THE OCTOPUS AT THE BERLIN AQUARIUM.

At the Berlin Aquarium there are several live specimens of the octopus, some of which are shown in our illustration, which we take from *Tycodnik Poroszechny.*

These animals have been for some time in the aquarium, and seem to thrive. They are very lively and exhibit a decidedly healthy appetite.

The cuttlefish family comprises several species, some of which have distinct exterior shells, like mollusca, while others are entirely naked and have interior bone-like formations. This group, to which the subject of our illustration belongs, forms a link between the vertebrates and the mollusca. The only remnants of an exterior shell in the octopus are two horny masses embedded in the flesh near the mouth.

The entire structure of the long, oval body of the octopus, with its rough, warty surface, somewhat resembles that of vertebrate animals. The body is symmetrical, both sides being equally developed. The nervous and circulatory systems and the blood corpuscles are also analogous to those of vertebrates. The eyesare well developed and protrude at the sides of the body. Adjoining them are the external respiratory organs. Eight muscular structures surround the mouth. These arms are nearly five times as long as the body, and are supplied with two rows of sucking disks. The entrance of the mouth is supplied with two horny jaws, working vertically like a bird's bill. The tongue is very large and fleshy, partially covered with recurved spines.

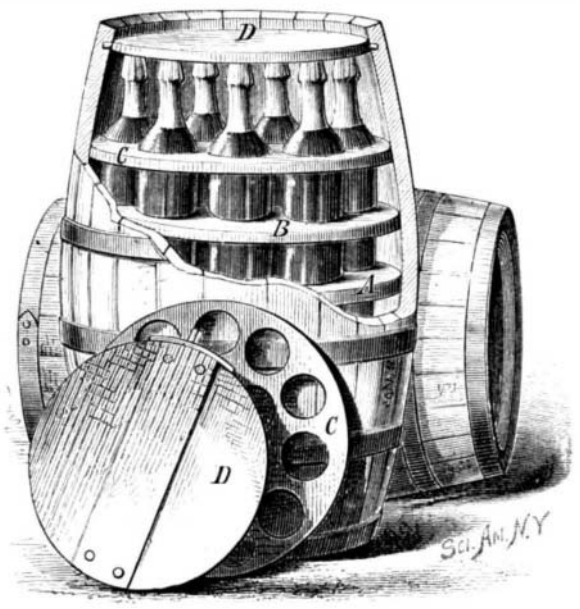
The brain is internally protected by a sheet of cartilage. The backbone consists of a shell-like formation, well known as the cuttle bone. A feature peculiar to all species of this family consists of an interior gland, secreting a brown liquid, which, being expelled by the animal, diffuses very easily in water and renders it cloudy and opaque. This brown liquid is employed as a water color, which is known as sepia.

The octopus moves with great rapidity by means of its arms and the violent expulsion of a quantity of water from the respiratory gills. When chased it instantly discolors the water by the expulsion of the inky liquid and makes its escape, or, by means of its long arms it drags its body into some narrow crevice, from which it can only be extracted by great force. Although frequently left in shallow places when the tide retires, they are nevertheless not very easily caught. In the dark they are slightly phosphorescent. They are all carnivorous and very voracious, swallowing an incredible number of small fish and shellfish, which they seize with their arms, holding them by means of their suckers, and introduce into the mouth.

There are now known about 200 species of the group of *Cephalopoda*, and of the octopus family about 40, the ordinary cuttlefish being the most common. They inhabit the seas of the moderate and tropical zones, and frequent principally rocky shores. They abound particularly in the Mediterranean; in Smyrna, Santiago, aples, and other places, they are regularly exposed at the markets as an article of food. They are ordinarily only a few inches in length, but specimens of five and six feet in length are not rare, and there are numerous cases on record of arms separated from some specimens which measured from ten to twenty-five feet.

BARREL FOR SHIPPING BOTTLED LIQUORS.

The accompanying engraving represents a novel barrel recently patented by Mr. S. Strauss, of Charleston, W. Va., for shipping bottles containing liquors, and for preventing access to the bottles by unauthorized persons.



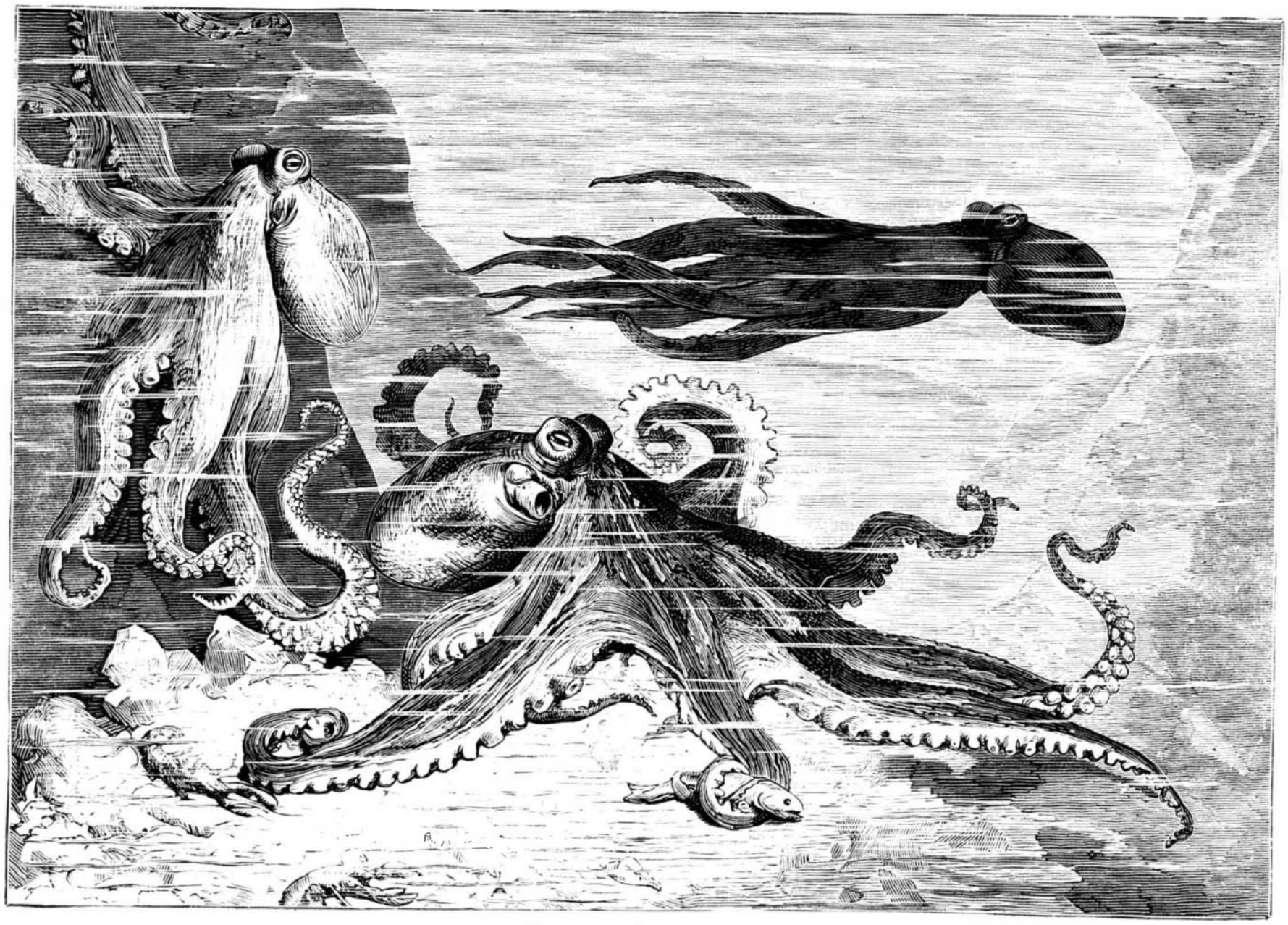
STRAUSS' SHIPPING BARREL.

The barrel has two removable heads, D, and a stationary middle partition, A. On each side of the middle partition there are two perforated supporting partitions, B C, which hold the bottles so that they are isolated one from the other, and are therefore not liable to breakage when the barrel is moved about. The heads when inserted are locked, so that no one can open them without a key. The lock may be sealed if desirable.

For further information address S. Strauss & Co., Charleston, W. Va.

Natural History Notes.

The Migrations of Animals and Plants.—The question how animals and plants migrate, says Dr. Hagen, in a recent lecture, is an interesting one. Generally the migration took place so long ago that only a conjecture is possible. Nearly everywhere it seems to have been from East to West. Only very few cases in the opposite direction are known; among the most remarkable is that of the potato bug during the last few years. The common cockroach, said to have been originally an inhabitant of Asia Minor, was first observed in an alarming number in English ships 300 years ago; it spread more than 200 years ago from England to France; and 100 years ago more or less slowly, but faster in the time of the Napoleonic wars, through Germany into Russia and Siberia. These facts are proved by the common name given to this disagreeable insect in different countries. In Germany it is called Frenchman; in Russia, Prussian. The most disastrous instance of an eastern propagation is that of the ill-famed phylloxera killing the choicest kinds of grapes known to man. The comparatively new cultivation of America has shed at least some light on the question of migration. In most cases the intruders accompanying emigrants follow strictly the ways of the latter and spread most rapidly along railroads. A careful comparison of the European weeds growing in the United States, and found in Professor Gray's Manual of Botany, represented two thirds of all the European weeds; and, perhaps, some more out of the remaining third. It is a certain fact that in some places the original vegetation is changed remarkably by such intruders. Indigenous plants are killed, and not only the plants, but the insects living on them, so that a keen observer, Baron Von Ostensacken, has stated that particular flies, living exclusively on certain plants, and common in many places in Virginia and adjoining States twenty years ago, are exceedingly rare now, and some species perhaps exterminated. The introduction of plants is often accompanied by the introduction of insects peculiar to them; therefore many enemies of fruit trees, shrubs, and flowers, formerly not known here, are now common. Such insects are even induced to infest indigenous plants belonging to the same order or genus as the imported one. For the same reason, plants entirely foreign to a flora, if introduced, remain at first intact. Besides the well known larger animals for food and agriculture imported from Europe, smaller animals, such as insects, also come over every year. Some butterflies have already made the trip round the world. A large species of fly, well known in Europe by its curious rat-tailed larva, was found here first three years ago, and was so common the past year that hundreds were caught. As steamers make the passage in a week or two, insects are imported living, and go on propagating here. Although



THE OCTOPUS AT THE BERLIN AQUARIUM.

it is common for entomologists to credit Europe with a large number of the imported noxious insects, it must not be forgotten that many are not really native to Europe, but were introduced there from the East ages ago, and not being able to cross the Atlantic till modern times, have settled so long in Europe, as to be considered indigenous species.

Electrical Telegraphing without Wires.

Professor Loomis continues his experiments in the mountains of West Virginia to demonstrate his theory that at certain elevations there is a natural electric current, by taking advantage of which telegraphic messages may be sent without the use of wire. It is said that he has telegraphed as far as eleven miles by means of kites flown with copper wires. When the kites reached the same altitude, or got into the same current, communication by means of an instrument similar to the Morse instrument was easy, but ceased as soon as one of the kites was lowered. He has built towers on two hills about twenty miles apart, and from the tops of them has run up steel rods into the region of the electric current.

Industrial Notes.

Protection of Iron from Corrosion.—A new method of protecting iron from corrosion has recently been patented by Mr. J. B. A. Dode, in England. Its cost is about one third that of a coat of paint, one tenth that of electro-plating with nickel and one twentieth of the ordinary process of painting and gilding. It can also be colored in a variety of ways. Iron treated in this way is said to be "platinized." The articles to be protected are coated with a thin film of borate of lead, containing a little caprous oxide in solution and bright scales of precipitated platinum in suspension. They are then heated to redness and become covered with a thin, glassy, bright gray coat, similar in appearance to polished iron. It is unaffected by sewer gas, dilute acids and alkalies, and the heat of the kitchen fire.

Stearate of Soda for Painting.—A new composition has recently been invented for use in painting. An alcoholic solution of stearate of soda is made in the proportion of 50 grammes of the salt in 1,000 grammes of 66 per cent alcohol. Solutions of soap in alcohol, more or less concentrated, may be used; but the stearate forms the most impenetrable and least costly material. The solution may be colored with aniline colors, yellow ocher, etc. It takes well on wood, lime, and cement.

Bleaching Feathers.—MM. Viol and Duflot have made known a new process of bleaching applicable to the decoloration of ostrich and other delicate feathers which enter into the manufacture of ornaments for ladies. According to the inventors, feathers dipped into a liquid hydrocarbon, such as oil of turpentine, mint, or thyme, become bleached under the subsequent action of light and heat. The process is as follows: The feathers to be bleached are placed in glass vessels filled with one of the above mentioned liquids, and exposed as much as possible to the light of day, and at a constant temperature of 30° C. At the end of two or three weeks the decoloration will be found completed, and it only remains to air the feathers, dry them, and finally to prepare them for use in the usual way.

Caterpillars and Gut.—Silkworms, up to the present time, have been the only larvæ from which "gut" has been prepared. This material has valuable properties—strength, fineness, and color; and if it could be produced in long pieces and at a low cost, it could be used for many purposes. It is now proposed (in the Colonies and India) to use the caterpillars which destroy food plants for this purpose. If practicable, the project is good and useful, and the idea will probably become valuable.

The Hectograph.

Herr Levitus, of Vienna, lately exhibited an arrangement called a "hectograph," for multiplying writing, which, though not directly connected with photography, may prove interesting. The hectograph consists of a flat sheet iron box filled with a gluey mass, upon which, after moistening and drying it several times, a sheet of paper, written upon with a specially prepared ink, is placed and lightly rubbed with the hand. When the paper is raised the writing is found to be transferred reversed to the film of glue, and from that film, by simply placing pieces of dry paper upon it and rubbing them, some fifty impressions of the writing can be taken in a short time. The negative impression can easily be removed from the film by washing with warm water, and the latter can be used over and over again for a long time.

Progress of the Telephone.

The Gold and Stock Telegraph Company, in its answer filed in the suit brought against it by the Bell Telephone Company, sets up the general claim that the telephone is not a new invention, and that Gray was the prior inventor. The Boston case, it is thought, will reach trial by April or May. The Bell Telephone Company has obtained injunctions against several smaller manufacturers of telephones, and suits against others are pending.

The company is turning out 1,500 telephones a month, and orders are so numerous that many are more or less delayed. There are now 17,500 instruments out, and 15,000 actually rented. Instruments are supplied principally to telephonic exchanges, which are being rapidly introduced into all the larger cities. At Albany and Troy there are 350 instruments in circuit; at Buffalo there are 250 subscribers; at Detroit about 150 instruments in circuit; at Chicago 550; at Indianapolis 150 subscribers; at St. Louis 325 instruments in circuit; at Cincinnati 200; at Philadelphia 500 subscribers and 250 instruments in circuit; at Columbus 200 subscribers and about 50 instruments in circuit; at Baltimore 300 subscribers and 100 instruments in circuit; at Washington, New Orleans, Louisville, Nashville, exchanges are being started. In Boston there are 500 subscribers and about 150 instruments in circuit; at Lowell 200 instruments in circuit, at New Haven 350; at Bridgeport 175, and at Springfield, Hartford, and Providence exchanges are being started. An exchange has just been started in this city, where there are at present about 750 subscribers and about 250 instruments in circuit.

[The foregoing we find in the *Operator*. Some idea of the enormous profits made by the telephone owners will be gained when we state that the cost of manufacture is less than one dollar each instrument, while the rental charged is rom two to three dollars per month for each instrument.]

Railway Notes.

From a table showing the mileage of new railroad constructed in each State and Territory during the past seven years, it appears that there were built in the United States last year 2,688 miles of new road, nearly one half of which is credited to the northwest, Minnesota, Iowa, and Missouri taking the lead. The number of miles of narrow gauge road built in 1878 was 871, against 776 in 1877. The amount of new road for each of the seven years named is shown in the following table:

Year.	No. of lines.	Total built.	Av. length.
1872	210	7,340	35·0
1873	137	3,883	28·3
1874	105	2,025	19·3
1875	94	1, 561	16·6
1876	107	2,460	23·0
1877	122	2,281	18·7
1878	144	2,688	18·7

At the beginning of 1878, according to Poor's Manual, there were 79,208 miles of railroad in the country. The addition of 2,688 miles is equal to 3½ per cent. According to this there are 81,896 miles of railway in the country at this time. Estimating a population of 48,000,000, this gives about 585 inhabitants per mile of railroad, a much smaller number than in any other country on the globe.

In the workshop of the railroad from Moscow to Nijni, the tires of wheels are not expanded by the direct action of fire, but by hot water, before being put on the wheels. With the assistance of a movable crane the tires are plunged into a metallic cistern containing water, which is kept boiling by means of steam from a boiler close by. An immersion for ten minutes expands a tire sufficiently to enable it to pass around the wheel. The heat is more uniform and the contraction more regular than when a tire is heated by fire in the usual way. It is said that in six years there was only one case of fracture of the water-heated tires, and only 1 per cent of them loosened upon the wheel.

In a review of an American work on railway service, the London *Iron* says: We do not allow for a moment that the Americans have beaten Old England either in engineering skill or in sound financial management in railway matters; yet there are a hundred things in either department in which our people may derive benefit from the splendid success and many failures of our American kinsmen. No man can go by rail from London to Inverness or Holyhead without an amount of fatigue and discomfort which would not be experienced in journeys thrice the length in the States; and we hope that our companies at home will in time endeavor to assimilate traveling conveniences a little more to that which in America the length of way has forced upon the great lines of railroad. It is small consolation that to many lines on the continent of Europe, in speed, comfort, safety from robbers, our railway trains are incomparably superior; nothing that the Americans have adopted should be overlooked in our longer lines, whether at home or in India or Canada.

Boston is working for an elevated freight railway to connect the extensive South Boston flats, which are being improved for the reception of freight at tide water, with the Fitchburg, Boston and Lowell, Eastern, and Boston and Maine roads. The track is to be double, and the lower line will pass from these roads through Prince and Commercial streets and Atlantic avenue, crossing Fort Point Channel at Oliver street. The line will be about a mile and a quarter long, and, it is thought, will cost, with terminal switches, engines, etc., less than $1,000,000.

There are at present 66½ miles of finished railways in Japan, 142¾ miles laid out, with working plans, sections, and estimates completed, and 455 miles projected, the general route only having been examined and decided upon. The earthworks of the existing lines have been made for a double way, and the bridges for a single way. The permanent way is of double-headed 60 lb. rails on the Yeddo-Yokohama and Kobe-Osaka lines; but on the Osaka-Kiota line 60 lb. flat bottomed rails on cross sleepers are used. The superstructure of the smaller bridges was originally of timber, but has been renewed with iron. The larger bridges are all of the Warren girder type, and as a rule of 100 feet spans. The foundations are on brick wells 12 feet in diameter, and on an average about 60 feet deep. The chief difficulty experienced by railway engineers in Japan arises from the nature of the watershed. The beds of the rivers are nearly all higher than the surrounding country, varying from a few feet to 40 feet or more. In some instances the railway has been taken unders the river by tunneling. As a rule, however, the rivers were bridged over, and approached by steep gradients and high embankments.

Nowhere else in the world have railway engineers to fight against the adverse conditions which beset railway communications in upper India, except, perhaps, on the Baroda and Bombay line. The rivers of the Punjaub are as captious as spoiled children. They shift their course with every rainy season. A splendid bridge is built across what seems the confirmed bed of a river. Next year that river abandons the channel over which the bridge has been thrown, leaves the great bridge spanning a mere rivulet, and carves for itself another channel elsewhere, sweeping away a slice of railway embankment, for which a bridge must be substituted, until, with the necessity for accommodating the fitful caprices of the snow-fed streams, the whole railway system of a large section of the Punjaub threatens to become one long bridge. In the season of the floods the officials of the railway company need to sleep with one eye open, and to live with their lives in their hands. The beds of these Punjaub rivers are littered with ponderous and costly iron work, girders, columns, etc., brought out from England, and now lost irrevocably in the all but fathomless quicksands which stud the river beds.

The Pullman Palace Car Company has been using steel tired paper wheels about nine years. The Chicago *Railway Review* publishes a table showing, from the records of the company, the mileage of a lot of sixty-six wheels on the Pittsburg & Fort Wayne and Pennsylvania roads previous to the first turning up of the tires. The average mileage is over 110,000 miles. As the poorest wheels give out first, it is evident that, by the time the last one is taken off for turning, the average of the whole will be very much greater than is shown by the table. In another table the mileage of twenty-four wheels, the most of which are still in service, is given, and the average is 184,000 miles. As each tire receives from three to four turnings, giving four periods of wear, probably a safe and just estimate from this data would be an average mileage to the steel tire of from 450,000 to 560,000 miles. It appears from the records of the Pullman Company that the average mileage per month of the cars under which the sixty-six paper wheels were run was 13,000 miles. The first cost of the paper wheel is $65, and of the best quality of cast iron wheel, $14. The mileage of the latter is usually guaranteed at 50,000 miles. The cost of renewal of the steel tire is $35. The cost of turning the tire may safely be estimated as equal to the cost of the more frequent renewals of cast iron wheels with the attendant expenses of transportation in each case. The paper wheel costs $65, and runs 450,000 miles in 2 88-100 years. For convenience in reckoning, and at a disadvantage to the paper wheel, on account of the interest money, call this period three years. At the end of this time the original cost, with 7 per cent compound interest, amounts to not quite $80. But during this period nine cast iron wheels have been used, costing $14 each. Allowing a rebate of $5 each for the worn out wheels, and calculating on simple interest at 7 per cent, the cost of the wheels for this service amounts to $91.50, showing a saving in the case of paper wheels of $11.50, and were compound interest computed, as in the case of the paper wheels, the saving indicated would be a much larger amount. In computing the cost for the second period of three years a much greater saving would by shown, since a renewal of the tire only, at a cost of $35, is necessary, instead of a first cost of $65 for a new paper wheel. The data from which this conclusion is reached are vouched for by the Pullman Company. The *Review* adds that the experience of the railway companies which have used the paper steel-tired wheels bears out the records of the Pullman Company. Among these roads it mentions the Central Vermont, Connecticut River; Cleveland, Columbus, Cincinnati and Indianapolis; Pittsburg, Cincinnati and St. Louis, and the Chicago and Alton. As engine truck wheels the paper wheels seem to be especially successful, the experience on some roads warranting the conclusion that they will make 800,000 miles before the tire requires renewal.

The Very Latest Electric Light Improvement.

At the Technical Society of St. Petersburg, M. Latchinoff lately delivered a very interesting lecture on the electric light. He made some experiments with Jablochkoff's condensators, which consist of a set of tin plates placed one on another; the surface of every plate is 0·7 square meter. Between every pair of such plates a piece of silk covered with varnish is introduced. The height of the condensator was about 6 feet. On introducing two condensators into a circuit the intensity of the electric light is doubled. Such condensators are not cheap owing to the great quantity of silk wanted, and thus the application of this apparatus is limited. The lecturer believes the new system of electric lighting devised by M. Rapieff to be a serious opponent of Jablochkoff's process. The chief advantage of the new system is that the luminating point does not change its position, and therefore this system is more suitable for the projection of the electric light at a distance. This advantage will give increase to the use of the electric light for military purposes.

A great deal of difficulty is experienced in cementing metal to glass. The *Faerber Zeitung* says that a mixture of two parts finely ground litharge and one part white lead, and working it up to a stiff paste with three parts boiled oil and one part copal varnish, adding more litharge and white lead as required, is the best material for joining the two substances.

American Torpedo Boat in Foreign Waters.

Mr. Herreshoff, of Bristol, Rhode Island, America, who has long had a great reputation for the building of small fast steaming vessels, recently sold to the English Government one of his launches in order that the American system might be thoroughly tested against the productions of the English building yards.

The boat is sixty feet all but three inches in length, with a beam of seven and a half feet, and when fully manned and equipped will float in less than four feet of water. Her speed is stated to be over sixteen miles an hour, above the standard of the Admiralty second class torpedo boats, which are nearly as possible of the same dimensions as the American launch. The hull, which in appearance is not unlike a coffin painted a dull gray, consists of bullet-proof steel, with a wooden skin below the water line. The funnel is almost in the middle of the boat, and the screw is placed under the patent boiler, or "steam generator," which is also in the center of the craft. She is steered from near the stern by a balanced rudder, and her powers of quick stopping and going astern, and ability to turn in a small circle, are said to be surprising.

During the trial she described a complete circle in a diameter of about 50 yards, came to a dead stop when steaming 12 miles an hour, in her own length, and then went astern at the same rate of speed and equally well under the control of the rudder. She steamed several times in the course of five minutes round and round a Russian steamer, Peter the Great, proceeding down the river, and amply proved her extraordinary powers to the entire satisfaction of every one on board. The steam is supplied by Herreshoff's steam generator, which will raise 100 pounds of steam within six minutes of the fires being lighted. The generator consists of a coil of 2 inch pipe, nearly 300 feet long, and possesses the valuable quality of an inability to explode. She works at a pressure of steam of 140 pounds, but has been tested up to 300 pounds. The screw is capable of 300 revolutions a minute. The absence of a heavy boiler adds greatly to the lightness of the boat, enabling her to be hoisted on davits with wonderful facility. It seemed to be the general opinion among the engineers present that the introduction of the Herreshoff steam generator into England would create a complete change in the method of producing steam for working machinery, and the success of the new invention appeared complete.

New Electrotype Process.

A new and ingenious process has lately been introduced in France for electrotyping on non-conducting materials, such as china, porcelain, etc. Sulphur is dissolved in oil of lavender spike to a sirupy consistence; then chloride of gold or chloride of platinum is dissolved in sulphuric ether, and the two solutions mixed under a gentle heat. The compound is next evaporated until of the thickness of ordinary paint, in which condition it is applied with a brush to such portions of the china, glass, or other fabric as it is desired to cover, according to the design or pattern, with the electro-metallic deposit. The objects are baked in the usual way before they are immersed in the bath.

CHEST OF EBONY.

The engraving on this page represents an ebony chest, richly ornamented with gilt, bronze, and silver castings and repoussé work. It was one of the exhibits at the late Paris Exhibition.

EBONY CHEST, WITH GILT AND SILVER ORNAMENTS.

Subterranean Telegraph Wires in Germany.

In 1876 the first subterranean telegraph wire was laid down in Germany. Recently, subterranean lines have been completed from Berlin to Cologne, from Cologne to Elberfeld and Barmen, from Frankfort to Strasbourg, and from Hamburg to Cuxhaven. Altogether the length of these lines now amounts to 1,554 English miles. Most of the cables consist of seven wires, very few of four only. The difficulties encountered in laying down the cables in marshy or rocky ground, along the streets of large towns, across, or rather under, rivers, and through fortifications, have all been successfully overcome. Next year six other lines are to be laid down, and then the projected system of subterranean telegraphic communication throughout the German empire will be almost complete. The cost of the lines already laid down amounts to about $3,039,000.

The Origin of Petroleum Springs.

The origin of our oil springs has been the subject of a great deal of investigation among scientific men, and various have been the theories they have advanced. A writer in the London *Grocer* takes the subject up and concludes, as many have before him, that if petroleum were found in the neighborhood of coal, or even in those rocks among which coal abounds, or somewhere near to such rocks, there would not be much difficulty in explaining its origin. We then need only suppose that a slow distillation had taken place similar to that which is carried on at the works for the distillation of paraffine oils from cannel coal or shale, and that the product thus evolved had somehow found its way into cavities, or had filled up crevices, and remained there until disinterred by human effort. This theory would be aided by the fact that the quality of crude artificial paraffine oil approaches more and more nearly to that of natural petroleum the more and more slowly the distillation of the coal or shale is conducted; and as nature has certainly operated very slowly indeed in the formation of geological products, the petroleum of Pennsylvania and Baku, and other places, might thus have been the result of ages and ages of very slow distillation at the low temperature which the mineral oil maker knows to be so favorable to the production of a light-colored crude oil, containing a large proportion of the more volatile products such as abound in natural petroleum. But, unfortunately for this theory, petroleum is not one of the products of the "coal measures," as miners and geologists call the coal bearing strata. It appears to be especially absent from them, or we should long ago have found it in our own island (Great Britain) where these rocks have been so riddled with trial borings, pits, and workings. It is true that a few small dribbles of something of the kind have been found here and there. We have heard of an enterprising publican in the neighborhood of Bilston, who discovered some gas or vapor hissing from the floor of his cellar, who fixed a jet thereto and lighted it, and thus converted the cellar into a subterranean tap room, the curiosity of which brought much custom. His business rivals affirmed that he had carried a gas pipe surreptitiously under ground.

We have ourselves visited a coal mine near Lilleshall, in Shropshire, known as "the tarry pit," on account of the liquid tar that oozed out of the sides of the shaft and accumulated in what the colliers call the "sump," that is, the lower wall of the shaft where it is sunk several feet below the road that leads to the workings for the purpose of receiving the water that has to be pumped out. But these and other similar cases are mere exceptional curiosities, by no means comparable with the vast and apparently inexhaustible subterranean reservoirs from which we derive our commercial supplies of hydrocarbon oils. These occur in the Silurian and Devonian rocks, which are of vastly greater antiquity than our coal-bearing rocks. These Silurian or Devonian rocks belong to the period when life was just making its beginnings upon the earth, or rather in the waters that covered the earth at that time; for the animals whose remains we find in these rocks are marine animals; no air-breathing creature, nor even an amphibious reptile like a crocodile, is found among the Silurian rocks. Nothing approaching to forest trees or other terrestrial vegetation is there; the only vegetable remains being aquatic plants, and these so scarce that small specimens are prized as curiosities. Land plants just begin to make a scant appearance in the Devonian, but are very rare indeed in those lower beds where petroleum is found.

This has led to many speculations. As the remains of odd-looking fishes, marine things like swimming wood lice, huge lobster like brutes (*pterygotus*) five or six feet long and a foot across, a variety of soft animals in shells, and vast quantities of coral, are found in these rocks, some have suggested that petroleum is produced by the decomposition of the flesh of these strange creatures. The very "ancient and fish-like" smell of some of the Canadian mineral oils was regarded as confirmation of this, which in the early days of American petroleum enterprise was a somewhat favored hypothesis. Another, and a very bold, theory has been propounded by Professor Mendelejeff. He maintains that neither the animal nor the vegetable remains of the Silurian and Lower Devonian rocks are sufficiently abundant to supply the petroleum and other bituminous matter they contain. He goes back to the origin of the earth, and to the hypothesis of Laplace, who has tried to show that our sun, our earth, and all its companion planets, were formed by the condensation of an enormous cloud or nebulous mass of heated vapors a few thousands of millions of miles in diameter. He supposes that when our globe was formed by the solidification of a portion of this, there were great masses of iron and of carbon, of inorganic origin, in the inner parts of the earth; that the iron remained melted within the earth long after the crust had cooled down and water had condensed upon it. Then this water found its way through fissures and came upon the molten iron and the inorganic carbon or graphite that was associated with it. What would happen then? Water is composed of oxygen and hydrogen. Iron has a strong affinity for oxygen—strong enough, when heated, to take it away from the hydrogen of water. Mendelejeff supposes that such a decomposition of water took place, that the iron was thereby converted into the oxide of iron (the iron ore that we now obtain for our blast furnaces), and that the hydrogen set free from the water combined with the carbon, and thus formed the hydrocarbons which are found in the forms of petroleum, asphalt, etc.

Dr. T. Sterry Hunt, of Massachusetts, one of our boldest and most able of philosophical geologists, still adheres to the theory he expounded in 1861, that "petroleum and similar bitumens have resulted from a peculiar transformation of vegetable matters, or in some cases of animal tissues analogous to these in composition;" and he derives these vegetable matters and animal tissues from the ancient limestones. He argues that the animals of very low organization, that resemble plants in so many respects, are composed of material also chemically resembling vegetable matter, or a sort of half-and-half between wood and flesh, and that this, in the course of ages, would decompose and produce hydrocarbons. If this is correct, he may find his supply in the coralline rocks of that period, and may get it in such quantities as to leave us in no apprehension as to failure of supply; and he actually has found certain oleiferous magnesian limestones which contain within their pores as much as 4¼ per cent of their bulk of petroleum supposed to be thus formed. A square mile of this only one foot in thickness would contain 221,247 barrels of 40 gallons each; and taking its actual thickness at 35 feet, every square mile contains 7,743,745, or nearly 8,000,000 of barrels, all this in store and ready to ooze and filter out into the cavities as they become pumped out. Whatever theory may be adopted, one important practical fact appears very certain, namely, that the supply of petroleum is by no means limited to the present contents of the oil wells, or the accumulations in the cavities which are tapped by the wells. This is shown by the fact that after a well has been pumped dry and then left for a while the oil returns, as though it came from such porous rock as the oil-bearing limestone of Chicago which Dr. Sterry Hunt examined. As this and other similar rocks cover some thousands of square miles of the American continent, the supplies of petroleum are likely to be quite as lasting as those of coal.