immediate vicinity of the bridge, which proved quite beneficial to the contractor of masonry, Mr. John G. Noakes. Four million pounds of iron and 7,000 yards of masonry will be consumed in the construction of the viaduct. It will cost not far from $300,000.

Work was commenced last August, and will be finished next August, about the same time that the grading will be done. It will be 60 feet higher than Niagara Suspension Bridge, 170 feet higher than the great bridge across the Ohio at Cincinnati, 189 feet above High Bridge, 170 feet higher than the East River Bridge, and 45 feet higher than Portage Railroad Bridge over the Genesee River.

The officials connected with the road are: O. Chanute, chief engineer; Chas. Pugsley, P. A. eng.; C. H. Keefer, div. eng. in charge of viaduct; Wm. Seaman, resident engineer; and C. E. Ball, inspector of masonry; Barnes & McFadden, contractors. The iron for the bridge is furnished by the Phœnixville Bridge Company, and erected by R. A. Simmons.

Heating by Sunshine.

Professor E. S. Morse, of the Essex Institute, has devised an ingenious arrangement for utilizing the heat in the sun's rays in warming our houses. His invention consists of a surface of blackened slate under glass fixed to the sunny side or sides of a house, with vents in the walls so arranged that the cold air of a room is let out at the bottom of the slate, and forced in again at the top by the ascending heated column between the slate and the glass. The out-door air can be admitted, also, if desirable. The thing is so simple and apparently self-evident that one only wonders that it has not always been in use. Its entire practicalness is demonstrated in the heating of the professor's study in his cottage at Salem. The value of the improvement for daily warming buildings like churches and schoolhouses, which, when allowed to get cold between using, consume immense quantities of heat before they are fairly warmed again, is evident. Of course some other means of heating must be available when the sun does not shine. But in the colder regions, say in the far Northwest, the sun shines a greater part of the time, and hence the saving of heating would be very large if the sun heat could be "turned on" for eight or ten hours out of the twenty-four.

Giffard.

Mr. Henri Giffard, inventor of the injector, is dead. He was born in Paris, on February 8, 1825, and he was thus but a little over 57 years of age at the time of his death. In 1841 he became engaged in the works' offices of the Paris-Saint Germain Railway, and shortly after he commenced the study of ballooning, a study to which he subsequently devoted a great part of his life. In 1851 he published his work entitled "Application de la Vapeur à la Navigation Aerienne,' and the following year he made his first ascent in a balloon of elongated form, which it was intended should be guided by steam power. The result, however, was not a success. In 1854 he published another book entitled "Du Travail depense pour obtenir un Point d'Appui dans l'Air," while during the Paris Exhibition of 1867, and again in 1878, he established captive balloons at Paris, the latter, which was of enormous size, having been fully described in our pages. Mr. Giffard is best known by his invention of the injector, which he brought out in 1859, and for which he in that year received from the Academie des Sciences their prize for mechanics. In 1863 he was created a Knight of the Legion of Honor.

Some of the Beneficial Effects of Electric Lighting.

An English writer, after describing the baneful effects of gas lamps upon the healthfulness of living rooms, goes on to notice some of the mischief done to books, wares, furniture, and the like. The evil effects of the heat of gas jets is augmented, he says, by the large amount of water produced by the gas flame.

Sixty burners will produce on the lowest computation two gallons of water per hour; hence in a November evening many large shops filled with delicate goods will have a nine-gallon caskful of water thrown into their atmosphere in the form of steam, to condense on any cool surface, as we often see it trickling down the windows in winter. But worse remains behind. The sulphur, always present in gas in larger or smaller proportion according to the character of the coal employed, burns into sulphurous vapor, which passes in the air to the state of oil of vitriol. The eminent chemist, Dr. Prout, exposed water in a drawing room in which gas was burnt, and found that it absorbed sufficient of these vitriolic emanations to redden blue litmus and show the presence of free sulphuric acid. The fumes from gas will indeed, in the long run, discolor every sort of fabric, rust metals, rot gutta percha, and reduce leather (as in the binding of books) to "a scarcely coherent powder with a strongly acid taste." After referring to the evidence of the librarians of the Atheneum Club, London Institution, etc., as to the rotting of the bindings of books kept in rooms lighted by gas, the writer says: "Drapers know to their cost how the edges of pieces of dyed fabrics become faded and rotten when kept long on the upper shelves of gas-lighted shops; no plant will grow in a room where gas is burning, and cut flowers quickly wither; while those who work long and habitually in gas-lighted rooms become blanched and sickly. From all these manifold evils electricity will deliver us."

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THE LIBYAN DESERT.

A closer study of the geological structure of the Libyan Desert is likely to change the views previously entertained regarding its origin. Prof. Zittel, in a lecture delivered in Munich, said that the scientific expeditions to that region, undertaken by Rohlfs, Zittel, Ascherson, and Jordan, have yielded a paying harvest in geology at least. We learn that this region, the geology of which was so little understood, as well as the so-called Arabian Desert, which lies between the Nile and the coast of the Red Sea, and which is inseparable from the Libyan Desert so far as the stratifications are concerned, is not, as has been generally supposed, the remains of a sea that has recently disappeared. On the contrary, it consists of formations that belong to the cretaceous and lower tertiary, formations long anterior to the geological present. The rocks of the cretaceous, which prevails, are principally sandstones, variegated marl, calcareous marl, and limestone; the cretaceous fauna was found to be extraordinarily richly represented, as rarely happens elsewhere, such as oysters, ammonites, sea urchins, etc. In the oldest tertiary the nummulites formed deposits, so called because the petrifactions which they held were considered by the common people to be petrified coins. There are shells of foraminifera from the size of a pea to that of a dollar, and elsewhere in the lowest layers of the tertiary they appear in immense masses. The soil of the desert is covered with them for miles.

With the exception that in the middle tertiary the sea pressed inward on the north in two comparatively unimportant depressions, every trace of any later sea is wanting.

The whole Sahara as well as the Libyan seems to belong, for the greater part, to the chalk formation, and while the older *stratified* rocks are wanting eruptive rocks appear, forming mountain chains.

Hence there can be no talk of the sea having covered the Sahara in the recent past, for if this were the case there would be later stratified rocks on top of the cretaceous with fossils resembling the marine fauna of the present time. Then, too, the surface of the desert is not of such a shape as to indicate that it has been the bottom of the sea; but, on the contrary, the torn, ragged, fissured chasms of the desert mountains, the deep cut valleys, indicate the erosive action of flowing waters which, perhaps, in the oldest historic times still lent luxuriant fertility to the region now so sterile. This sterile character of the Sahara is to be attributed entirely to the unfavorable meteorological conditions, to the almost total lack of rain. The soil itself is well adapted to the production of a rich vegetation.

The quantity of salt present in the collections of water rendering many of the oases uninhabitable, depends upon the rock salt, which, with gypsum, is very abundant in the chalk marl as well as elsewhere. The ascending thermal waters, which make a paradise in the midst of the cheerless desert, according to Zittel's investigations, are not, as was formerly supposed, referable to the Nile, but have their origin in the rainy zones of Central Africa, whence they are led northward on impenetrable strata that have an inclination in that direction.

The sand of the desert is from the "Nubian sandstone," which belongs to the cretaceous formation and extends along the left bank of the Nile through the tenth degree of longitude. It has been transported hence by ancient water courses, aided by the wind.

The National Academy of Sciences.

The announcement that Mr. J. H. Cushing would read a paper "On the Mythology of the Zunis" drew an exceptionally large attendance upon the meeting of the Academy, April 20. The six Zuni chiefs were present, and were introduced to the audience by Mr. Cushing at the opening of his address. After giving an account of the intricate system of priesthood among the Zunis, Mr. Cushing gave an enumeration of the Zuni gods, who are divided into six great classes. Interesting among the hero gods is the great priest of all religious orders save one. He is supposed to have appeared among the ancestors of the Zunis, so poor and ill clad as to have been ridiculed by mankind. He it was who taught the fathers of the Zunis their architecture and their arts; their agriculture and their system of worship by flames and painted sticks; but, driven to desperation by the ingratitude of his children, he vanished beneath the world, never to return to the abodes of men; yet he still sits in the city of the sun, ever listening to the prayers of his ungrateful children.

The address was followed with many interesting illustrations of a poetical character of this strange people. The other papers for the day were as follows: "On the Polarization of the Light of the Moon," by A. W. Wright; "On the Results of the Incandescent Lamp Tests at the Paris Exhibition," by G. F. Barker; "On the Formation of Metalliferous Vein Formation at Sulphur Bank, California," by Professor Joseph LeConte; "On a Form of Standard Barometer," by A. W. Wright, and "On a Marsupial Genus from the Eocene," by Professor E. D. Cope. On the last day one new member was elected—Prof. Ira Remsen, of Baltimore.

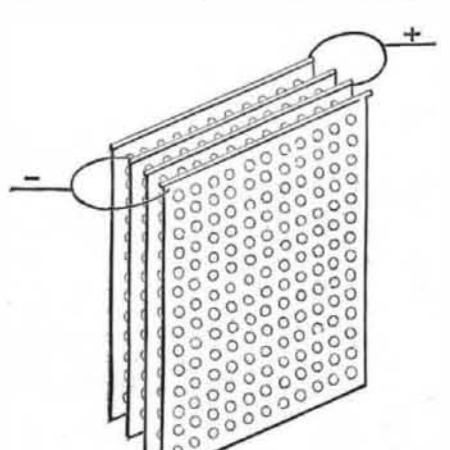
ANOTHER ELECTRIC RAILWAY.—The second electric railway constructed by Messrs. Siemens and Halske in Berlin was formally opened, April 29. It runs from Lichterfelde, a suburban station on the Berlin-Anhalt Railway, to the Military Academy, about one and a half English miles.

The Sellon and Volckmann Storage Battery.

Last week we gave a brief account of this new invention for the storage of energy, which is now in successful operation at the Electrical Exhibition, London. We now present further particulars, which we find in a recent number of *Nature:*

"The new accumulator of Messrs. E. Volckmann and J. S. Sellon, exhibited at the Crystal Palace Electrical Exhibition, in connection with the Lane-Fox system of electric lighting in the Alhambra Courts, has already been announced, but its construction has hitherto been kept a secret for reasons of patent right. The storing power of this new secondary battery may be gathered from the fact that 33 cells feed 201 Lane-Fox incandescent lamps, nominally of 20-candle power for seven hours at a time, if the battery is fully charged to start with. The actual light of each lamp, however, is nearer 30 candles; and it is found that these lamps, which are designed to bear a 20-candle current from the generator, will stand a 30-candle current from the accumulator owing to its more uniform flow.

"Each cell is stated to contain 5 horse power of energy acting for an hour, or 1 horse power for five hours, and so on. It consists of a series of metal plates of some alloy, each plate being five-sixteenths of an inch thick, and perforated with round half inch holes, as close as they can be punched or cast. These plates are connected alternately in series like the plates of a condenser, as in the figure, and joined to two



stout terminals, which are the poles of the cell. The holes are filled with a metallic paste, the composition of which is not yet divulged, but may readily be guessed, from the fact that metallic lead is reduced on the negative plates, and peroxide of lead on the positive plates. The spaces between the plates, which are placed nearly an inch apart, are filled up with water mixed with one-tenth part of sulphuric acid, to give good conduction. The whole is contained in a wooden trough about 30 inches square and 8 inches in thickness. The weight of each cell is about 375 pounds, including 295 pounds of the metallic composition which is the storing agent. The sparks given off on connecting several cells of the charged battery by a stout copper wire are remarkably violent, the deflagrated wire flying off in a perfect shower of red hot sparks of copper accompanied by loud cracks. On examining the wire afterwards, it is found to be literally torn asunder in small pieces by the force of the discharge. A considerable quantity of hydrogen is evolved from the cells.

"The exhibition of Lane-Fox lamps fed from this battery is without doubt the most brilliant display of incandescent lighting which has yet been made in this or any other country."

The *Engineer* has the following:

The new secondary battery, of which a good deal has been published without stating by whom it was made or invented or what it was like, was recently exhibited and shown in operation to the Prince and Princess of Wales in the Alhambra Courts of the Crystal Palace, by the Electrical Power Storage Company, of 74 Hatton Garden. The battery is the result of the labors of several inventors, among whom are Mr. E. Volckmann, Mr. Sellon, and Mr. Swan, and it is, it need hardly be said, entirely different in construction from the Faure battery, of which so much has been heard and comparatively little seen. For the purpose of the display, the Alhambra Court is richly furnished in the Moorish style, and electric chandeliers or candelabra have been specially designed by Mr. Johnson, a pupil of the late Owen Jones. Of the design of these fixtures and fittings we can only say that they must be seen to be appreciated. Altogether they carry 201 incandescent lamps, all of which are connected up to 33 of the new batteries out of 38 at present in an inclosed space next the engine and machine shed of the Brush Corporation. The 33 are connected up to a switch-board in such a way that the current from any number from about 10 to 33 may be put in circuit by simply turning the switch handle, and thus anything from a very dim to a very bright light may be used as required.

The cells each contain twelve elements, each about 20 in. by 15 in., and about $\frac{5}{16}$ in. in thickness, and placed in a box of about 25 in. by 16 in. by 7 in., the whole weighing about 370 lb., and containing about 295 lb. of metallic material. Each cell stores electric energy equivalent to about 5-horse power for one hour, which can be used at the rate of fully 40 ampères per horse-power, or say 200 ampères. The plates are closely perforated with holes about half inch diameter, the holes being afterward filled with a composition, the exact nature of which we are not yet at liberty to make known, further than to say that it is such that it expands when the plates are first polarized, and thus finds itself under a pressure sufficient to cause a considerable superficial extension of the positive plate. Perfect metallic contact between the composition and the material of the plates is thus permanently insured, so that the plates cannot become inactive by local action or by deposit of a salt of lead between the composition and the walls of its containing holes forming a solid mass of alloy. The plates are strong and are maintained at a very short distance apart by splines of wood, and stand with their longest dimension vertical. They are connected up to a plate on the top of the cell in a very simple way, the whole producing a perfectly satisfactory, efficient, and practical battery, having neither of the chief faults of the Faure battery.

From the figures we have given, and to which we shall add on an early occasion, it will be seen that the weight of the battery per one hour horse-power is about 60 lb. of metallic composition. To give off 400 horse power for one hour or 200 horse power for two hours would thus require about 10 tons of batteries, and for the 201 Lane-Fox lights in circuit, a little over 4½ tons were coupled up.

The Lane-Fox lamps are 20-candle power pushed to 30-candle power, so that the weight of battery coupled up was 1·65 lb. per candle, or 50·14 lb. per 30-hour candles.

It is generally acknowledged by electricians that without a satisfactory secondary battery domestic electric lighting cannot become general. This is not, however, confined to domestic lighting, but applies to lighting public buildings and to many other applications of electricity. Something must be had which in an electric lighting system, or in an electromotive power system, will take the place represented by the gasometer in the gas-lighting system and by the accumulator in a hydraulic power system. The battery which will do this is now provided, and the application of electric currents will probably make more rapid advance from this time than it has done even within the past three years. The new battery may be made to meet any requirements. It may be of small size to go into the place of the gas meter in a house, or in large masonry tanks for extensive public buildings and it will probably be made to fill very large tanks at central electric lighting and power-generating stations, so that smaller engines running continually may take the place of large engines running as at present only during the hours that lights are required. It will be possible to obtain a light or work an electric motor at any time by one movement of a handle, and the batteries will probably, in some cases, constitute the motor for domestic lighting. One of each pair of the elements or plates will last almost indefinitely, while the other will only require renewal when constantly in use about once in, say, fifteen months, as far as can at present be seen, and they may turn out to be made more durable. They are easily renewed, and the batteries require no attention whatever, except for a little filling up at long intervals of the acidulated water in which the plates are immersed.

The lamps were nominally 20-candle power, pushed to 30-candle power, the total candle power being 6,030 candles.

The Parasitic Nature of Tubercular Consumption.

Professor Tyndall has communicated to the London *Times* an account of results obtained by Dr. Koch, of Berlin, in the investigation of the etiology of tubercular disease, as set forth by him in an address delivered, March 24, before the Physiological Society of Berlin.

It was the aim of Dr. Koch to determine the precise character of the contagium which previous experiments on inoculation and inhalation had proved to be capable of transferring and reproducing tubercular consumption.

In pursuing these investigations Dr. Koch subjected the diseased organs of a great number of men and animals to microscopic examination, and found, in all cases, the tubercles infested with a minute, rod-shaped parasite, which, by means of a special dye, he differentiated from the surrounding tissue. It was, he says, in the highest degree impressive to observe in the center of the tubercle cell the minute organism which had created it. Transferring directly, by inoculation, the tuberculous matter from diseased animals to healthy ones, he in every instance reproduced the disease. To meet the objection that it was not the parasite itself, but some virus in which it was embedded in the diseased organ, that was the real contagium, he cultivated his *bacilli* artificially, for long periods of time, and through many successive generations. With a speck of matter, for example, from a tuberculous human lung, he infected a substance prepared, after much trial, by himself, with the view of affording nutriment to the parasite. Here he permitted it to grow and multiply. From this new generation he took a minute sample and infected therewith fresh nutritive matter, thus producing another brood. Generation after generation of *bacilli* were developed in this way without the intervention of disease. At the end of the process, which sometimes embraced successive cultivations, extending over half a year, the purified *bacilli* were introduced into the circulation of healthy animals of various kinds. In every case inoculation was followed by the reproduction and spread of the parasite and the generation of the original disease.

In the course of his experiments Dr. Koch determined the limits of temperature between which the tubercle bacillus can develop and multiply to be 86° Fah. and a maximum of 104°.

He concludes that, unlike the *bacillus anthracis* of splenic fever, which can flourish freely outside the animal body, in the temperate zone animal warmth is necessary for the propagation of the newly discovered organism. In a vast number of cases Dr. Koch has examined the matter expectorated from the lungs of persons affected with phthisis and found in it swarms of *bacilli*, while in matter expectorated from the lungs of persons not thus afflicted he has never found the organism. The expectorated matter in the former cases was highly infective, nor did drying destroy its virulence. Guinea-pigs infected with expectorated matter which had been kept dry for two, four, and eight weeks respectively were smitten with tubercular disease quite as virulent as that produced by fresh expectoration. Dr. Koch points to the grave danger of inhaling air in which particles of the dried sputa of consumptive patients mingles with dust of other kinds.

Commenting upon this important communication from Prof. Tyndall, the London *Times* points out the significant fact that though the experiments of Dr. Koch seem as yet to have been carried no further than to the repeated cultivation of the tubercle bacillus in its original virulence, they will speedily be followed, as a matter of course, by attempts at cultivation in diminished intensity. The evidence, even now, the *Times* continues, does not rest upon the labors of Dr. Koch alone, for Prof. Klebs, five years ago, declared the infective property of tubercle to be due to the presence of a microphyte (practically a synonym for bacillus), and Dr. Schüller, of Greifswald, a résumé of whose investigations was given by Mr. Simon to the International Medical Congress, has proved that the microphyte which characterizes turbercle characterizes, also, certain affections popularly called scrofulous, such as diseased joints and glands, and that inoculation from any of them, or with a fluid in which their microphyte has been cultivated, will infect with general tuberculosis. Dr. Schüller, according to the same authority, has also made proposals for the treatment of tubercle on the basis of its micro parasitic origin, and has shown the successful results of such treatment upon animals which he has inoculated.

The Recent Lawson Boiler Experiment.

To the Editor of the Scientific American:

Referring to the Lawson experiment (exploding boilers), on page 230, SCIENTIFIC AMERICAN, it is stated that there was twenty inches of water in the boiler. This, we infer, was at the commencement of the operation, as there was no means of supplying more water, and no means of knowing how much of that water was wasted or became steam previous to the explosion. The pressure is said to have been 235 pounds, representing a temperature of 400° Fah. Now the question in my mind is: In what condition was the water at 400° Fah.? Supposing the boiler strong enough to sustain twice the pressure and a corresponding degree of heat, is it possible for water to exist (*as water*) at a like temperature? It seems to me there must be a point or degree of heat where the water in a boiler—under like circumstances—will all become steam.

Will some one please give us more information on this subject through the SCIENTIFIC AMERICAN? and oblige,

WM. ORD.

Brooklyn, Ohio, May 1, 1882.

The Chalmers-Spence Fire.

The recent disastrous fire which occurred in the establishment of the Chalmers-Spence Company (Morgan Iron Works), New York, manufacturers of boiler coverings, will not interfere with the business of the company in the least, and all orders will be filled promptly as usual. The loss was about $50,000, mostly covered by insurance.

The Care of the Eyes.

At the recent Sanitary Convention at Ann Arbor, Mich., Dr. C. J. Lundy, of Detroit, read a paper on "Hygiene in Relation to the Eye," which should have the widest circulation, especially among teachers and school officers. A fruitful source of eye troubles is shown to be the excessive strain upon the muscles and nerves of the eyes due to faulty educational methods, the ill-planned and insufficient lighting of school rooms, poor ink and fine print in school books, and other causes, which education might correct.

In conclusion, Dr. Lundy lays down the following rules for the better care of the eyes:

1. Avoid reading and study by poor light.
2. Light should come from the side, and not from the back or from the front.
3. Do not read or study while suffering great bodily fatigue or during recovery from illness.
4. Do not read while lying down.
5. Do not use the eyes too long at a time for near work, but give them occasional periods of rest.
6. Reading and study should be done systematically.
7. During study avoid the stooping position, or whatever tends to produce congestion of the head and face.
8. Select well printed books.
9. Correct errors of refraction with proper glasses.
10. Avoid bad hygienic conditions and the use of alcohol and tobacco.
11. Take sufficient exercise in the open air.
12. Let the physical keep pace with the mental culture, for asthenopia is most usually observed in those who are lacking in physical development.

Effects of Jets.

In 1826 a French engineer discovered that when a jet of gas flows through an orifice or nozzle under pressure, and a plate be held normal to the axis of the jet at a certain height above, it is repelled, whereas if held lower it is attracted; and there is a neutral point at which it is supported on the jet, and emits an audible note as it oscillates about this position of equilibrium. M. Th. Vautier has recently succeeded in evoking very high sounds in this manner and registering them. With a jet of steam having a pressure in the boiler of 4½ atmospheres, and issuing from an orifice of 2·7 mm. in diameter, against a plate 6 mm. in diameter and 1½ mm. thick, held 0·2 mm. from the orifice, the note obtained was La^6 sharp=7,250 single vibrations per second. An electro diapason was employed to register the vibrations—by means of a sharp style tracing a line on smoked mica.

To Europe in Less than a Week.

QUEENSTOWN, May 2.—The Guion Line steamer Alaska, Captain Murray, which sailed from New York on Tuesday, April 25, at 1:12 P.M., for this port and Liverpool, passed Fastnet at 3:20 o'clock this afternoon, having made the passage in 6 days 21 hours 46 minutes. The company claim that this is the fastest passage ever made by several hours.

The Inspection of Foreign Passenger Ships.

A bill was recently passed by the House of Representatives requiring the inspection of foreign vessels carrying passengers from American ports; and it is to be hoped that the Senate will not fail to pass a similar bill, as it did at the last session.

The urgent need of such inspection was forcibly stated by the representative from this city, the Hon. S. S. Cox. In the course of his speech he arraigned particularly a steamship company whose practice has been to use in the West India trade vessels whose extreme age and rottenness made it impossible for them to pass inspection anywhere. Flying a foreign flag, however, they were free from inspection in the ports of the United States, and were thus continued in service long after they had ceased to be fit to go to sea. Of this class of vessels the Bahama, which went to pieces in a slight gale off our Florida coast last summer, was a fatal example.

Mr. Cox pointed out the startling fact that during the past year the loss in vessels flying the British flag was $900,000,000. There were 144 steamships lost—151,000 tons!—with a total loss of life amounting to 1,459. Every day last year 5 vessels and 4 lives were lost on all the seas by reason of such disasters. Many of these losses were from foundering, overloading, bad stowage, structural defects, and bad machinery. Six vessels were abandoned at sea because they were utterly unfit. "So long," he said, "as we allow English vessels to escape inspection in our harbors we share the responsibility of this terrific loss of life. No life-saving service of ours which concerns stranding can guard against the body of these losses."

The bill passed provides that Section 4400 of the Revised Statutes of the United States be amended and enlarged by adding thereto at the end of said section, as it now appears, the words:

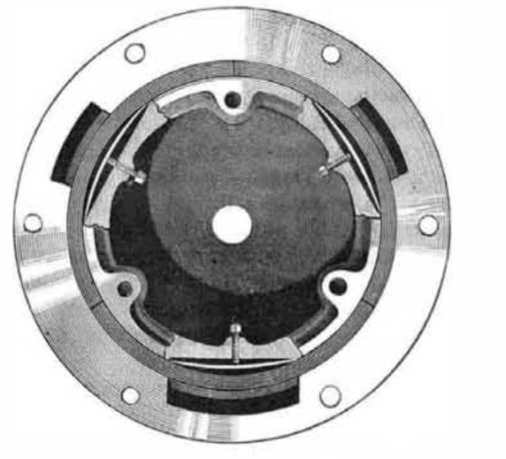
"And all foreign private steam vessels carrying passengers from any port of the United States to any other place or country shall be subject to the provisions of Sections 4470, 4471, 4472, 4473, 4479, 4482, 4486, 4488, and 4489, of this title, and shall be liable to visitation and inspection by the proper officer, in any of the ports of the United States, respecting any of the provisions of the sections aforesaid."

Boiled Milk.

To distinguish boiled milk from fresh milk the smell and taste are called into requisition, but only the experienced succeed in this. Quevenne's assertion that boiled milk does not coagulate as soon or as completely as unboiled is frequently incorrect. According to C. Arnold, in the *Pharmaceutische Archiv*, if a little tincture of guaiac is added to fresh milk a more or less intense blue color will appear at once or in a few minutes, and last a long time. More than twenty different sorts of milk were tried, and all gave the reaction without exception. By carefully warming the milk to 40° or 60° C. (104° to 140° Fahr.) the reaction took place at once; and also at 70° to 78° (158° to 172° Fahr.) it took place, but more feeble. Milk warmed above 176° Fahr. (80° C.) remained uncolored when guaiac solution was added, either to the warm milk or after cooling. Milk once cooked did not show it, neither did condensed milk.

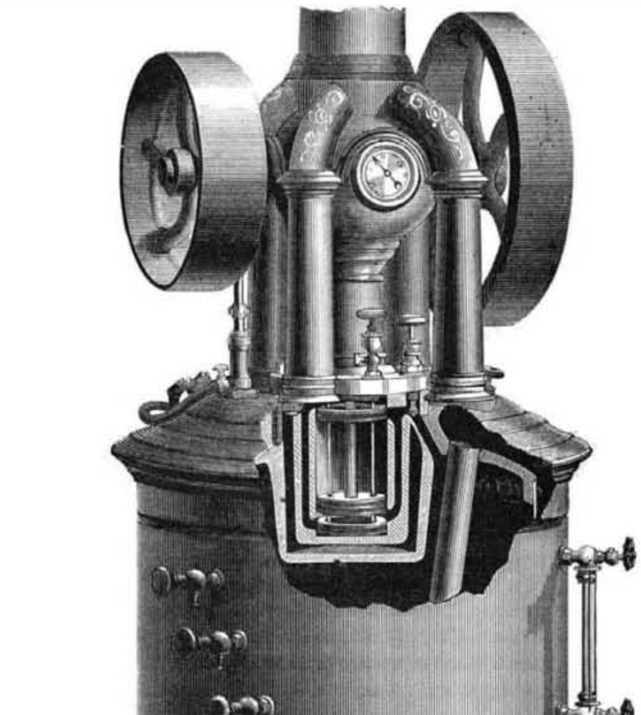
The reaction with tincture of guaiac is so delicate that one drop of milk added to a trace of the tincture on a watch glass, or a drop of milk on filter paper, turned blue when rubbed with a glass rod dipped in guaiac tincture. Sour milk also gives this reaction, but the addition of mineral acids and caustic alkalies destroys it.

According to some further experiments which he made



SECTION OF ENGINE CYLINDER.

this reaction must be due to ozone in fresh milk. It must also be mentioned that emulsions of olive, castor, linseed, and poppy seed oil, made according to the pharmacopœia, also blue the tincture of guaiac.



HUNT, HALSEY & BUDINGTON'S STEAM ENGINE.

That this reaction agreed with that of other emulsive liquids caused the experimenter to examine whether milk and blood did not possess a common reaction. In fact, fresh milk, as well as boiled, acts as a carrier of ozone just like blood corpuscles, etc. If old oil of turpentine is added to a mixture of iodide of potassium starch and milk, a blue zone is formed at once where the layers are in contact, and rapidly spreads. Milk that has been boiled a long time does not give the reaction for several minutes, and at this length of time a mixture of turpentine and iodide of potassium starch frequently turns blue without any ozone carrier. Milk from which the albuminoid bodies have been removed no longer give the reaction.

If caustic potash and a trace of sulphate of copper solution is added to fresh milk, from which the casein has been removed by acetic acid, the violet color characteristic of peptones no longer appears. When the milk has been standing ten to twenty hours the continual increase of the peptones is indicated by the violet color growing all the time more and more intense.

COPPER IN BREAD.—The author concludes that wheat normally contains copper to the extent of 8 to 10 parts per million. He has experimented with grain, the seed of which had not been "pickled" with sulphate of copper (as is often done to prevent smut), and has satisfied himself that the copper was not due to any impurity in his reagents, or to the gas pipes and burners.—*Jules Van Dens Berghe.*

A NEW STEAM ENGINE.

We give engravings of several forms of an engine that marks a new departure in steam engineering. These engines are new in form, and embody features in their internal construction which distinguish them from all others. The principal novelty is in the valves and valve motion; the valves being located inside the cylinder, and the valve motion being such as to insure a quick opening and closing of the valve at the most favorable time. The ports communicate with the interior of the cylinder near opposite ends, and the exhaust and induction ports are, in the present case, placed diagonally opposite each other. In the future, however, it is designed in the larger sizes of engine to place two supply and one exhaust port at each end of the cylinder and on opposite sides of the valves, so as to insure a perfect equilibrium of pressure, and so to relieve the valves from friction.

The valves consist of two rings, one placed at each end of the cylinder in an annular cavity between the inwardly projecting heads of the cylinder and the inner surface of the cylinder. The two valves are connected together by rods, which project through the top cover of the cylinder, and are connected with a rocking lever having forked arms, which straddle the engine shaft and carry rollers engaged by a cam on the main shaft, which moves the valves one way and the other.

The steam, at boiler pressure, is admitted by the valves directly into the cylinder without the loss due to steam contained in the ports and steam passages of engines as usually constructed. This is an important advantage, especially in quick running engines, since every half revolution of an ordinary engine is accompanied by the loss of a quantity of steam contained in the steam passages, and this loss, happening perhaps hundreds of times each minute, amounts, in the course of the day, to a considerable percentage of the steam used.

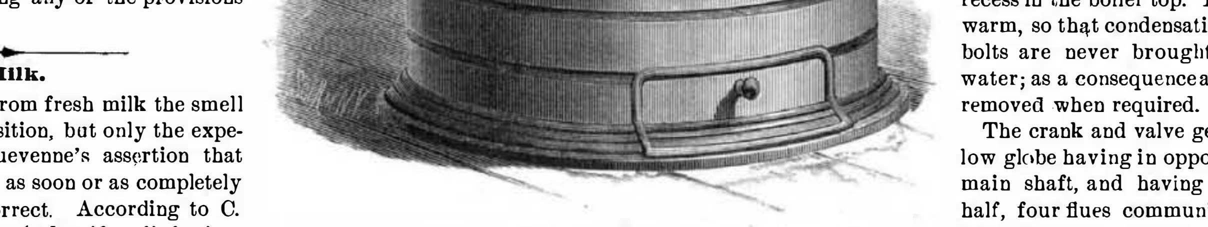
The ring valves are so related to the supply and exhaust ports that when the exhaust is open the supply will be closed, and *vice versa.*

In the engine shown in Fig. 1 the cylinder is seated on the top of the boiler and projects downward into a recess in the boiler top. By this means it is always kept warm, so that condensation is avoided. The screws and bolts are never brought into contact with steam or water; as a consequence all of the bolts may be readily removed when required.

The crank and valve gear of the engine are in a hollow globe having in opposite sides the bearings for the main shaft, and having cast together with its upper half, four flues communicating with the smoke chamber below and uniting at the top in a common flue, with which is connected the smoke pipe. The exhaust pipe of the engine extends upward through one of these flues, and discharges into the smoke pipe above, disposing of the exhaust steam and at the same time affording an efficient means of increasing the draught. The boiler of this engine has a number of flues leading directly to the smoke box, and several short flues leading from the fire box laterally to the jacket surrounding the boiler and communicating with the smoke box.

In the horizontal engine, shown in Fig. 3, the same general plan is followed, and in the locomotive engine, shown in Fig. 5, the construction of the cylinders and valves is substantially the same.

In the locomotive it is essential to provide a reversing gear; this consists



HORIZONTAL ENGINE.