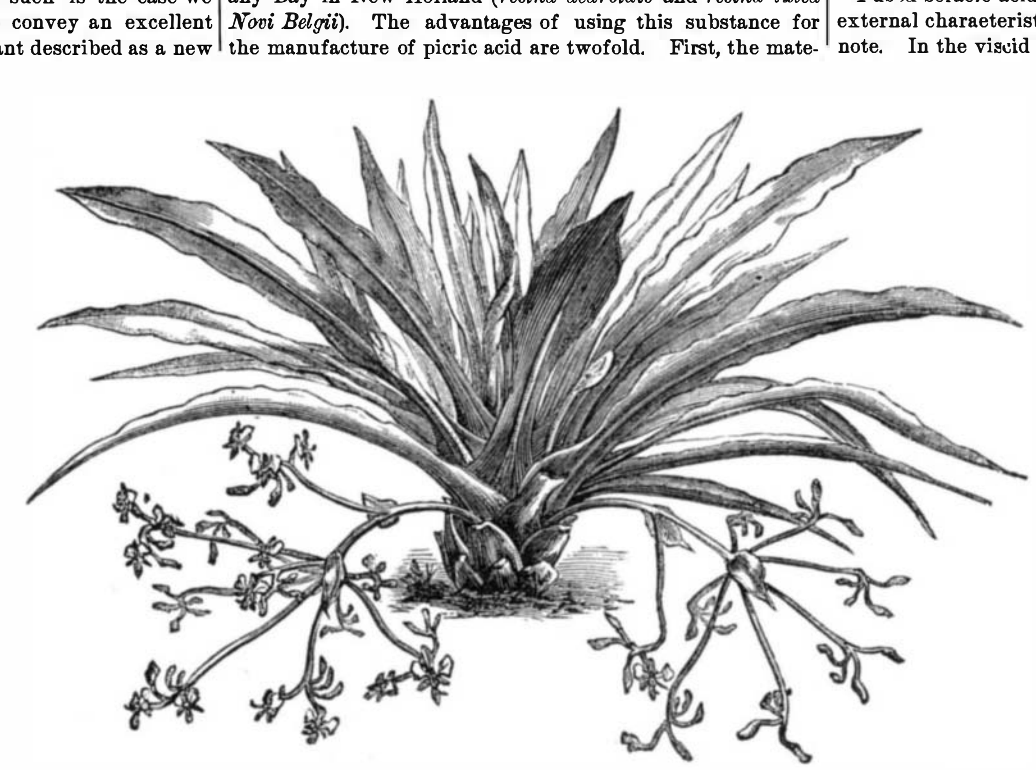
COCHLIOSTEMA JACOBIANUM.

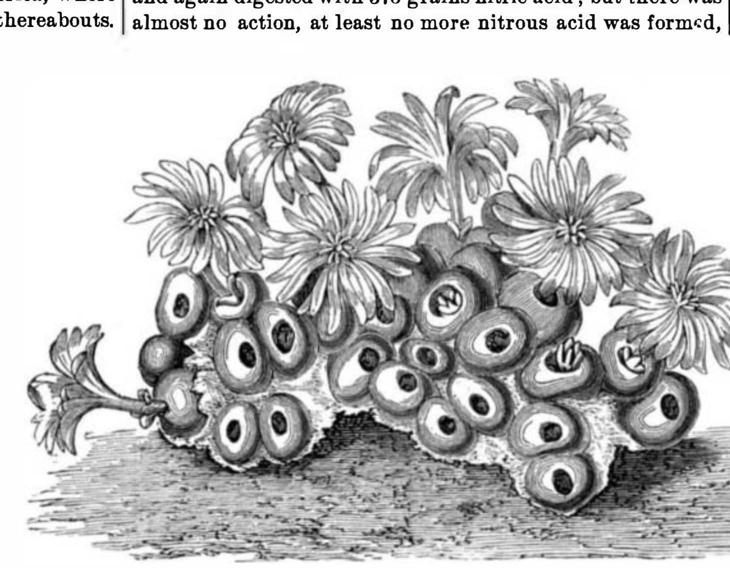
This singular plant, with agave-like foliage, and somewhat orchid-like blossoms, is one of great beauty. A plant belonging to the same genus was introduced in England some few years ago, and more than one of the principal nurserymen flowered it successfully. M. E. Andre, however, who, in the *Revue Horticole*, recently gave a figure of what he deems to be a new species, appears to think that the elder species is now entirely lost to the English gardens; but whether he has sufficient proof that such is the case we doubt. Our engraving will serve to convey an excellent idea of the agave-like foliage of the plant described as a new species by M. E. Andre. An engraving, however, can give no idea of the beauty of its inflorescence. The petals of the flowers, which are of a soft velvety purple, measure 1½ inches across, while the sepals are of a pale rosy white. The spoon-shaped bracts are of a deep bright salmon color, the whole of the stalks being of a paler tone of the same color, flushed at the joints with a full brownish pink. The flowers exhale a delicate perfume, similar to that of certain *oncidiums*, to the blossoms of which they present a superficial resemblance. The beautiful flowers of *c. Jacobianum* have the defect of being exceedingly evanescent, as noticed in the previously known species which has flowered in England. This defect, however (which is peculiar to nearly all commelyna ceous plants), is more than counterbalanced by the profusion with which the flower spikes are seemingly produced on well grown plants. In the new (?) species described by M. E. André, he relies for its distinctness on the following differences from the old one: First, by the far less hirsute character of the flowers; and secondly, by the uniform green of the leaves, the elder species having them either strongly blotched or bordered with purple. He also relies on the much larger general dimensions of the plant. It is presumed that so large a plant can only be an epiphyte upon some of the forest giants that clothe the deep slopes and valleys of equatorial America. In a shaded part of the stove house it is not difficult to flower, and its multiplication may be effected by the separation of the small lateral buddings until seeds shall have been obtained. It is well worthy of a place in the orchid house.



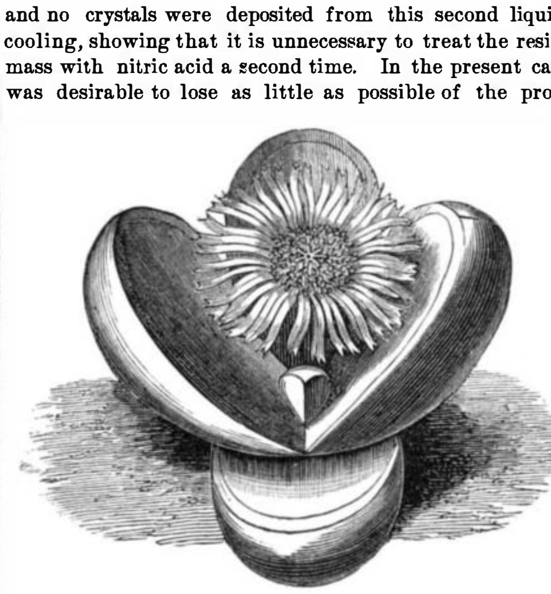
COCHLIOSTEMA JACOBIANUM.

MESEMBRYANTHEMUMS.

These beautiful flowers belong to South Africa, where there may be found no fewer than 250 species or thereabouts. For the sake of convenience, Haworth has divided mesembryanthemums into forty-three sections and sub-sections. *M. debile* and *crassifolium*, though thought by some to be Australian species, nevertheless belong to the Cape, and probably went first to Australia from there or from England. *M. cordifolium* (the ice plant), so well known in country districts, was sent to England a few years ago by Baron Müller; but it is likely that some plant-loving emigrant took it out to Australia. The majority of mesembryanthemums are easily grown, and make firstrate window and rockwork plants. Common garden soil suits them perfectly; the kinds represented in the accompanying illustrations, and their immediate congeners, may be placed among fancy sorts—little gems well worth cultivating on account of their quaintness and variety rather than as subjects for purposes of general decoration. For those who are fond of uncommon forms among plants, but who have little time or space to devote to their culture, these are plants well worth attention. *M. minimum*, of which we give an engraving, belongs to the sphæroide section, a group in which there are four others, *m. truncatulum, obconellum, nuciforme*, and a new species which is much larger than the others, and which has been named *m. truncatellum*. These plants never form a stem, and increase in size by bursting through the fleshy top, when the outer part shrivels up, and the new formation takes its place. The flowers, which issue from the center, are pale rose. Plants like these require to be potted in very sandy soil, and require to be well drained, when they will grow well. *M. testiculare*, of which an illustration is also given, is a rare and beautiful plant, with a skin as smooth as silk, and very glaucous. It is sometimes called *m. octophyllum*, but we never yet saw it with eight leaves. It is somewhat delicate, and should be potted in half silver sand, the other half being loam and brick rubbish, and should be kept near the glass in a dry house. *M. fissum* is closely related to this species, but it is more easily cultivated than *m. testiculare*. Among the most interesting of the mesembryanthemums are *m. tigrinum* (tiger's chap), *m. lupinum* (wolf's chap), *m. felinum* (cat's chap), *m. erminum* (rat's chap), *m. murinum* (mouse's chap), and *m. mustellinum* (weasel's chap), all exceedingly interesting, and easily cultivated kinds; their flowers, which are all yellow, open in the afternoon. They form valnable plants for rockwork in summer, standing well out of doors in the south of England from May until October. They are easily propagated by pieces pulled or cut off and laid in the sun on moist sand, where they root freely in a few weeks, and often keep on flowering as though nothing had happened.



MESEMBRYANTHEMUM MINIMUM.



MESEMBRYANTHEMUM TESTICULARE.

A Profitable Source of Picric Acid.

G. C. Wittstein calls attention to a new source of picric acid. This is a long and well known drug, the resin of *xannthorrhœa arborea*, a plant which is a native of Australia. It is known as acaroid resin and as the yellow resin of Botany Bay in New Holland (*resina acaroidis* and *resina lutea Novi Belgii*). The advantages of using this substance for the manufacture of picric acid are twofold. First, the material is cheap; second, the yield is large. About one hundred and fifty grains of the pulverized resin were placed in a beaker glass, and 750 grains crude nitric acid, of specific gravity 1·16, poured over it; the beaker was covered with a glass capsule and digested at a gentle heat. The mass soon swelled up, and a deep brown crust formed over the liquid. This crust needed to be broken up from time to time with a glass rod. After about three hours, nitrous fumes ceased to be evolved, and the mass was allowed to cool. The next day, he found the bottom of the beaker covered with a thick layer of yellow crystals. Above this was a brownish red tarry mass, which hung together in a lump. This was taken out and again digested with 375 grains nitric acid; but there was almost no action, at least no more nitrous acid was formed, and no crystals were deposited from this second liquid on cooling, showing that it is unnecessary to treat the resinous mass with nitric acid a second time. In the present case it was desirable to lose as little as possible of the product sought; hence, after the crystals that formed had been taken out, the second liquid was added to the mother liquor and evaporated to dryness. The first crystals were added and the adhering nitric acid driven off at 212° Fah. The total residue weighed 100 grains, almost ⅔ of the resin taken; it was yellow and crystalline, and contained nothing amorphous but single crystals of oxalic acid. The picric acid thus obtained, after recrystalizing to secure the oxalic acid, weighed 75 grains. Hence, the yield is 50 per cent of the crude material.

Fused Boracic Acid.

Fused boracic acid, which approaches glass in some of its external characteristics, presents some properties worthy of note. In the viscid state it may be drawn out into threads, which solidify rapidly, and from this point of view its ductility rather resembles that of silica than of glass. Its hardness, between 4 and 5, places it between fluor spar and apatite; it scratches glass, and is with difficulty attacked by sand, and even by emery, dry or with oil. It takes seven to eight times as much time in grinding as glass under the same circumstances. This resistance to friction, which does not accord with its hardness, depends doubtless, as M. Damour has recognized in the case of other miner als, on a speciality of structure. Melted boracic acid, in mass, becomes slowly hydrated in contact with water. In powder it is acted on rapidly, as shown by Ebelmen. If thepowder is sprinkled with water, its temperature may rise to 100°. Boracic acid is chiefly remarkable for the persistence of its temper. If poured upon a cold metallic surface, glassy plates are obtained, the under surface of which, chilled by the metal, is more strongly tempered and more expanded than the upper. Hence results a flection which may be strong enough to cause the rupture of the plate and its projection in fragments. If poured into oil it may be obtained in small masses with short tails, under the same conditions as Prince Rupert's drops. A tempered plate of boracic acid, with parallel surfaces, acts upon polarized light like tempered glass; but while the latter loses this property by re-heating, boracic acid preserves it with great tenacity.— *V. de Luynes.*

Eighty Miles an Hour in Pneumatic Tubes.---The Atmospheric Post between Paris and Versailles.

The National Assembly of France holds its sittings in Versailles, a kingly residence distant some eleven miles from Paris. The latter is the real seat of government, and it was therefore of great importance to introduce a means of communication by which official documents could be transmitted between the two places, at any moment when required, with great rapidity. For this purpose the pneumatic method has been put into operation, with much success, and it is stated that letters and packages are now sent through, in either direction, in eight minutes' time, being at an average velocity of more than eighty miles an hour.

To produce this enormous velocity—the tubes being only four inches in diameter—requires the use of three steam engines having an aggregate of one hundred and fifty horse power, besides other extensive apparatus, which we will briefly describe, quoting from a recent number of the *Engineer*.

A report on the system of M. Crespin, on the application of pneumatic power over long distances, has been reported upon by M. Tresca, of the Conservatoire des Arts et Metiers, with the Academy of Sciences, and the report is now published. We copy from the *Engineer*.

When it was found necessary to connect Paris and Versailles by means of a pneumatic tube, it was impossible to make use of the method adopted in Paris, which only gives the required speed over a distance of about 1 mile. The problem was to apply the same force along a line from 11 to 12 miles in length. This result has been obtained by the adoption of an apparatus called a relay, which, placed at various points along the line, acts upon the train and urges it at full speed to the next station. The column of air within the tube is set in action by forcing or by exhaustion, and the two operations are employed concurrently, but in a novel manner.

As in the pneumatic telegraph, M. Crespin uses a series of boxes to form a train; the impulse is given by forcing the air in at one end of the tube and exhausting it at the other; the pressure accumulated in the reservoirs comes into action at the moment the train passes a relay, and continues until the arrival of the train at the next post, when it is taken up by another reservoir, and so on to the end.

The line is double, up and down, and each is divided into sixteen sections of 3,650 feet in length, and each section has its relay. The necessary motive power is obtained from three stations, one at each end of the line, the other in the middle. The last is the most important, and comprises two engines of fifty horse power each, with pumps capable of exhausting the 280 cubic yards contained in the part of the line it serves in ten minutes, at the same time storing it in the reservoirs under the pressure of one atmosphere, necessary to supply successively behind the train 188 cubic yards of air, representing 11 miles in length. The two stations at the ends of the line have each two engines of twenty-five horse power, with pumps, which in ten minutes exhaust nearly 3 miles of line, and which at the same time compress in the reservoirs sufficient air to fill, at the moment required, double that length of line.

The reservoirs at each of these three stations are connected together by means of cast iron tubing, 5 inches in diameter, placed in the same excavation as the main tubes, at a depth of 2½ feet, and opposite to each relay a branch is connected with a reservoir containing 20 cubic yards of air for the service of the relay in both directions. The relays are placed under the main tubes in a small chamber closed by a trap similar to those used for sewers. The exhaust relays are placed at two points, each one quarter of the length of the line from the end, and consequently with half the length of the line between them. The exhaust receivers are much larger than the others, and they are connected with the central establishment by means of cast iron pipes 4 inches in diameter, which contribute to regulate the action of the exhausting engine. In order to insure regularity in working, large reservoirs are also placed at each end of the line, and all the accumulators of pressure are in communication with each other. At the central station, the capacity of the pressure reservoirs is 80 cubic yards, and those at the termini half that amount. The exhaust reservoirs have a capacity of 97 cubic yards at the central station, of 60 cubic yards at each intermediary station, and of 52 cubic yards at each terminus. The last named are not in communication with the rest, and thus 5½ miles of tubing are dispensed with.

With this arrangement no obstacle can arrest the movement of the trains; the pressure in the reservoirs is an atmosphere higher than that of the ordinary air. The train is introduced through a kind of sluice gate, or chamber, closed by means of a valve at the entrance of the line, and the train is furnished with a piston fitted with leather, which has precisely the contour of the tube. When the train is in place, the valve is opened and the pressure turned on. With a pressure of one atmosphere behind, and a partial vacuum in front, the train starts with a speed of 130 feet per second, or 7,800 feet per minute; and at the moment of passing the first pressure relay, at 3,650 feet from the terminus, it opens behind it a large valve, which places the line in communication with the reservoir of 20 cubic yards placed at the foot of the relay, and this second current of air takes up the work. When the train arrives at a station, an electric bell informs the attendant at the station last past, and he closes the valve there.

In order to suspend the current of air of one relay, after the train has entered the next section, the pressure itself is made use of to set in motion a piston in the cylinder; this piston moves, of course, at the same rate as the current of air, and it is so calculated that the piston stops at the end of the section. Admission is thus cut off, but the tube is full of compressed air. When the train has passed the third and fourth sections of the line, and has arrived at the first vacuum relay, the compressed air which follows the train acts on a piston freed by the train, and this piston enters rapidly into a cylinder with a valve, which puts the up line in communication with the exhaust of 60 cubic yards at this station. The compressed air escapes rapidly through a safety valve placed above the exhaust relay. As soon as the train has passed the fourth section, the current of air of the relay presses on the exhaust valve, closing the line, and the train proceeds at the same rate as before; but by a special arrangement, the speed slackens towards the terminus to avoid any shock. The time occupies in the transit is eight minutes.

The pneumatic tube itself is formed of wrought iron tubes brazed, 4 inches interior diameter, with a thickness of ¼ inch, and weighing about 26 lbs per meter run = 8 lbs. per foot. They are joined together by means of six bolts with an india rubber washer between. In places the tube is curved, but the radius generally exceeds 19 feet.

The working of the line is regulated throughout by electric signals, and a special wire connects all the pressure relays, and tells whether they are in action or not. The carrier pistons are of iron, with an interior diameter of 3½ inches, and 9 inches in length; the boxes are placed in a case which is slightly conical. On the outer surface of the carrier pistons are fixed two strips of metal which are turned to 3·95 inches, and started longitudinally so as to produce rotation, this arrangement causes the wear to be equally distributed, and, should a grain of sand get into the tube, it prevents stoppage by friction. The piston is also hollow and similarly provided, and between the two strips of metal there is a series of openings into the interior to receive any dust which may arise from the wear of material. The packing leather is fixed solidly between two washers by means of a bolt at the end.

The exhaust relay consists of a piston which enters a vertical cylinder, and draws with it a disk, which closes the pneumatic line, and a valve, which opens a large rectangular orifice communicating with the reservoirs. The top of the cylinder in which the piston moves is connected by a tube with the back part of the valve above mentioned, and above the valve is a grating closed by a clack. The piston is held down by means of a bolt until the passage of the train, when the adjoining pressure relay comes into action. The piston thus released has then its upper portion in relation with the exhaust and the lower acted upon by the pressure of two atmospheres, and therefore it rises rapidly into the cylinder and closes the line, at the same time opening the lower valve by which the exhaust is effected; all the air at a pressure superior to that of the atmosphere has been expelled by the safety valve placed above, so that the aspiration only draws off air at the normal pressure. The pressure relay is the main feature of the arrangement; but should it not act, the train is only retarded, not stopped.

Each of the pressure relays is in immediate communication with its reservoir of 20 cubic yards for accumulating the pressure. These reservoirs are formed of iron plate like ordinary boilers, and are tested to about 570 lbs. per square inch; they are made cylindrical in form, the ends being closed with a single plate; they are 16 feet 6¼ inches long and 6 feet 6⅝ inches in diameter; the exhaust receivers differ from the others by having their ends concave without and convex within. The tubes which connect the relays of pressure are about 5 inches in diameter, and those of the exhaust 4 inches. The pumps make forty strokes a minute, are single action, with cylinders 3 feet 3⅜ inches in diameter, and 4 feet stroke; they draw or force nearly 1 cubic yard of air at each complete stroke of the piston.

[For the Scientific American.]

THEORIES OF THE EARTH'S INTERIOR.

It has long been known that, as we descend towards the center of the earth, the temperature rises at the rate of one degree Fah. for about 50 to 60 feet of descent. In artesian wells and other deep excavations, the increase of heat has been noted and mathematically calculated; but so many elements of error enter into the computation—among which are heat due to friction of the implements used in excavation, animal heat of those engaged in the work, and currents of air from the surface—that the results can be considered, at best, as only approximations to the truth. If the heat increased uniformly from the surface to the center, it would be sufficient, at a depth of two or three hundred miles, to melt the most refractory substances to be found at the surface. Hence the general conclusion is that the solid crust of the earth cannot be over two hundred miles in thickness. But Hopkins calculates, from data furnished by the precession of the equinoxes, that the crust of the earth has a thickness of eight or ten hundred miles, while Hennessey's investigations, in a similar way, assign six hundred miles as the maximum thickness of the crust.

Till within a few years, all below this crust has been supposed to be in a state of igneous fusion, and our earth to be, for the most part, in a liquid state. This conclusion has long been looked upon as a necessary result of the nebular hypothesis which is now so generally accepted. The fact that molten matter appears at the surface, in the form of volcanic ejections, trap dikes, and the like, and that warm, hot, or boiling springs are variously distributed over the globe, has given foundation and sufficient authority to these views. But these phenomena are not conclusive proof that the interior of the earth is in a state of fusion; for, according to Mallet—though in substance previously enunciated by others—the crushing force, due to the lateral pressure caused by shrinkage of the earth's crust, is sufficient to melt the hardest rock; and the pressure that would crush 7,200 cubic miles of rock would generate heat enough to cause all the volcanicity on the globe. According to other authorities, the melted matter of volcanic eruptions may be produced by local chemical action in the earth's crust. Again, the diversity of composition in the ejected matter would tend to the conclusion that all cannot come from a single and uniform molten mass. Many veins of rock, also, which were formerly looked upon as injected into or through the surface strata from the melted mass below, are now regarded by many eminent geologists as of aqueous origin, and formed by the percolation of heated water holding solid matter in solution through the surrounding rocks into a fissure, and its subsequent evaporation, which left the rock material to gradually fill the fissure.

Recent observations of Hopkins have shown that the melting points of various bodies, as wax, sulphur, and resin, are greatly and uniformly raised by pressure; and, from analogy, the opinion is now gaining ground that the interior portion of the earth, though heated far above the point of fusion, may be solid from the great pressure to which it is subjected. While it is now considered true that sufficient pressure on ice—which expands in freezing—will change it to water, pressure upon any substance that contracts in the process of congelation, like rock, would, on the other hand, aid in its solidification. Hence the conclusion is that the pressure existing at great depths would make solid the molten mass at a temperature at which, under a less pressure, it would have remained liquid.

There are two hypotheses based on the supposition of a solid nucleus. The first, maintained by William Hopkins, Scrope, Shaler, and others, supposes solidification to have commenced at the center of the liquid globe, and to have advanced towards the circumference. Before the whole mass was congealed, the portion near the surface became of so great a consistence as to prevent the sinking of the cooled and heavier particles, thus giving rise to a superficial crust, from which consolidation would proceed downwards. Between the nucleus and the crust is conceived to be matter still in a state of more or less perfect igneous fusion, either forming a continuous sheet of comparatively slight depth, or deposited in isolated reservoirs or subterranean lakes. It is interesting to notice, in connection with this hypothesis, that a similar one was reached from the study of terrestrial magnetism. Halley "supposed the existence of two magnetic poles situated in the earth's outer crust, and two others in an interior mass, separated from the solid envelope by a fluid medium, and revolving, by a very small degree, slower than the outer crust."

The second hypothesis is credited to Dr. T. Sterry Hunt. He accepts the first hypothesis so far as to admit a solid nucleus and a superficial crust. But he conceives it to be improbable that the cooling of the crust should have commenced at so early a period that the molten matter beneath it was too deep to become entirely solidified by subsequent refrigeration. He holds that only a thin belt of partially fluid matter exists between the solid exterior and the core, and argues, with Sir John Herschel, that this layer is not matter still unsolidified, but the under portion of the crust encroached upon by internal heat, "disintegrated and modified by chemical and mechanical agencies, impregnated with water, and in a state of igneo-aqueous fusion." Keferstein whose work, published in 1834, has been generally overlooked, considers the liquid stratum, or seat of volcanic action, as part of the sedimentary formations which have been subjected to a peculiar kind of fermentation, which crystallizes and arranges the elements in new forms with an evolution of heat as the result of chemical action. But Hunt rejects as irrational the idea of subterranean combustion or fermentation as a source of heat.

Professor Hall denies that we have any positive evidence of a former molten condition of any considerable portion of the earth, but denies it absurdly, on the lack of the visible exposure of any considerable part of the primitive crust. Sir William Thomson argues that the phenomena of precession and mutation demand greater rigidity of the earth than would be possible with a comparatively thin crust. This is opposed by Delaunay, but is again recently defended by Thomson.

The question respecting the earth's interior lies at the very foundation of the disputed theories of mountain formation, of earthquakes, and of volcanic action. S. H. T.

The Steam Yacht Hermione.

The steam screw yacht Hermione has been recently constructed for Captain W. H. Gordon, R. N., by Messrs. Edwards and Symes, yacht builders, Cubitt Town, London. She is one of the fastest of her size and construction afloat; the following are the principal dimensions: Length, 55 feet, breadth, 11·0 feet, depth 5 feet 4 inches; diameter of cylinders, 8 inches; length of stroke, 9 inches; heating surface, 325 square feet; grate surface, 13 square feet. When the engines were worked about three quarter power, the speed was 13 miles an hour, or 11·28 knots, the number of revolutions 220 per minute, and mean effective pressure in cylinders 80 lbs. per square inch. The power developed would thus be 80·4 indicated horse power, and the constant in the Admiralty formula $C=\frac{s^3\times D^{\frac{2}{3}}}{\text{I.H.P.}}$ would be 120, an exceedingly good result for so small a yacht. From these results it is anticipated by the builders that, when the engines are worked to their full power, namely, 120 indicated horse power, at least 14½ miles or 12·58 knots will be obtained. The yacht is constructed entirely of teak and mahogany, coppered, and copper fastened, and is fore-and-aft schooner rigged, and, considering her great power and speed, has good accommodation for crew forward, while she has a neat polished mahogany cabin aft, and her fittings throughout are of a superior quality. The engines are high pressure surface-condensing, with inverted cylinders, and fitted with separate variable expansion valves, and screw reversing motion of most compact and effective construction. The condenser and pump are small, being only required to condense the steam for supplying the boiler; but when working at half speed a good vacuum is obtained, or by means of a suitable cock the exhaust can be turned into the chimney. The propeller shaft is of steel, cased in gun metal and fitted with one of Hirsch's patent propellers, which works very satisfactorily, and with little vibration. The boiler is of locomotive construction of steel with brass tubes, and has been proved to 200 lbs. per square inch. It is fitted with a superheater and has given very good results, making steam well. We may here mention that the above firm have recently constructed the beautiful little steam launch Black Angel, 33 feet keel, 5 feet 6 inches beam, built entirely of mahogany, copper fastened, for Messrs. Willans and Ward, and fitted by them with Willans' patent three cylinder engine, which worked very satisfactorily, driving the boat at a speed of 13 miles per hour. The total weight of boat and machinery was under 2 tuns. The engines are very neat, and most compact and handy. Messrs. Edwards and Symes have likewise in construction the first ferry boat for the Thames Steam Ferry Company for heavy goods traffic, plying on the Thames between Rotherhithe and Wapping.—*Engineering.*

Pictorial Tiles.

A comparatively new mode of employing tiles for the lining of rooms has been introduced by Messrs. Simpson, who have decorated the interior of several important buildings in this manner. The tiles are placed together in their unglazed state, and a picture is painted upon them in colors suitable for firing. They are then taken asunder and put into the furnace, and then subjected to great heat and glazed. If this is successfully accomplished, the tiles can now be fixed against the wall of the room and present an absolutely indestructible decoration, which can be washed as often as it is needed, though from its high glaze it is not easily apt to catch dirt.

Copying Pencils.

Pencils are now sold by stationers, the marks of which may be copied in the same manner as writing made by the pen with ordinary copying ink. The method of preparing the leads is as follows: A thick paste is made of graphite, finely pulverized kaolin, and a very concentrated solution of aniline blue, soluble in water. The mixture is pressed into cylinders of suitable size and dried, when it is ready for use Gum arabic, it is said, may be substituted for the kaolin