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WHAT CONSTITUTES A STATIONARY ENGINEER.

A correspondent in a recent number of the *Stationary Engineer* says: "In answer to the inquiry as to the definition of stationary engineer I would give this: 'Any person capable of erecting and running a stationary steam plant successfully and safely.' Some will take exceptions to this answer, and say it is too strict, claiming that there are many persons who can run a plant who are incapable of erecting it. Others will say it is too liberal, as it would include those handling plants in which there was no engine used.

"To the first I would say that I hold no man is an engineer who could not have put up the plant he runs. To the second I reply that there are numerous steam plants used for heating, pumping and other purposes, where no engine is used, which require the attention of persons equally qualified with those who have charge of plants using an engine, and who have an equal right to the title of stationary engineer.

"In a large Eastern city is a firm who makes a business of manufacturing machinery for steam plants. In this same city there lived a young man whose ambition was to become an engineer. With that intention he entered those shops as an apprentice. Step by step he mastered each branch, including several months in the fireroom. After serving his time in the machine shop, he worked a year in the boiler department, in order to aquaint himself with boiler construction. Having a chance to take charge of a plant which he had helped to erect, he did so. Under his management everything was soon running smoothly and satisfactorily. He was justly proud of his plant, and took pride in showing it to visitors, together with his indicator cards and records of engine and boiler tests, and when Saturday night came he received his wages with a consciousness of having earned them.

"After having been there over three years, his employer, after paying him on Saturday night, told him that times being dull, they would be obliged to cut down expenses, and that his salary must be reduced. Feeling that he had been earning all that he had received, he refused to take the reduced wages, and picking up his tools left for good. Monday morning the fireman was in his place and a new man at the scoop. It was spring, and navigation on the great lakes just opening, he secured a position on a steamer, and continued to run until December found them icebound, and laid up for the winter at Chicago. He then went South and took a job in the great coal fields of Illinois, running an engine at a mine. Here he staid until the following summer, when, the miners going out on a strike, the works were shut down and he was again out of work.

"He then went to San Francisco, where his love for the water induced him to secure a position on a steamer running to different parts on the coast. This place he held for four years, until the vessel becoming unserviceable, the owners laid her up. A new railroad was being built, and he took a position as engineer on a construction train. The road being finished, he was offered a job in the shop, which he accepted. His abilities soon becoming known, he was given charge of the shops at a salary more liberal than he could receive as an engineer. This position he still holds.

"What would you call him? If you asked him he would reply proudly that he was an engineer, and I think he is right, and that he is no less an engineer to-day than he was when in charge of the first plant because he learned that as a trade, and because he is competent to perform all the duties of such a position. In contrast to this man, I will write of one whom I met several years ago. I stopped at a mill, one of the kind very common in the timbered portion of the Western and Southern States, a saw-mill with a grist mill attachment, where they divided their time between sawing logs and grinding corn for the farmers of the surrounding country. In entering, the only person that I would have taken for the engineer was a boy of perhaps sixteen years, who was cutting slabs near the boiler. Asking him if he were the engineer, he said:

"'No, that was the engineer on that barrel near the saw.'

"Looking in the direction indicated I saw the man busy mending a whip lash for a teamster who stood near, while the sawyer and men were engaged rolling a large white oak log on the carriage. While these preparations were going on, I took a look around the mill. The engine, a plain slide valve, was running slowly and was pounding in a way that would remind one of the Anvil Chorus on a small scale, and steam was whistling from around the well-fluted piston rod. The boiler, which was an ordinary two flue boiler, was in keeping with the condition of the engine. The front had a desire to part company with the rest of the boiler, but was prevented from doing so by two posts propped against it. Water was dripping from the gauge cocks and from under the soft patches on different parts of the boiler. The steam gauge was in such a condition that I could see no figures on it. A place in the delivery pipe from the pump had evidently been cracked, and was repaired with a piece of leather bound on with rope, and every stroke of the pump served to increase the general dampness of the place.

"The engineer, having finished the whip, and the log being nearly set, came over to the engine, and while squirting oil over it, we engaged in a general conversation. Presently I remarked that he had been in charge there a long time. 'Yes,' said he, 'I have been here twelve years, and I know every joint in this machine (I did not doubt that, for every joint was speaking for itself.) Yes, sir, for twelve years I have stood at that throttle. In fact, I have worn out three throttles on her, so you can judge how much I have pulled it. Turning to the boy he said: "Whoop her up, Jim, they have got an old butt cut on there and we'll need more gas."

"'How much steam do you usually carry?" I asked.

"Well, about eighty pounds. I don't know exactly, for the gauge ain't as good as it used to be. We had a little fire here two years ago that burned it some, so you can't see the figures, but I put that big black mark on it where the eighty was, and I tell Jim to keep her up to that.

"'Don't you fear that she will let go some time?' I asked.

"'Oh, no, a boiler can't bust if you keep plenty of water in it, and I always see that Jim keeps two gauges in her.'

"'Well, I suppose living out here, where you see so few people, you must read a good deal; do you take any mechanical or engineer papers?'

"'No, sir, no. I got no use for book learning. I believe in learning everything by experience. Experience is the best teacher in the world, sir. That is where I got mine, and I don't take a back seat for any of 'em. Book learning is for them soft fingered kind that's got gall enough to make some city man thinks he needs a fine-haired man to stand in his high-toned engine room and do nothing but boss the men that do the dirty work. No, sir, I don't want no books in mine.'

"The sawyer now gives the signal for more speed, and telling Jim again to 'Whoop her up!' he pulls the throttle with a jerk, and the engine, giving a loud groan at such treatment, gets away at a speed that sends the saw flying into the log, and the bystanders looking admirably on exclaim: 'My, don't she hum!'

"When the cut is finished with steam cut down at least thirty pounds, and the speed of the engine to less than half of the starting speed, the engineer turns to me and says: 'That's the way we do it here. You can't learn that out of books, now, can you?' I sorrowfully answer no, and bidding him good-bye I turn to pursue my benighted way. People there speak of him admiringly as the engineer. By courtesy we also call him the engineer. Stationary he is as regards the years in which he has stood by this his only engine, and stationary he is and always will be in his ideas. Is he an engineer or not? Echo answers, Not."

NINETY MILES AN HOUR BY RAIL.

Recently we gave accounts of three very remarkable runs. The Philadelphia & Reading run was made with one of the class "D" 33 engines with four 68½ inch driving wheels, the total train load being about 169 tons. The fastest time made was 90½ miles per hour for about one mile, on a level immediately following a descending grade of 37 feet per mile. The fast run on the New York Central, with a Schenectady engine, was more difficult, owing to the long time and distance from start to final stop. In that run 436½ miles was made in an actual running time of 425 minutes and 14 seconds, giving an average speed, excluding stops, of 61·56 miles per hour.

The maximum speed between stations on the Central run is unknown. It is said that the fastest mile was made in 47 seconds, or at the rate of 76·6 miles per hour. It is to be regretted that in such cases as this, and the fast run on the Reading, a speed recorder was not used on the engine or one of the cars. An analysis of a diagram made by a recorder on these runs would have permitted an extremely satisfactory investigation to be made of the detail of the velocities and rates of acceleration and retardation. Such a diagram taken in connection with the profile of the road would solve one or two perplexing questions which inevitably arise when reports are made of fast runs. However, this much is certain: A speed of 90 miles an hour has been attained, and the possibility of it is proved beyond question. This will settle once for all the argument of those who have heretofore held that speeds above 70 miles an hour were not only impracticable, but impossible, in spite of the fact that trains run short distances at over 70 miles an hour every day in the year. While there are conditions which would prevent the common adoption of a 90 mile an hour speed, yet it is possible to so improve the permanent way and the coupled locomotive as to make such a speed perfectly feasible.

It will be noted that this fast time was made with locomotives having parallel rods, and as this is essentially a feature of American locomotives, it would appear that our engines are well adapted for high speeds, and we shall not be compelled to resort in the future to single pairs of drivers with the necessary loss of traction. Our locomotives stand to-day as the most powerful in the world, as the most economical under equal conditions, and last, but not least, capable of making the highest maximum and average speed. These two instances of high velocities were not with light train loads; the loads were not equal to our heavy passenger traffic loads, but compared to English and foreign train loads for high speed they are certainly not to be termed "light loads." The New York Central train weighed about 230 tons; the Reading train weighed about 169 tons.

During the past two years we have reviewed at different times some of the necessary changes that must be made in locomotives to adapt them for extremely high speed. Of all of these changes the most important ones are in the counterbalances and reciprocating parts, the steam ports and valve travel, and the arrangement of the exhaust. Radical changes are probably unnecessary, but decided modifications must be made to adapt the average locomotive for fast runs.

It is well understood what will have to be done with the reciprocating parts, and a great improvement is noticeable in the most recent designs. The pistons are now made of less than one-half their former weight, and of cast steel or wrought iron. The reduction in the crosshead is not as great but a further reduction is at hand. The main rods, which largely affect the counterbalancing, have been reduced one-half in several instances. The parallel rods, which do not affect the accuracy of the counterbalancing, and hence produce no detrimental effect on the track when counterbalanced, have been supposed to be one of the limitations of speed, but the rapid introduction of solid ends and "I" sections, as well as the use of an extremely fine grade of steel having a high tensile strength and great ductility, have so improved the strength, and at the same time decreased the strain by reason of a decrease in weight, that the limit of safety in increasing speed, as determined by side rods, has been raised considerably. If 60 miles an hour was a safe speed with the parallel rods of five years ago, then 90 miles an hour is a safe speed with the most improved form and kind of rod. The reciprocating parts of our best engines to-day, when perfectly balanced, have less detrimental effect upon the roadbed than the best single driver engines. Hence, so far as counterbalancing is concerned, we may consider that the best locomotive designs in this country are such as to remove the limit of speed to a point above the highest practicable speed with permanent way as it is.

The other two necessary changes in design to adapt the present locomotives to high speed have not received the attention they should have. It is only now that we can say that any efforts which promise success have been made to determine what is the proper form of an exhaust pipe and smokestack to give the least back pressure in the cylinders. The Master Mechanics' Association committee reported this year a few general facts which will assist in a solution of the problem; but we expect the most conclusive results from the experimental work being carried on by two railroad companies with old engines jacked up in the shop, on which a large variety of exhaust apparatus will be tried. Within another year one will probably know how to construct a locomotive blast apparatus so as to give approximately the least back pressure to the cylinders.

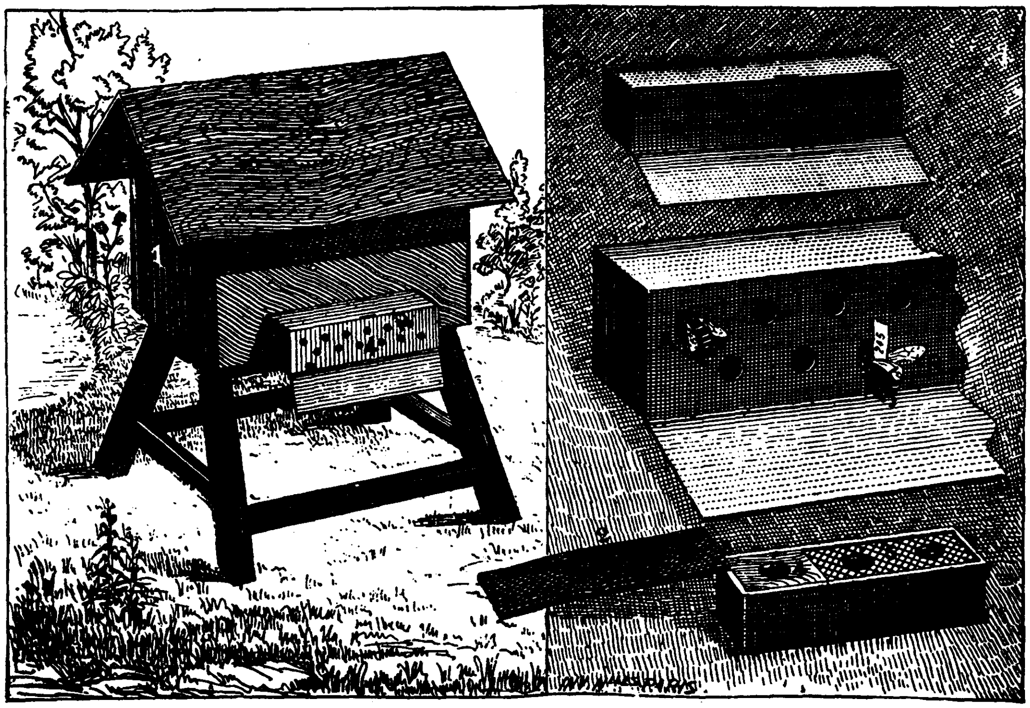
It is the mean effective pressure on the piston at high speeds that must be increased before we can hope to haul heavy trains at a higher rate of speed than is now common. This average pressure on the pistons is to be increased by decreasing the back pressure, as just shown, and further by so increasing the opening of the steam ports at short cut-offs, and prolonging the period of exhaust, that the wire drawing at admission and the loss by compression shall be materially reduced. There are those who have proposed, and will continue to propose, radical changes in the valve motion, such as a substitution of a new gear in place of the Stephenson link. While in a general way this is to be encouraged, yet the most advisable and desirable thing to do is to improve the plain "D" valve and the Stephenson link as much as it can be improved before we give it up. This gear we know all about in service. It is reliable and positive, and gives little or no trouble. There is no substitute yet proposed which does not promise trouble from the start when operated at high speed. As we have before shown in the *Railroad Gazette*, there are ways of increasing the port opening at short cut-offs and prolonging the period of exhaust which are perfectly practicable, and are being used with good success on several roads, notably the Reading, where the high speed was made which has called forth these comments. The engine which made this fast time had the following dimensions of ports, outside lap, and valve travel: cylinders, $18\frac{1}{2}$ inches in diameter by 22 inches stroke; steam ports, $1\frac{1}{4}$ inches by $16\frac{3}{4}$ inches; exhaust ports, $16\frac{3}{4}$ by $3\frac{1}{4}$ inches; travel of valve, 7 inches; outside lap, $1\frac{1}{8}$ inches; inside lap, zero; diameter of drivers, $68\frac{1}{2}$ inches; weight on drivers, 64,400 pounds; weight on truck, 31,800 pounds: total weight, 96,200 pounds.

Undoubtedly, the area of port opening was much more than common with this engine at short cut-offs, and was 25 or 30 per cent greater than with the ordinary engines used on express trains. The indicator cards which we have seen from this class of locomotives have the least compression and the best admission line of any that have been put before us. The engines were built in 1886, and have been operated since that time with perfect success with these foregoing dimensions of valve and valve travel. Hence the feasibility of the arrangement is proved beyond question.—*Railroad Gazette.*

A patented process for obtaining cellulose and oxalic acid from the vegetable fibers contained in wood, which is the invention of M. Liefchutz, consists in reacting on wood with dilute nitric acid, in the presence of sulphuric acid, separating the intermediate product from the acid liquor, which contains in solution the oxalic acid formed, and subjecting the intermediate product to a further treatment to remove the remaining incrusting matters from the cellulose. As to the acid liquor, it is set aside and subsequently treated in a process for recovering the oxalic acid. The oxalic acid dissolved in the weak nitric acid can be obtained direct in the crystalline form, by repeatedly using the separated acid liquors for the treatment of fresh wood.—*Bull. Fab. Papier.*

THE CONVEYANCE OF DISPATCHES BY BEES.

Let not our readers think of a hoax on reading the title of this article. It is a question entirely of asking a new service of the bee—that insect so useful in the country; and it is desired, neither more or less, to obtain, after it has contributed to increase the national wealth in time of peace, its aid in the common defence when the country shall be threatened. But, what! it will be said, you do not think seriously of replacing the carrier pigeon, which travels im-



FIGS. 1 AND 2.—HIVE AND SHIPPING BOX.

mense distances in order to regain its cote, and with a speed equal to, and often greater than, that of our fastest trains, by an insect incapable of guiding itself if the hand of man or the force of the wind carries it to some leagues from its hive, and whose qualities of speed bear no comparison with those of the winged messenger that is called upon to render so great services in time of war. Do not be uneasy, for such is not our thought, and we do not believe, even, it is that of Mr. Teynac, the distinguished bee master of the Gironde, who has conceived the idea of this ingenious innovation. It is a question, for the moment at least, only of some curious and interesting experiments, which are insufficient, however, to permit of prejudging of the services that this new mode of transmitting correspondence may render in the future. However this may be, the results obtained up to the present by the author of this method are so remarkable that we do not fear to lay them before our readers, being certain that they will think, as we do, that we have here the elements of a most interesting study. Numerous experiments, not altogether new, have established the fact irrefutably that, if a swarm of bees be inclosed in a bag and carried to a distance of less than two or three miles from the hive, and the bag then be opened, the bees, after whirling around for a few instants, will quickly take flight in the direction of the hive with that certainty of instinct with which nature seems to have endowed all animals to a greater or less degree. The most active ones will cover the distance within a length of time varying between twenty and twenty-five minutes, which corresponds to a mean speed of seven miles per hour. It was starting from this fact that Mr. Teynac conceived the idea of utilizing the instinct that leads the bee to its home for making a messenger of it, and that he constructed the material represented in our engravings, and the use of which we shall explain.

Let us suppose that the owner of a swarm wishes to establish a system of correspondence with a friend whose residence is 2 or 2½ miles distant from his own. He begins by sending him a small hive constructed as shown in Fig. 1, and well stocked with bees and food for them. At the end of a few days, the bees will be sufficiently accustomed to their new surroundings to allow experiments to be begun. A certain number of bees are taken from each hive and introduced into a small shipping box (Fig. 2). The greater part of the top of this box is covered with wire gauze, which permits of the entrance of air to the prisoners. The bees are introduced through the orifice, 4, that may be seen to the left of the box, and which is afterward closed by the pivoting cover, 2. In this way, the sending may be easily done by mail. On reaching their destination, the bees are set free in a room in which a saucer containing a little honey has been arranged upon a table. The bee alights on the repast, and this is the moment that the operator must take advantage of to glue to its thorax the previously prepared dispatch. As may be seen in Fig. 3, the extremity of the dispatch (here magnified ten times) is slit with a pair of scissors so as to form two flaps, which are covered with fish glue and quickly applied to the bee held with pinchers. Care must be taken that the glue does not touch either the head or the wings of the insect, which, as soon as it is satiated, takes its flight and steers straight for its hive. But here it meets with an unexpected obstacle. In fact, care has been taken to place before the entrance of each hive a small tin box having apertures in front of just sufficient size to allow of the passage of the males or drones. The opposite side, which is entirely open,

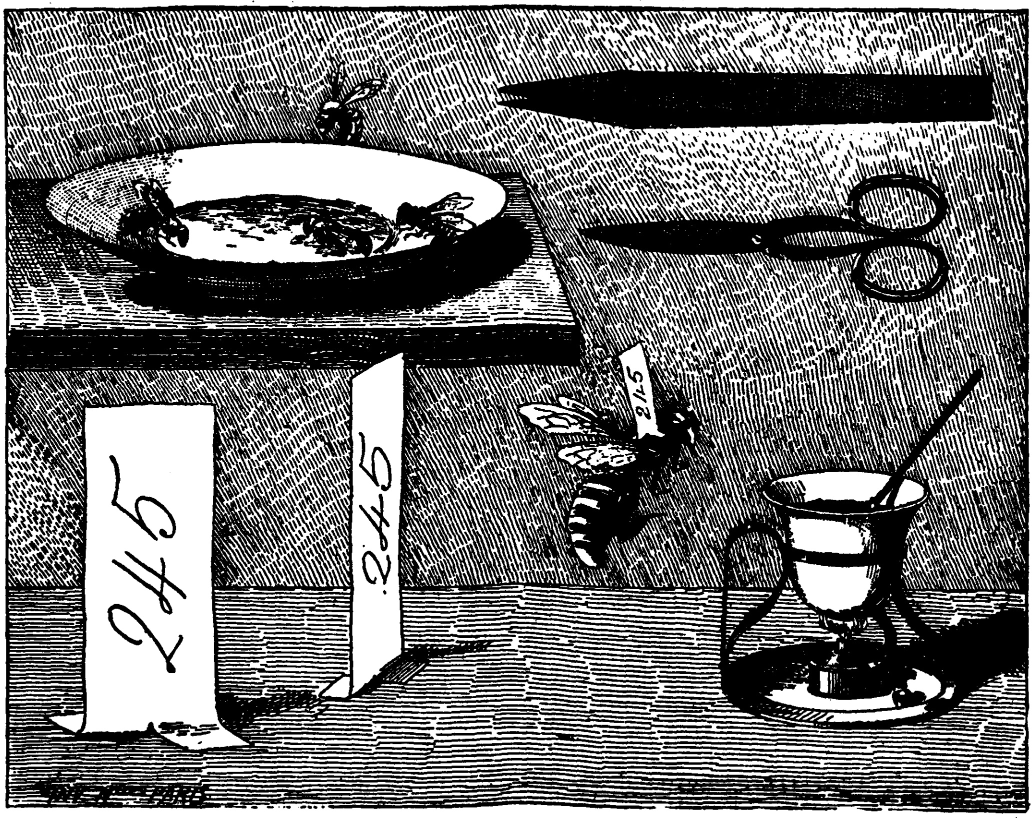


FIG. 3.—SAUCER OF HONEY, PINCHERS, SCISSORS, DISPATCHES, GLUE POT, AND BEE WITH DISPATCH AFFIXED.

is applied exactly against the entrance to the hive, so that, in order to enter or make their exit, all the bees are obliged to pass through these apertures. The little messenger, hampered by the protuberance that the dispatch forms upon its back, exhausts itself in vain efforts to pass through in its turn, and is obliged to wait for some one to free it from the burden that prevents it from entering the hive.

Here, then, is the system of correspondence devised by Mr. Teynac. It will be seen that the use of it is as yet not very practical. The difficulty resides in the small extent of the field of operations of the same swarm, and this would, for transmission to a long distance, necessitate a multitude of intermediate stations two or three miles apart. It is true that the establishment of such stations is neither difficult nor costly, since there is no need, as with the other messengers, to trouble one's self with the question of feeding, but, on the contrary, each station would be a source of revenue to its guardian. But, in most cases, for a besieged city, the establishment of a station at a distance of two miles is so evident an impossibility that it is not necessary to dwell upon this point. Moreover, relays so close together would occasion great loss of time. It remains to be seen whether in the immense family of hymenoptera there may not be found a messenger which, through patient training and proper selection, might be able to travel greater distances. It is toward this point that the researches of Mr. Teynac are being directed, and he is now experimenting with the *Bombus hortorum*, domesticated by him.—*Les Inventions Nouvelles.*

YOU MAY SEE A MILLION.

A concession has been granted to M. Stepanni to erect a Moorish palace at the World's Fair. One of the many attractions which he proposes to exhibit in this palace is $1,000,000 in gold coin in one pile. He believes that this will be a great drawing card and that nearly every visitor will want to see it. Of course great precautions will be taken for the safety of such great treasure. It will be in a strong cage and, Mr. Stepanni says: "Just under the gold will be constructed a fire and burglar proof vault. To the doors of this vault will be connected electric wires. In the event of an attempt to rob the palace my guards will press an electric button, the entire pile will fall into the vaults, and the doors will spring shut." A space 200 by 250 feet was granted for the Moorish palace, upon which Mr. Stepanni says he will expend $400,000.

CANADIAN DEMANDS ON BRITISH INDUSTRIES.

A good deal of interest is being evoked just at present on behalf of Canada and the Canadians. It appears to be assumed that they are discontented with their present circumstances, and that they are resolved to throw in their lot with the United States, or to set up as an independent kingdom or republic, as the tastes of the majority may dictate. The question, in view of these prospects or probabilities, is naturally asked—What is Canada worth to the mother country as a factor in her commercial and industrial prosperity, and what would be the extent of the loss entailed upon Great Britain, if instead of remaining an integral part of the United Kingdom, she were to become an independent and, possibly, a hostile state?

Regarded as a problem affecting British industry, the retention of Canada as an integral part of the Empire has a two-fold aspect—namely (1) The markets that it would open up to British produce, and notably to British iron and steel, in the construction of the system of railways that must be laid down in the future, and (2) the value of Canada as a source of supply of raw materials for our industries. There are, of course, the further and wider issues of the importance of the Dominion as an outlet for our surplus population, and as a means of supplying our food requirements, but with these, as they are less of an industrial character, we need not deal at present.

The trade with Canada in articles of British manufacture is by no means so considerable as is generally supposed. Our principal exports to the Dominion are iron and steel, woollen and worsteds, cotton manufactures and haberdashery. For a number of years past these have made up more than one-half of our total exports to what is grandiosely described as "the larger half of the American Continent." The annual Canadian consumption of iron and steel, which has been comparatively stationary for a number of years past, has not been large, being, indeed, less than a sixteenth part of that of the United States. Such as it is, it has been received mainly from the United Kingdom. But the expectations of our home industrials have been disappointed as to the extent of the trade. They have not unreasonably made comparisons of Canada with the United States, and have said to themselves that, with an area of over 3½ millions of square miles, a temperate climate, an industrious and thriving population, magnificent waterways, and the credit of England at its back, the Dominion should have made a much better show than it has done. The actual facts are by no means remarkable. Between 1860 and 1880 the Canadian railway system had only extended by 4,804 miles, while the adjoining system of the United States had increased by more than ten times that mileage. Between 1880 and 1890 the Canadian railway system only increased from 6,891 to 13,256 miles, an increased mileage of only 6,365, as compared with an increase of over 70,000 miles on the other side of the line. Nor are the differences as to the traffic at command much less striking. The Canadian railways only carried, in 1890, 21 million tons of freight, which was a thirty-fifth part of the freight tonnage carried by the United States railway system in the same year. Nor is the rate of growth of the two systems quite equal, for, while the railways of the United States increased the tonnage carried between 1880 and 1890 from 300 millions to 721 millions of tons, those of Canada only increased the tonnage carried from 10 to 21 millions of tons. This record would be remarkable if Canada had no traffic to carry on a large scale; but, as a well-known fact, the Dominion has very large coal fields, important and extensive iron ore measures, now being worked to a slight extent, the finest stores of lumber in the world, and large resources in other minerals. These possessions justify the hope that in the future Canada may make industrial history more rapidly than she has done in the past, but the rate of development up to the present time has been extremely slow and unsatisfactory. Canada has not, therefore, been a really serious factor in the calculations of the British iron and steel trades. In 1889 she received manufactured iron and steel, including hardware, to the extent of about £1,600,000, or about a thirtieth part of our total exports of these metals in the same year. We could lose Canadian custom without feeling it appreciably, in so far as our staple industries are concerned, but while this is comforting, as far as it goes, it would be more comforting still to think that Canada was to be one of our mainstays in the time to come, which she might easily become if the enormous resources of the country were developed with judgment, enterprise, and the command of capital.

Unfortunately, our total exports to Canada have been steadily declining for a number of years past. In 1886 they formed about 3 per cent. of our total exports, and in 1890 they were only about 2 per cent., the figures being:

	1886.	1890.
	£1 = £1,000.	£1 = £1,00 .
Total exports..........	£268,959	£328,252
Exports to Canada....	7,546	6,827

Here, again, our manufacturers and exporters may take comfort, for if Canada does "kick over the traces" she is not likely to inflict irreparable injury on the mother country, even if she transfers her trade *en bloc* elsewhere, as there have been threats of attempting to do by a differential tariff in favor of the United States. Besides this, it is important to remember that, as we now take from Canada, in the form of imports, almost twice the value of what she receives from us—in 1890, £12,020,000, as against £6,827,000—Canada would lose more than we should by a withdrawal of business, and her loss would be one that could hardly be made up by closer trade relations with the United States, since the goods that we mainly receive from the Dominion are of a kind that the mother country will always want, but with which the United States can supply themselves—the main items being cheese, cattle and sheep, timber, and fish. Nor is Canada in any way indispensable to us, whether as a source of food supplies, or as a source of raw materials for manufactures. Towards the latter, indeed, her contribution for many years past has been practically *nil*. She sends us, it is true, a good deal of timber, but that commodity is sufficiently abundant elsewhere. Of breadstuffs we receive from the Dominion next to nothing, nor is it likely that she will compete under existing conditions with the United States for many years to come.—*Industries.*

NEW AIR SHIPS.

Other parts of the world as well as the United States have new projects for the navigation of the air, and whatever may be our liking for experiment and invention in these matters, it is obviously interesting, not to say important, to keep well informed about the development made. It is hardly to be doubted that one of these days the air ship will be as common in use and its name as much employed in our vocabulary as steamship or war ship or vessel. Henry Lecomte, Director of the School of Aerostation at Paris, will soon make a rash attempt to cross Africa by balloon, starting from Mozambique. The peculiar feature of his balloon is a special apparatus for the production of hydrogen gas, so as to maintain the floating power. This gas is to be generated during the night time. The balloon will carry provisions for 100 days and will have a capacity of 10,000 cubic metres. Experienced aeronauts believe that this is a very hazardous undertaking. Lecomte proposes to cross Africa in its wider part, making a longer journey than any yet recorded.

Mr. Maxim, of whose experiments in this line we made mention recently, is now completing his invention of an aerial machine which he asserts will be superior to all other agencies of destruction in warfare. He has already spent $50,000 on his invention, and if necessary $50,000 more will be expended to insure success. The machine is building at Crayford, near London, and is nearly ready for a practical trial. Maxim has made an exhaustive series of experiments to test the practicability of his idea, and it remains to be seen whether he can carry out his scheme with a full-sized machine.

He says his invention has been recently tested while captive, the engine propelling it being at work, and he thinks he proved it to be capable of carrying at least 10,000 pounds. The weight of the full size machine, including men, engines, fuel, water, and all accessories, is 5,400 pounds. The fuel is gasoline, giving 5,000 gas jets. The machine is propelled by two screws and there is an engine to each screw.—*World's Progress.*

TO REMOVE IRON RUST.

The engineer who is so unfortunate as to have a portion of his engine become rusted, or the more fortunate man who takes charge of an engine which has been neglected and is covered with rust, finds before him a tedious job in cleaning and getting the metal to again present a polished surface. Rust, chemically considered, is an oxide of iron when it appears on iron or steel, but the combination of oxygen and any other metal will form a rust, although in such cases it is usually given another name. The combination of oxygen with iron can only take place to an appreciable extent in the presence of moisture or hydrogen, and if extensive leaves little depressions in the metal when the rust is removed. This occurs from the fact that when the oxygen combines with the iron, that portion of the iron forming the combination is loosened or separated from the mass. There are two ways in which rust may be removed from iron or steel. The first and most common practice is by the use of some abrasive material, and the process is usually termed scouring. Another method is by chemical action, by the application of some chemical applied in solution, which has a high affinity for oxygen and which withdraws the oxygen, leaving the iron particles free.

One of the best compounds for such purposes is given by the *Chronique Industrielle* as follows: Potassium cyanide 15 grammes, soft soap 15 grammes, whiting 30 grammes, and sufficient water to form the ingredients into a paste. This is to be applied as a scouring material and well rubbed over the rusted surface, after which it is to be thoroughly wiped off and a coating of oil applied to stop further action. The active material in this composition is the potassium cyanide, which has the strongest deoxidizing property of any substance with which we are acquainted; and further, it is one of the most poisonous substances known, the base being potassium, which is combined with cyanic acid, and cyanic acid is so poisonous that it is extremely dangerous to use in any manner unless partially neutralized by combination with some other substance, as in the present case.

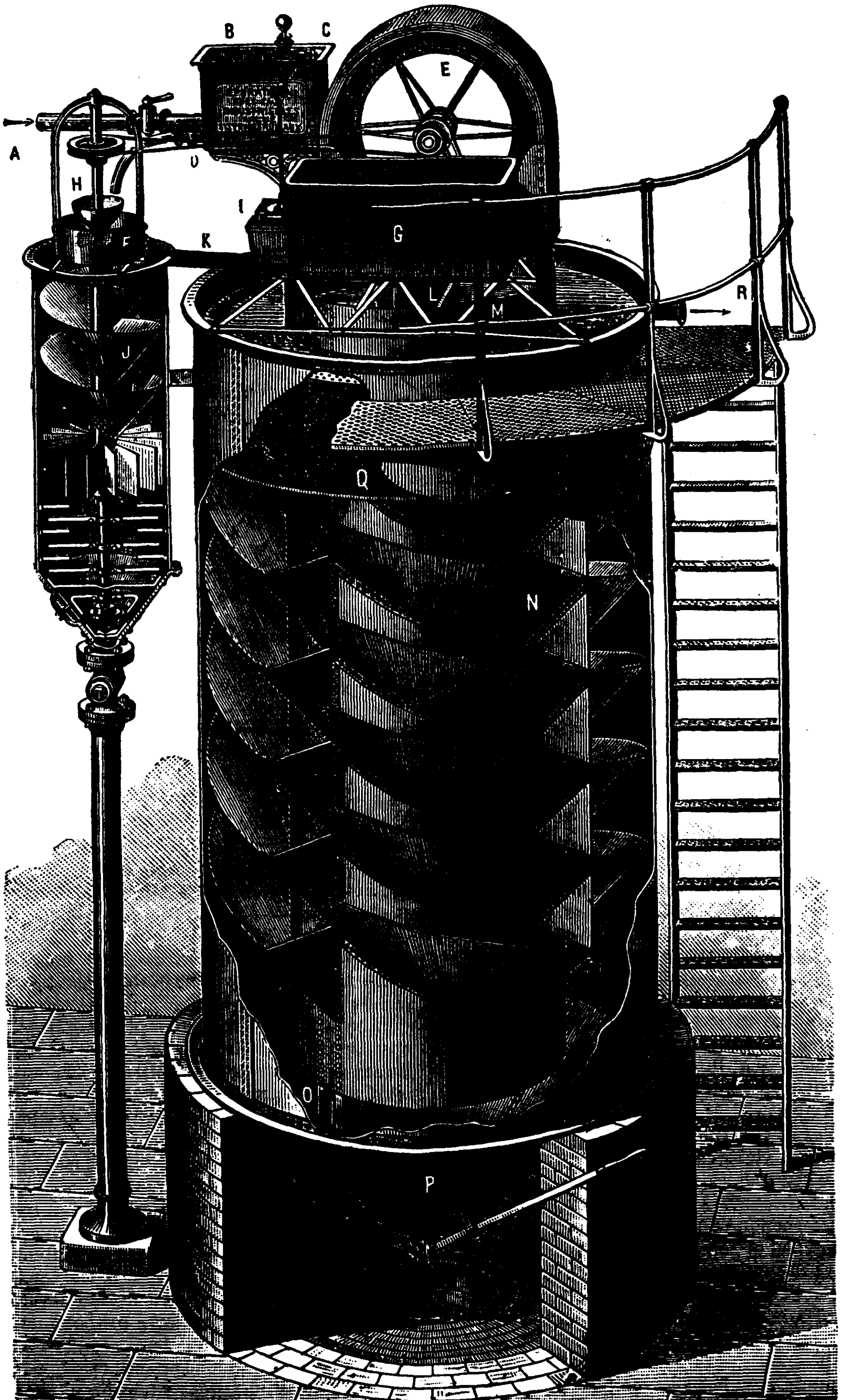
Cyanic acid is of itself a gas, and in this condition it is extremely destructive to life, the inhalation of even a small quantity being sufficient to cause instantaneous death. When in solution in water the liquid is called hydrocyanic acid, a single drop of it, if taken internally or entering the system in any manner, being sufficient to cause death within the short space of two seconds of time.

No particular danger is to be apprehended from the use of the composition given for removing rust, as the addition of soft soap, which is of equal weight with the cyanide of potassium, goes far to counteract the acridity of the cyanide. Then the further addition of whiting in double the amount of cyanide reduces the strength of the compound so much that it is relieved of the greater part of its dangerous properties.

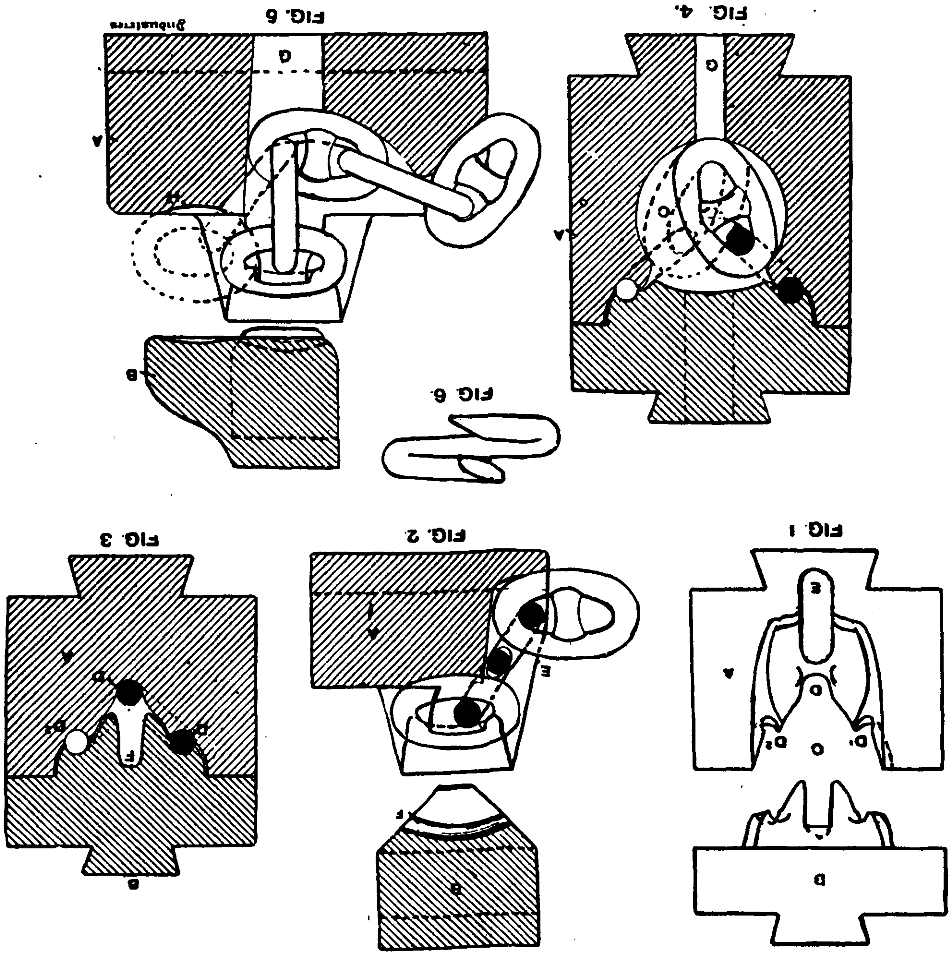
If any one attempts to make use of this compound for scouring purposes, we would suggest that he do so only when the hands are free from abrasions of any kind, as if it should come in contact with any portion of the flesh where the skin is removed a very bad sore would probably be the result.—*Stationary Engineer.*

A NEW WATER SOFTENER.

We illustrate herewith a new water-softening apparatus devised by M. H. Desrumaux, which is now being introduced by La Société Anonyme Française, "L'Epuration des Eaux Industrielles," Lille, and which is reported to give excellent results. Like most of the modern forms of water-softening plant, it consists of two parts—(1) a tank in which the precipitation of the lime salts is effected, and (2) a special form of apparatus for removing the precipitate from the softened water. The preparation of the lime water, which is the reagent used to bring about the precipitation, is also effected in a special form of mixing plant which produces lime water of the maximum strength. The water to be softened enters the apparatus at A, and passes into the small regulating tank B, which ensures a constant level, and which distributes such a proportion of the water to the lime in the accessory cylinder J as to form sufficient reagent to effect the complete softening of the water, whilst the remainder and greater portion of the water passes at once into the interior of the precipitation cylinder at L. A determination of the hardness of the water indicates the relative distribution of water to the two parts of the apparatus, and, when once regulated,



A NEW WATER SOFTENER.—GENERAL VIEW.



A New Method of Making Chain Links.

will work without any further attention so long as the charge of lime is unused. The preparation of the lime water is effected as follows :—The tank F, with a perforated bottom, is filled with lime, and the adjusted quantity of water flows on to this from the tap D. Below the charge of lime at J is a concentric helix and paddle, which is set in motion by the revolution of the wheel E, which is itself moved by the flow of water into the precipitation cylinder. The revolution of the helix below the lime tank ensures a complete saturation of the water with lime, and thus allows a lime solution of constant strength to pass from the apparatus by the conduit F into the precipitation plant. G is a reservoir containing soda solution, and it is regulated by the float I, which is connected with the tank B. The mixed waters first pass down the central cylinder M, and then ascend the spiral of the external concentric cylinder. This spiral is fitted with diaphragms at frequent intervals, which, while arresting the passage of the precipitated carbonate of lime, do not hinder the ascending water, which finally passes through the filter Q and arrives at the top of the apparatus clear and bright, and passes away through the tube R. The precipitate is removed from time to time by opening the precipitation cylinder at the base P, and the lime tank F is recharged from day to day. La Société Industrielle du Nord de la France recently appointed a committee to examine the working of this plant in that district, and in the report the satisfactory use of these softeners is recorded. We are indebted to the *Revue Industrielle* for our illustration.

A NEW METHOD OF MAKING CHAIN LINKS.

The ordinary method of making chain links is to employ a pair of dies, the bottom one, which is fixed, having in its face a U-shaped groove constructed to receive the end portion of the link to be welded; and the upper, or moving one, being a substantial counterpart of the lower one. Each link is welded separately, and after each stroke of the hammer it is necessary to turn it over on the die, so that both sides shall be subjected to the stroke of the moving die. As the dies are so constructed that one end is closed, the end next the operator at which the links are inserted being open, the part of the chain already formed is drawn out in order to turn the link round, by doing which it is also necessary to turn a portion of the chain. This, besides occupying considerable time, is arduous work, and consequently adds materially to the cost of manufacture. This method, moreover, provides only for the manufacture of end-welded links, which are not considered so reliable as those welded at the side. Further, the upper die on coming into contact with the lower one is apt to move endwise, and thereby give an inaccurate shape to the link.

Mr. J. H. Baker, of Allegheny, Pa., U.S.A., is the inventor of a new method of making chains which is illustrated herewith, and which is being introduced by the Baker Chain and Waggon Iron Manufacturing Company, of the same place. The illustrations which are reproduced from some recently published in our American contemporary *The Iron Age*, show in Fig. 1 a rear elevation of the improved dies, in Figs. 2 and 3 longitudinal and transverse sections of the same and, in Figs. 4 and 5 modified forms of the patent dies. The lower die A is made with a cavity C, which tapers downward into a groove D, and has on either side of it two welding grooves D^1 and D^2, so constructed relatively to D that when one side is in the latter groove the other side will lie in one of the welding grooves. It will be understood that by turning the links, as shown in dotted lines, both sides of the links may be placed in the welding grooves.

In using the dies the attendant takes an open chain link similar to the one shown in Fig. 6, and, after previously closing up the gap with a hammer, places it in the die as shown in Fig. 3, so that the whole side shall lie in the lower groove, and the side which has to be welded shall lie in one of the grooves D^1 and D^2. After the die has, in this position been struck by the upper die B, the link is simply turned over into the opposite groove, where the same process is repeated, and so on until the link is sufficiently welded. Link No. 2 is then taken from the heating furnace, and is threaded into the welded link and placed as shown in Fig. 2, while link No. 1 rests in an upright position in a seat E. When in this position No. 2 can be turned about on the die without interfering with No. 1. When the links are required to be made with strengthening bars or studs as shown, the link, after being welded, is set on its edge in a vertical position on A, and after inserting the stud the die B is brought down upon the link, so closing it upon the bar. For this purpose the die B is provided with a groove F, the base of which forms the striking surface. In Figs. 4 and 5 the bottom die is shown of a modified form, and, instead of the groove D, the cavity is made circular in form; this gives more space for manipulating the work. The vertical slot G is intended for the accommodation of the previously formed link. In using these dies for inserting the stud, the link is drawn after it has been welded upon the die surface H (Fig. 5), and there subjected to the action of the moving die B.—*Industries.*

THE PHYSICAL ACTION OF ODORS.

The direct action of odors on the nervous centers is a subject worthy of careful research and study. Goethe had a strong dislike to the odor of apples; Schiller liked the odor. Some persons are made absolutely ill by the odor of onions that are being cooked; while other persons rather like it. The odor of the lily has a most potent effect in many instances, and I believe there is no person on whom it does not produce a sense of depression and nausea I have known it cause positive faintness. I am myself always disagreeably affected by the odor of carbolic acid, and can never remain many minutes in a room where a trace of it prevails. In cases where the effect of an odor is instantaneous, it is fair to suppose that the impression made on the olfactory surface is transmitted direct to the olfactory center of the brain; but there must also, in certain examples, be a further transmission to the sympathetic ganglia.

The central seat of the olfactory sense must be very near to the central seat of memory, for it is noticeable that nothing recalls a past event like an odor. A little child was accidentally thrown out of a pony-carriage in a country lane. Near the spot where the fall took place there was a manure heap, which gave forth the peculiar dry ammonical odor so often recognizable from such heaps—an odor distinctive yet not altogether unpleasant. The child was stunned by the fall, and on recovering and returning to consciousness smelt this odor powerfully. Over fifty years have elapsed since that little mishap, and yet whenever the person referred to passes, in country lanes, a heap giving out the same odor, the whole scene of the accident recurs with every detail perfect, and sometimes with a recurrence of the giddiness and nausea which were experienced at the moment.

In some of the lower animals memory by odors is often singularly exhibited. In the dog the memory by odor seems a special part of the nature of the animal. The "scent" of the fox-hound and of the stag-hound is of this character. In the trained collie the remembrance of an object hidden, a stick, for instance, may be retained for three-quarters of an hour, so perfectly that the animal will fetch the object at command. But if the object be coated with something giving an odor which the animal is familiar with, the time is infinitely more prolonged.

Some odors lead to sleep, like the odor from dried hops; others lead to wakefulness, like the odor of dead flowers or leaves. Still others allow sleep but provoke the most terrible dreams, like the odors arising from a pillow in which feathers are decomposing.

Habit modifies the effects of odor. Merciless smokers laugh at the "faddery" of women who become faint if a smoker charges the air they breathe in a confined space, a small room or a railway carriage, and are ready to compare the objection of a lady unaccustomed to the odor from the pipe or cigar with the carelessness of the matter shown by another lady who has become accustomed to the effect. But if a smoker gives up smoking and all contact with smoke for a few years, he is astounded at the unpleasantness of an air charged with smoke when he is then inclosed in it. I was once summoned, professionally, to a youth who was temporarily poisoned by inhaling the atmosphere issuing out of a small window of a clubroom in which a number of men were smoking freely. They, in the body of the smoke, were not perceptibly affected. He, partly in the open air, was positively smitten to faintness by the empoisoned current from the room which flowed out of the window, and is still affected whenever he comes within the cloud of a pipe.—*Dr. B. W. Richardson, in the Asclepiad.*

PROPERTIES OF COLOR.

The sun is, doubtless, the origin of all colors, as colors, with all their variations, are due to light. To us, color would have no existence if the eye and light did not exist to make it. Sound has no more to do with the eye than color has with the ear. Thus we see that both sound and colors are the results of their conditions. Reflection is to light what echo is to sound, so that when light is reflected from visible bodies, it paints the image of those bodies upon the retina of the eye; thus we see them. In the autumnal season when we look across the landscape to the bordering forest with its green and yellow tinted foliage, how impressed we are with the transformation scene! At noon it is light and dazzling; in the evening, when the sun is lowering, it is sombre and mellow. These effects are caused by the varying shades of light.

Newton was the first to discover the analysis of white light. He decomposed solar light, or rather common daylight, by means of a prism, or triangular piece of glass. To do this, he made a small, round hole in the window shutter of a darkened room. The aperture was large enough to admit of the necessary ray of light, which, passing through the prism, threw a prismatic spectrum on the black-board placed to receive it. This spectium was really an artificial rainbow, or solar spectrum. The solar spectrum is caused by suspended water in the atmosphere, or a rain shower falling between the sun and the dark cloud which forms the background of the rainbow. The rain shower acts as a prism. By means of a prism, Newton found that white light was capable of being broken up into its component parts, each part being a constituent of white light.

From such experiments it has been inferred that the sun's light is not homogeneous, but that it consisted of seven cardinal colors. These seven colors have different forms of refrangibility—that is, the prism through which the light passes bends some of the colors to a greater extent than others, giving each its respective place in the spectrum. From bottom to top, colors range as follows: Red, orange, yellow, green, blue, indigo, and violet. Green, you will perceive, is in the center, and for that reason, perhaps, is the most universally agreeable to the eye.

From the arrangement of the colors, however, we see that red has the least degree of iefrangibility, and violet the greatest, while green has the intermediate. Through the round aperture, used by Newton for the transmission of light, it was found that the colors overlapped or intercepted each other; but a German scientist, Kirchoff, experimented with a slit in the shutter, which he found gave a distinct and definite spectrum, free from the interceptions caused by the round aperture, and thus the color theory was definitely settled.

Natural bodies, such as flowers, plants, textile materials, and all other bodies, of course, possess the power of extinguishing or absorbing some of the colors which enter them, reflecting others from their surfaces. This property of absorption is selective, and decides the color of the said plants and flowers, as also of painted or dyed materials. When the light which enters a body is wholly absorbed, the body is black, none of the seven colors being reflected, either combined or separate. The combined colors, when reflected in compounds, give tints which differ from the cardinal colors, such as pink and magenta, the latter being so called from its being discovered in the year of the battle of Magenta, 1859. A body which absorbs all the light waves equally, but not totally, is gray, while a body which absorbs all the waves unequally is tinted with various colors, hence the vast variety in the color of flowers. A body which gives back all the waves, without absorbing any, is white. Those constituents of white light, which bodies return to the eye, constitute their colors. A body placed in a light, which it is incompetent to transmit, appears black, however intense the illumination.

A stick of red sealing wax, when placed in the vivid green of the spectrum, is perfectly black, and red cloth on which the red of the spectrum is permitted to fall, shows its color vividly, but appears black beyond that position. Indigo is largely used in dyeing. The indigo plant could itself be largely used for that purpose, but from 200 to 250 pounds of it would be required to produce the effect of a single pound of prepared indigo. The most important of red colors are produced from cochineal, a small insect found chiefly in Mexico, and from madder, the root of a certain plant, the former being used for woolen and the latter for cotton.

Indigo is distinguished from nearly all other coloring matter by its complete insolubility *per se* in water. Alcohol, methylated spirits and the like have to be resorted to as solvents, as indigo is largely used in dyeing. Let wool or silk be immersed at boiling temperature, in decoctions of any of the best known natural dyestuffs, such as cochineal, logwood, madder, or quer-citron bark, etc., and then washed in water, it will be found that the fibers of the material are merely discolored or stained of no definite shade, hence the use of mordants.

The term "mordant" is found in Latin and Italian manuscripts of the twelfth and thirteenth centuries, as the name of an adhesive composition by the means of which gold leaf was attached to wood, marble, and the like, but was latterly used for the decoctions used to give permanence to color in clothing materials. The chief mordants used in dyeing are salts of aluminium, of iron, tin, copper, and a few other metals.

The purple dye is spoken of from earliest history, and the priests were distinguished from common folks by the colors of their garments, and other favorites wore coats of many colors, such as Joseph, who was sold into Egypt. We also learn from the writings of Pliny that the priests of Isis and Osiris in Egypt wore garments ornamented with purple trimmings, the colors of which were derived from a certain shellfish. By the aid of Pliny's records, this shellfish has been rediscovered, but the color derived from it is said not to be very brilliant. The ancients, however, may have had a better method of preparing it, for some of the colored threads found among the wrappings of Egyptian mummies distinctly show that the ancients of Egypt excelled in imparting colors to woven materials, and doubtless the Hebrews derived their superior knowledge of dyeing wool from the Egyptians.—*Fiber and Fabric.*

THE USES OF PEAT.

The *Handels Museum* publishes an extract from an article by Dr. Leo Pribyl, who maintains that peat is a valuable raw material, the uses of which, except as fuel and litter, are as yet very limited. The fiber is unsurpassed as a packing material for use in the case of breakable merchandise, being much superior to straw, hay, etc., owing to its greater elasticity and dryness. In the case of consignments consisting of liquids, it possesses the advantage of being peculiarly adapted for absorbing any of the contents which may have escaped through breakage, and thus preventing damage which might result to other consignments through damp. In the shape of dust and litter it is especially adapted for preserving perishable articles. Meat when packed in it will keep fresh for weeks, and will eventually dry up, the moisture being absorbed by the peat. In this way fresh sea fish has been sent from Trieste to Copenhagen, and has reached its destination in perfect condition. Peat is also successfully used for preserving fresh fruit; even grapes may be made to retain their fresh appearance for months, and, owing to the high prices of this fruit in spring and summer, would amply repay the trifling expense incurred by the use of peat dust. Experiments have shown equally satisfactory results in the case of pears, apples, plums, etc., as also in the case of cabbage, turnips, and potatoes, peat packing having the advantage, not observable with other packing materials, of preventing the sprouting of potatoes in spring. The question as to the best method of preserving eggs for the winter months is an important one, and still remains without any satisfactory answer. Possibly the preservative qualities of peat might here again be illustrated, and a satisfactory solution of this important question be arrived at.

It has been found a drawback in the use of artificial saline manure that in wet weather it forms itself into hard lumps, which cannot be scattered by the manure-spreading machines, a difficulty which may be obviated by the use of a small quantity (2·5 per cent has been found to be sufficient in the case of kainite) of peat dust with the manuring salt.

As a substitute for ashes and straw in filling up the partition walls of cellars and ice houses, broken peat is most suitable, as the effect of moisture on the ashes or straw is such as to render their immediate removal a necessary condition for the continued use of such places. Ice has been preserved for eight days in a cement barrel when covered with dry peat litter. Two pieces of ice were exposed to the sun's rays in Braunschweig; one of them was covered with wood shavings and the other with a layer of equal depth of peat litter. The former had thawed in 72 hours, when it was found that the latter was still almost entire. From this it is seen that peat is a bad conductor of heat, and is consequently well adapted for isolating purposes.

Peat dust has been recommended as an excellent ingredient for use in the manufacture of light, porous bricks, being mixed with the clay previously to baking. Bricks of this kind are much sought after in certain branches of architecture. But still further industrial uses are found for peat. The peat bogs of Northern Germany and of Sweden are being worked by joint stock companies, with a view to obtaining the elastic fiber, which, when free from dust, is used for weaving into carpets and other textile fabrics. Considerable capital is invested in these undertakings in Oldenburg and Sweden. The paper industry, too, in the manufacture of peat cellulose, has shown a decided preference for this tender and pliant fiber, so that it may be justly said that at the present time the supply of good peat is inadequate to meet the demand, considering the varied uses of this unpretentious raw material.

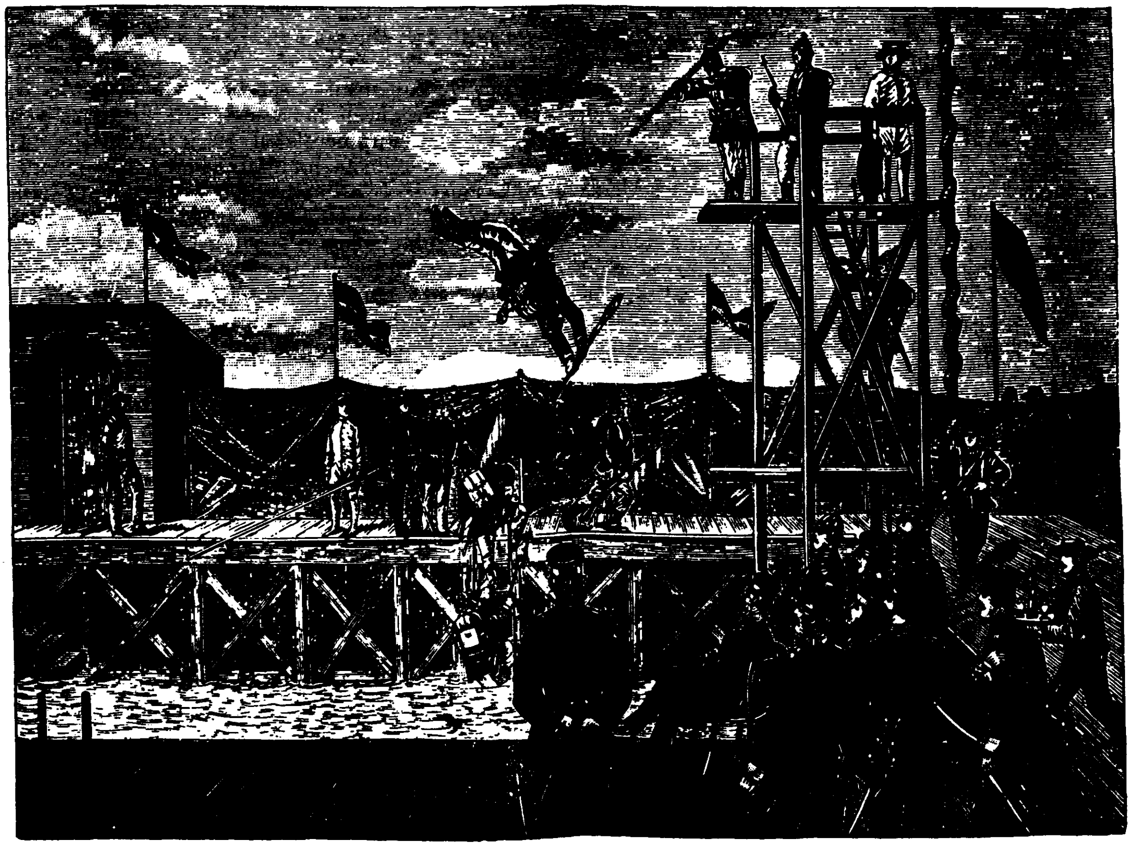
The chemical industry is using peat in the manufacture of charcoal, peat coke, peat gas, etc., thus converting a cheap raw material into a valuable industrial product. Boghead naphtha, tar, solar oil, paraffine, acetic acid, and gas have been produced from peat, and it has even been used in tanning. It has been for years used in Germany for absorbing waste liquids and refuse in factories, and in this way has furnished large quantities of valuable manure in certain districts.

An enumeration of the manifold uses of peat will prove that this raw material, which has hitherto been considered of little importance, and which nature has provided in such abundance, even if it be in many districts partially distributed, is destined not only to benefit agriculture by its valuable properties and chemical composition, but to lay the foundation of a flourishing and widespread industry. A new era has been entered upon in the sanitation of towns by using peat, and it is to be hoped that advantage will be taken of the undoubted benefit arising from its use, both as regards the health of urban populations and the promotion of agricultural interests by the supply of large quantities of manure. In this way extensive and unproductive tracts of bog land would be converted into valuable properties, and a flourishing industry would provide work and wages for thousands of hands.—*Jour. Soc. Chem. Industry.*

THE GERMAN ARMY SWIMMING EXERCISES.

While the swimming service is obligatory on the pioneers, and lately also on the cavalry, it is optional with the members of the other departments of the army, and the fact that the annual subscription list is always more than full is a pleasant indication of the love of sports among our "Blue Boys." Many an enthusiastic admirer of Neptune must, to his great sorrow, be turned away on account of the great number of applicants.

The instruction is given, under the direction of lieutenants, by under officers. It begins with the regular practice of the swimming strokes, the pupil being supported meanwhile by the so-called "fishing rod." When he has learned the movements well enough to be able to support himself above the water, he begins to swim on a loose line. At this stage it is often found that those for whom the highest hopes had been entertained lack one quality that is indispensable for a good swimmer; we mean that Olympic calm without which the most carefully acquired knowledge of the strokes is useless. When the pupil is able to keep himself on the surface safely and quietly, he must go into the water without the helping line, but



THE GERMAN ARMY SWIMMING EXERCISES

a rod is placed a certain distance above his head for use in case of need. After this he must submit to the test of swimming alone for fifteen minutes, then for half an hour, accompanied by a boat, then comes the "Todtenfahrt" (death trip), which lasts an hour.

The swimming exhibitions held at the end of the summer before the commanders of the battalions or regiments are pleasant festivals and those held in Berlin or Potsdam are often attended by any princes of the reigning house who happen to be in the neighborhood. Classes of men clad only in their swimming tights exhibit their proficiency in swimming, jumping, and diving, and this water exercise in regularly formed lines, squads, and sections is a pleasant sight. Lastly comes the most important feature of the programme, the exhibition of the finest swimmers in full marching uniform and with bayoneted guns in their hands. They jump from a high tower into the cool water, on the surface of which they amuse themselves until the command of the officer in charge calls them from the damp element.

The swimming service of the German army is an excellent institution, for besides giving the men healthy exercise, it tests the courage and self-control of the men in time of peace.—*Illustrirte Zeitung.*

To remove rust stains from nickel plate, grease the rust stains with oil, and after a few days rub thoroughly with a cloth moistened with ammonia. If any spots still remain, remove them with dilute hydrochloric acid and polish with tripoli.

PICTURES IN SULPHUR.

In demonstrating that sulphur melted at about 115 degrees can be cooled in paper, the author happened to use a lithographed card, of which the edges were turned up. Upon taking away the card he discovered that the lithographed characters were clearly and distinctly impressed upon the cooled surface of the sulphur, and remained after hard friction and washing. By repeated experiments he has been able to get very fine results, removing the paper each time by a mere washing and rubbing process. He finds that sulphur will receive impressions from and reproduce faithfully characters or designs in ordinary graphite crayon, colored crayons, writing ink, typographical inks, china ink, lithographic inks—colored or uncolored—and others. He remarks, too, that it will reproduce with remarkable exactitude geographical maps.—*Charles Lepierre, Bull. Soc. Chim.*

SEALS FOR THE WORLD'S FAIR.

Under the direction of Henry Elliott, the only artist who has ever drawn and painted the seal and walrus in their native haunts, an interesting exhibit for the World's Fair is being prepared by the Smithsonian Institution. This exhibit consists of models in papier mache representing the fur seal and walrus fisheries on the Alaskan coast. The animals to be represented as well as the men who catch them, are being modeled in clay. One of the models shows a seal "drive." This model includes hundreds of mimic seals which Aleuts are driving along to the killing grounds by waving cloths and shouting. Another illustrates a "rookery" on which the full grown seals, bellowing and pugnacious have "hauled up" out of the surf upon the islands to breed. Another model will show a hauling ground of bachelor seals. The killing of seals will also be shown, a group of Aleuts being represented in the act of smashing their heads with clubs. There will also be represented a number of hair seals, which are not useful for their fur, but merely for food supply to the natives of that region. The walruses, now rapidly becoming extinct, are also to be reproduced in material that will give them a remarkably life-like appearance. Hundreds of models in clay are made of these animals, in order to represent the different species and sizes of each.

AMERICAN vs. ENGLISH ENAMELED BRICKS.

THE ENGLISH BRICKS SELLING FOR MUCH THE HIGHER PRICES.

The question has been asked why can American manufacturers not produce as durable enamel as the English manufacturers.

The answer is easy; the American manufacturer is not prevented by the lack of any raw materials, to even supercede, from Europe imported goods. It is not a matter of good or indifferent glazes, for American clay workers have as beautiful glazes of every variety as the foreign manufacturers have; the secret of the inferiority lies simply in this: Americans do everything on principles of their own, the aim in all American enterprises is the financial success, and the American thinks that the only way to reach it, is by speedy productiveness. The American mechanic forever studies to accomplish rapidity and do as much labor in an hour as the best European mechanic could do in three hours.

Working upon this principle is the result of America's superior productiveness, the American watch, the American reaper, the American sewing machine, the tanning leather and the boot and shoe are all a financial and commercial success. It is true that thousands upon thousands of dollars were recklessly sunk and lost in experimenting to develop a method of manufacture that is purely simple and mechanical (for the American mechanic has no patience to learn handy work that is slavish in moral and laborious in exercise). He goes to work with a business feeling to accomplish something, not to enter upon his duty with a feeling of repelling retardness, as if in bondage, so commonly seen in the old country workshops.

The American ornamental and glazed brickmaker is too young yet, or rather he has not experimented long enough to gain all the experience necessary to gain his point in view.

He wants to make this ware at the most minimum cost, he wants to do it in a simple, uncomplicated and careless manner, further his idea is to make and handle them by the tens and hundreds of thousands, while the European manufacturer cares for them by the single one.

The home manufacturer thinks that they ought to be handled in the same kiln and at the same firing or burning as his other plain or unglazed brick; his idea is that open kilns can be made to do the work. The latter has been his defeat, because to get a satisfactory and durable glazed brick that will hold the glaze in any climate, no matter how cold and wet, the brick must be fused and vitrified throughout its body —and this cannot be done in open fire kilns without having a ruinous loss.

The American glazed brick is not burnt hard enough, not sufficient shrinkage or life has been taken out of the clay—glaze being thoroughly melted or vitrified, being impervious to water in addition, undergoes much less expansion and contraction during climatical changes than a porous partially burned or vitrified product. Such being the case, it can at once be seen that that is the bottom of all the evil. Most English makers burn their brick twice; they fire them to an extra hard body before the enamel is cast upon them, the second firing is merely to vitrify and amalgamate the enamel or glaze to the terra cotta surface.

Let American producers do the same, adopt closed kilns or properly protect the material otherwise, and the people would not suffer the high tariff taxation— and the now so generally adopted white-washed courts and alleys would be oftener seen as a place of more attraction and cleanliness, the result of introduction of cheap American and equally serviceable and durable production.

There is no doubt but that the imported wares have seen their most and best days of golden prosperity.—*The Chicago Clay Journal.*

HINTS FOR MERCHANTS TRADING WITH CHINA.

At the recent Congress of Orientalists, Professor Schegel delivered an address conveying some useful hints on European commerce with Eastern countries, and gave some examples of the mistakes made by merchants in sending out goods to China and Java. One instance he gave was the following:

The Chinese are in the habit of boiling their rice in flat iron boilers. These are very thin, and they burn through very quickly. Some English firms thought it would be a very good thing to make these boilers in England and send them to China. Accordingly a shipload was sent to Hong Kong, and were cheaper and stronger than the native boilers; but after a few hundred had been sold, the Chinese would buy no more. They refused to give any reason to the merchants, but the professor asked some of them, and they said to him, "Their boilers are much too expensive." He said, "Oh, but they are cheaper." They said, "Oh, yes, but to boil them we have to use so much fuel. They are too thick, and before we can get our rice boiled we have to spend more in the way of fuel than it would cost to renew our boilers every few months." Another merchant sent out some magnetic horseshoes stamped with the Chinese dragon, but for this very reason the Chinese would have none of them. Merchants did not sufficiently study the prejudices of the people with whom they wished to trade. The Chinese were very particular about lucky and unlucky colors. They liked English sewing needles, but would not buy many of them because they were wrapped up in black paper, black being an unlucky color. Another man developed a very good trade in printed Chinese calendars, and that trade continued good until he commenced printing his calendars on green paper, when his trade closed. He wondered why until he discovered that green was an unlucky color.

TABLE OF SECONDS PER MILE AT VARIOUS SPEEDS IN MILES PER HOUR.

When travelling by rail it is often convenient to know, when one wishes to determine the speed of the train, just how many seconds are taken to go one mile at any speed in miles per hour. The accompanying table gives the number of seconds required to go one mile at any speed in miles per hour from 1 to 100. In using this table one may take the time required to travel from one mile post to the next, and then look in the table for the speed in miles per hour corresponding to the number of seconds.

TABLE OF SECONDS PER MILE AT GIVEN MILES PER HOUR.

Miles per hour.	Seconds per mile.	Miles per hour.	Seconds per mile.	Miles per hour.	Seconds per mile.
1	3,600	34	106	67	53·7
2	1,800	35	103	68	52·9
3	1,200	36	100	69	52·2
4	900	37	97	70	51·4
5	720	38	95	71	50·7
6	600	39	92	72	50
7	514	40	90	73	49·3
8	450	41	87·8	74	48·7
9	400	42	85·7	75	48
10	360	43	83·7	76	47·4
11	327	44	81·8	77	46·7
12	300	45	80	78	46·2
13	277	46	78·3	79	45·5
14	257	47	76·6	80	45
15	240	48	75	81	44·4
16	225	49	73·5	82	43·9
17	212	50	72	83	43·4
18	200	51	70·5	84	42·9
19	189	52	69.2	85	42·4
20	180	53	67·9	86	41·9
21	171	54	66·7	87	41·4
22	164	55	65·5	88	40·9
23	157	56	64·3	89	40·4
24	150	57	63·2	90	40
25	144	58	62·1	91	39·6
26	13	59	61	92	39·1
27	133	60	60	93	38·7
28	129	61	59	94	38·3
29	124	62	58·1	95	37·9
30	120	63	57·1	96	37·5
31	116	64	56·2	97	37·1
32	113	65	55·4	98	36·7
33	109	66	54·5	99	36·4
				100	36

Almost every one knows the following rule, which gives the result with sufficient accuracy for ordinary purposes: The number of rails passed in 20 seconds equals the number of miles per hour. If all rails were 30 feet long, we should add about 2¼ per cent to the speed in miles per hour as given by this rule, but as there are some short rails, the result will be very close without correction. Up to pretty high speeds, say to 60 miles an hour, one can ordinarily count the click of the joints.—*Railroad Gazette.*

FROZEN ADS.

A PITTSBURGH THEATRICAL MANAGER PUTS PICTURES ON ICE.

Henry Williams, the Pittsburgh theatrical manager, has originated a new means of advertising. He secured permission from the chief of police to deposit cakes of ice on the sidewalks for the occupants of the neighboring buildings to use if they chose. He then arranged with an ice manufacturing company to freeze lithographs of his coming attractions in big cakes of ice. The clearness of the ice gives the effect of the scenes being painted on its surface. It is claimed that the quality of the ice is not injured in the least by the pictures.

HUMAN CAPACITY.

Is the human race endowed with talents, tastes, and capacities so as to furnish to-day the requisite number to conduct the varied affairs of life and business, so that every department could be properly filled, and all be occupied?

In reply to this question, we may say that human nature is susceptible of varied culture, and that all the *faculties exist in all* men (except idiots), but the faculties are naturally developed by the incidents and circumstances which may act upon given tribes or classes of people; and if the question were asked, "Are all men now qualified to adapt themselves to the different economies of life?" we would say "NO." A great majority of mankind to day are adapted to the commonest drudgeries only, because the majority of the race have not been cultivated so much in the faculties of philosophy, and ethics, and æsthetics' and mechanics, as they ought to have been; hence some nations are behind in arts, science, and literature.

On the seacoasts we find men developed in reference to following the water, and seamanship chiefly is the result, and men have become almost amphibious. In other sections we find that the mechanical elements have been cultivated until the strength of the character finds its outlet in mechanism. We know of a town in Massachusetts where they nearly all tend toward the ministry and missionary work. Somebody has succeeded in that direction, and others have followed, until the strong current in that town is toward the ministry, as in other towns in the same State the current is toward navigation, especially the fisheries, and in others toward mechanism. In Kentucky there is a public sentiment that runs toward fine horses, and fine horses are the result. In other sections, not denying Kentucky her share, law, politics, statesmanship, public affairs, seem to be the aspiration of the people, as in California and Colorado, mining is the drift, and millionairism is the prayer, if not ultimately the song, of the people. The Spaniards have made most of their colonies on the false basis of hunting for precious metals, and their colonial civilization is faulty. The English have colonized for homes, farms, mechanism, and trade, and their footsteps have been firm, and the results permanent and powerful. France cultivates ornaments and æsthetics, and we have a nation of fancy, style, and decoration. The Scandinavians, by necessity, followed the sea, and they became navigators and the explorers of the world.

If we could find a country with the soil and climate adapted to the development of every useful trade, art, or occupation, doubtless the public would become classified so as to adapt a proper number of persons to each department of effort and achievement pertaining to all the phases of an excellent civilization. New England could not raise wheat and Illinois lacks the water power to be, like New England, a manufacturing region. The faculties become cultivated by practice, and practice is invited by necessity, and necessity is met or not met by opportunity, hence culture in diverse directions depends largely upon the wants of the people and the opportunities for such development. A hundred years from now this country may illustrate a harmonious division of talent and its adaptation to the different pursuits and attainments of life.—*Phrenological Journal.*

ALUMINUM AIR SHIPS OF THE FUTURE.

To the Editor of the Scientific American:

I think it was about 1843 that aluminum was discovered, and for some years the process of separating it from the clay near the earth's surface was very tedious and quite costly, it being sold at about $12 per pound, and for many years French chemists held a monopoly of its product.

At length Yankee genius took hold of the business, and in a few years reduced the price to about $1 per pound, and it being three times lighter than steel and nearly as strong, and no doubt it will still be cheapened, and it has been hinted by some to even five cents per pound, and we dare not dispute this. Be this as it may, we can but hope, and I really expect, that an air ship will yet be constructed principally of this wonderful metal, with buoyant and propelling wheels similar to those of an ocean steamer, driven by electric power, possibly carried in a storage battery, or produced by the air ship itself.

The balloon, so far, has proved a very dangerous means of flying in the air, as well as a very expensive means.

Possibly, some Yankee or French genius may discover a simple method of separating the 20 per cent. of oxygen from the atmosphere, which is a supporter of heat, which will assist greatly in solving this difficult problem. Some aerial wizard will spring up, like Edison of Menlo Park, and then accomplishment is certain. At our 1876 centennial an electric light was produced as a mere curiosity. I then did not imagine that I would live to see cities and dwellings illuminated as they now are; but so it is. In my boyhood there was no railroad, no electric telegraph. No steamer had crossed the ocean. Talking with each other by telephone was scarcely thought of. Professor Morse, who, in 1842 I think it was, sent the first message from Washington to Baltimore, lived to stand in Central Park, New York, in front of the bronze statue placed there, and send a message under the ocean and around the globe, and I had the pleasure of being present when this was done; and now, no doubt, a man will soon be able to stand in New York and talk with a man in London by telephone.

We truly live in the age of possibilities and probabilities. One scientific discovery aids another. And an aerial ship is more probable to-day than a steamship was two hundred years ago.

J. E. EMERSON.

THE GOOD OLD TIMES.

Chancellor Kent, in his very valuable legal text-book, remarks, with quiet humor, somewhat to the effect that in going back to find solid bottom for these halcyon days we shall arrive at unsatisfactory results, for they do not exist when we have got as far as the record showing that Cain killed Abel. So, also, in these latter days, when men are groaning about high taxes and increased cost of living, and are sighing for those happy times when there were no railroad monopolies, or oil or other trusts, they do not know what they are talking about.

The sober fact is that the spirit of invention has revolutionized the world and sped the times forward toward halcyon days in truth. If our readers will pause and think matters over candidly, taking mere home comforts and home conveniences within sight and reach as the eye glances round the farmer's house, the mechanic's home, the day laborer's cottage, the substantial dwelling of the rich, it will be found that invention has made toil easier and more profitable and has added, for all, comforts and conveniences almost countless.

Let us consider how an old farmer of four score years, in New York State, puts the whole matter sharply and truly, and realize that the good old times is a myth and the true good times are here to stay:

"I remember when we used to haul our grain, butter, pork, eggs, and everything else we had to sell, all the way to Newburgh, taking one day to go and another day to come home. We generally got 15 cents a bushel for oats and 10 cents a pound for butter. Anything like 75 cents a bushel for wheat was a fancy price. If we got 6 or 8 cents a dozen for eggs we thought we were doing well. Nice corn fed pork, dressed, we carted to market for $2 a hundred. The butter we put on the market in those days was the genuine Orange county article, yellow as gold and as hard as a walnut. I have sold tubful after tubful of the choicest butter for 10 cents a pound that would net me 75 cents if I had it to sell now.

"That was before the Erie Railway came through here and put us up to selling our milk instead of making it into butter. We didn't have any lime preserved eggs to sell in those days, either. As for taxes, I paid $100 on my farm of 100 acres when I was getting 10 cents for my butter. On the same farm now I pay less than $50, and I sell my entire dairy of milk for what would be more than three times 10 cents a pound for butter. I tell you there is a good deal of humbug in this referring to the good old days as being the golden age of farming. They were nothing of the sort."—*Ex.*

FLOATING GARDENS IN CHINA.

An interesting description is given by Dr. Macgowan, in the *China Review*, of the manner in which the floating gardens of that country are formed. The method is briefly summarized by an exchange as follows: In the month of April a bamboo raft, ten to twelve feet long, and about half as broad, is prepared. The poles are lashed together with interstices of an inch between each. Over this a layer of straw an inch thick is spread, and then a coating two inches thick of adhesive mud taken from the bottom of a canal or pond, which receives the seed. The raft is moored to the bank in still water, and requires no further attention. The straw soon gives way, and the soil also, the roots drawing support from the water alone. In about twenty days the raft becomes covered with the creeper (*Ipomœa reptans*), and its stems and roots are gathered for cooking. In autumn, its small, white petals and yellow stamens, nestling among the round leaves, present a very pretty appearance. In some places marshy land is profitably cultivated in this manner. Besides these floating vegetable gardens there are also floating rice fields. Upon rafts, constructed as above, weeds and adherent mud are placed as a flooring, and when the rice shoots were ready for transplanting they were placed in the floating soil, which being adhesive and held in place by weed roots, the plants were maintained in position throughout the season. The rice thus planted ripened in from 60 to 70, in place of 100 days. The rafts are cabled to the shore, floating on lakes, pools, or sluggish streams. These floating fields serve to avert famines, whether by drouth or flood. When other fields were submerged and their crops rotten, these floated and flourished; and when a drouth prevailed they subsided with the falling water, and while the soil around was arid, advanced to maturity.

ORIGIN OF POTTERY WARE.

Every man, no doubt, used his gourd as a gourd alone. But as time went on he began at last, apparently, to employ it as a model for pottery also. In all probability his earliest lessons in the fictile art were purely accidental. It is a common trick with savages to put water to warm on the camp fire in a calabash or gourd, with wet clay smeared over the bottom to keep it from burning. Wherever the clay thus employed was fine enough to form a mold and bake hard in shape, it would cling to the gourd, and be used time and again in the same way without renewal, till at last it came to be regarded almost as a component part of the compound vessel. Traces of this stage in the evolution of pottery still exist in various outlying corners of the world. Savages have been noted who smear their dishes with clay; and bowls may be found in various museums which still contain more or less intact the relics of the natural object on which they were modeled. In one case the thing embedded in the clay bowl is a human skull—presumably an enemy's.

In most cases, however, the inner gourd or calabash, in proportion as it was well coated up to the very top with a good protective layer of clay, would tend to get burned out by the heat of the fire in the course of time, until at last the idea would arise that the natural form was nothing more than a mere mold or model, and that the earthenware dish which grew up around it was the substantial vessel. As soon as this stage of pot making was arrived at the process of firing would become deliberate instead of accidental, and the vessel would only be considered complete as soon as it had been subjected to a great heat which would effectually burn out the gourd or calabash embedded in the centre.—*Manufacturer and Builder.*

WHAT STEAM USERS SHOULD KNOW.

A fair "horse power" in a steam boiler is an evaporation of twenty pounds of water per hour from a temperature of 212 degrees.

Ten pounds of water evaporated from a temperature of 212 degrees for each pound of coal is high economy. Six pounds would be fair work and above the average.

Under the best conditions a horse power can be had from an evaporation of less than twenty pounds of water.

A measure of some kind that will show the weight of feed water passing into a steam boiler with accuracy should be used with all boilers when economy is an object.

Every owner of steam power should weigh the water evaporated in his boiler, and also the coal used to produce such an evaporation.

It should be the duty of a fireman to know the weight of fuel used, as well as the weight of the water.

No man has any right to find fault with the economy of his boiler until he knows the amount of water evaporated per hour and the amount of coal required to produce the same.

In getting the evaporated power of a steam boiler, it is necessary that the steam should be dry to get a fair result.

A boiler that carries out water with its steam may show a large apparent evaporation, but the steam being wet is of less value in the engine. A boiler should give dry steam in all cases. Superheating is beneficial.

Boilers that are overworked necessarily waste fuel.

The only way to know where the fault lies is to know by absolute weight the amount of evaporation in the boiler.

A boiler may generate steam with great economy, and, owing to the steam being wasted by improper application to the work through the engine, the result in work be very unsatisfactory and the boiler blamed unjustly.

A boiler taxed to its full evaporative power evaporates about five pounds of water to one pound of coal; double the size of the boiler and you will get the same amount of steam with probably thirty to fifty percent less fuel.

When steam is used expansively, under the best conditions, it will give double the power for the same amount of steam that can be got from it worked at full stroke without expansion.

When steam is used in non-condensing engines at low pressure the loss is great, owing to the pressure of the atmosphere (fifteen pounds) being a greater percentage of a low than high pressure.—*The Tradesman.*

ELECTRICAL

The late International Electric Congress held at Frankfort, in Germany, has been styled the "High-tension Congress" from the thoroughness with which enormous voltages have been discussed as available potentials. A pressure of 30,000 volts was used in transmitting power from Lauffen to Frankfort, a distance of over 140 miles. If America leads the world in the development of electric street railways, Europe certainly does in practical schemes for transmission of power.

If reports are true it would seem that the Germans are contemplating the transmission of a 1500 horse-power alternating three-phase current, at a pressure of 50,000 volts, from Niagara to the Chicago Exposition, a distance of about 475 miles. This enormous pressure will be sent along an uninsulated copper wire of about No. 6 A. W. G. It will indeed be a significant occasion when the practical endeavor is made to utilize some of the vast energy of Niagara falls.

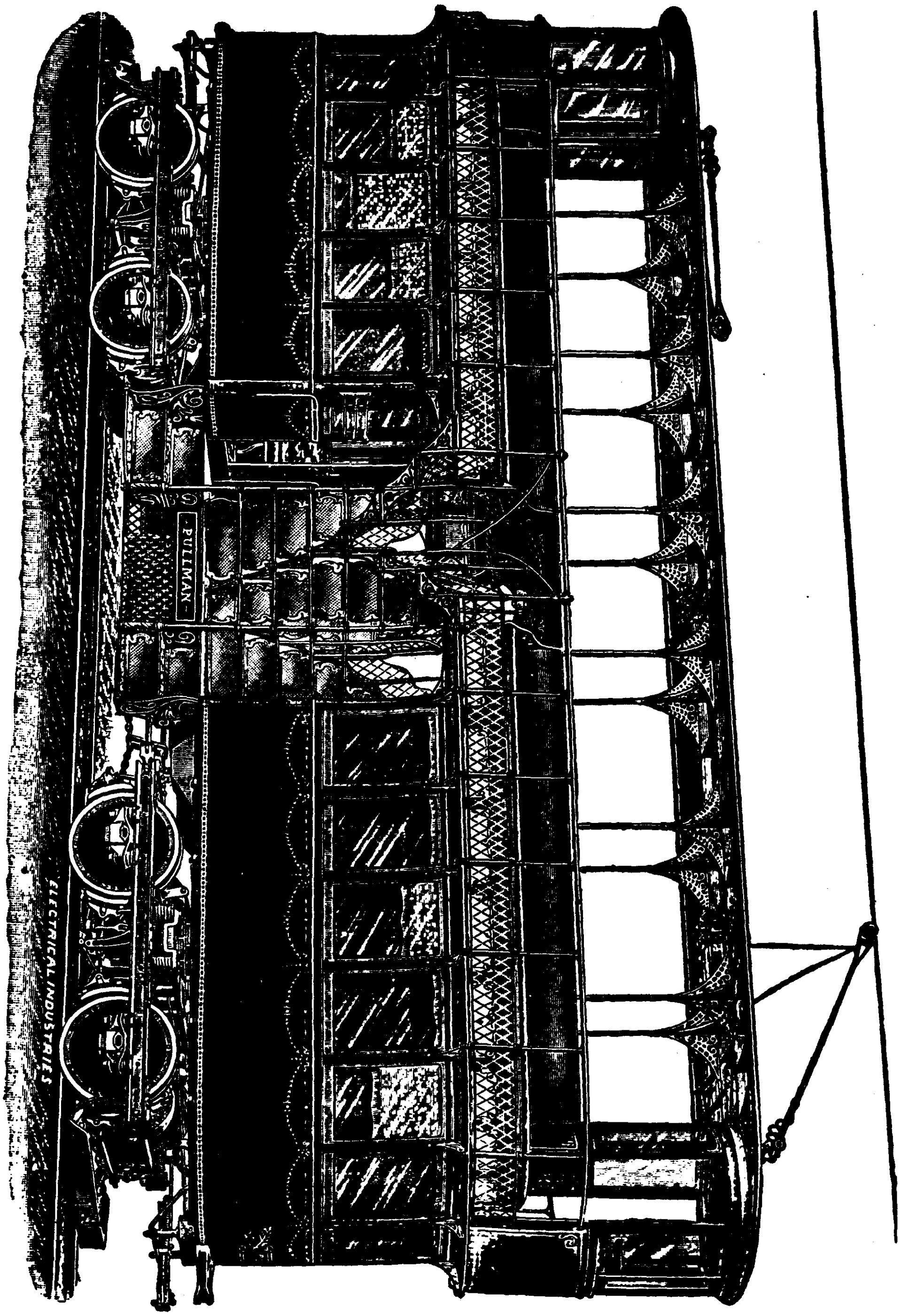
The importance which our neighbours across the line attach to the electric motor as a means of transportation can be seen in the way in which the horse-railways are gradually being displaced by the electric. The very evident tone of the recent Convention of the American Street Railway Association was that the horse cars are rapidly becoming a thing of the past, while the electric cars are absorbing more and more the attention of prominent city passenger railway managers. President Col. Henry M. Watson pointed out in his opening address that in 1890 the total number of horses in use for street railways in the United States and Canada fell from 116,795 to 88,114; that is, 28,681 in one year. This is a very remarkable decrease and one that points very strongly to the fact that in a few years' time there will be few if any horses used in the service. As stables are turned into power-houses, so are the health and morality of our cities increased. As stablemen and drivers are turned into engineers and motor-men, so are the chances for higher intelligence increased. Perfection we may not at first reach, but with the increase of roads and the greater number of men employed, there will ensue the greater chance of improvement for which we all strive and hope.

The development of the electric road in Montreal is only a question of time, and were it not for the great quantity of snow which lies in our streets in winter, in all probability one would have been running ere now. Plans have been formed and only await the decision of the City Council before being put into operation. Should the decision come in time to ensure the equipment of the cars, work will be commenced on the road in the Spring, as soon as the snow leaves the ground; and in that event cars will be running in the autumn. One of the proposed routes will be along Craig St. to Bleury, up Bleury St. and Park Avenue, connecting with the Mount Royal Incline Railway, through Montreal-Annex, to the new freight-yard of the Canadian Pacific Railway, where it will terminate, and where the power-house will be situated. As there will be employed permanently in the new yard of the C. P. R. some 800 men, who will have to communicate with the city, and as all freight trains passing in or out of the city will be billed there, making an additional 700 men, such as trainmen, conductors and others, who will be frequently passing through, the electric road will form a convenient means for their transportation to or from the city. Montreal-Annex is also building up, and the residents will soon feel the need of the electric cars.

Another line will branch out along Mount Royal Ave. to Papineau road, down Papineau road to the Dalhousie Square station of the C. P. R., from thence through the city to Bleury St. It is with great interest that we look forward to the development of this road, chiefly because of the need in Montreal for some efficient system of rapid transit, and also from the fact that should this line be successfully operated other lines are likely to branch out, until Montreal shall be well supplied with, what it much needs, electric traction.

A NEW TYPE ELECTRIC CAR.

The West-End Electric Railway Co. of Boston has lately ordered two colossal cars from the Pullman Palace Car Co., for use on their roads. It is a decided change from the older types, and one that combines the facilities of both open and closed forms. As seen from the illustration it is double-decked, with the entrance and exit of the car on the sides. The motorman has a separate cab supplied for him at each end on the upper deck, cutting him off from all communication with the passengers, which would otherwise tend to abstract his attention from his work. On the upper deck also are seats open to the air on all sides. Descending from this light and airy level we come to the lower deck, where



PULLMAN CENTRE-VESTIBULE DOUBLE-DECK ELECTRIC CAR.

everything is of the most beautiful workmanship. The wood-work is of mahogany with decorated quartered oak ceiling. The glass in the windows is crystal sheet, while that in the doors is embossed French plate. The beautiful tapestry-covered spring backs and seats are a great addition. The wheels are Allan 30 inch, with steel tires, and the motive power consists of two 25 h.p. single reduction Westinghouse motors mounted on Pullman double trucks. The car has two short trollies, one at each end which can be controlled from the cabs, as seen in the cut. It is also lighted by 25 sixteen c.p. incandescent lamps, 10 on the upper deck and 15 on the lower. The car is heated by eight Burton electro-heaters. The extreme length is 33 feet 7 inches, and the seating capacity is of 80 persons. The whole exterior of the car is finished after the Pullman style. This form of car will be a great addition to the already well-equipped stock of the West-End Electric Railway Co. of Boston.

ELECTRIC RAILROAD CONSTRUCTION AND OPERATION AND A CONSIDERATION OF THEIR CONNECTION WITH CENTRAL STATION INTERESTS.*

BY C. J. FIELD, OF THE FIELD ENGINEERING CO., NEW YORK.

INTRODUCTION.

The advantages of the electric railway have passed beyond the age of experiment or question. They are proved by their development in the past four years, and any argument as to their advantage in the general development of street railway practice or suburban rapid transit is antedated. It took several years to convince old staid financiers and directors of the larger street railway properties that it was to their financial advantage to throw in the scrap heap several million dollars, more or less, in equipment and spend that amount in addition and still make it pay; but they have seen this advantage in the development and increase of traffic and returns to their company. These returns have been brought about principally by the development of rapid transit, in the introduction of electricity and the flexibility of the system in adapting itself to all and any conditions of commercial practice.

In looking over the past four years of practice in electric railway work, we have much to commend and considerable to condemn. The boldness of the achievements, the problems that have been solved, the rapidity of development and the perfection of the apparatus, seem almost beyond comprehension. That this apparatus, in less than four years, should reach the high state of perfection, economy and efficiency that it has, as compared to the long years of development of other mechanical appliances, is remarkable. The natural consequence of this large amount of work and development in this short time is that there has been much work done that had better been left undone. In the way of poor engineering, cheap work, and not a proper appreciation of the problem to be solved. These, in some poor instances, have retarded the development and progress of electric railway work in their vicinity, but street railway companies have now come to a proper appreciation of the necessity of good work well done and that the wisest and best method is to consider carefully what will bring the best return for the money invested—not necessarily on the blind basis of the highest cost being the cheapest, for money can be wasted in this way as well as others. We have examples now in several directions of large equipments being installed on a sound engineering basis and with careful consideration of the best interests of the electrical interests, street railway owners and public combined, and we can safely add that there is no problem in this line which cannot to-day be taken up with a full assurance of practical solution and successful development in electric railway traction.

The future outlook of electricity in the development of rapid transit, inter-suburban, and even express service is assured. We are coming now to the solving of the larger problems in this work and bringing the public to a proper appreciation of the resources and possible achievements in this line and its superiority over the old fogy systems of the past. We even see a considerable number of our friends from the cable engineering lines of street railroad work coming over into the electrical fold, fully appreciating that the cable system has a very limited field for successful development and that electric traction is very broad guage in the field of engineering work. Therefore, with this outlook, better construction work, better engineering, better mechanics, the solving of these larger problems are assured, and we see even to-day, in a number of cases, electric suburban traffic supplanting steam on a cheaper, better and more successful basis. The favorable report of the New York Rapid Transit Commissioners has done much to add to public confidence in this direction. Electric manufacturing companies are assisting the development of the work, by making their apparatus more substantial, better in construction and more satisfactory in its mechanical design and operation. The reduction in the speed of the motors, the development of single reduction and even of direct connected motors, is doing much to add to the confidence in this line.

We hear asked sometimes, by laymen, the question: "What speed can electricity obtain in railway work?" The able consideration of this subject in several papers, and practical experiments as well, enables us to reply very briefly but confidently to this inquiry, that speed and power in electric railway traction are only limited by road-bed construction; in other words, any speed is obtainable within the range of possibility, with the maintenance of proper track. We do not intend, however, to generally review electric railway work, but more particularly to give some details of the practical problems in their construction and operation, and, therefore, we will leave the consideration of other parts of this subject to papers which will, no doubt, treat it more fully.

STEAM PLANT.

The consideration of the best development in the power generation of electric railway work has been one that has received considerable attention in past years from the best engineers in this line. We reach here a part of the problem which requires much more careful consideration than has been given steam power in electric lighting generally in the past. The work to be successfully done by the steam engine in the generation of electricity for the operation of railroads is the severest kind, and can be compared only to that of the engine operating rolling mill trains. It is owing to not fully appreciating this fact that we hear in some parts of the country of failures of steam plant on this kind of work. Electrical manufacturers are assisting the solution of this problem by the building of larger generators in units of 200 to 400 or 500

*Paper read before the National Electric Association, Montreal.

horse-power. What we want in the generating station for electricity is the smallest division of units consistent with the safe and economical operation of the station. Following the problem out on this line, we can build a successful station; and we would add to this that each unit should be entirely independent and separate from all other units, thereby increasing the reliability. This cannot be obtained in a safe and economical way by the use of our old friend, the countershaft. Undoubtedly, the countershaft has been of much use in electric lighting service, and particularly in arc lighting, but in railway work, with large generators, we can see no excuse at the present time for its use. Generators should be belted direct to the engines, whether Corliss or high speed, or else coupled direct to the engine shaft. With a Corliss engine of 500 horse-power, operating at 80 or 90 turns, with a fly-wheel 18 to 20 feet in diameter, we can belt with belt centers of, say, 40 feet, 2 inches, generators of several different commercial types; this gives us advantages which we have heretofore had only in high speed engines with direct connection. The engines should, in any event, as heretofore stated, be extra heavily built for the work to be done, with ample fly-wheel capacity. On engines of this size and speed a fly-wheel capacity of approximately 60,000 lbs. is about right. On engines operating about 150 turns, say, 30,000 to 40,000 lbs.

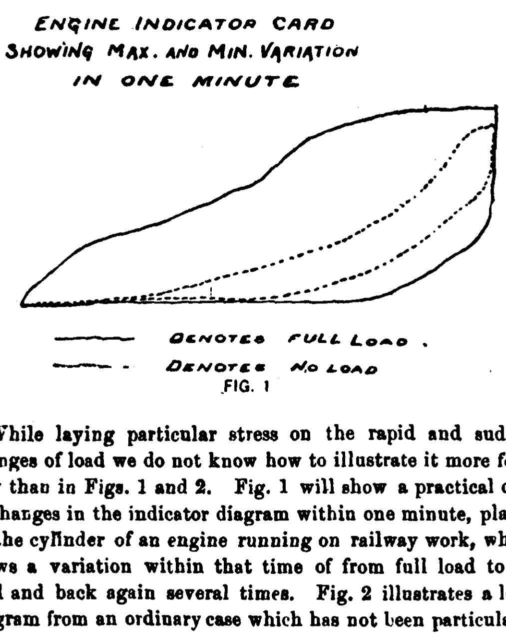


FIG. 1

While laying particular stress on the rapid and sudden changes of load we do not know how to illustrate it more forcibly than in Figs. 1 and 2. Fig. 1 will show a practical case of changes in the indicator diagram within one minute, placed on the cylinder of an engine running on railway work, which shows a variation within that time of from full load to no load and back again several times. Fig. 2 illustrates a load diagram from an ordinary case which has not been particularly selected for its maximum and severe conditions. These impress on the mind more forcibly than words can the requirements of this work. High speed engines in the development of railway work have received in some cases a set-back, owing to the engine manufacturers not appreciating fully the conditions and necessity of the work undertaken. So-called high speed or automatic engines can be as successfully operated on this class of work as on any other, if they are specially built for it. This means larger parts, bearings of more ample size and length and ample fly-wheel capacity. On a cross-compound engine of, say, 300 horse power, there should be about six to eight tons in the fly-wheels, the bearings seven or eight inches in diameter and 15 or 18 inches in length. (Such a type of engine is being furnished by the manufactures of the Ball Engine.) In the case of engines built in this manner, there can be no fault found with their operation. A type of engine, which we believe is going to be largely used on this class of work, as well as lighting work, is one that will come in between the high speed engine and the Corliss and will combine many of the advantages of both. Such an engine has been sought for by many engineers and has been attempted by a number of builders. To-day, however, we can not find it on the commercial market. This engine, in units of 500 horse-power, would run at a rotative speed of about 140 or 150 revolutions and with a piston speed of about 650 to 700.

The question which has troubled most engine men in regard to the high speed engine, with a single valve covering this kind of practice, has been a question of valves and clearances. Beyond any question, when it comes to this size, we have got to come to the Corliss practice of double valve, thereby reducing the clearances and bringing it down to the extent of the Corliss practice. The writer's company is having built, for the electric railroad at Buffalo, two engines of this class, by the Lake Erie Engineering Works, which we believe will do much to develop this line of work, and, also, will be particularly adapted for coupling direct to the engine shaft. The trouble in this line has been to get electric manufacturing companies to take up the building of large multipolar generators adapted for direct coupling at a speed of from 100 to 200 revolutions. This problem was developed on a much smaller scale in this country, for marine plants, several years ago. We find that in Europe, where their work has been more special, that they have successfully developed this type of engine and generator, and beyond any question, it is going to be both for lighting work and for railway work the type of unit for central station practice in the future. It means, where the vertical engine is used, the installation of the steam and electric plant in the space formerly used for engines alone. This means reduction in the cost of building, operation and maintenance.

In concluding this part of our subject on steam generation, we trust that our experience in the past in lighting will show us the fallacy of poor steam engineering, and that we will build our stations for the future, and not have the problems before us that nine-tenths of the electric lighting stations have to-day, which mean, that in order to get down to commercial economy, and competition, they have got to rebuild their whole outfit. We will merely append to the consideration of the steam plant part of our problem a few interesting figures and data which the writer collected for presenting to street railway companies, in order to give them some useful information in this respect. We believe that they may be well introduced here. The figures given on the tables, etc., are not ones that the manufacturer of an engine would tell you were those of the best economy for his engine or plant, but they are figures which will be appreciated by station owners and railway companies as those which are obtained in every-day commercial tests.

The relative commercial economy of engines and cost are as follows:

TYPE.	Lbs. of Coal per H.P. Hour.	Cost per H.P. Sizes Over 100 H.P.	
High speed single	4 to 5	$11 to $13	This is based on an evaporation of 9 lbs. of water per lb. of coal.
" " compound	3 to 3½	14 to 16	
" " " cond.	2¼ to 2½		
" " " triple	1¾ to 2	18 to 22	
Corliss single	3½ to 4	16 to 18	
" compound condensing	1¾ to 2	22 to 25	
" triple	1½ to 1¾	27 to 30	

There are four classes of boilers:

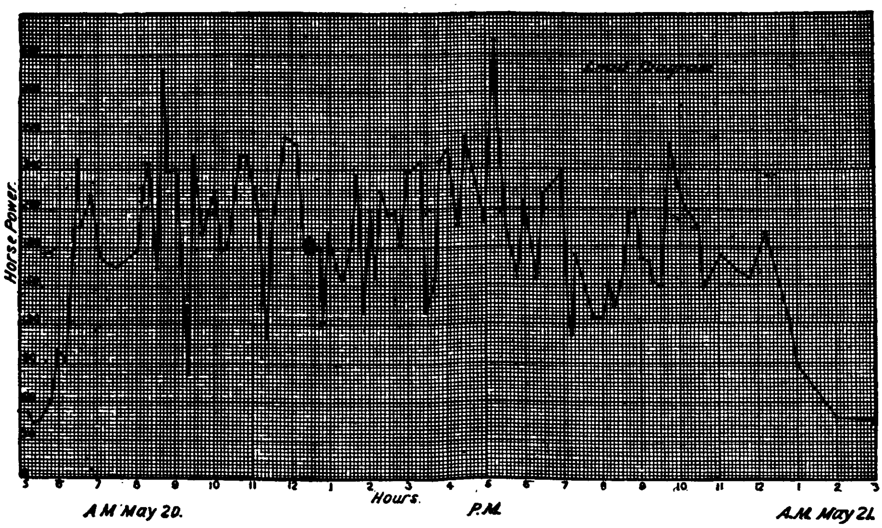


FIG. 2.

1. Horizontal return tubular, which is the most general in use, and costs $9 to $10 per horse-power.

2. Vertical tubular (Corliss or Manning) which is a vertical tubular boiler with water leg, giving an internal fire-box, economical in floor space, largely used throughout New England. Cost $10 to $12 per horse-power.

3. Sectional or water tube boiler, of which Babcock & Wilcox is the best known, especially adapted for higher pressures and safety. Cost $17 to $19 per horse-power.

4. Scotch type of Marine boiler—one that has not been used to any extent as yet in station work—but we believe it will be as an offset to the sectional type; and fulfilling the requirements for higher pressure and economy of space.

Capacity of engine requisite for different generators:

Generator.	ENGINE.						
		High Speed.			Corliss.		
Watts.	Horse-Power.	Size.	Speed.	Wt. 2 Fly-Wheels	Size.	Speed.	Wt. 2 Fly-Wheels.
				lbs.			
50,000	75	12 x 12	280	7,000			
80,000	125	15 x 16	225	9,000			
150,000	225	18½ x 18	200	15,000	20 x 36	90	25,000 lbs.
2,150,000	450				24 x 48	80	50,000 "

Steam pressure, 100 lbs.

The cost of steam plant complete is about $50 to $60 per horse-power for high speed, and $65 to $75 per horse-power for Corliss.

ELECTRIC PLANT.

The question of the best electrical generating plant for railway work is one which is allied closely to that of the steam plant, particularly in relation of the generators to that of the engines. In some respects, in treating of the steam plant, we have intimated what our idea was in connection with the generators. All large generators of from 200 to 500 horse-power connected as directly as possible, either by direct belting or shaft coupling, with the engines operating the same. It is only by this development that the safest and best solution of electric railway station practice—in fact, station practice in general—can be reached. Manufacturers of railway generators have had an experience extending back many years, that experience in the development of direct current incandescent machinery, although not of quite the same voltage, has led the way up to the safe, economical and commercial development of railway generators; and we find the railway generator of to-day one of the most perfect and reliable factors in the electric railway system. The only problem remaining to be solved in this connection is to build them in larger types and have slower speed for direct shaft coupling. Generators on this work are subjected to the severest and most excessive strain, particularly of small type, but the building of them in larger units is going to remove, to a great extent, the question of the overloading of the machine. Railway machines are often subjected to an overload of from 25 to 50 per cent. In general these are only momentary, and we find most of them able to stand up to the work to be done.

The question which puzzles many of the railway companies, as well as the electric companies, is what amount of generating capacity is necessary for a given number of cars. This question, of course, has got to be carefully considered in connection with each case, but there can in a general way be laid down an approximate basis for this work. Some railway companies, in order to show a higher economy than their competitors, are unwisely claiming the requirement of a smaller amount of power than others; but the wisest manufacturer is the one who urges his client to install a larger amount of power than is barely required for the successful operation of the road under any and all conditions. For if any one thing will lead the public to condemn the electric railway traction it is a lack of power, thereby causing the cars to move slowly, and in case of any accident, disabling part of the power. A fair basis on general conditions for 16 to 18-foot car bodies is 20 to 25 horse-power per car, which, with a properly designed and constructed plant, will give the desired power. The cost of generating this power for railway work for 16 and 18-foot cars is three to five cents per car mile for all expenses of the generating station. In some roads we find that cars of a larger size than these do not necessarily take a proportionately larger amount of power. We find from practical experience that a car 32 or 33 feet long, double the size of the 16-foot car, takes, under general conditions, about 50 per cent. more power, and we find by the same experience that a trail car adds about

50 per cent. to the amount of work to be done on the motor car for the same size. As to the minimum and maximum amount of power taken on an electric car, we find that a general average for a 16-foot car, under ordinary commercial conditions, without excessive grades, is one horse-power per car mile per hour; or, a car operating at an average 10 miles per hour means an average of 10 horse-power per car. This same car will give, however, on a load diagram, taking all its conditions, from maximum to minimum, a variation of from nothing to 50, 60 or even 80 horse-power. This gives us an idea of the severe strains and conditions to which an electric motor is subjected.

ELECTRIC CARS AND THEIR EQUIPMENT.

One of the questions on which we find more variety of opinion than any other is what is the best size, type and style of car for given case and conditions. The old standard 16-foot car body we find is now being widely departed from, and the problem is, How large a car can we get on a single truck with four wheels without excessive destructive effect on the road-bed? and, What is the longest car we can operate on street car service economically on an eight wheel base? We believe the limit is reached with a single truck in a 20-foot car body; we know that the truck manufacturers claim in some cases to operate a longer body, but we do not believe it wise. An 18 or 20-foot car running under close headway we believe to fulfil best the conditions of city traffic in the larger cities. Such a car, with a wheel base of seven feet, and in some cases seven feet six inches, where curves are not too sharp, will give satisfaction, and not be too severe on the road-bed where the same is properly constructed. As to the difference in effect on the road-bed between the electric car and the horse car, it is briefly that the horse car is pulled by horses, from which it receives a balancing power and a steady pull, whereas an electric car is operating itself by a power moving the wheels against the track, having no steadying or balancing power from the pull of the horses, and transmitting all its power and moving itself through the wheels. We find, therefore, that it subjects the track to a very severe pounding, necessitating a much better construction of road-bed practically equaling that of a steam railroad.

Some companies have favored the use of a vestibule on street cars. We believe, though, that any vestibule is a failure and a misnomer. It accomplishes no good and causes much trouble; a shield over the dashboard for the motor man in winter weather would give all that would be required. What is wanted on a street car is that which will allow the freest ingress and egress from the car for the passengers, and anything that retards this—and a vestibule most certainly does—is a detriment and an obstacle to rapid transit. On some roads we have tried the introduction of even larger cars, say, 28-foot body, or 36 feet over all. Such a car, of course, has to be put on a double truck. These cars have found favor with some companies when first considering the problem; the difficulty with them is in getting the passengers in and out of the cars as quickly as possible, and making too many stops, due to the larger number of passengers carried. For inter-suburban heavy traffic, with few stops, we believe such a car would fulfil the requirements, but only in such a case.

Thus, having gone over the question of the cars, we come to the consideration of the electric equipment for the same. To-day we find the double reduction motor discarded, as far as any new equipments are concerned. All the large electric manufacturing companies are placing single reduction motors on the market, and they are in successful commercial operation. One company is placing on the field a motor directly connected to the shaft and without any gearing—in other words, there is no reduction in speed, the speed of the armature being the same as that of the wheels—the same is accomplished by a very ingenious arrangement. We have heard asked in the past the question, Why was it necessary to place 30 horse-power to operate an electric car to do the work that two horses had done formerly? The answer is: The two horses did not do the work in a proper manner and give rapid transit. The life of a street car horse is very short, and we find under general conditions that 30 horse-power with two 15 horse-power motors has been found about right; in fact, we even find the companies tending towards a larger installation of power, particularly when using larger than a 16-foot car body, and we find to-day, being installed for rapid transit in inter-suburban work, 40 and 50 horse-power electric equipments per car, many of them operating at a speed of 30, and even 40, miles per hour. As the amount of power is directly proportionate to the speed, we can readily see the requirement for such an amount of power. The cost of a single car equipped, including the car body, truck and motors, is from $3,000 to $3,500, and the cost of the electric part of the power generating plant is from $35 to $45 per horse-power.

LINE CONSTRUCTION.

We find in the past about as great a development in overhead and line construction for electric work as in any other part of the subject. While formerly this was one of the greatest sources of unreliability in the operation of the plant, to-day it has reached a very practical development. Formerly the trolley wires were too light, the feed wires were insufficient to furnish power, and the line was giving trouble, grounding and breaking continually. In the insulation of a single trolley system, with one side of the system grounded, we have the most severe requirements that it is possible to obtain in any electric insulation, in that any grounding on the other side of the system means trouble in the operation of the road. This has led to the introduction of double and even triple insulation into our line material to properly protect the trolley wire from grounding. Where streets are wide enough to spread the tracks to six feet and six feet six inches within the near rails we see introduced in many places centre iron poles, which make a considerably stronger style of construction than cross-suspension. There are not many streets, however, where street cars are in operation that are wide enough, or where the city will allow the spreading of the tracks to this distance, and in closer proximity it is not safe to operate with centre poles. On the work installed by the Field Engineering Co., in Buffalo, we find the most extensive system of overhead and underground construction in operation anywhere. Here all the feed wires, with a few exceptions, are placed in underground conduits, thus removing all cause for objection to the unsightliness of a large number of feed wires overhead. These underground feed wires are connected to the overhead wires from junction boxes up the poles.

The cost of overhead construction may be about summarized as follows:

Line construction per mile, complete, including track bonding, plain pole work, cross suspension, or bracket with feed wire...	$2,000 to $2,500
With sawed and painted poles.............	2,500 to 3,000
Iron poles, cross suspension, concrete setting, double track, feed and guard wires......	6,500 to 7,500
Same with centre poles....................	4,500 to 5,500

We also append a table which will give a general summary of the cost of electric equipment of street railway systems, omitting the track construction, which, of course, varies with the number of miles to be equipped.

COST OF ELECTRIC EQUIPMENTS FOR STREET RAILROADS.

No. of Cars.	Steam Plant. H.P.	Capacity of Generators. K. W.	Steam Plant. *	Station Electrical Equipment.	Car Equipments, Car Trucks and Motors.	Line Construction ½ mile of Double Track per car.	Total Equipment (omitting track).
6	120	80	$ 7,000	$ 6,400	$19,500	$ 7,500	$40,400
10	225	150	11,000	10,500	32,500	12,500	66,500
15	375	240	17,500	15,000	48,750	30,000	111,250
20	450	300	22,000	17,5 0	65,000	40,000	144,500
30	675	450	28,000	22,000	97,500	90,000	237,500
50	1,125	750	50,000	33,000	162,500	187,500	433,000
100	2,025	1,350	90,000	60,000	325,000	375,000	850,000

The above figures are approximate only and based on the best City R.R. practice.

* Add 25 per cent. to these figures for Corliss.

TRACK.

The track of street railway companies before the introduction of electricity was more behind the times than any other part of their equipment. The old flat rail is antiquated and antedated, and in a few years its use will be obsolete. The necessities of electric railway traction—in fact, of any traction—have impressed upon the street railway companies in their equipments the requirements of a good road-bed for the successful operation of a road, and we find this part of the problem receiving as much attention as any with companies who appreciate fully the work before them. The general construction to-day is girder rails of from 60 to 80 lbs. per yard, placed on chairs where block paving is in use, with ties 2½ to 3 feet between centers. We find in some cases even 90 and 100 lb. rails used, but we believe in more moderate weight for the rails and the ties placed closer on centres. We believe this has been the general experience in railway work. Such a style of construction costs from $9,000 to $10,000 per mile. In suburban roads, on streets where there is no paving, we find the T-rail being used; the road-bed can be properly constructed on this basis with 45 to 50 lb. rail, for $6,000 to $6,500 per mile, the rail being spiked directly to the ties.

In order to make a summary of the data and figures, I will summarize them in a practical example.

AN ILLUSTRATIVE EXAMPLE.

I propose to take, as the best means of illustrating practically, the purchase, equipment and operation of a street railway system with electricity, a city with a population of say 100,000—with a dilapidated street railway system, earning a gross income of $125,000, to purchase same for $500,000—property, rights, franchises, etc., and equip it with 40 miles of single track and 65 electric cars.

COST OF EQUIPMENT.

Steam Plant (1,500 horse-power steam plant):
Five engines, 250 horse-power each, compound condensing, size 16 inches x 32 inches x 42 inches, with wheels weighing 30,000 lbs.......... $32,500
Eight R. T. boilers, 72 inches x 16 feet.. 9,600
Jet condensers.......... 3,000
Two boiler feed pumps.......... 900
Steam and exhaust piping.......... 12,000
Five engine foundations.......... 3,500
Eight boiler settings.......... 3,200
Five 30-inch belts.......... 2,000
Erecting and starting.......... 3,500
Freight and miscellaneous.......... 2,500
$72,700

Electrical plant:
Five generators, 200 kilowatts, 7,500... $37,500
Switchboard installation, foundations, etc. 4,000
41,500

Building:
Power station, including stack, traveling crane, etc.......... $25,000
Car house and repair shop, including tools, etc.......... 15,000
40,000

Track construction:
40 miles girder rail construction, ties 2½ feet centers, 63 lb. rail, etc., $1.15 per foot..........$244,880
Relaying, including paving, etc., at 60 cents per foot.......... 126,720
Trucking, hauling, etc.......... 24,000
Ties, including 10 per cent. of joint ties, 130,000 at 40 cents.......... 52,000
Ties, including 10 per cent. of joint ties, 15,000 at 70 cents.......... 10,500
456,100

Line construction:
Ten miles iron poles, etc.......... $75,000
Ten miles wooden poles, etc.......... 40,000
115,000

Car equipment:
65 electrical equipments at $2,000......$130,000
65 car bodies, 18 foot body, with open ends.......... 65,000
65 trucks at $250.......... 16,250
211,250

Summary:
Steam plant.......... $72,700
Electrical plant.......... 41,500
Building.......... 40,000
Track.......... 456,100
Line construction.......... 115,000
Car equipment.......... 211,250
$936,550

Superintendent's and Engineer's work.......... $50,000
General and miscellaneous.......... 50,000
100,000

$1,036,550

Original purchase.......... 500,000

Total cost re-equipped..........$1,536,550

Gross income, say, $350,000.

Net income, say 35 per cent., equal to 8 per cent. on cost, on the basis of an investment of about one million and a half of dollars, and from a property which in many instances was hardly earning its fixed charges formerly.

We have here illustrated a practical example of what is being done every day in this country at the present time in the purchase and equipment of street railway systems. In fact, we find a large number of bankers and capitalists giving it their earnest attention as one of the best fields for investment at the present time.

CENTRAL STATION IN CONNECTION WITH ELECTRIC RAILWAY WORK.

We desire to call the attention of central station owners to the profit to be made from the furnishing of power in street railway operation, and also by the combining in smaller towns of the street railway companies and electric light companies. The trouble in most cases in central stations obtaining contracts for power, outside of small roads, has been to convince the railway companies that the electric light station can economically and reliably furnish this power, and we must say that in many cases their fears are well founded. Therefore it behooves the central station companies to place their generating plants and station, not only for their own business, but for this added business, in such a shape as to remove this objection. There is no reason why electric light stations should not do a large and profitable business in this line as well as in stationary motor work, for the same factor is introduced here and the same reasons why they can safely and profitably furnish this power; if they have a station properly built, and large enough to add this power, that factor is established. If they have a proper station operating force, in many cases this force need not be added to at all. As to what basis this work can be profitably done on, we hesitate to state figures, except in specific cases, but will try to give a general idea of some of them. For many small roads power contracts have been taken at so much per day, assuming a basis of 100 to 125 miles operated. Such contracts have been at from $3 to $5 per car. The regular basis, in accordance with which most street railway companies make their contracts and desire to base their cost of operation, is the unit of car mile operated; therefore, most contracts are on this basis. This comes down, therefore, to a basis of from three to five cents per car mile; the latter figure we consider excessive, and one which would be only made by any company for temporary necessities. We know of cases where the matter has been carefully considered and the plant properly installed for it, where contracts have been made for between 2½ and 2¾ cents per car mile for 16-foot cars, on roads with grades not exceeding 1½ to 2 per cent. In this case, and, in fact, in most cases where the closer figures prevail, the railway company furnishes the generators and the station owner furnishes the steam power and all expenses of both steam and electric power due to ordinary wear and tear. A profitable source of investment has been found in the more moderate sized towns of say, up to 30,000 or 40,000 inhabitants, in the installation of combined electric railway and lighting stations; the companies either equipping new ones or purchasing old street railway systems and dilapidated lighting plants running on an unproductive basis, but which have a good franchise and field for business. Such companies have proved very profitable, as the combining of the operating expenses for railway and lighting station has done much to reduce expenses, and in many cases one manager or superintendent has proved sufficient for the entire system.

What we have tried to prepare here has been, not a paper which will be so attractive to merely read, but in which will be combined a certain amount of data information which will be of use in the further consideration of the problems herein outlined, and trusting that, if we have accomplished nothing else, we have led you to a profitable line of thought, it is respectfully submitted.

EXPLANATION OF ELECTRICAL WORDS, TERMS, AND PHRASES.

(From Houston's Dictionary.)

Capacity of a Telegraph Line or Cable.—The ability of a wire or cable to permit a certain quantity of electricity to be passed into it before acquiring a given difference of potential.

Before a telegraph line or cable can transmit a signal to its further end, its difference of potential must be raised to a definite amount dependent on the character of the instruments and the nature of the system.

The first effect of a given quantity of electricity being passed into a line, is to produce an accumulation of electricity on the line, similar to the charge in a *condenser*. Cables especially act as condensers, and from the high specific inductive capacity of the insulating materials employed, permit considerable induction to take place between the core, and the metallic armor or sheathing, or the ground.

The capacity of a cable depends on the capacity of the wire; *i.e.*, on its length and surface, on the specific inductive capacity of its insulation, and its neighborhood to the earth, or to other conducting wires, casings, armors, or metallic coatings. Submarine or underground cables therefore have a greater capacity than air lines.

This accumulation of electricity produces a *retardation* in the speed of signaling, because the wire must be charged before the signal is received at the distant end, and discharged or neutralized before a current can be sent in the reverse direction. This latter may be done by connecting each end to earth, or by the action of the reverse current itself.

The smaller the electrostatic capacity of a cable, therefore, the greater the speed of signaling.

Capacity, Specific Inductive; Dielectric Capacity, or Dielectric Constant.—The ability of a dielectric to permit induction to take place through its mass, as compared with the ability possessed by a mass of air of the same dimensions and thickness, under precisely similar conditions.

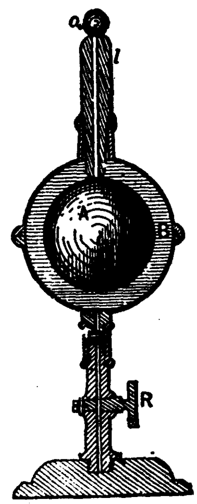


FIG. 79.

The inductive capacity of a dielectric is compared with that of air.

According to Gordon and others, the specific inductive capa-

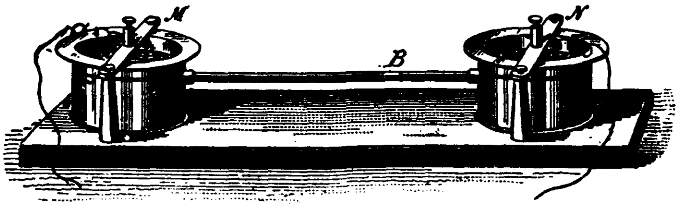


FIG. 80

cities of a few substances compared with air, are as follows :—

Air	1.00
Glass	3.013 to 3.258
Ebonite	2.284
Gutta-percha	2.462
India-rubber	2.220 to 2.497
Paraffin (solid)	1.994
Shellac	2.740
Sulphur	2 580
Turpentine	2.160
Petroleum	2.030 to 2.070
Carbon bisulphide	1.810
Vacuum	0.99941
Hydrogen	0.99967
Carbonic acid	1.00036

Faraday, who proposed the term *specific inductive capacity*, employed in his experiments a condenser consisting of a metallic sphere A, Fig. 79, placed inside a large hollow sphere B.

The concentric space between A and B was filled with the substance whose specific inductive capacity was to be determined.

Capillary Electrometer.—An electrometer in which difference of potential is measured by the movements of a drop of sulphuric acid in a horizontal tube filled with mercury.

The horizontal glass tube with a drop of acid at B, is shown in Fig. 80. The ends of the tube are connected with two vessels, M and N, filled with mercury. If a current be passed through the tube, a movement of the drop *towards the negative pole* will be observed. Where the electro-motive force does not exceed one volt, the amount of the movement is proportional to the electro-motive force.

Carbon.—An elementary substance which occurs naturally in three distinct allotropic forms, viz.: charcoal, graphite and the diamond.

Carbon, Artificial.—Carbon obtained by the carbonization of a mixture of pulverized carbon with different carbonizable liquids.

Powdered coke, or gas-retort carbon, sometimes mixed with lamp-black or charcoal, is made into a stiff dough with molasses, tar, or any other hydro-carbon liquid. The mixture is moulded into rods, pencils, plates, bars or other desired shapes by the pressure of a powerful hydraulic press. After drying, the carbons are placed in crucibles and covered with lamp-black, or powdered plumbago, and raised to an intense heat at which they are maintained for several hours. By the carbonization of the hydro-carbon liquid the carbon paste becomes strongly coherent, and by the action of the heat its conducting power increases.

To give increased density after baking, the carbons are sometimes soaked in a hydro-carbon liquid, and subjected to a re-baking.

Carbon Electrodes for Arc Lamps.—Rods of artificial carbon employed in arc lamps.

Carbons for arc lamps are generally copper-coated, so as to somewhat decrease their resistance, and to ensure a more uniform consumption. They are sometimes provided with a central *core* of soft carbon, which fixes the position of the arc and thus ensures a steadier light.

Carbon Holders for Arc Lamps.—Various clamping devices for holding the carbon electrodes of an arc lamp in the lamp rods.

Carbon Telephone Transmitter.—A telephone transmitter consisting of a button of compressible carbon.

The sound-waves impart their to-and-fro-movements to the transmitting diaphragm, and this to the carbon button thus varying its resistance by pressure. This button is placed in circuit with the battery and induction coil.

Carbonization, Processes of.—Means for suitably carbonizing carbonizable material.

Carbonizable material is placed in suitably shaped boxes, covered with powdered plumbago or lamp-black, and subjected to the prolonged action of intense heat while out of contact with air.

The electrical conducting power of the carbon which results from this process is increased by the action of the heat, and, probably, also by the deposit in the mass of the carbon, of carbon resulting from the subsequent decomposition of the hydro-carbon gases produced during carbonization.

When the carbonization is for the purpose of producing conductors for incandescent lamps, in order to obtain the uniformity of conducting power, electrical homogeneity, purity and high refractory power requisite, selected fibrous material, cut or shaped in at least one dimension prior to carbonization, must be taken, and subjected to as nearly uniform carbonization as possible.

Carbonized Cloth for High Resistances.—Discs of cloth carbonized by heating them to an exceedingly high temperature in a vacuum, or out of contact with air.

After carbonization the discs retain their flexibility and elasticity and serve admirably for high resistances. When piled together and placed in glass tubes, they form excellent variable resistances when subjected to varying pressure.

Carbons, Cored, for Arc Lamps.—A cylindrical carbon electrode that is moulded around a central core of charcoal, or other softer carbon.

These carbons, it is claimed, render the arc light steadier, by maintaining the arc always at the softer carbon, and hence at the central point of the electrode.

A core of harder carbon, or other refractory material, is sometimes provided for the negative carbon.

Carbons, Concentric, Cylindrical.—A cylindrical rod of carbon placed inside a hollow cylinder of carbon but separated from it by an air space, or by some other insulating, refractory material.

Sometimes Jablochkoff candles are made with a solid cylindrical electrode, concentrically placed in a hollow cylindrical carbon.

THE PROPHYLAXIS AND TREATMENT OF DIPHTHERIA.

At the recent meeting of the American Medical Association, Washington, D. C., Dr. J. Lewis Smith, of New York, read a paper on this subject. The room should be disinfected by adding to one quart of simmering water one or two fluid ounces of the following mixture :

℞. Oil of eucalyptus..................℥j.
Carbolic acid.........................℥j.
Turpentine, q. s. ad..........℥vj. to ℥viij.

Everything and every person not absolutely necessary for the comfort and management of the patient should be excluded from the sick room. Physicians undoubtedly conveyed the disease. They should always examine the fauces by standing behind or at the side of the patient, so that no ejected mucus may come upon them. After each visit they should wash thoroughly, in a sublimate solution, hands, face, and beard. Walking cases without fever, anorexia, or malaise diffused the disease. Daily inspection of the fauces of school children had been proposed. Convalescents should not mingle with healthy children for four weeks. He admitted the full claim of the Klebs-Loeffler bacillus to be the cause of the disease. It was a surface microbe—never penetrating the interior of the body, but attacking only mucous surfaces or cutaneous abrasions. It produces a ptomaine containing carbon, hydrogen, azote, sulphur, and oxygen, which, by absorption through both blood and lympth channels, causes the nephritis-granulo-fatty degeneration of heart muscle and paralysis.

The treatment should embrace hygiene, diet, and alcohol. Rectal alimentation could be followed for a time. Failure of appetite rendered the outcome doubtful. Diet could embrace milk with sarco-peptones, beef tea, or meat juice, and the various pre-digested compounds. Large and frequent doses of alcohol were positively necessary. It is quickly eliminated, and often will save life unless blood-poisoning has actually set in. In the proportion of one to five it has been shown to have a destructive action on the growth of the bacillus.

Locally we should remember that normal epithelium was a barrier to the germ's enterance, and hence our remedies should be such as not to destroy the epithelial covering. Denuded or diseased surfaces were favorable starting points for the disease. Corrosive sublimate, 1 to 8,000 ; carbolic acid, 1 to 50 ; salicylic acid, 1 to 80 ; has proved of service in arresting the gem growth. Potassic chlorate was useless in this direction, and he had come to discard its internal employment entirely. It had undoubtedly caused nephritis in many cases. The corrosive sublimate could be given by nasal injection, gargling, and internally. Where the false membrane was very thick and tenacious, equal parts of tincture of iron and glycerine should be given three or four times a day. Loeffler himself uses a mixture of carbolic acid, alcohol, and distilled water for the mouth. Our local remedies should be penetrating. Therefore, glycerine and water, never sirups and mucilages, should be our vehicles f r all local applications. The officinal solution of iron chloride might be diluted three or four times for this purpose. While it undoubtedly contracted the vessles, it was often painful. It congeals the muco-pus of the fauces. Carbolic acid, Monsel's solution, and glycerine could be advantageously used in this way. For nasal disinfection a saturated solution of boracic acid was preferable.

For internal treatment, iron assisted the anæmic condition. Vegetable tonics, including quinine, were probably useless, as were also quinine insufflations in the oral cavity. The main reliance was to be placed on the bichloride. He was in the habit of giving a two-year-old child $\frac{1}{72}$ grain every two hours ; four years, $\frac{1}{40}$ grain ; six years, $\frac{1}{36}$ grain ; ten years, $\frac{1}{24}$ grain. His solution was made by dissolving the sublimate in alcohol and adding elixir of bismuth and pepsin. Sublimate solution, two grains to the pint, could be used for the nose. The mercurial should be continued at least one week, unless diarrhœa supervened, but not longer. Calomel had been suggested. Many gave an initial dose, and some continued it through the entire disease. It undoubtedly increased the anæmia. Of late it had been given in the New York Foundling Asylum by sublimation, from ten to forty grains being used, under a tent over the patient's bed. The indication for its use was the supervention of hoarseness. The attendants had been salivated in several instances, but the patients were apparently not injured. It seemed to lessen the necessity for intubation. The process might be repeated in three or four hours. The percentage of recoveries from intubation where necessary was better in the calomel cases than in others. For the nephritis he gave iron, and for the paralysis tonics, strychnine and electricity.

Dr. A. Seibert, of New York, remarked that we must see way down down to the epiglottis in order to have our examination amount to anything. Children should not be allowed to kiss each other when there was any sore throat about, and very young children should not be allowed to creep around on the floor. They scraped up the dust with their fingers, which they would afterward put in their mouths. Thus the germs which settled on the floor were conveyed to the sensitive membranes. The experiments of Gebhardt, of Bonn, have shown that false membrane could be dipped in a sublimate solution, and then, after drying and teasing, cause a bacillus development in a culture medium. It was, therefore, especially under the conditions of diphtheria, slow in germicidal action, but thorough if once brought into perfect contact with the affected areas. A five per cent solution of acetic acid has been shown to be quickly penetrating.—*Scientific American.*

A JOURNEY THROUGH THE AIR.

The air is in constant motion, and every current of air, from the lightest zephyr to the blast of the hurricane, is called wind. The force which sets and maintains it in motion is the warmth of the sun's rays. These pass through the air without appreciably warming it, but impinging upon the surface of earth and ocean they are absorbed ; and the heat being again radiated warms the atmospheric strata nearest the surface.

But the ratio in which the different regions of the earth are warmed varies considerably. Around the equatorial belt the sun's rays fall vertically or nearly so and the heat is absorbed in a narrow area, but in higher latitudes the slanting rays diffuse an equal amount of warmth over a wider area. The zone of greatest heat has its centre north of the equator, owing to the fact that there is more dry land in the Northern Hemisphere, and that solid bodies absorb and radiate more heat than water. Over this warm region, which by no means covers the whole tropic zone, the heated air at the surface, becoming lighter by expansion, ascends through the cooler strata above it. It could not, however, continue to rise unless it were replaced, and this occasions the inrush from the north and south of cooler air, which in its turn gets warmed and ascends. The ascent of the upward currents is arrested as they reach a rarer atmosphere, and being debarred from falling back by the presence of ascending currents from below, they take a horizontal course towards the poles. A vertical ascending current of air is not regarded as wind, because there is no horizontal motion attending it, and the zone of ascending columns is consequently dreaded by the sailors as the region of calms. Occasionally the calm is interrupted by thunder-storms, due to the watery vapor which the ascending currents carry up with them. This, by its condensation in the upper atmosphere, forms clouds from which thunder-storms break out, liberating heat, which gives a new impulse to the ascending currents.

The warm, moist air rising from the region of calms, and taking its course toward the poles, does not remain in the upper air. Even before it leaves the tropic regions it divides, giving off a vertical descending current, which reaching the lower cool currents, is borne back to the torrid zone again. The regions through which it passes are again characterized by calms and storms. The main current, after having given off this descending current, continues its course towards the pole, approaching the surface of the earth nearer and nearer, until it reaches it in the temperate zone. Thus arises a double circulation, the lesser caused by that portion of the ascending current which descends near the edge of the tropics, and flows back to the equator; the greater caused by the main volume, which, descending gradually in higher regions, and becoming cooled, flows back over the surface towards the equator and is known, within the tropics, as trade winds. This double circulation would occur uniformly in all meridians, if the earth stood still, but as a consequence of the earth's motion, every current of air on the surface is appreciably deflected from its original course. As the earth revolves on its axis, from west to east, in twenty-four hours, every part of its surface, with its atmosphere, describes a circle greatest at the equator and lessening towards the poles. While a point on the equator is traveling 463 m. from west to east, a point under 45° lat. traverses only 326 m., and under 60° lat. only 231 m. Every place takes its own atmosphere along with it. If, then, a volume of equatorial air traveling at a speed of 463 m. an hour were suddenly transferred to the latitude of 45°, where the air has a speed of only 326 m., it would generate a gale rushing from west to east at a speed equal to the difference, *i. e.*, 137 m. an hour. While a volume of air transplanted from 45° lat. to the equator, would create a terriffic hurricane from the east.

Happily such sudden transfers with their violent consequences do not actually occur. Nevertheless the aerial currents on their way from the equator to the poles and back again, are subject to the influence of the earth's revolutions, only gradually, and for that reason with less violent results. The equatorial current apart from its drift from south to north, is also subject to motion from west to east, imparted to it by the speed of the earth's revolution at its birthplace on the equator; and traversing regions in which the speed from west to east is steadily diminishing, it is deflected from its course of south to north, in an easterly direction, until the original south wind becomes a sou'wester. On the same principle the Polar or return current on its way to the tropics, entering regions in which the rate of revolution is increasingly higher, gets left behind at every stage, until the original north wind becomes nor'easter in the tropics. The trade wind in the Northern Hemisphere has consequently one invariable direction, entering the tropics as a nor'easter. No wonder, then, that Columbus's sailors, who knew nothing of the trade winds, argued from the prevalence of the nor'easter on their outward course, that they would never be able to return to Spain. The upper or counter trade winds, subject to the same law, pursue an opposite course, at a height far above that of the highest mountain; the dust from volcanoes is, nevertheless, sometimes projected into and borne along by them.—*The Literary Digest.*

ANTHOPHAGY.

A writer in *La Nature*, quoting from Ovid,

"Qui amat flores reputatur
Amare puellas,"

says that it is well to-day to modify this aphorism and to say: "Those who love flowers are friends of good living." It appears, in fact, that in France as well as in England a true crusade is going on at present for the introduction of a certain number of flowers into our regular list of foods.

It was some London botanists who conceived this eccentric idea of rendering us *anthophagists*, a word which may be translated "eaters of flowers."

If the learned Englishmen succeed in their enterprise, we shall very soon see the edible flowers of the phog (*Caligonum polygonoides*), of the mahwah (*Bassia latifolia*), of the *Dillenia pentagnia*, etc., appear upon our tables and triumphantly take their place alongside of the violets, jasmins, and rose petals that we have long been receiving from Italy in the form of preserves.

In fact, in spite of our English neighbours, who would like for once to obtain the reputation of being initiators, flowers have been daily eaten by everybody for a long time.

Anthophagy is assuredly one of the commonest of practices; but ordinarily we are anthophagists without knowing it. The experimental proof of this assertion is soon and easily found. Thus, for example, when we eat the artichoke with pepper-sauce, we are eating the immature flower heads of the plant, and when we partake of a common cauliflower with butter-sauce we are eating flowers.

The cabbages, like the artichoke, are plants of many possibilities.

See, in fact, what we owe to the *Brassica oleracea* alone—the common cabbage—which the housewife daily puts into the soup pot.

In a wild state, the *Brassica oleracea* is a rare plant, at least in France, where it is scarcely ever met with except in the inaccessible parts of the chalky shores of Cape Gris-Nez. In order to develop at its ease, it requires sea air, saline spray, and phosphate of lime. But when man comes to take it under his protection, then, according to the mode of culture applied to it, it furnishes the common cabbage, the turnip cabbage, the cauliflower, Brussels sprouts, etc., according as the leaves, root, or flowers of the plant have been more especially developed. This latter is especially the case of the cauliflower and Brussels sprouts. The cauliflower, in fact, is nothing but the plant's inflorescence which has not reached its complete development, while Brussels sprouts are buds that have not reached perfect maturity. To add again to the list of Brassicas, there is the brocoli, a maritime and wild (or nearly so) variety of the *Brassica oleracea*, and the inflorescence of which, less tufted than that of the common cauliflower, is likewise edible and just as delicate.

In Holland, as well as in Brittany, the brocoli is cultivated upon a large scale in the *polders* (as the large pasturages on alluvial soil that has been reclaimed from the sea are called in the Netherlands), and, in order to secure for it an existence approaching as nearly as possible its normal conditions of growth, the peasants furnish it with a manure that is both mineral and organic; that is, the star-fishes that they gather by the cartload upon the beaches. Let us add, further, that the crop of brocoli inflorescences is placed in casks that have contained the generous wines of France (Burgundy or Bordeaux). This gives it a particularly fine and agreeable aroma, and it is afterward shipped to England, whence we see it finally return to our tables in the form of pickles in vinegar or of chow chow. So much for the simple cabbage.

As for the artichoke, the *Cynara scolymus* of botanists, that shares, with several other of its near relatives, the property of having a fleshy and succulent floral receptacle. These flower-vegetables of which we have just spoken are in general use as food. Along with them, it is well to mention a number of others, which, although not so well-known, are none the less valuable. Thus, for example, the sea kale (*Crambe maritima*), a near relative of the cabbage, belonging, like it, to the great family of Cruciferæ, and which grows naturally and in great abundance at the seaside, in the shingle, upon our Channel coast, produces an inflorescence that is particularly esteemed by connoisseurs. It is a vegetable of which the culture will doubtless be carried on regularly some day.

The most diverse families of plants furnish species having edible flowers. The delicately perfumed, freshly expanded flowers of the yellow pond lily (*Nymphæa lutra*) are employed in the east of France in the manufacture of certain preserves that possess an exquisite flavor. The white and odoriferous racemes of *Robinia pseudacacia*, dipped in batter are used in some countries for making fritters that are no less savory than those made of sliced apples or peaches. The flowers of the Judas tree (*Cercis siliquastrum*), too, are sometimes made into fritters with butter, or are mixed with salads, and the flower buds are pickled in vinegar. The flowers of the American species (*C. canadensis*) are used in salads and pickles in Canada. The flowers of the nasturtium and borage are used as an addition to salads. We use the flower buds of the caper bush, preserved in vinegar, in certain sauces. The cloves, so much used for flavoring, are merely the unexpanded flower-buds of the clove tree, dried in the sun.

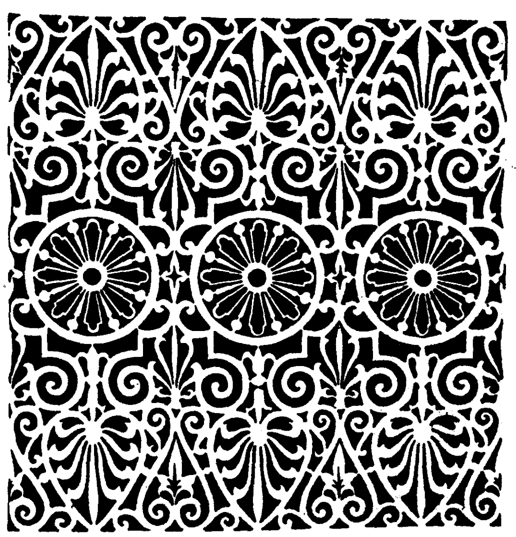
The flowers of *Abutilon esenlentum* are used as a vegetable in Brazil. In India, the flowers of *Agati grandiflora* are used by the natives in their curries. The flowers of the pumpkin vine are cooked and eaten by some of the tribes of North American Indians. This list is far from being complete, and we hope to add to it at some future time.

LEARNING THE PRINCIPLES.

Some engineers find a great difficulty in learning from books such things as are applicable in their business. The chief complaint from many engineers in regard to books is that they cannot understand the application of the information they contain, and in many cases there is good reason for this, but it is principally owing to their defective training when children. Many good engineers who have learned what they know by daily practice in the engine room, who have shown their qualifications by years of constant work at the business, and who are capable not only of taking care of the plant as it stands, but of erecting a plant and making it work successfully, are completely floored when they are called on for a rule that applies to any branch of the business, and yet at the same time in their own minds they understand the principles, and express themselves to the effect that if they knew the rules and could figure those things out, it would help them greatly in their practice.

A rule which will apply in a particular branch of work does not, as a general thing, contain anything that shows directly the application of the rule, and in fact, a rule is a simple statement of general principles that will apply almost indefinitely, and it is for this reason, perhaps, that they are confusing to those who have not been especially drilled in the comprehension of such methods of showing the results of special investigation and the methods of applying the principles, but a similar difficulty is experienced by those who have learned the rules and formulas from the book and have not been taught the general application, for, while the practically educated man is at sea, when rules and formulas are in question, so in a similar number of cases will the graduate meet with difficulties in his efforts to put his rules into practice. Formulas are even more confusing to those who have not been taught their use and application than are rules, but when once understood they are more serviceable and much more easily made use of.

Among the many engineers of my acquaintance, writes C. Davidson in the *Weekly Stationary Engineer*, I frequently find those who can best understand through the medium of the eye; that is, what they see worked out and put into practice, that they can thoroughly understand, for the eye has the faculty of following and the mind of noting every movement, every change, and every arrangement throughout the whole operation in a manner somewhat similar to that in which the skilled phonographer will follow the words of a rapid speaker, and these engineers who have once seen an operation performed can at any time thereafter go through the same operation themselves, even though weeks or months may have elapsed between the time when their attention was called to it and the time when they are called to do the same thing themselves. For reasons similar to those mentioned above, all men cannot have the same use of their faculties, neither can the same faculty be the strongest in all, but each man according to his aptitudes may become an expert in some branch from the use of faculties entirely different from those employed by others who are also expert in the same branch; but in spite of this, the purely practical man and the purely theoretical man can never be brought to agree on the same subject, although both may attain the same end by different means, simply because each looks at it from a different standpoint.



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