: ordinary	Comp. Bacteria.	Species of Bacteria.	
12.7.02	600,000		0	Coli *	Infected Water.
16.7.02	600,000		0	Vibrios	
17.7.02	600,000		0	"	

* Not pathogenic.

SIEMENS & HALSKE.

b.				
28.6.02	39,000	8		Water mixed with colonies of bacteria.
30.6.02	26,000	12		
2.7.02	55,000	5		

Species of Coli similar to those of typhus and *Vibrios* similar to those of cholera; they are very similar to pathogenic bacteria as regards their resistance to sterilizing agents.

Publications (F):
Further Experiments with Ozone as a Sterilizing Agent in the Ozone Water Works at Wiesbaden, by Prof. Proskauer and Dr. Schüder.

experiments being the first made by them for this object with the exception of some made twelve years ago. The results of these experiments were tested by Privy Councilors Ohlmüller and Prall on behalf of the Imperial Health Bureau and the scope of their investigations was widened by exposing, not only ordinary Spree water, but Spree water highly infected with pathogenic bacteria, including cholera and typhus bacteria, to the action of ozone. Following the investigations of the Health Bureau, Robert Koch sent Prof. Proskauer and Dr. Schüder to examine the work of the establishment, and a series of experiments lasting several months was made, exclusively with a view to ascertaining whether the sterilizing action of ozone on pathogenic bacteria (the bacteria of cholera, typhus, and dysentery) could also be relied upon if the water contained a greater number of germs to the cubic centimeter than in the experiments conducted by the Health Bureau. Moreover, Koch's Institute has made additional experiments at the ozone water-works at Wiesbaden and Schierstein on various kinds of bacteria resembling the pathogenic bacteria as regards their behavior under the action of disinfectants. The bacterial infections were prepared by adding concentrated cultures in an agar medium.

It is scarcely necessary to mention that in carrying out these dangerous experiments, the utmost care was taken to guard against the possibility of carrying away any of the bacteria.

The bacteriological results of the experiments at Martinikenfelde and Wiesbaden are given in the official publications of the Health Bureau and the Koch Institute, and are also given in round numbers or average values in the accompanying tables (A, B, C, D, E, F). They show that ozone completely destroys the pathogenic germs such as cholera, typhus, and dysentery germs, even in cases of infections such as never occur in the experience of water-works, even during epidemics, and at the same time reduces the number of harmless bacteria far below the number to which they are generally reduced in well-conducted water-works.

I should like to explain that in their bacterial examination of the treated water, the Imperial Health Bureau and Koch's Institute did not limit themselves to one cubic centimeter of water, the quantity usually taken when water is tested in water-works, but made their tests with 180 to 200 cubic centimeters or to 20 to 22 liters, using the so-called enrichment process and the latest biological and chemical methods of bacterio-

B'. OPERATING EXPENSES FOR OZONE PLANTS TREATING 2,000 AND 200 CUBIC METERS PER HOUR RESPECTIVELY. (SUPPLEMENT TO B.)

	Steam power.	Steam power.	Producer-gas power.
Quantity treated per hour	2,000 cubic meters	200 cubic meters	200 cubic meters
Total quantity treated per year	13,000,000 cubic meters	1,300,000 cubic meters	1,300,000 cubic meters
Power required per hour	275 h. p.	45.5 h. p.	45.5 h. p.
Total power per year	1,787,500 h. p. hours	295,800 h. p. hours	295,800 h. p. hours
Annual working expenses:			
(1) 4% Interest	650,000 @ 0.04 = 26,000 marks	200,000 @ 0.04 = 8,000 marks	200,000 @ 0.04 = 8,000 marks
(2) 4% Sinking fund	650,000 @ 0.04 = 26,000 "	200,000 @ 0.04 = 8,000 "	200,000 @ 0.04 = 8,000 "
(3) Cost of fuel	$\frac{1,787,500 @ 1.35}{100}$ = 24,500* "	$\frac{295,800 @ 2.7}{100}$ = 8,000† "	$\frac{295,800 @ 1.4}{100}$ = 4,140‡ "
(4) Wages and maintenance	= 16,500 "	= 7,000 "	= 6,860 "
	Total....93,000 marks	Total ...31,000 marks	Total....27,000 marks
Cost per cubic meter of water:			
(1) 4% Interest	$\frac{2,600,000}{13,000,000} = 0.2$ } 0.4	$\frac{800,000}{1,300,000} = 0.6$ } 1.2	$\frac{800,000}{1,300,000} = 0.6$ } 1.2
(2) 4% Sinking fund	$\frac{2,600,000}{13,000,000} = 0.2$ +	$\frac{800,000}{1,300,000} = 0.6$ +	$\frac{800,000}{1,300,000} = 0.6$ +
(3) Cost of fuel	$\frac{2,450,000}{13,000,000} = 0.2$ } 0.3 pfennig	$\frac{800,000}{1,300,000} = 0.6$ } 1.1 pfennig	$\frac{414,000}{1,300,000} = 0.3$ } 0.8 pfennig
(4) Wages and maintenance	$\frac{1,650,000}{13,000,000} = 0.1$	$\frac{700,000}{1,300,000} = 0.5$	$\frac{686,000}{1,300,000} = 0.5$

* Consumption of coal, 0.8 kilogramme per horsepower hour; cost of coal, 170 marks per 10 t.
† Consumption of coal, 1.6 kilogrammes per horsepower hour; cost of coal, 170 marks per 10 t.
‡ Consumption of anthracite, 0.61 kilogramme per horsepower hour; cost of anthracite, 230 marks per 10 t.

TABLE B. DAILY OPERATION, ABOUT 18 HOURS.

Comparative Cost of Different Methods of Purifying Water.		I. Sand Filtration.		II. Ozone Plant Without Filtration.		III. Ozone Plant With Filtration. a. Surface Rapid Filter.			III. b. Machine Rapid Filter.		
A. Supplying Crude Water, etc.											
		Data.	Marks.	Data.	Marks.	Data.		Marks.	Data.		Marks.
*Installation Expenses	Exclusive of Purchase of Land.										
*Cost per Cubic Meter of Water Supplied.	Interest and Sinking Fund.										
	Working Expenses.										
B. Purifying Water.											
		Data.	Marks.	Data.	Marks.	Data.		Marks.	Data.		Marks.
†Installation Expenses	Exclusive of Purchase of Land.	2,000 Cubic Meters per Hour.	2,400,000	2,000 Cubic Meters per Hour. Machines 100% Res.	650,000	Ozone Plant as under II.	2,000 Cubic Meters per Hour.	650,000 + 600,000	Ozone Plant as under II.	2,000 Cubic Meters per Hour.	650,000 + 300,000
		200 Cubic Meters per Hour.	300,000	200 Cubic Meters per Hour. Machines 100% Res.	200,000		200 Cubic Meters per Hour.	200,000 + 80,000		200 Cubic Meters per Hour.	200,000 + 60,000
† Cost per Cubic Meter of Treated Water.	Interest and Sinking Fund.	Interest 4% and Sinking Fund 2.5% on Invested Capital.	1.2 to 1.5 Pfg.	Interest 4% and Sinking Fund 4% on Invested Capital.	0.4 to 1.2 Pfg.	Ozone Plant as under II.	Interest 4% and Sinking Fund 2.5% on Invested Capital.	0.4 + 0.3 to 1.2 + 0.4 Pfg.	Ozone Plant as under II.	Interest 4% and Sinking Fund 3.5% on Invested Capital.	0.4 + 0.17 to 1.2 + 0.35 Pfg.
	Working Expenses.	2,000 Cubic Meters per Hour. 13,000,000 Cubic Meters per Year. 0.1 m. Filtering Speed. Cleaning Filter and Lifting Work for 1 m. Pressure Height.	0.35 to 0.43 Pfg.	2,000 Cubic Meters per Hour. 13,000,000 Cubic Meters per Year. Steam Power. 4 m. Pressure Height.	0.3 to 1.1 and 0.8 Pfg. Respectively.	Ozone Plant as under II. 4 m. Pressure Height.	2,000 Cubic Meters per Hour. 13,000,000 Cubic Meters per Year. 1 m. Filtering Speed. Cleaning Filter and Lifting Work for + 4 m. Pressure Height.	0.3 + 0.25 to 1.1 + 0.32 and 0.8 + 0.32 Pfg. Respectively.	Ozone Plant as under II. 4 m. Pressure Height.	2,000 Cubic Meters per Hour. 13,000,000 Cubic Meters per Year. 1 m. Filtering Speed. Cleaning Filter and Lifting Work for + 3 m. Pressure Height.	0.3 + 0.20 to 1.1 + 0.36 and 0.8 + 0.30 Pfg. Respectively.
		200 Cubic Meters per Hour. 1,300,000 Cubic Meters per Year. 0.1 m. Filtering Speed. Cleaning Filter and Lifting Work for 1 m. Pressure Height.		200 Cubic Meters per Hour. 1,300,000 Cubic Meters per Year. Steam Power. Gas Power. 4 m. Pressure Height.		Ozone Plant as under II. 4 m. Pressure Height.	200 Cubic Meters per Hour. 1,300,000 Cubic Meters per Year. 1 m. Filtering Speed. Cleaning Filter and Lifting Work for + 4 m. Pressure Height.		Ozone Plant as under II. 4 m. Pressure Height.	200 Cubic Meters per Hour. 1,300,000 Cubic Meters per Year. 1 m. Filtering Speed. Cleaning Filter and Lifting Work for + 3 m. Pressure Height.	
		Total Cost.	1.55 to 1.93 Pfg.	Total Cost.	0.7 to 2.3 and 2.0 Pfg. Respectively.		Total Cost.	0.7 + 0.55 = 1.25 to 2.3 + 0.72 = 3.02 and 2.0 + 0.72 = 2.72 Pf. Respectively.		Total Cost.	0.7 + 0.37 = 1.07 to 2.3 + 0.65 = 2.95 and 2.0 + 0.65 = 2.65 Pf. Respectively.

* Exclusively Cost of Supplying Water and Lifting Work necessitated thereby.
† Exclusively Cost of Purifying Water and Working Expenses.

Building Plots Requisite for a 2,000 Cubic Meter Plant:
(I) About 25,000 Square Meters.
(II) About 1,200 Square Meters.
(III) a 4,200 Square Meters.
b 3,300 Square Meters.

logical diagnosis. Drigalski-Conrad's plate method and red or nitrosoindol reaction.

To avoid misunderstanding, I may also mention that bacteriological tests of this nature are not necessary in ozone water-works; all that is required is to make sure, by applying the ozone color test, that the water leaving the tower has absorbed an amount of ozone which experience has shown to be sufficient to destroy the bacteria.

With regard to the chemical results of ozonization, the degree of oxidation of the water has been reduced 15 to 18 per cent by the treatment, while the amount of oxygen was increased. No substances can enter the water by ozonization which were not already contained in it as natural constituents. The ozonized water shows traces of ozone only for a few seconds after leaving the tower. The taste remains unaltered.

The ozone system will also find a field of usefulness in countries where absolute reliance cannot always be placed, as it can be in our country, on the efficiency and trustworthiness of the attendants. Hence a system will always receive consideration which, like the ozone method, automatically announces and renders harmless any disturbance in the work, and in which the purification of the water can be immediately and easily controlled by the application of the chemical color test. These considerations have already led many colonial authorities to interest themselves in the system.

The treatment may also be used with advantage in some special though rare cases where the oxidizing of organic iron, or the elimination of organic substances injuriously affecting the smell or the taste of the water, is desired.

I wish again to point out that the bacteriological results which I have brought to your notice are to be regarded as absolutely verified, and that they hold good for all water that can be used for drinking purposes; moreover, they agree exactly with the results of the investigations made in other countries, e. g., by the Pasteur Institute in France.

My remarks on the economic side of the question of the ozone treatment will be less general in character, because a special investigation is demanded in each case. This investigation should be conducted in accordance with the plan which I will now explain, giving the principal items of the working expenses:

1. With ordinary sand filtering.
2. In ozone works without quick filtering (as in the works at Paderborn).
3. In works with—
(a) Rapid surface filters.
(b) Rapid filtering machines.

The figures in the second column in plans A and B and in the corresponding supplementary plans A′ and B′ are based on the results of our experience in Wiesbaden and Paderborn and on careful estimates for projected larger works. The calculations have been made for establishments turning out (1) 2,000 cubic meters per hour with steam power and (2) 200 cubic meters per hour with either steam or gas power; and in each case for a working day of 12 and 18 hours (the latter on account of the difference in the items for interest and sinking fund arising from the difference in the quantities turned out). The estimated cost of fuel varies for large and small works, being dependent on the varying working capacity of the machines, and the consumption of ozone has been taken at two grammes per cubic meter, this being the amount which experience has shown to be sufficient for sterilization in most cases.

The figures in columns 1 and 3, showing the comparative cost of sand filtering and rapid filtering, are not the result of our experiments, but are contributed by eminent specialists in this branch of water technics.

In conclusion, it will be advisable, for the sake of avoiding any misconception, for me to indicate briefly my views as to the prospects for the employment of ozone in water technics.

The use of ozone is excluded whenever a supply of good underground water can be procured at moderate cost, which according to our experience is frequently, but by no means always, the case.

The claims of the ozone system should not make us forgetful of the good work done in the sanitation of German towns by the sand-filtering process, notwithstanding the advantage possessed by the ozone treatment, an advantage which I have already pointed out and which will perhaps become still more important in time, that it destroys *all* pathogenic bacteria, whereas sand filtering only diminishes their number.

The claims of the system will always have to be seriously considered whenever, as frequently happens in the neighborhood of large towns, difficulty is experienced in acquiring land on reasonable terms for extending or reconstructing really adequate sand filters, or when the possibility of a sudden deterioration in the bacterial quality of the water has to be kept in view, rendering an immediately available reserve power, such as is possessed by an ozone establishment, desirable.

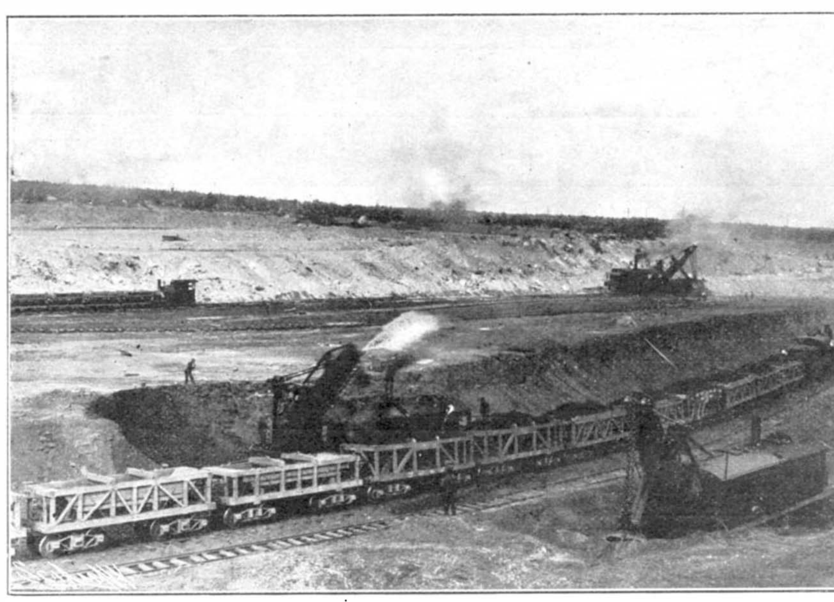
No general rules can be laid down to meet these cases; they all demand special investigation. It is to be hoped that those engaged in the practical work of the ozone treatment will receive the same help from workers in the field of water technics that has been given to them by bacteriologists and hygienists, to the great advantage of the system.

MINING ORE IN THE MESABI DISTRICT.

By KIRBY THOMAS.

IN the Special Iron and Steel Number of the SCIENTIFIC AMERICAN reference was made to the rich Mesabi iron deposit in Northern Minnesota, as being one of the chief contributory causes of our supremacy in the iron and steel industry. This range was first opened in 1893; since which date it has produced 66,800,898 tons of iron ore. In 1902 nearly 45 per cent of the total iron output of the Lake Superior district came from the Mesabi range, or 33 per cent of the total iron ore output of the United States, the greatest iron-producing country in the world. In 1903 the Mesabi district produced 53 per cent of the Lake Superior output.

VIEW SHOWING EXCAVATION OF ORE IN TERRACES.



STEAM SHOVELS DIGGING OUT ORE AND LOADING CARS.

SURFACE MINING OF IRON ORE IN THE MESABI DISTRICT OF MINNESOTA.

Owing to the shallow nature of the ore deposit and the soft character of the ores, it has been found possible and economical to mine this Mesabi ore with steam shovels in open cuts, and it is on this range that this method of mining is developed to a remarkable extent. The ore lies in broad basins in the rock, covered with glacial drift from a few feet to 100 or more feet thick. The method of mining most used is to strip off the overburden of gravel and load the ore direct into steam cars with steam shovels for transportation to the lake ports. A steam shovel will load 2,000 cubic yards of gravel in twenty hours, and considerably more ore. A fair output in ore for a steam shovel is 75 cars of 25 tons capacity in ten hours. The cost of "stripping," as the process of removing the gravel is called, is about 40 cents a cubic yard, and most of this work is done by contract. The cost of removing 40 feet of gravel from an acre then would be $16,000. The ore can be mined and put on the tracks for less than 5 cents a ton, to which must be added the distributed cost of the shipping and general management.

The work of excavating the ore is carried on in parallel benches, the ore being scooped up directly from the natural bed and loaded into the adjacent train of cars. The rich, loose ore in the richest mines will run over 60 per cent of iron to the ton. Several of these mines shipped last year over a million tons of ore each, and the total shipment of ore reached thirteen and a half millions in 1902 and almost as much in 1903. A number of the Mesabi mines are worked by the underground methods, but it is as an example of steam-shovel mining that the range is known the world over.

PRODUCTION OF CAMPHENE FREE FROM CHLORINE.

THE new Schering process is designed to produce camphene free from chlorine by causing the action of bases in chlorhydrate of pinene (bornyle chloride) in aqueous solution, employing as solvents alkaline salts of the superior fatty acids, in particular soaps of every kind. In presence of these substances, the action of the bases on the pinene chlorhydrate, even in aqueous solution, is very favorable.

The production of camphene, on heating the chlorhydrate together with dry soap powder, is familiar. This reaction is designed to separate the alkali from the combination of alkali and fatty acid, with formation of free fatty acid, this alkali being employed to separate the chlorhydric acid from the chlorhydrate of pinene. On heating to a temperature of 240 deg. to 250 deg. C. for forty hours, the reaction takes place, provided a considerable excess of the soap in powder is employed (according to Berthelot eight times the quantity).

But if, conformably to this process, alkaline salts of the superior fatty acids are employed, especially soaps, as the solvent of the pinene chlorhydrate, and if the chlorhydric acid is separated from this by means of bases, a good yield of camphene free from chlorine is readily obtained, without its being necessary to employ an excess of soap.

1. 10 kilogrammes of pinene chlorhydrate are heated with 10 kilogrammes of potash soap (soft soap), 4 kilogrammes sodium hydrate and 5 kilogrammes warm water, for twenty hours in an autoclave at a temperature of 210 to 220 deg. C. After cooling, it is acidulated, and the camphene drawn off with steam and found free from chlorine.

2. 10 kilogrammes of pinene chlorhydrate are heated with 5.3 kilogrammes ammoniacal soap (stearate of ammonia) and 5 kilogrammes of aqueous ammonia, for twenty hours at 210 deg., after which the product of reaction is purified, as has been said above. The camphene is entirely free from chlorine.

It is better not to employ the manufactured ammoniacal soap, but to proceed in such a way as to combine an excess of aqueous ammonia with stearic acid; in the present case, 6 kilogrammes aqueous ammonia, of a density of 0.910, and 5 kilogrammes of stearic acid; which gives rise to the formation of stearate of ammonia, with an excess of ammonia designed to act on the pinene chlorhydrate. The process is applied in the same way when other bases are employed. In all cases camphene free from chlorine is secured. The bromhydrate and the iodhydrate of pinene may be employed in place of the chlorhydrate of pinene, though with less advantage.

The word "camphene" includes the hydrocarbides, which, without reference to the process described above, are obtained from borneol or iso-borneol on separation of the water, and may be converted anew into borneol or into isomeric borneols by hydration.—Translated from La Revue de Chimie Industrielle.

THE DE BROUWER MECHANICAL STOKER.

THE feeding of retorts with coal for the production of illuminating gas is, when performed by hand, a long, costly, and troublesome operation. In large gas works the total weight of the raw material treated amounts to a great deal more than is generally suspected. In the year 1900, for example, the quantity of coal distilled by the Parisian Gas Company was more than 2,497,000,000 pounds. It will be readily seen what an advantage the mechanical handling of such masses presents, and what a saving may result therefrom in the expenses of manufacture. For works of less importance, the advantage, although less striking at first sight, is just as great, since it is proportional. So, for a long time past, an endeavor has been made to devise mechanical feeders; but, since the apparatus proposed necessitated very heavy expenses of first installation, were incapable of application to all works, and required an immense outlay for maintenance, they have generally not been installed.

The unfavorable state of things with which the gas industry has been contending for some years past, such as the rise in the price of coal, the greater and greater exigencies of municipalities, and the incessant claims of laborers as to the number of working hours, wages, etc., has had the effect of stimulating greatly the imagination of inventors.

At the last congress of the Technical Society of the Gas Industry in France, held at Toulon in the month of May last, M. H. Louvain presented a feeder devised by M. De Brouwer, superintendent of the Bruges gas works, and which affords a neat and practical solution of the question, since it does not necessitate a costly installation, is of inexpensive maintenance, and can be operated by laborers of little experience. It is just as applicable to works of small size as to great exploitations. Its operation may be easily understood by reference to the diagram in Fig. 2. Three pulleys, *B*, *O*, and *A*, loose upon their axes, are operatively connected by a wide belt, *C*, of strengthened leather. One of them, *B*, actuated by an electric motor, *P*, serves for driving the belt, which passes around *O*. As for the pulley *A*, which constitutes the principal element of the feeder, the periphery of this is provided with a deep and wide channel of rectangular section, which is closed by the belt for a quarter of a revolution, and thus forms a sort of tube into which falls the coal contained in a hopper, *T*. This coal is carried along in the rotary motion, and, through the action of centrifugal force, is strongly compressed against the belt and acquires the latter's velocity. At the point where it leaves the "tube" it tends, by virtue of well-known mechanical laws, to escape according to a tangent to the circumference of the pulley at this point. If the velocity is sufficiently great, it will be projected into the retort, *W*. The De Brouwer feeder therefore constitutes, as it were, a precise and powerful sling.

Fig. 1 represents the apparatus in its industrial form, and as constructed by the Continental Company for the Manufacture of Meters. As may be seen, it is mounted upon a small carriage which runs upon rails especially in works of very small size, since a small force of men, without much experience, can replace a piece that has become worn or that has been injured by an accident. The electric motor, which is of four horse-power, communicates its motion to the wheel *B* through a friction roller. It is mounted upon the general frame through universal joints, and a strong spiral spring assures the necessary pressure upon the driving pulley, so that, if for any reason whatever, an abnormal resistance should occur, a sliding would take place and the armature of the motor would not be damaged. The diameter of the channeled pulley is 40 inches, and its angular velocity is from 160 to 220 revolutions per minute. The circumferential velocity may therefore attain from 26.25 to 37.75 feet a second. It is easily regulatable by means of the rheostat of the electric motor; but, in a given installation, after the preliminary tests have been made, it suffices to place the lever of the rheostat in a determinate position forward in order to obtain the results desired. By simply causing the velocity to vary, the same apparatus may be used for charging retorts of different sizes.

For furnaces with ordinary retorts 40 inches in length, the time required to introduce a charge reaching as many as 400 pounds of coal, is 9 seconds. At Bruges, it has been found possible to effect the charging of four retorts in 54 seconds, inclusive of the work of shifting the feeder in a lateral direction. With feeding by hand, it would have taken at least 8 or 10 minutes to perform the same operation. The saving in manual labor is therefore considerable. Besides, the coal is thrown directly into the interior of the retort, in which, by virtue of the velocity acquired, it

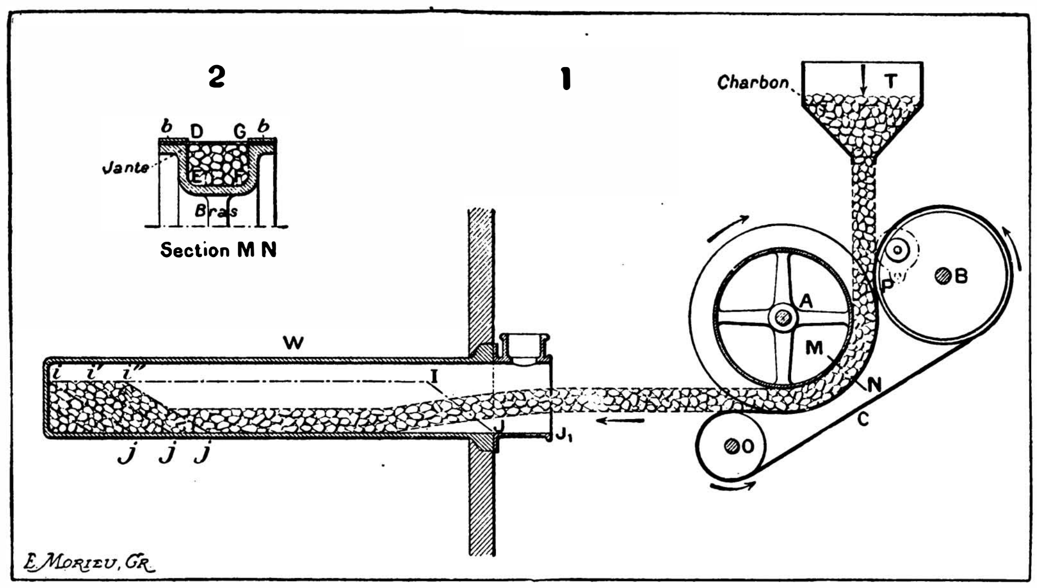


FIG. 2.—DETAILS OF THE FEEDER.

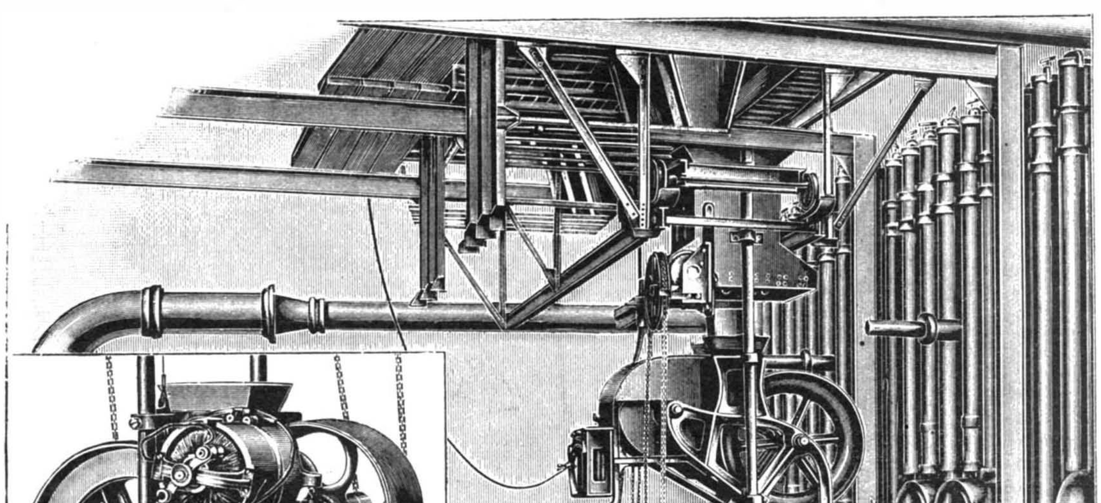


FIG. 1.—THE DE BROUWER PATENT FEEDER.

placed above the gas furnaces parallel with their front. The pulleys and electric motor as a whole can be raised or lowered along the uprights of the frame, and it is thus possible to bring the feeder quickly opposite each of the retorts placed in rows one above another. The coal is emptied into the hoppers by the ordinary mechanical methods. The pulley shafts are hollow and keyed to the frame. The lubricating is done through the interior of these tubes by means of lubricators filled with solid grease, and this efficaciously prevents the introduction, between the rubbing surfaces, of coal dust, which is very destructive at the velocities reached. Wear is thus prevented. The great simplicity of the parts has permitted of a strong construction with easily dismountable pieces. This is a great advantage, becomes spread out and placed in layers as indicated by the lines *i*, *j* of Fig. 2, No. 1; so that, after the charging has been wholly effected, the slope has the same form, *I*, *J*, and the space *J J'* is absolutely free from any particles of coal. Another advantage of the mechanical charging is the diminution in the accumulation of graphite in the retorts. During the six months that the apparatus has been feeding the furnaces at the Bruges gas works, no removal of the graphite has been necessary. This unlooked-for result seems to be due to the fact that a certain quantity of air is, at every operation, carried along with the carbon and serves to burn the graphite residuum produced during the preceding operation.

Since its appearance this apparatus has been introduced into a certain number of gas works, especially at Bruges, Toulon, Barcelona, and Paris-la-Villette, and it will doubtless be applied for the coaling of ships of war.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

ELECTROLYTIC IRON.*

By PROF. C. F. BURGESS and MR. CARL HAMBUECHEN.

A GREAT deal of attention has been devoted of late to the application of electrical energy to the metallurgy of iron, and some of the results attained seem to point to developments of industrial importance. Most of the attempts to apply electrical energy have been through its transmission into heat, for use in various smelting and reduction processes. That the electrolytic as well as the electro-thermal effect might be utilized industrially does not seem to have been considered seriously, as it has been commonly held that the difficulties inherent in the deposition of iron are such as to preclude its playing an important part in the industrial electro-metallurgy of this element.

It has, however, been shown as a result of recent experimental work carried on in the laboratory of Applied Electro-chemistry of the University of Wisconsin, that electrolytic iron can be produced in such quantities and at such cost as to make it a material of commercial as well as of scientific importance, should sufficient demand for it arise.

A survey of available literature on the subject of electrolytic iron leads naturally to the assumption that its deposition is difficult to accomplish, and that there are few solutions from which it can be deposited. Moreover, it has been held that a satisfactory quality of deposit can be attained only by the use of very low-current densities and an exceedingly slow rate of deposition. Practically, the only uses to which electrolytic iron has been put are in the so-called "steel facing" of dies and electrotypes and as a material for investigating the properties of the pure metal.

The hardness of electrolytic iron, which makes it especially suited to the facing of electrotypes, is due to the occluded hydrogen, which is practically the only impurity present. In fact, the very term "electrolytic iron" is commonly assumed to be synonymous with "pure iron." In just what manner the hydrogen is held by the metal is a matter of doubt, it being claimed by some that it is simply condensed, and by others that it forms a definite hydride. Such iron may contain this gas in quantities equal to several hundred times the volume of the metal, and it can be almost entirely freed from it by heating. Certain investigators have found that electrolytic iron contains carbon in appreciable quantities, while others have found that carbon is absent.

Dr. John A. Mathews (Alloy Steels, Mineral Industry for 1902) states that "Pure iron may properly be classed among the 'rare metals;' thousands of tons of iron alloyed with impurities from a fraction of one per cent upward are produced annually, but not a pound of iron in its pure elemental condition has ever been made under ordinary smelting conditions. By 'pure' we mean in a condition comparable with that in which the precious metals are produced, or as pure as the best electrolytic copper and nickel. . . . Just as pure iron is a chemical curiosity, so also is an alloy containing only iron and carbon. In practice at least four other solid elements occur fortuitously in all steels, viz., manganese, silicon, sulphur, and phosphorus.

Something over two years ago the authors of this paper undertook an experimental investigation of the conditions suitable for electrolytically depositing iron, and this work has proceeded almost without interruption since that time. The primary object of the investigation was to produce, if possible, pure iron in such quantities and at such cost as to make it an available material for further inquiry into its properties. Since our attention has been confined almost exclusively to this phase of the problem, the observations which have been made as to the physical and chemical properties of the product are by no means exhaustive, and indeed are considered only as preliminary to a more

* Read at the Washington meeting of the Electro-chemical Society, April, 1904.

extensive research, which it is hoped to take up in the future.

The preliminary work consisted in testing the various electrolyte materials which had been suggested previously, and from these the most promising were selected as the basis for further trials. It is needless to record here the many hundreds of tests which were made, for most of them were unsuccessful, nor is it necessary to recite the difficulties encountered. The investigation was necessarily a slow one, since many of the trials required days and even weeks of operation before conclusions could be drawn as to their success. A large number of iron salts were used, and the effects of variations of density of solutions, current densities, temperature, agitation of electrolyte, and various other factors were noted. As a result of such observation, ferrous sulphate with a certain percentage of ammonium sulphate was chosen as affording the most satisfactory results, and the process as it is now being operated on a small experimental scale may be briefly described as follows: The electrolyte consists of ferrous and ammonium sulphates; the current density at the cathode is 6 to 10 amperes per square foot of cathode surface, and at the anode slightly less; the electromotive force for each cell is slightly under one volt; the temperature of electrolyte is about 30 deg. C.; the anodes consist of ordinary grades of wrought iron and steel; the starting-sheets for the cathodes are of thin sheet iron previously cleaned of rust and scale.

One of the most serious difficulties encountered was in obtaining a thick deposit of iron. While it was proved that there is a considerable range of conditions under which iron can be deposited uniformly and densely for a few hours, or perhaps for a few days, it was almost always found that the surface would become so rough or pitted, or that such a rapid treeing would take place, or that the deposit would curl up to such a degree, that it was necessary to discontinue the experiment and start a new one under different conditions. But improvements have been gradually effected, until at the present time it is possible to continue the run four weeks without replacing the cathodes. At the end of this time the cathode reaches an average thickness of about three-quarters of an inch, and the surface is so rough and nodular that it is not considered advisable to carry the deposition further.

The current efficiency of deposition is very closely 100 per cent; that is, there is a deposition of about one gramme per ampere-hour. The electromotive force being one volt gives about 2.2 pounds of iron per kilowatt-hour. Since all the factors which go to make up the cost of large-scale production cannot be accurately determined from a small-scale experiment, it is impossible to state from our investigations what would be the cost of working on an industrial scale. For the past six months three tanks have been maintained in almost continuous operation, these tanks having the dimensions 8 inches wide x 13 inches long x 15 inches deep and containing two anodes and one cathode. The finished cathodes from these tanks weigh about 20 pounds and constitute, perhaps, the largest pieces of electrolytic iron which have, up to the present time, been produced. The total amount of the material which has been produced from all of our experiments is about a half-ton.

A run of two months' duration was made to determine the extent of the deterioration of the electrolyte, resulting in the conclusion that the solution can be kept in good working condition with little trouble or expense. It would appear therefore that the cost of refining, aside from fixed charges on plant, and with power at $30 per kilowatt-year, would be under one-half cent per pound of iron, thus placing it not greatly in excess of the cost of refining copper.

Even with these figures realized, whether or not electrolytic iron can be profitably produced depends upon the uses which can be made of the refined metal. These in turn depend upon its properties, the most striking of which is its purity. Although our work was directed toward the production of electrolytic iron in a dense and massive condition rather than in a high degree of purity, analyses which have been made show the purity to be in excess of 99.9 per cent. Not a trace of carbon was detected, and silicon, manganese, and other impurities commonly found in iron appear to be absent. The only impurity which has been detected is hydrogen, which is present in appreciable quantities in the metal as taken from the electrolytic tanks. This gaseous element in its physical or chemical combination with iron influences, in a most striking manner, the physical properties of the metal. The hydrogen can be driven off almost completely, if not entirely, by heating to a white heat, the evolution commencing at a temperature below 100 deg. C., and becoming rapid at a temperature below a red heat. Electrolytic iron heated in a Thomson welder or even in a Bunsen burner has been observed to give off hydrogen so rapidly that it ignites, and continues to burn after removing the source of heat, presenting an appearance similar to that which would be produced by dipping the iron in alcohol and igniting it. The metal containing the hydrogen is so hard that it can be filed or sawed only with difficulty, and is so brittle that it is readily shattered by a sharp blow from a hammer. After the expulsion of the gas it becomes softer, and after having been raised to a welding temperature it assumes properties of malleability and toughness similar to those of Swedish iron.

The iron, when heated in a forge fire, can be readily welded and forged into any desired shape, and various test samples were made in this way. During such working, however, impurities are introduced, analyses invariably showing the presence of a very small percentage of carbon. The cathodes, three-fourths of an inch in thickness, have a surface so rough that they cannot be rolled satisfactorily into sheets, though it is possible that improvements can yet be made in this respect which will enable smooth surfaces to be obtained. The deposit adheres so loosely to the starting sheets that it can be removed easily.

A considerable amount of work has been expended in the attempt to melt electrolytic iron without at the same time introducing impurities. The difficulties that lie in the way of doing this, however, are great on account of the high temperature necessary, and the affinity which the iron at such temperature has for many of the elements. The melting temperature of the pure iron seems to lie closely to that of platinum, though actual values have not as yet been determined, from lack of suitable measuring instruments. Various forms of electric furnaces have been constructed for this purpose, a furnace of the inductor type appearing to be the most suitable for preventing the introduction of carbon. Results which have been somewhat satisfactory have been obtained by heating a molten electrolyte between graphite electrodes to a suitable temperature and introducing the metal into such molten bath. The metal thus produced is tough and malleable, while it also has a fracture of a coarse crystalline nature. The affinity which the iron has for carbon is shown by the fact that it can be readily melted in a graphite crucible, while a silica crucible heated to a considerably higher degree melts before the iron in it begins to flow. The absorption of the carbon in the former case produces a fusible alloy of iron.

Experiments have shown that the hysteresis, permeability, and electric resistance of electrolytic iron are greatly influenced by the amount of hydrogen in it. An iron ring was deposited in such form that a hysteresis and permeability loop could be determined by the Ewing method. It was found that by heating in boiling water, the hysteresis was lowered several hundred per cent. By further heating in an oil bath to 200 deg., the value was decreased still further, but to a smaller extent than in the first heating, and upon attempting to heat it to 500 deg. the ring broke, and the experiment was therefore interrupted. Certain samples of forged iron have shown permeability values equaling or even exceeding those of the highest permeability standard samples of Swedish iron. Other samples prepared under apparently identical conditions showed much poorer results, so that it is impossible as yet to draw definite conclusions as to the magnetic properties of electrolytic iron.

It having been shown that it is possible for electrolytic iron to be produced at a small cost, the question naturally arises as to what uses there may be for it. The first suggestion which naturally presents itself is that on account of its purity, it would serve as a basis for investigating the properties of iron and its alloys. Investigations having for their object the determination of the influence of various elements alloyed with iron as regards its electrical properties have been unsatisfactory, on account of the presence of other impurities which modify or mask the effect of the element which it is desired to study. Starting with the pure iron, therefore, alloys of a predetermined and definite composition can be produced, thus making such investigations of greater simplicity. Unless the difficulties encountered in the working of electrolytic iron on account of its roughness offer too serious an objection, it should compete favorably with the purer grades of commercial iron, which are used for various purposes and which sell for three cents and upward per pound.

Electrolytic iron naturally offers the means of manufacturing chemically-pure iron compounds and for standardizing solutions in the analytical chemical laboratory. The electrolytic iron, in addition to its purity, has an advantage for the purpose just mentioned of rapidly dissolving in an acid solution. A test which was made to determine the rate at which electrolytic iron and iron wire sold as chemically pure for standardizing purposes dissolves, showed a ratio of one to twelve in favor of the former. By reason of the brittleness imparted by the occluded hydrogen, it can be readily broken up into grains of a desired size, and even reduced to a fine powder.

Although the investigations referred to in this paper have covered a considerable length of time, the work which has been done should perhaps be considered only as preliminary to a more extended investigation, which it is hoped may be taken up in the future. Summing up the work thus far done shows that it is possible to obtain electrolytic iron in large quantities and at a reasonable cost, and that, therefore, iron should be added to the list of metals to which the process of electrolytic refining can be applied satisfactorily. It has been demonstrated also that such iron possesses a high degree of purity, though just how closely it approaches absolute purity can be shown only by spectroscopic analyses or by other methods which are more accurate than those which have been available.

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Antwerp, according to an official return recently published in the Department of Commerce and Labor at Washington, stands third on the list of the world's ports, with a total tonnage of 16,721,011 tons, entered and cleared. London is first, with a total tonnage of 17,564,108 tons, and New York the second port in the world, with a total tonnage of 17,398,058 tons. These figures refer to ocean-going traffic only, and are for the year 1902.

A FORGOTTEN NATIONAL HIGHWAY: PENNSYLVANIA'S FIRST MOUNTAIN RAILROAD.*

By WILLIAM ALLMAND ROBERTSON.

IN the mind of the westbound traveler over the Pennsylvania Railroad, one of the objects to be longest remembered is the famous Horseshoe Curve in the Allegheny Mountains. This great piece of engineering helps to carry the train over the heights that form the watershed separating the Juniata and Conemaugh Rivers. But of the thousands of travelers who weekly swing round its great loop, how many know anything of another and earlier railroad that crossed that same ridge of mountains long before the Pennsylvania Railroad was chartered or even thought of. That early mountain railroad has a story of its own, full of interest, though now almost forgotten.

Six miles from Altoona lies the little town of Hollidaysburg, near the headwaters of the Juniata. Seventy years ago, when the site of the present busy city of Altoona was marked only by meadows and woodlands, this old town was the western terminus of the Juniata Canal; and every traveler between Philadelphia and the West knew it as the place where he must change from the canalboat to the cars of the Portage Railroad for the passage over the mountains to Johnstown. If you will leave Hollidaysburg, and walk a mile or more across the fields, past Duncansville, where the United States Steel Corporation has one of its hoop mills, you will presently find your further progress barred by an extensive chain of high hills, rising almost to the dignity of mountains. Here on the hillside is plainly visible a long, smooth incline, rising by an easy grade for a distance of half a mile. This is Plane No. 10, the first eastern plane of the old Portage Road, a railroad begun by the State of Pennsylvania in 1831, and which formed for nearly a quarter of a century a very important link in the only through route from Philadelphia to Pittsburg, connecting the Atlantic Ocean with the valley of the Ohio River. The commonwealth was moved to this vast undertaking by the pressing competition of her immediate northern and southern neighbors. Just six years before, New York had completed her Erie Canal. It had been hailed with shouts of popular acclamation; perhaps no public work ever had a more hearty greeting; and it began immediately to justify the hopes and predictions of its builders and friends. Soon after its completion, Maryland commenced the Baltimore & Ohio Railroad. It was a very short line indeed when the first locomotive was put upon it as an experiment in 1830, but it was designed to become, eventually, a road over the mountains to bind the West to Baltimore and the Chesapeake. And now in this very year 1831, a movement was gaining headway to build the Erie Railroad through southern New York, and afford an all-rail route from the Atlantic to the Great Lakes.

These great lines of trade and travel were ominous for the Keystone State; and her citizens bestirred themselves, and considered how they might best surmount that long and lofty range of mountains which crosses their State from north to south. Extensive as the range is, it is but a part of the great chain which we call the Appalachian System, extending from New York to Georgia. The average traveler of to-day crosses it so swiftly and comfortably that he seldom shakes himself out of his cushioned ease to reflect upon the important part that it played in our early history. But it was for more than a century and a quarter the boundary line of colonial life. The Virginian could see from his plantation the distant peaks of the Blue Ridge. They barred his progress inland, and yet, like all mountain heights, they furnished both the invitation and the incentive to pass over and beyond. But not until the administration of Gov. Spotswood in 1716, a century after the founding of Jamestown, did Virginians make their first serious attempt to scale those heights. Even that expedition was hardly more than an experiment. The Quaker colony at Philadelphia was content to dwell more than fifty years on the banks of the Delaware without much concern about that lofty region where the Juniata takes its rise. South Carolinians for many years knew but little of the back mountain lands of their colony; and the Dutch settlements in New York clung closely to the valleys of the Hudson and the Mohawk. For the colonial world of the seventeenth and eighteenth centuries, the Atlantic seaboard was, naturally and necessarily, the great theater of thought and action. So thoroughly did the French generals realize this, and so confidently did they rely on the natural difficulties of progress westward, that Mr. Hulbert has observed in his recent book† that they "were invariably defeated by the British on this continent because the latter overcame natural obstacles which the former blindly trusted as insurmountable. The French made a league with the Allegheniès—and Washington, Braddock, and Forbes conquered the Alleghenies." Nevertheless, so tremendous was the task of a mountain passage in 1755, that a less resolute man than Braddock would assuredly have turned back in despair.

But in 1831 it was impossible that Philadelphians should continue to ignore the Ohio Valley and the West, unless they meant to take a distinct step backward in wealth, trade, and influence. The question of the hour was how to place themselves on a footing with New York and Baltimore. As early as 1825 an important canal convention had met at Harrisburg, already the State capital, and in 1827 the Union Canal had been completed to the mouth of Swatara Creek,

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.
† "Braddock's Road." Series of National Highways.

thus establishing water communication between Philadelphia and the Susquehanna River. Very soon afterward the State went a step further, and constructed a railroad from Philadelphia to Columbia on the banks of the Susquehanna. One of the most important western tributaries of that river is the Juniata, which meets it just above Harrisburg; and it was both practicable and advisable to utilize this latter stream in the construction of a canal along its banks to Hollidaysburg, at the foot of the Alleghenies. This was a long stride toward Pittsburg; and when the Conemaugh Canal was finished in 1831, from Pittsburg to Johnstown, there was but one gap in Pennsylvania's western route—the thirty-six miles of mountains lying between Johnstown and Hollidaysburg. Let this be covered, and Philadelphia and Pittsburg might clasp hands.

A mountain canal being out of the question, a railroad was decided upon; and as it was to be a mere carrying road over a watershed, designed to connect two water routes, it was properly called the "Portage Road." Railroad building was then in its infancy. Englishmen had only just commenced a few short lines like the Liverpool & Manchester. In America, besides the germ of the Baltimore & Ohio, we had a short line from Charleston, S. C., into the interior, the line from Philadelphia to Columbia, already alluded to, and sundry other bits and embryos of lines, many of which have since become well known, although some were mere gravity roads or tramways, like the quarry road at Quincy, Mass., or the coal road at Mauch Chunk, our switchback of to-day. Most of them had been commenced as horse railways. A locomotive that could haul a hundred tons of freight up the side of a mountain was hardly even a dream; and so the Portage Road was planned to consist of a series of planes and levels. Along the levels the cars were at first drawn by horses, but locomotives were soon tried with success. The cars were hauled up or lowered down each plane by powerful stationary engines located at the top, operating ropes or cables. Five planes sufficed to carry the road from Hollidaysburg to the crest of the mountains at Blair's Gap. This eastern slope is much steeper and more rugged than the western. Five more planes with their intervening levels brought the road down to the basin of the Conemaugh Canal at Johnstown. The planes were about half a mile in length, though they varied considerably. They were quite straight, and the slope was easy. The track was of an old-fashioned kind, and was laid on stone blocks, with occasional cross ties of stone to prevent spreading. The rails fitted in iron chairs, bolted to the stone blocks, and, judged by our modern way of thinking, were turned upside down. The construction of the road occupied three years. It was on the 8th of April, 1831, when the first engineering party climbed the mountain; and on the 18th of March, 1834, the road opened for business.

It has been my good fortune to visit the old roadway, and to walk over a large part of its course. Leaving Hollidaysburg at the terminus of the old Juniata Canal, there is, as we have said, a stretch of two miles or more over meadows to the foot of Plane No. 10. This portion of the old roadbed of the Portage Road is still in full use for most of the distance, having become part of the Newry branch of the Pennsylvania Railroad; but at Duncansville the modern line turns off toward Newry. Although more than half a century has rolled away since the old plane was abandoned, and though the rails have long since been taken from its face, it is easy to see what solid and enduring work has been done by those early engineers. It is a half mile climb to the top of the plane, but the grade is easy; and from the head of it to the foot of No. 9 is a level of a mile or so, skirting along a towering hillside between earth and heaven, with a grand view of the country below. Going on up 9, 8, and 7, still skirting the steep hillside, one has Blair's Gap on his right, and the old Pittsburg turnpike far below in the valley. Just at the foot of Plane No. 6 the turnpike, which has been painfully climbing up the gap, crosses the course by a stone bridge; and when the head of No. 6 is reached, the ascent is over. We are standing on the highest ground in Cambria County, almost on the summit of the mountain. Close by is a fine old building known as the Stone House, formerly a place of entertainment for travelers, in the days when the Portage Road was at its best. The ruins of the old engine-house at the head of the plane are easily discovered. How massive and enduring is the masonry! Surely, the buildings of that day compare most favorably with the flimsy articles of the present.

On this high level between Planes 6 and 5, half a mile further on, is the village of Summit. And there, close by the roadway, is an old-time inn, built when the Portage Road was opened, and still used as a summer hotel. I slept in one of its ancient rooms, and in imagination conjured up the past, and peopled the halls and passages with the travelers of the first decade of the age of steam.

We have reached a delightful spot, and may well pause to look around us before commencing the downward run into Johnstown. This is the land of the great Russian missionary and enthusiast, Father Demetrius Augustine Gallitzin, better known as Prince Gallitzin. Brought up without religious education, by a father who had embraced the principles of Voltaire and Diderot, he traveled to America, and landed at Baltimore in 1792, in the twenty-second year of his age. Owing to the influence of his tutor, his thoughts turned to the Roman Catholic priesthood, which he entered three years later. Visiting this part of Pennsylvania, his heart was so drawn toward it that, in 1795, he settled on a rugged hillside in Cambria County, and founded the town of Loretto, a few miles from Summit. He was an active missionary, traveling hither and thither; and the curious little sleigh in which he rode is remembered to this day by old inhabitants. Down on the Pittsburg pike, somewhere between Planes 7 and 8, is a fine spring of cold water which bears his name, and which he is said to have blessed. He was well liked by the people, and his work prospered. At his death in 1840, his community numbered 6,000 persons; and to-day Loretto is adorned with a costly church.

But the memory of other famous names clings round the Portage Road. At Y-Switches, which we passed a mile or so from Hollidaysburg, local gossip has it that one of our most successful iron and steel manufacturers began his career as a telegraph operator; while at Duncansville Col. Thomas Alexander Scott, one of the most distinguished railroad managers in the world, and a former president of the Pennsylvania Railroad, is said to have once been station agent.

From Summit westward the Portage Road is now used as a highway, and an excellent one it makes, with its solid bed, easy slopes, and long levels. The longest level is between Planes 1 and 2, thirteen miles; and here was used one of the first locomotives ever put upon the road. Not far from Johnstown the road passes through a tunnel, probably the first railroad tunnel ever cut in the United States. Certainly it ranks among the earliest. Near it stood, for years after the Portage Road was abandoned, a handsome stone viaduct over the Conemaugh, built for the Portage Road, and subsequently purchased by the Pennsylvania Railroad, and used as part of its main line till 1889, when the structure yielded before the fury of the Johnstown flood.

The final drop into Johnstown brought the track to the level of the Conemaugh Canal, when the western trip was resumed by water. When the road was at its best, the entire journey of thirty-six miles from Hollidaysburg to Johnstown consumed about four hours. The inconvenient change from canal to rail, and back again to canal, on all through shipments, necessitated breaking bulk; and to avoid this, the plan was adopted of running the canal-boats on cars, fitted with framework of the proper shape to receive them. The cars were then drawn out of the basin with the boats upon them, and were hauled over the mountains, very much as the boats on the Morris Canal are hauled over the planes to this day. It must have been a strange sight to see a train of canalboats making its way over the hills, gliding down the planes, and hurrying along the roadway amid the farms and villages.

By 1851 railroad building was so advanced, and locomotives were so immensely improved, that it was time for something better than the Portage Road could offer. The operation of the planes was not only slow, but difficult and dangerous. The cables needed constant repair. A new road was accordingly built without planes. It ran over various portions of the old roadway, but at the foot of Plane No. 8 it turned completely away from Blair's Gap, swung around the mountain to Sugar Run Gap, and pierced the dividing ridge with a tunnel at Gallitzin. Of course it quickly superseded the old route, and it became known as the "New Portage Road." It was an excellent piece of engineering, but was not destined to be used very long. About 1854 the Pennsylvania Railroad completed its main line from Harrisburg to Pittsburg by way of Horseshoe Curve and Gallitzin, by a still easier grade; and three years afterward the New Portage Road was abandoned.

Although nearly forgotten to-day, the Old Portage Road was one of the wonders of its time. For boldness of conception and success of execution, it has not often been equaled. It reflects the utmost credit upon the State of Pennsylvania and her engineers, and it received the applause and encomiums of all who saw it. Charles Dickens was delighted with his passage over it, and has left us an interesting account of it in his "American Notes." Travelers used to say that there were few things more exhilarating than to be drawn up above the level of the common things of earth, into the solitude and beauty of the Alleghenies.

It was the writer's good luck to visit this ancient highway in September, and his trip was deeply impressive. The trees in Blair's Gap were putting on their autumnal tints, a rich and varied mass of foliage. The disused planes, the ruins of the engine-houses, the old stone ties still buried in the roadway, all were highly suggestive of a busy and useful past. He felt he was standing on the remains of a once great artery of travel. Up these planes were once hauled merchants, lawyers, politicians, statesmen, authors—the traveling public of a half century ago. Just over the mountain is plainly audible the loud puffing of a modern high-power locomotive on the Pennsylvania Railroad. Here, almost within gunshot of each other, are the four routes, the old Pittsburg Pike, the Old Portage Road, the New Portage Road, and the Pennsylvania Railroad, the latest and best of all. Like the rings on a tree trunk, they mark the steps of time and progress. Truly, the present is built upon, and is the creature of, the past.

All things come to him who waits. At the very time this article is in preparation, steps are being taken to revive the New Portage Road once more. The Pennsylvania Railroad Company, embarrassed by its immense freight business of last year, has at length decided to re-equip the New Portage Road from Gallitzin to Newry, so as to form a relief branch for its overburdened main line; and ere long the whistle of the locomotive and rumble of cars will be heard after fifty years of silence and neglect.

In conclusion, it must be added that the Old Portage Road is an object lesson to the advocates of government ownership of public works. Designed and planned by the State as a great public highway, it furnished such a field for the politician and the spoilsman, and was the cause of so much corruption and mismanagement, that, with the coming of the Pennsylvania Railroad, there arose a powerful popular demand that the State sell the entire plant. The attempt to allow every farmer and tradesman to run his own wagon upon the road, in true democratic fashion, had proved not only a vexatious nuisance to travelers, but a menace to life and limb. It was impossible to compete successfully against private corporations, and the management was not above suspicion. By legislative decree, the whole system was finally sold to the Pennsylvania Railroad Company, and the State of Pennsylvania retired from the transportation business, let us hope, forever.

SOFKA AND BLUE DUMPLINGS—A NATIONAL INDIAN DISH.*

By WILLIAM R. DRAPER.

EVERY class of people have their favorite dish and their most beloved cup. The Creek Indians have sofka and blue dumplings, and since the Creek Nation in Indian Territory has commenced to fill up so rapidly with white people, this dish has popularized itself until it equals the mint julep.

The white people, when first taking up abode in the land of the Five Civilized Tribes, find many things unique and interesting. Most of these Indians have attained that height of civilization that they no longer wear the feathers and blankets of their forefathers, neither do they dwell in wigwams or tepees. When the red man imitated his white brother in mode of dress he also followed many of his habits and characteristics, and in a crude way his habitation and foods. But the Creek Indians cling to their national dish—and it promises to change the leading diet of those who have invaded their country.

Sofka is a drink, blue dumpling a food, both of which are very palatable and nutritious. Sofka is a non-intoxicant, and it possesses a wonderfully attractive flavor. It is found in every Creek home. Sofka has been generally known as a food, but this is a common error concerning many dishes set out by the Indians. There are three kinds of the liquid, plain, sour, and white. The plain sofka is used by the poorer element, the sour by the full-bloods only and the white by the Creek aristocrats. A half-dozen blue dumplings are as necessary to go with a mug of sofka as a handful of pretzels are to accompany a glass of beer; and it is much more appetizing. The habit once entered cannot be shunned very easily.

Sofka is made of corn and water and lye. The corn used for the purpose is made into meal by the Indian in his primitive way of pounding it in some vessel by the use of a pestle. The Creek Indians have a dish which they use expressly for this purpose. It is called a "sofka dish."

When an Indian wants a new sofka dish, he goes to the woods and hews down a tree. A hickory tree about 16 inches in diameter is most likely to be the one of his choosing. After he has hewn down the tree he cuts from it a block about ten inches thick. Out of one of the sides of this block he hollows a cavity, the shape of a bowl. It is dug six inches deep and is made smooth by filling with small pebbles and running them about over the surface very rapidly. Water is used to soften the inside of the bowl. Once dry it is then ready for use. Women are employed for the most part in sofka making.

In this wooden vessel, the Indian squaw places her corn and, taking a pestle, which is made either of hard hickory or stone, pounds the corn until it is a coarse meal. She then takes a fan and blows out the broken grains and husks. A coarse sieve is used to get all the remaining large particles and these are beaten again into a finer pulp. Two quarts of this coarse meal are used in a gallon pot of hot water. This water is placed over a fire out of doors and allowed to boil. Meanwhile another vessel with small perforations in its sides is taken and filled with clean wood ashes. Water is poured in upon the ashes and about two quarts of this lye for every gallon of water is used. The lye as it comes through the ashes and drops into the meal and water turns it yellow. Water is kept upon the sofka for hours at a time and finally after the mixture has become very thick, is removed and allowed to cool off. If the family who are making it should happen to be full-blood Creek Indians they prefer to allow the preparation to sour or ferment, but the more civilized drink it at once. It tastes not so very different from thick wine, only sourer and stronger perhaps. Half-breeds often add a little soda to sour sofka to make it more healthy, as they claim. The mixture has wonderful strengthening power, even greater than malt, and those redskins who drink it regularly are seldom ill.

White sofka is made by using white corn for the meal instead of red or yellow corn. It tastes a little sweeter and has a clearer appearance. White sofka is sold as a health tonic in many places. Those of the upper class drink white sofka and raise white corn expressly for that purpose.

Blue dumplings which go as a side dish to sofka are made in a very simple manner. They are made

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

by the mixture of two cups of corn meal, a half teaspoonful of baking powder and a little butter. The meal and soda are mixed thoroughly, and enough butter is added to hold the meal together in little balls. These balls are then dropped in boiling water and allowed to remain there for five minutes. This is all that is required for the making of the blue dumpling and those who have tasted them seem to acquire an appetite for more. Hot blue dumplings and a mug of sofka is sufficient to make a Creek Indian spend his last penny for a mere morsel of the two.

GINSENG: ITS CHARACTER, HISTORY, COMMERCE, AND MEDICINAL VALUE.*

By CHARLES H. COE.

THE antiquity of ginseng in medicine; the universal faith of millions of people in its virtues, and the oppo-

LEAF FROM AN OLD PLANT.

site belief among other millions; the marvelous cures it is said to have wrought; the fabulous prices it often commands; and its fixed place in commerce, have possessed this plant with an interest that make it conspicuous among the flora of the world.

Although our own physicians consider ginseng of little medicinal value, it is nevertheless the most prized remedy in the pharmacopœia of the Celestial Empire. The inhabitants of China, Japan, and Korea have gathered it in its wild state, and cultivated it more or less, for centuries. In the new world it has been an article of commerce for nearly two hundred years, and for some time has been successfully cultivated.

In view of the above facts, this little plant deserves more extended notice than it has heretofore received in this country.

The valuable part of ginseng (*Panax quinquefolium*[1], Linnæus, 1753; order, *Araliaceæ*) is the root, which resembles a small parsnip (indeed, it is closely related to the latter), being spindle-shaped and in color creamy white. When from one to six years old it ranges from three to ten inches in length and one-eighth to one and one-half inches in diameter. The weight of the dried wild root varies from one-eighth of an ounce to seven ounces, five-year-old roots averaging about two and one-half ounces. Roots weighing five ounces or more are rare. Cultivated roots generally weigh more than wild ones. Some are forked, especially in the wild state, bearing a slight resemblance to the human form. As will be seen later, the common name of the plant was derived from this peculiarity.

An erect stem from 12 to 24 inches in height rises perpendicularly from the root, terminating in three, sometimes four or five, leaf-stalks. Compound leaves appear on the latter in palmately-arranged clusters of five leaflets, as a rule, although three on young plants and seven on old ones are common. They are abruptly-pointed, parallel-veined, and deeply serrate. Their outer or upper ends are broader, and the lower two are comparatively small. Sometimes two stems are produced on the older plants, especially under cultivation.

Flowers appear in the second or third year. The flower-stalk is one to nine inches in length, rising from the apex of the leaf-stalks, seemingly being a continuation of the stem. An umbel of small, yellowish-green flowers appears about the first of July, developing small, berry-like fruit, which turns scarlet in the early fall. The berries contain two seeds each, and the whole umbel from thirty to fifty. They require about eighteen months to germinate.

The stem dies in the autumn, and finally falls to the ground, leaving a scar on the perennial root-stalk, by which the age of the plant may be ascertained. As many as sixty-five of these scars have been counted on a single root-stalk.[2]

Ginseng is used at nearly all stages of its growth, but it is not in its prime until about ten years of age. It has an agreeable aromatic taste and slight odor, resembling licorice.

The following is a partial analysis of the dried root, according to Dr. A. M. Peter, of the Kentucky Agricultural Experiment Station:

Substance.	Root.	Ash.
Crude ash	5.278	
Nitrogen	1.660	
Lime	.856	16.22
Phosphoric acid	.535	10.14
Potash	.776	14.70

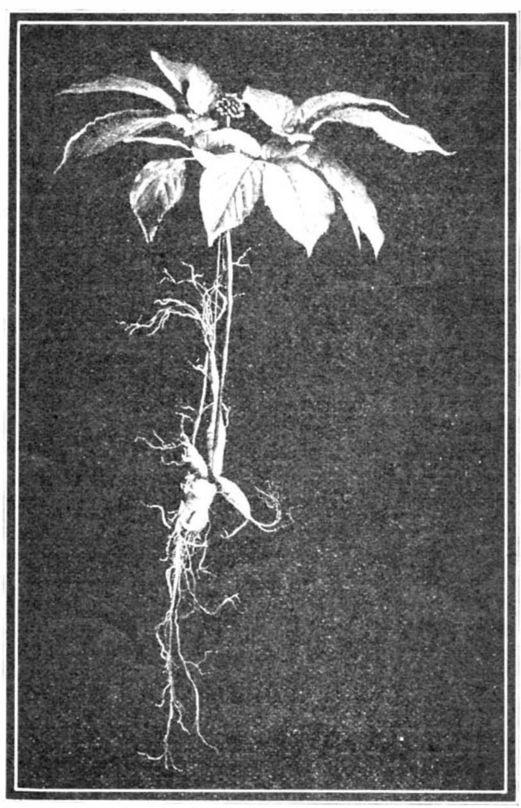
Some years since, Mr. S. S. Garrigues, a Philadelphia chemist, discovered a peculiar substance in the root, which he called *panaquilon*.[3]

The first description of ginseng reached English-speaking people through the correspondence of Father Jartoux (1711), and in a work by Kaempfer, the celebrated traveler and physician, describing the plants cultivated in Japan.[4]

Various names have been applied to the plant, nearly all of which seem to have been derived from the same source. A writer in the year 1680 calls it "nean or ninsing."[5] Six years later a description in Latin (accompanied by another in Chinese characters, with a page of curious illustrations) refers to the plant as the "curious root gin-sén, commonly called gensing; by the Japanese, Nisi."[6]

In the year 1711, Father Jartoux, a Jesuit missionary in China, who was employed by the Emperor to map the country, sent home a "Description of a Tartarian Plant Called Ginseng." Regarding its name, he says:

"I know not for what reason the Chinese call it gin-seng, which signifies the representation or form of man. Neither I myself nor others who have searched and inquired into it on purpose, could ever find it had any resemblance to the signification of its



CULTIVATED PLANT THREE YEARS OLD

name, though among other roots [specimens] there may now and then be found some which by accident have very odd figures. The Tartars, with more reason, call it Orhota, which signifies the Chief of Plants."[7]

It is interesting to note that when ginseng was discovered in America (Canada, 1704) the plant was known among the Iroquois Indians as "garent-oguen," which signifies a representation of man's thighs and legs separated.[8]

According to Peter Osbeck, who wrote in 1771, the Chinese name was "Yan-sam or Yan-som." At that period the root was sold in the apothecary shops in England under the name of "ninsi," every ounce of which was worth thirty or forty ounces of silver.[9]

The original discovery of ginseng and its employment in medicine is unknown. It is mentioned in some of the earlier Chinese works, and has long been styled the fabled root of antiquity. A German author, writing in 1787, believes it is the mandrake of the Bible (*dudaim*, Heb.)[10]. Other writers and students of Bible history have taken the same view. The conclusions of the Rev. John McClintock, however, would seem to be more reasonable, viz., that "there is little to guide us in determining what plant is alluded to at such early periods; . . . interpreters have wasted much time and pains in endeavoring to ascertain what is intended by the Hebrew word *dudaim*."[11]

Many fables are connected with the plant, among the most common being the following:

Some plants are said to have a berry or two situated an inch or more above the regular cluster, which indicate a point of the compass, and which direction, if followed, will seldom fail to locate another root a few paces distant; that the root has the power to travel from place to place underground; that it will restore the circulation and respiration after life has deserted the body; that it has the power of concealing itself to escape capture; and that God has appointed the wolf, tiger, leopard, and snake to watch over and protect it.

Ginseng was formerly supposed to be confined to the Chinese Empire, but it was finally discovered in North America and in the Himalayan Mountains of Nepal (at an altitude of 10,000 feet above the plains of Bengal).[12] Father Jartoux, in his description of the Tartarian plant, thus forecasts the discovery of ginseng in America:

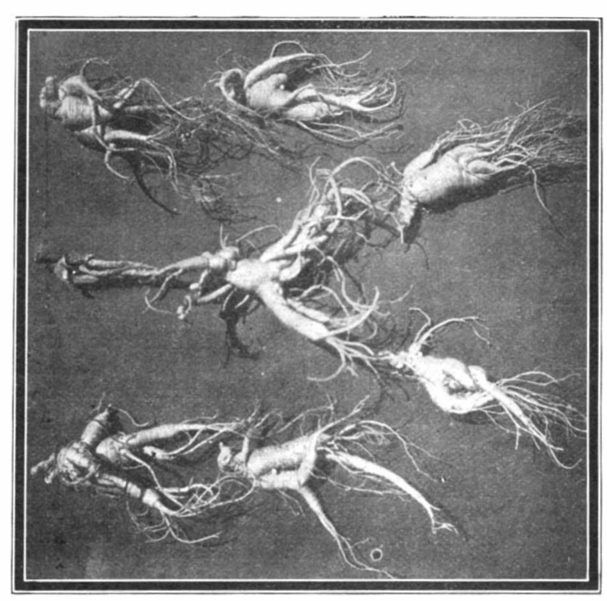
"If it is to be found in any other country in the world, it may be particularly in Canada, where the forests and mountains, according to the relation of those that have lived there, very much resemble those here."

This was seen by a missionary among the Iroquois Indians of Canada, Father Lafitau, who refers (in his work previously quoted) to his supposed first discovery of the plant, as follows:

"It was by accident that I first learned of ginseng. I had stopped in Quebec on business connected with our mission in the month of October, 1715. They have a custom of sending us every year a copy of the edifying letters of the missionaries of our company who labor in every part of the world. . . . The tenth parcel of these letters fell into my hands, and I read with pleasure one from Father Jartoux. In it I found an exact description of the ginseng plant. . . . After spending three months in looking for the ginseng, by accident I found it, when I was not thinking of it, near a house I was having built (at Sault St. Louis). It was then ripe, and the color of the fruit attracted my attention. I pulled it up, and with joy took it to an Indian I had engaged to help me hunt for it. She recognized it at once as one of those the Indians used."

Father Lafitau returned to France in 1717[13] and his book was published in the following year. The honor of first discovery in America, however, does not, as stated by other writers, belong to him. Twelve years before (1704) the Jesuit found the plant, Michael Sarrasin (Sarrazin) King's Physician for Canada, discovered it [near Quebec] and sent specimens to Paris.[14] It was through Father Lafitau's efforts, nevertheless, that the public first learned of the American plant.

Botanists have not agreed upon a specific difference between the Chinese and the American plants. Few authorities, however, regard them as different species; many believe them to be identical, or with only slight variation. Prof. C. S. Sargent, of Harvard College, one of our most reliable authorities, who has traveled extensively in Japan and China, regards the plants as one and the same.[15] His opinion is corroborated by the Royal Botanical Gardens, Kew, England,[16] also by Mr. A. J. Pieters, Division of Botany, United States Department of Agriculture. The latter made a careful microscopical study of the two roots, Japanese (imported for the purpose), and American and found their characters identical. The reader has already learned that Father Lafitau was enabled to find the plant in Canada from the "exact description" given by Jartoux.



CULTIVATED ROOTS, FOURTH YEAR.

A few years after the discovery by Father Lafitau, a company was formed in Quebec to gather and ship the root to China. It was one of the first articles exported from Canada after the treaty of Utrecht (1713), and for several years commerce in ginseng was almost as important as the fur trade.

When Peter Kalm, the Swedish botanist, traveled through Canada in 1749, the trade in ginseng was still very active. Regarding this, and the extermination of the plant, he tells us:

"During my stay in Canada, all the merchants at

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

[1] Panax americanum, Rafinesque, 1836; Panax ginseng, Meyer, 1843; Auralia quinquefolia, Decaisne and Planchon, 1854.

[2] This root is in the possession of George Stanton, Summit Station, N. Y.

[3] U. S. Disp., 1896.

[4] Amoenitatum exoticarum, 1712.

[5] Some observations on the root called Nean or Ninsing. By a Doctor of Physick. London, 1680.

[6] Radice Chinensium Gin-Sen. Christiani Mentzelius. 1686. Contained in Miscellanea Curiosa, etc. Vol. 2, 1687.

[7] Philosophical Trans., Royal Society, London, 1713, Vol. 28.

[8] Memoire concernant la precieuse Plante du Ginseng. Joseph François Lafitau. Paris, 1718.

[9] Voyage to China and the East Indies. Vol. 1.

[10] Panax der biblische Wunder-Medicus. Stuttgart, 1853.

[11] Cyclopedia Biblical Literature. 1867.

[12] An Account of the Nepal Ginseng. Wallach. Trans. Med. and Phys. Soc., Calcutta, Vol. 4, 1829.

[13] Jesuit Relations, etc. Thwaites. Vol. 67.

[14] History of the Vegetable Kingdom. Rhind. London, 1855.

[15] Flora of Japan. Boston, 1894.

[16] Official Guide, Museums of Economic Botany, 2d ed. London, 1886.

Quebec and Montreal received orders from their correspondents in France to send over a quantity of ginseng, there being an uncommon demand for it in this summer. The roots were accordingly collected in Canada with all possible diligence; the Indians especially traveled about the country in order to collect as much as they could, and to sell it to the merchants at Montreal. The Indians in the neighborhood of this town were likewise so much taken up with this business that the French farmers were not able during that time to hire a single Indian, as they commonly do, to help them in the harvest. Many people feared lest by continuing, for several successive years, to collect these plants without leaving one or two in each place to propagate their species, there would soon be very few of them left, which I think is very likely to happen, for by all accounts they formerly grew in abundance round Montreal; but at present there is not a single plant of it to be found, so effectually have they been rooted up. This obliged the Indians, this summer, to go far within the English boundaries to collect these roots."[17]

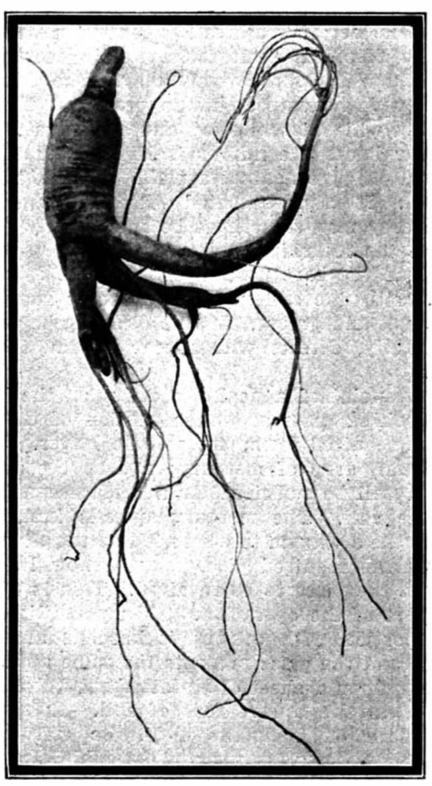
The price paid in Quebec ranged from two to thirty-three francs per pound. The latter sum prevailed in the year 1752, at which time a quantity was shipped to France amounting to 500,000 francs. Owing to carelessness in gathering and curing, the Canadian product finally acquired a bad reputation, and the trade was a few years later nearly destroyed.[18]

In 1750 ginseng was found growing plentifully in the western parts of New England, says Williams, and in 1751 about Stockbridge, Mass., and in central New York.[19] In Vermont it was for many years the only medicinal plant gathered and exported. Collectors received thirty-four cents per pound in its crude state. It was a profitable industry, the root being purchased by nearly every retail store in the State, until it became scarce through exportation and the clearing up of the country.[20]

Ginseng formerly grew more or less abundantly in every State except two (Florida and Louisiana) east of the Mississippi River, and in four States (Minnesota, Iowa, Missouri, and Arkansas) west of it. In the high altitudes and heavy forests of the Appalachian system, it flourished everywhere, reaching its highest development. But it is now comparatively scarce; indeed, in many localities where it formerly grew in abundance, it is entirely extinct. The gradually diminishing supply and the increased price furnish proof that unless steps are taken to prevent it, the complete extermination of the wild plant will soon become an accomplished fact.

Michaux, writing in 1804, mentions the custom of gathering the roots at all seasons of the year.[21] This ruinous practice still prevails; roots are taken up before the seeds have a chance to ripen and fall, thus preventing a succession à la nature. The author of the Western Gazetteer, published in 1816, unwittingly refers, as follows, to another possible cause of its extinction in some localities:

"Ginseng grows in the bottoms [Franklin County, Indiana] to a perfection and size I never before witnessed, and so thick, where the hogs have not thinned it, that one could dig a bushel in a very short time."



TWO-YEAR-OLD CULTIVATED ROOT.

Ginseng has been included among the principal exports of the country for nearly two hundred years. The following statistics, compiled from the records of the Department of Commerce and Labor, will enable the reader to form an idea of its commercial importance:

Years (inclusive).	Exports. Pounds.	Average value.	Total value.
1820 to 1845	1,977,355	$0.60	$4,680,470
1858 to 1868	4,343,519	0.88	3,862,095
1869 to 1878	3,932,868	1.10	4,359,451
1879 to 1888	3,577,330	1.84	6,603,350
1889 to 1896	1,884,698	3.18	6,012,273
1897 to 1903	1,165,850	4.85	5,549,582
Totals	16,881,620	.....	$31,167,221

Practically all exports go to China, entering that country *via* Hongkong, and consist almost entirely of the wild root. The largest shipments formerly came from New York, Pennsylvania, Wisconsin, and Minnesota.

The commercial value of ginseng in this country at the present time varies with the locality of its growth, although the distance from market no doubt has more influence on prices than quality. Roots gathered in the Northern States command from $2.50 to $4.75 per pound, dried; Southern States, $2 to $3.75.

There are three principal grades of the foreign product. The most valuable is known as Imperial or Manchurian. This is the wild root under imperial protection. It goes through a process of clarification which renders it translucent. The price ranges from $40 to $200 per pound. It is consumed among the wealthy classes in Peking and other cities. The next in value comes from Korea, and includes both wild and cultivated roots. Its value is from $15 to $25 per pound. The third grade is grown in China and Japan, and is valued at $1 to $10 per pound. The American product ranges between $2 and $8 per pound, the best clarified selling for the latter sum.

The cultivation of ginseng is in its experimental stage with us. Many have tried to raise it, but few have succeeded. And yet, under proper conditions of soil and shade its cultivation is not difficult. As far back as 1877 "hundreds of dollars" were spent by one man in Wisconsin in trying to raise the plant from the seed, but he failed utterly.[22] A few growers in New York State and elsewhere have been successful, but only after years of careful experiment and culture.

About fifteen years since the cultivation of ginseng was attempted by the Botanical Gardens, Jamaica, W. I. Plants were set out in the forests of her highest mountains, but without successful results.[23]

A ROOT OF GINSENG FROM NORTHERN OHIO.

Very little cultivated ginseng is exported, our growers finding a better market at home in selling to others for transplanting. Whether the cultivated root will ever be grown in this country in sufficient quantities to replace the wild plant, is a question of time and patience.

The scarcity of the wild root caused the legislatures of West Virginia (1872-3), and Virginia (1875), also of Ontario, Canada (1890), to enact protective measures. The time of gathering is limited, and fines are imposed for violations of the law. It is an easy matter, however, for the "sang hunters," as they are called, to gather roots in the sparsely-settled regions without detection, and it is doubtful if the above laws prove effective. So far as can be learned, no other States have taken action in the matter.

As stated in the beginning of this article, ginseng is considered of little medicinal value in this country. It has never been used here in practice, however, and for this reason, perhaps, its true worth has been underestimated. It has been stated that its action is too mild to prove effective. The reply is that mild-power medicines, even in infinitesimal doses, often perform wonders where harsher measures only aggravate.

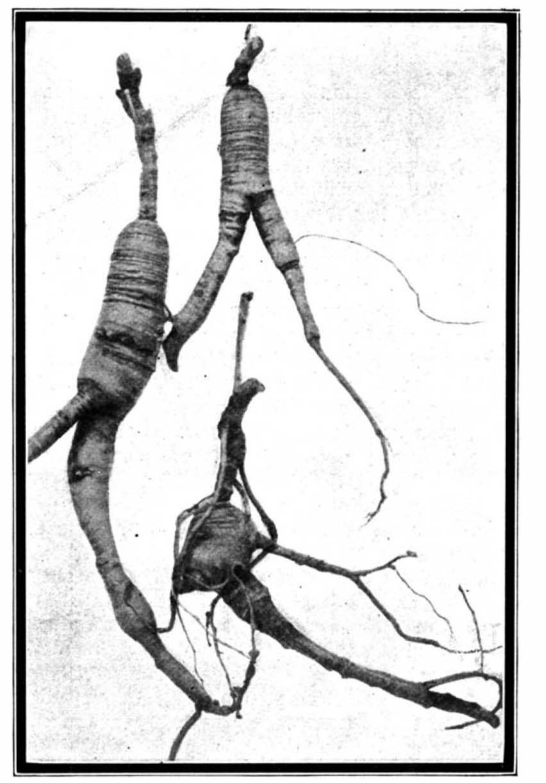
Ginseng is the panacea for most of the diseases of the Chinese and Koreans. It is not only taken in sickness, but by well persons to make them more vigorous, or as a precautionary measure. It is especially recommended for all weakness of the body, general debility, nervous disorders, and for the prolongation of life in old age. It is used in four forms: As pills, ointment, confection, and infusion, the latter being the most common.

It is absolutely believed in by all Chinese, says one of our consuls, from the highest to the lowest, and there would be millions of testimonials as to its efficacy and the wonders it has accomplished for any one who desired them.[24] It cannot have attained and preserved this reputation, among these millions of people, says another, without possessing at least some of the virtues attached to it.[25]

A medical missionary informs us that its effects are apparently those of an alterative tonic, stimulant, carminative, and demulcent nature, and that some positive efficacy of a sustaining character does really exist in the plant.[26]

A former consul at Seoul, Korea, thus states:

"From personal experience and observation I am assured that Korean ginseng is an active, strongly-heating medicine. . . Western people appear to regard the virtues of ginseng claimed by Orientals rather contemptuously—as imaginary and based on superstition. The evidences are that the mystic value attached itself to ginseng after its virtues had been practically ascertained."[27]



WILD ROOTS, SHOWING ROOT STALKS AND BUD.

Volumes have been written by the most eminent physicians of China on the virtues of ginseng. Over 400,000,000 people have been using it for centuries. As a race these people are our equals in native intelligence, and by far our superiors in natural art. Taking all into consideration, it may be well to suspend judgment regarding the medicinal qualities of their panacea.

A RÉSUMÉ OF SOME RECENT STUDIES OF RADIO-ACTIVITY.

F. C. GATES presented a paper at a recent meeting of the American Physical Society, in which he stated that sulphate of quinine becomes temporarily phosphorescent when heated, and can discharge an electroscope. Unlike the radiations from radio-active substances, which appear to be unaltered either by time or temperature, quinine sulphate radiations are only rendered apparent by great temperature changes, and cease after a short time. They are completely absorbed by a thin sheet of aluminium, and largely by a few mm. of air. The current obtained varies greatly with the direction of the field. Since these effects are accompanied by marked phosphorescence, it is possible that they are caused by very short waves of ultra-violet light, such as Lenard has shown to be active in ionizing gases, and therefore that the ionizing action is altogether different from that of radio-active substances.

From observations made by W. Crookes with his spinthariscope, Prof. Becquerel (Comptes Rendus) was led to resume his former study of the phosphorescence produced by the radiation from radium. He has repeated the experiments carried out by Crookes with screens of hexagonal blende, and agrees with him that the scintillations are produced by the α-rays only. The crystals of the zinc sulphide, under the impact of the α-rays, alter progressively and undergo cleavage unequally, according as they are more or less large. The cleavage of the crystals employed is accompanied by the emission of light, even when the cleavage is produced mechanically. The author has obtained the effect by crushing crystals of hexagonal blende between glass plates. He considers that the facts observed establish a very strong presumption in favor of the hypothesis which attributes the scintillation to cleavage produced irregularly on the crystalline screen by the continuous action, more or less prolonged, of the α-rays.

Referring to Becquerel's paper on the scintillations

[17] En resa til Norra Amerika. Abo, 1753.
[18] Williams' History of Vermont, 1794.
[19] Letter of Rev. Jonathan Edwards, quoted in Oldest and Newest Empire. Speer. 1870.
[20] Thompson's History of Vermont. 1842.
[21] Voyage a l'Ouest des Monts Alleghany. Paris.

[22] U. S. Agr. Rept., 1877.
[23] Private letter from the director of the gardens.

[24] U. S. Cons. Repts. April, 1898.
[25] U. S. Cons. Repts. No. 211.
[26] Chinese Materia Medica. F. P. Smith, 1871.
[27] U. S. Cons. Repts. No. 65.

produced by radium when near a crystalline zinc sulphide screen, Tommasina (Comptes Rendus) confirms the hypothesis put forth in that paper. He has obtained revivification of the scintillations on the screens by means of electric discharges in their neighborhood. The action appears to be limited to the surface, and the luminous phenomenon may be electrostatic in origin and may be due to the irregular production of small discharges at the places where the modifications of the cleavages occur. The intermittent character of the phenomenon may be due to the fact that each little crystal only becomes sufficiently electrified to produce a discharge after it has received a great number of impacts from the particles constituting the α-rays.

On the Analogies between Radio-Activity and the Behavior of Ozone, F. Richarz and R. Schenck have reported in the Preuss. Akad. Wiss. Berlin, Sitz. Ber., freshly prepared ozone, and ozone that has been decomposed by deozonizers, have the power of causing condensation in a steam-jet; this effect is produced in the absence of dust, and, in accordance with modern theories, must indicate that the ozone "ionizes" the air. Such "ionization" always renders the gas conducting, and this effect has been detected by the experimenters and Uhrig (Dissertation, Marburg, 1903) in several cases of chemical action, including the case of ozone. The experimenters and Gunckel have shown that this effect is very strong in ozone that has just been decomposed by platinum, and further that the platinum, when introduced into pure, dry, non-conducting oxygen, renders the gas conducting; it is therefore clear that, according to the current phraseology, the ozone is *radio-active* and the platinum exhibits *induced radio-activity*. The production and decomposition of ozone and of hydrogen peroxide are constantly occurring in the atmosphere, and this is regarded as a sufficient explanation of the slight conductivity normally observed in atmospheric air. The action of radio-active substances on a photographic plate finds an analogy in the case of ozone, experiments on this point having been made by the author and Braun, while Van Aubel has shown that ozonized oxygen increases the conductivity of selenium cells. Freshly prepared ozone also causes hexagonal zinc blende to fluoresce brightly, though barium platinicyanide and zinc oxide do not fluoresce; the blende is specially sensitive to massive ions such as the α-rays of radium and the canal-rays of the vacuum tube, and its fluorescence indicates that these are produced during ozonization. The fluorescence continues during twenty-four hours if the blende is left in a flask containing ozone, but after forty-eight hours the fluorescence disappears together with the odor of ozone. It is possible that the fluorescence of zinc blende under the influence of radium salts is merely a secondary effect produced by ozone.

W. B. Hardy and Miss Willcock (Roentgen Ray Archives) report that the action of radium on solutions of iodoform in chloroform is due to the β and γ rays. The action of light on the solution is due to the ordinary light waves. Such a solution in an ordinary test-tube is changed to a deep purple in 12 minutes by resting the point of the tube upon a mica plate covering 5 milligrammes of radium bromide. Radium rays, however, are much less active toward the solution than daylight.

G. Bohn in Comptes Rendus discusses the action of radium rays on living tissues. The action of radium rays on the integuments (worms, amphibians, man) is multiple: first, they act on the peripheral nerves, causing a kind of anæsthesia, which may be succeeded by fatigue or paralysis of the organs of external function, often followed by death; in vertebrates vasomotor troubles are especially produced; secondly, they modify permanently the epithelial cells and consequently the growth of epitheliums; thirdly, they influence pigmentation.

A somewhat similar study has been carried on by J. Danysz (Comptes Rendus). The gravity of the lesions he finds increases with the purity of the radium and with the time of exposure. Microscopical examination of the lesions produced in the brain or spinal cord in cases in which paralysis and rapid death occurred, showed that they are chiefly of vascular origin. The capillaries are ruptured and the nerve substance is stained with blood. The nerve cells presented no appreciable change. In cases in which death occurred in ten to twelve days, there is paralysis or cachexia and softening of the skin without appreciable congestion. Radium has therefore evidently a direct action on the epithelial and nervous cells. Young cells are more susceptible than older ones. This fact explains to some extent the action of radium on neoplasms which can be attacked and profoundly modified through the skin and a layer of muscle, without the latter being affected. A hæmolytic serum from a dog completely lost its hæmolytic properties after three days' contact with a tube of radium salts, while the activity of trypsin was appreciably increased by fourteen hours' exposure. The action on diphtheria toxin was negative, even after prolonged exposure.

The physical and therapeutic properties of radium have been studied by Jumon (Archives d'El. Medicale). He enumerates and describes the physical properties of radium and its salts. As regards its therapeutic use, there are two methods: The first is by short seances; the second by prolonged applications with the object of producing ulceration. The earliest phenomenon noticed is redness of the skin over the area treated, which appears after five or six days. A more intense reaction produces slight swelling or a definite induration, and at the end of a variable time desquamation of the skin. A still more intense reaction is accompanied by exudation of serum which dries and forms small yellow scabs. These fall off and leave shallow ulcers which have little tendency to granulate and heal very slowly. Very rarely, the ulceration extends below the dermis, and is then extremely painful. In the treatment of lupus, if the application be not sufficiently prolonged, cicatrization is rapidly produced, but the disease tends to recur. Longer applications produce a cure which seems to be permanent. The resulting scar is white (often surrounded by pigmentation), supple, and free from cheloid, and the subjacent tissues are not indurated.

ELECTRICAL NOTES.

Mr. George H. Winstanley gave an interesting address before the members of the Manchester Geological and Mining Society recently, in which he spoke in favor of electricity as being an ideal form of energy for mining purposes. He concluded that the application of electricity on proper lines was no more dangerous than the application of energy in any other form. As a rule the plant was not so costly as compressed air, and the cables were much more convenient to install than the air-pipes. Mr. Winstanley said that he had investigated a number of so-called accidents which had occurred in coal mines, and was satisfied that it was not electricity that was to blame. It was too frequently the employment of unsuitable appliances or the misuse of proper appliances, and in some cases the result of woful and unpardonable ignorance.

When Mr. J. Ricalton returned, in 1889, from a year's exploration tour in foreign climes, made in Edison's behalf in search of a suitable bamboo fiber for electric lamp filaments, he told how he had learned to regard Edison as the most widely known man in the world at that time. In all his journeyings in the Far East he had been astonished many times to find his name so familiar; even the unlettered natives of half-civilized countries had learned to associate it with the electric light. His donkey boy in the streets of Cairo was endeavoring, in broken English, to tell him something about the Khedive, when Mr. Ricalton asked him the name of the American Khedive. The boy shook his head to indicate that he did not know. Mr. Ricalton mentioned the name Harrison, who at that time was President of the United States, but the boy did not recognize it. Then Mr. Ricalton mentioned Edison's name; the boy smiled cognizantly and drawled the name—"Ed-ee-sone"—while pointing to an electric light in front of the hotel. A few weeks later Mr. Ricalton mentioned the name to his courier in Morocco, whereupon the latter quickly proceeded to offer his knowledge of the man. Edison's name truly, Mr. Ricalton concluded, was a household word even at the ends of the world.—Cassier's Magazine.

According to experiments by Mr. Maubain, recently described before the French Academy of Sciences, the hysteresis of iron may be diminished or entirely eliminated by means of an oscillating magnetic field. In the place of the well-known magnetizing curve comprising two lines, a one-line curve containing all the points both for increasing and decreasing values of the field is obtained in the case of an iron or steel core being submitted simultaneously to the action of a cyclic magnetic field and of another magnetic field oscillating constantly in the same direction. In order to be sufficiently penetrated by the oscillating field, the iron piece should be of sufficient thinness. The author used both tempered and non-tempered clockspring steel 0.1 to 0.15 millimeter in thickness and 0.2 to 1 millimeter in breadth, as well as cylindric steel and iron pieces, held in position within a glass tube by means of paraffin. These pieces were surrounded by two long wire coils, the outer one producing the magnetizing field, while the inner one, consisting of a single layer of well-insulated wire, was traversed by oscillating electric currents. These currents were obtained by connecting either pole of a Leyden jar with the terminals of an induction coil, the other communicating with the inner coil through a spark gap. The magnetization was measured by means of an elastic magnetometer, when in the thinnest non-tempered samples the hysteresis was found to be eliminated entirely. The separation of the two curve branches became more and more distinct as the thickness increased. Tempered steel showed similar phenomena, though requiring stronger oscillations. The magnetization obtained during the action of the oscillations was stronger than the one usually obtained. These results were obtained in the case of the induction coil being fed with alternating current, i. e., of the induction effects being symmetrical. For intermittent direct currents, producing asymmetrical inductive effects or oscillations acting after each discharge in the same direction, a strong magnetization in a determined direction was produced, which persisted after the oscillation had ceased, while with primary alternating current no definite magnetization was obtained. The non-symmetrical induction, therefore, gives a magnetizing curve, passing, instead of through zero, through another point characteristic of the magnetization by oscillation. This curve accordingly will be reversible only for a suitable intensity of the oscillations, and only in the portions where the direction of the magnetizing field and the direction of the magnetization by oscillation will coincide, while in the remaining parts the two curve branches are somewhat distant from one another. A continuous action of the oscillations on pieces of iron and other metals of sufficient thinness will result in definite reversible magnetizing curves rising rapidly and without any deflection from the point of zero.

TRADE NOTES AND RECIPES.

Gilding on Glass.—The parts to be gilded are covered with a saturated aqueous solution of borax. Gold leaf is then applied and smoothed out with pledget of cotton in the usual way. The glass cup, or what not, is then held in the flames of a spirit lamp and heated until the borax melts, when it is allowed to cool down. If lettering is to be put on, water-glass is better than borax, using a solution of about 40 deg. Baumé. The gold is applied in the same way as with borax, and the article heated in an oven or otherwise to about 30 deg. C. (107 deg. to 110 deg. F.) in order to dry it off somewhat. The glass is then heated to a high temperature to drive off all traces of moisture, and set the gold leaf. Burnish as usual. If this does not answer try again, as there are other processes. This one is spoken of in German and French journals as yielding excellent results with the minimum of labor and trouble.—Nat. Druggist.

For Etching on Glass.—Dissolve, on the one hand, 345.5 parts of sodium fluoride and 81.6 parts of potassium sulphate in 3,840 parts of distilled water. Dissolve also 134.4 parts zinc chloride, and 624 parts of hydrochloric acid in 3,840 parts of distilled water. Keep in separate containers until desired for use, then mix in equal parts and apply to the surface with a quill pen or small camel's-hair pencil. At the end of 30 to 35 minutes wash off under running water, when the lines will be found sufficiently deeply etched. A better plan of applying the liquid is first to coat the surface to be etched with wax, by melting a bit of wax on the surface and letting it flow over the glass. Then, with a needle or other sharp instrument, cut the design through the coating and apply the liquid. The following plan for applying an etching fluid by means of a rubber stamp was patented some years ago:

A mixture, in equal parts, of ammonium fluoride, sodium chloride and sodium carbonate, is put into an India rubber bottle and covered with a mixture in equal parts of strong hydrofluoric and sulphuric acids. In another leaden vessel mix in equal weights potassium fluoride and hydrochloric acid. For use mix the two liquids and add to the mixture enough sodium silicate to thicken it sufficiently to make it stick to the stamp. The stamp is then applied to the glass in the usual way.—Nat. Druggist.

Making Glass Mirrors.—Mirror plates are made by coating glass with an amalgam of mercury and tin, but the process is not an easy one. A sheet of pure tinfoil, slightly larger than the glass plate to be silvered, is spread evenly on a perfectly plane stone table having a raised edge, and is well cleaned from all dust and impurity. The foil must be free from the slightest flaw or crack. The tin is next covered uniformly to the depth of one-eighth of an inch with mercury, preference being given by some to that containing a small proportion of tin from a previous operation. The glass plate, freed from all dust or grease, and repolished if necessary, is then carefully slid over the mercury. This part of the work requires skill and experience to exclude all air bubbles, and even the best workmen are not every time successful. If there is a single bubble or scratch the operation has to be repeated and the tinfoil is lost; not a small expense for large sizes. When this step has been satisfactorily accomplished the remainder is comparatively easy. The glass plate is loaded with heavy weights to press out the excess of mercury which is collected and used again. After twenty-four hours the mirror is lifted from the table and placed on edge against a wall, where it is left to drain well. If mirrors coated with amalgam become damaged they may sometimes be successfully repaired by one of the following processes:

(1) Clean the bare portion of the glass by rubbing it gently with fine cotton, taking care to remove any trace of dust and grease. If this cleaning be not done very carefully, defects will appear around the place repaired.

With the point of a penknife cut upon the back of another looking glass around a portion of the silvering of the required form, but a little larger. Upon it place a small drop of mercury; a drop the size of a pin's head will be sufficient for a surface equal to the size of the nail. The mercury spreads immediately, penetrates the amalgam to where it was cut off with the knife, and the required piece may be now lifted and removed to the place to be repaired. This is the most difficult part of the operation. Then press lightly the renewed portion with cotton; it hardens almost immediately, and the glass presents the same appearance.

(2) Pour upon a sheet of tinfoil about 3 drachms of quicksilver to the square foot of foil. Rub smartly with a piece of buckskin until the foil becomes brilliant. Lay the glass upon a flat table, face downward; place the foil upon the damaged portion of the glass; lay a sheet of paper over the foil, and place upon it a block of wood or piece of marble with a perfectly flat surface; put upon it sufficient weights to press it down tight; let it remain in this position a few hours. The foil will be then adherent to the glass.

The insides of globes may be silvered, it is said, by the following methods:

(1) Take 1-3 ounce of clean lead, and melt it with an equal weight of pure tin; then immediately add ½ ounce of bismuth, and carefully skim off the dross; remove the alloy from the fire, and before it grows cold add 5 ounces of mercury, and stir the whole well together; then put the fluid amalgam into a clean glass, and it is fit for use. When this amalgam is used for silvering, it should be first strained through a linen rag; then gently pour some ounces of it into the globe intended to be silvered; the alloy should be

poured into the globe by means of a paper or glass funnel reaching almost to the bottom of the globe, to prevent it splashing the sides; the globe should be turned every way very slowly, to fasten the silvering.

(2) Make an alloy of 3 ounces of lead, 2 ounces of tin, and 5 ounces of bismuth; put a portion of this alloy into the globe, and expose it to a gentle heat until the compound is melted; it melts at 197 deg. F.; then by turning the globe slowly round an equal coating may be laid on, which, when cold, hardens and firmly adheres.—Drug. Circ.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Suggestions for Exporters.*—Finland.—The markets of Finland are reported to demand only the cheaper-priced commodities. The days of high prices and great profits are gone. Competition is strong and is entered into by many countries. Only those who are indomitable in the prosecution of a systematic and energetic canvass of the country can hope to reap remunerative business. Finnish industries are also developing rapidly and are with each succeeding year supplying the home markets with better goods. Broadcloth, buckskins, and overcoatings, which, as far as the Austrian export is concerned, had come largely from the cities of Brünn and Reichenberg, are no longer in such demand as in former years, because of the development of the Finnish industry in these cloths. The Finnish weaving industry is expanding more and more by producing not only the coarser cloths, but those of a medium grade as well, while the finest goods are also slowly being made at home. It is the opinion of the Austrian consul at Helsingfors, however, that the Finnish market for the finest textiles, though very limited in amount at present, will remain largely in the hands of the strongest foreign competitors for the coming years. The trade in fine pattern goods is largely in the hands of foreigners. With the development of the economic conditions of the country and the raising of the standard of life, the Finnish market for the finer qualities of pattern textiles will undoubtedly grow rapidly and acquire considerable importance for the exporter of this line of goods.

Export Houses of Holland.—The American manufacturer, like the European, who contemplates the exportation of his goods to the more remote regions of Asia, Africa, or South America by way of the large export houses of Holland located at Rotterdam, Amsterdam, or The Hague is interested in knowing the general method of doing business with these places. The Oriental and the Southern trade that is annually carried on through the above-named great seaports, as well as through Hamburg, Bremen, Trieste, London, Liverpool, etc., has assumed tremendous proportions. In many cases, possessing the inestimable advantage of priority upon the scene, these houses enjoy a prestige that gives them a deciding advantage in the competition for patronage.

It is a common policy for these merchants to conceal from their distant purchasers the place of manufacture of the commodities in which they trade. The goods are shipped as though originating within close proximity to the place of shipment, no matter whether in reality they come from farther Germany, Austria, Russia, or Italy, or even America. The "Made-in-Germany" principle finds no application here. Manufacturers who are desirous of selling to these exporters must recognize the common practice of quoting prices, not in the factory, but as delivered in Rotterdam, Amsterdam, or other place of shipment. The reason for this is that these big exporters will not take the time and trouble of calculating the freightage and other transportation on goods from the place of manufacture to the place of shipment. Their work is too heavy for this, and rather than consider factory quotations they will waive the opportunity of entering into business relations. The prices of the goods delivered at the place of shipment need not be stated in the currency of Holland, but may be given in that of the country in which the goods are manufactured. The big exporters are so familiar with the different currency systems that the reduction of prices from one system to another is a simple matter. However, it stands to reason that if the manufacturer finds no particular difficulty in quoting in the currency of the Netherlands he had better do so, as this will lighten to that extent the work of the Dutch exporter.

It is reported that many manufacturers refuse to supply the Dutch houses with the necessary samples free of charge, with the result that no business is done. This is a mistaken policy, as the expense of shipping a number of effective samples is not great and the proceeds of the sales that are likely to follow in case the samples are such as the markets controlled by the exporters call for are out of all proportion to the risk involved. The results of trying to do business without the tangible facts of a sample to calculate upon are generally unsatisfactory. No amount of description can replace the ideas gathered through inspection of concrete objects, and American manufacturers who wish to try for business with these Dutch houses ought to bear this fact in mind.

Trade With Roumania.—It is an old story that losses because of failing credits are not uncommon in the trade relations with Roumania. If a distant manufacturer is to prosecute his sales effectively in this country, as in other regions of the Levant, he must resort to some well-informed agent whose business integrity is out of question. It is difficult to find such men. Not that they are so infrequent, but that one never knows just when the right person has been discovered until a trial has been made. It is by no means safe to rely upon appearances in the selection of a representative, as there are disreputable men who use stationery with large and beautiful headlines advertising their agencies, and giving "reliable references." But on closer investigation it is often found that the references are to firms which never had any existence, and that the headlines mean no more than a batch of printer's ink.

The same precaution is necessary in dealing with Roumanian firms direct. It is of great advantage to make a personal visit to the region and meet the men on their own ground, as business correspondence flows much more smoothly when spiced with personal acquaintance. It is wise to inquire from some reliable agent or well-known firm in Roumania before giving credit to a smaller buyer, as some of these cannot be trusted, while others are young beginners who have a future before them, who are honest, and whose disfavor it is not well to incur.

It is a common practice with European manufacturers who sell to the Orient to quote prices to Roumanian buyers, not in the factory, but as delivered at the place of sale. In making a shipment the freight is often collected on delivery, and so relieves the shipper of this responsibility. He will then have to see that he gets his account for goods actually delivered, and no more. However, great care is required in sending goods with freight unpaid, as large, responsible firms may interpret this as drawing into question their integrity and their honesty. It is only when dealing with unknown buyers that free delivery is not generally practised, purely to reduce the risk involved to a minimum. Many of the larger buyers have special rates with the transportation and forwarding agents, so that it is well to leave the fixing of the shipping charges to them.

Russia.—The credit conditions and facilities in Russia at the present time are set forth by an Austrian consul as follows:

"In most cases cash within thirty or sixty days after the receipt of the goods seems to be the rule, where business is done with the leading houses; in other cases bills of exchange running for six months are issued, the date counting either from the receipt of the goods or from the date of the invoice. When the shipment cannot be taken out of the Russian custom house until after three or four weeks after its arrival, the date of payment is generally extended for an additional month, so that not infrequently some houses ask for not less than seven or eight months of grace."

It is interesting to note here the contrast between the English and the German method of doing business in Russia, as sketched by the consul already referred to. The Germans are reported to reign supreme at the great center for textiles (Lodz), while the English are unimportant factors in the competition for that market. The reason given for this is that the German exporters make a systematic canvass of the country. They send out their well-equipped men, and mail to prospective buyers detailed price lists in the Russian language. The English, on the other hand, are said to be content with mailing a few circulars and price lists to the Russian buyers every year, not in the Russian, but in English language. Besides, while the German not infrequently gives the Russian two or three years' credit for certain orders, the English merchant demands a payment of one-third of the amount of the order as soon as it is placed, one-third on the completion of the goods, and the balance on the arrival of the goods. If credit is given at all it is generally for not more than one year at the most.

This experience ought to be a good lesson to all export merchants who are engaged in the Russian trade, or who contemplate entering it. The transaction of business on a credit basis is so general, even though it be for but a period of a month or two, as in case of the best houses, that no merchant can afford to overlook this condition. On the other hand, the transaction of business on a credit basis calls for endless vigilance and careful inquiry into the character and integrity of the men with whom dealings are to be conducted.

The Germans, as is well known, are probably the most thorough and systematic canvassers of the immense Russian territories, and their rewards are correspondingly large. They take pains to send out men who are familiar with the economic conditions of the country, who know the peculiar tastes of the people, who have mastered sufficiently the difficult language to explain their mission intelligently, and who, while they are cautious and discreet in their solicitation of orders, do not hesitate to give credit in order to conclude a bargain. That losses often result through this general practice of credit sales is well known, but the German merchant is a firm believer in those principles of life that make the insurance business a success, and which reassure him that even though he must expect losses in some cases these will be more than counterbalanced by the profits on other sales into which he can alone enter because he is willing to afford credit to his buyer.—J. F. Monaghan, Consul at Chemnitz, Germany.

Heating and Cooking Stoves in Mexico.—Heating is not of so much importance here as lighting, because of Durango's splendid climate. Despite the altitude of over 6,000 feet, it is not often the thermometer goes below the freezing point at night during the winter, and 24 deg. F. is reported to be the usual minimum. In so dry an atmosphere greater cold than this can be endured without discomfort. The people here are, as usual in such countries, more inured to the cold they have than people coming even from colder climates, especially Americans, accustomed to furnace-heated houses. Most of the houses in Durango have, therefore, in the past had no other arrangement for heating than was provided by the charcoal brasiers of brick masonry in the kitchen. If necessity arose, a rather crude charcoal brasier of metal is placed in the sitting room, warming it somewhat, but also vitiating the air. The newer houses here are now being provided with fireplaces; some few have furnaces. The American residents, who in most cases can find no houses with fireplaces, either provide them or use oil stoves. Wood stoves can be used by sticking the stovepipes out of the windows or into the courtyards; few houses have chimneys.

Any one having a patent heater of any sort, suitable for such conditions and needed for use mornings and nights, might find an opening here, certainly with the American residents and perhaps with the native population. If burning oil, it should not be the usual crude, malodorous, and unhygienic oil heater.

Cooking stoves are, as indicated, little sold here. Charcoal is the cheaper fuel, and the people are used to the open brasiers to cook on. When the timber resources of western Durango are more developed, there may be a better market for some lines of cooking stoves.—James A. LeRoy, Consul at Durango, Mexico.

American Cash Terms in the Orient.—There was received a letter from one of the most respectable Chinese firms in Siam complaining of the terms of American manufacturers as being "too strict and independent," in that they demand cash on all transactions in foreign countries. This is an excellent example of the attitude of wholesale and retail dealers toward the American trade, applying not only to Siam, but the Far East generally—an excellent example of wasted opportunity on the part of our own manufacturers. Why should we be so suspicious? Business honor is much more universal than we seem to imagine. There is no reason in the world why the methods of the manufacturers and exporters of Europe, so successfully used in dealing with the Far East, should not be employed by Americans with equal success. There is no doubt much truth in the proverb, "He who goes slowly goes safely," but it is equally true that the manufacturer or business man who follows too closely this precept, much at variance with the push and go-aheadism which characterize us, generally finds himself the last in the race.—Paul Nash, Consul-General, Bangkok, Siam.

Agricultural-Implement and Harness Dealers in Munich.—United States Consul-General J. H. Worman, of Munich, Germany, under date of January 29, 1904, sends the following list of dealers in agricultural implements and harness in Munich:

Saddlery and Harness.—Anton Aumueller, Gabelsbergerstr., 8-9; Matth. Dallmaier, Cettingenstr., 42; Friedrich Beyer, Theresienstr., 7; W. Herink, Theresienstr., 45; Johann Haeusler, Thierschstr., 20; Karl Huber, Zehentbauernstr., 8¼; Benno Marstaller, Pfandhausstr., 8; J. W. Mayer, Schoenfeldstr., 14; Muenchner Werkstaetten fuer Militaer Effekten, Augustenstr., 1-7; and A. Schaefer, Burgstrasse 13.

Vehicles and Farm Implements.—Karl Bamder, Jr., Dachauerstr., 42; Franz Gmelch, innere Wienerstr., 17-19; Frz. Xaver Meiller, Lilienstr., 4; Karl Moessbauer, Sigmundstr., 2; Ludwig Weinberger, Brunnenthalstr., 8; and Gustav Werberger, Landsbergerstr., 67.

American vs. German Washing Machines.—Under date of November 4, 1903, United States Deputy Consul-General S. W. Hanauer, of Frankfort, Germany, transmits the following translation of a paragraph from the last annual report of the Berlin Chamber of Commerce:

"The demand for washing machines has largely increased in recent years. Steam laundries for hotels, hospitals, and for private use are springing up everywhere. In foreign markets the German washing machines have to meet American competition, but have the satisfaction of maintaining the field. The German machines, though higher in price, are popular because they are more strongly built and easier to manage than the American article."

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* The facts presented here are based upon reports submitted to their governments by the consular representatives of Germany and Austria.

ENGINEERING NOTES.

Of next importance to hoisting and haulage is the use of tramways and cableways in mining. These tramways are used to carry to or from the mine, to the mill or furnace or shipping point for hoisting the material from the quarry, for actual mining of placer ground, and also for a multitude of shorter transportation purposes about the mills and furnaces, also for loading and unloading ships, for coaling ships, as feeders to main railway lines; occasionally to transport persons; and for numerous purposes not so closely allied to mining. It is no exaggeration to say that many mines are at present absolutely dependent on tramways for their successful operation, for owing to their location they are inaccessible by a railroad or wagon road and in some cases even to a burro. In many cases the cost of a railroad is prohibitive even if it could be built. The slate and other quarry industries are entirely dependent on the cableway, and it is safe to say that both the cableway and tramway are only just beginning to be appreciated, and their adaptability and advantages realized. The possibilities in the way of a cableway span have grown with the demands of purchasers, and in this number we have two cableways described with spans of 2,140 and 2,180 feet, respectively. One of the longest cable spans is that at Carquinez, Cal., where the clear span of the cables used for carrying power across the Straits of Carquinez is 4,427 feet, and the cables are 200 feet above the water in the center. The possibility of long-distance tramways is well shown in the description of the Grand Encampment tramway described in this number.—Mines and Minerals for April.

The most important requirements in a hoisting rope are strength, durability, lightness, and flexibility, and as all of these items depend upon the quality of wire used in the manufacture of the rope, it may not be amiss to give a brief description of the process of manufacture. Great care must be taken in the selection of iron or steel, and the chemical and physical properties must be just right. Unless the basis is right the finished material will not be right, for it is impossible to make good wire from poor iron or steel. The wire manufacturers have their billets made according to their own specifications, and these billets are subjected to very complete chemical tests to determine whether or not they conform to the specifications. Great care must be taken to keep the percentage of phosphorus and sulphur as low as possible, as both of these elements are very injurious to wire. The billets are placed in a furnace until they get to a certain heat and they are then deposited upon rolls by means of a hydraulic machine, and are carried to the rolling mill, where they are reduced to rods about 7-32 inch in diameter. The rods are then taken to the wire mill, where they are subjected to a cleaning process to prepare them for drawing. The rod is reduced by being drawn through a steel die cold, this reduction taking place gradually. At a certain point before the wire is drawn to the required size, it is taken to the tempering furnace to be properly tempered, and as this process is one of the most important items in the entire history of the wire, great care must be taken throughout the entire operation. The temperature must be just right, and should the temperature in the factory be too low, even this would spoil the wire. It is only by the exercise of the utmost patience and skill in this operation that first-class wire can be produced. When the tempering is completed, the wire in question is taken to the wire drawer, and reduced to its proper size, the wire being carefully annealed after every two or three draws. The wire is oiled to prevent injury from rust, and is then delivered to the wire-rope department, and upon receipt a test piece is taken from each end of each coil, and carefully tested for tensile strength, torsion, and bending. Every coil which does not come up to the standard qualities required is cast aside, and generally used in inferior grades of rope. The coils are then put on swifts and spooled on steel bobbins. These bobbins are placed in a stranding machine, and the wires are twisted into the strand. The strand thus made is put upon steel bobbins, which are put into the closing machine and this closing machine twists the strands around the hemp center. The hemp center is treated with a lubricant to prevent the same from deteriorating, and also to lubricate the rope. The completed rope then passes to a reel, and is ready for shipment. Great care must be taken both in making the strands and the finished rope, and it is necessary at all times to maintain an equal tension upon the wires and strands. Carelessness in this respect will spoil any rope, no matter how good the material is. A very important item in the manufacture of a wire rope is to have the "lay" of the strands and rope in exact proportion to each other. In ordinary lay rope the lay of the wires in the strand is from two and one-half times to three and one-half times the diameter of the rope, the lay of the strands from six and one-half times to nine times the diameter of the rope. As the wires are thus given a shorter twist than the strands any single wire is exposed to wear for only a short distance at any one place. In long-lay rope a greater lay of any one wire is exposed to wear at one place in the rope, the rope is smoother, and as the wear is distributed over a greater area, the wires on the crown of a strand do not wear thin as quickly as those on the crown of a regular lay rope. A short-lay rope is more flexible and elastic than a long lay, and both of these qualities are important in hoisting ropes. Also the longer the lay the more troublesome are the loose ends, and the faster will the rope go to pieces.—Mines and Minerals.

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