for surface drainage only, was laid under my direction in Madison Square; located from seven to fourteen feet distant from white willow trees, *Salix alba*. The mortar used in making up the joints of the pipe when laid was composed of equal parts of Rosendale cement and sand. Three years after, in 1874, this drain pipe was found to be partially obstructed; and an effort made to force an opening with stiff wire met with only partial success. The following year the pipe was taken up, and found completely filled with fibrous roots growing from the willow trees; and so compact had the mass of roots become that a horse attached to one end removed a piece sixty feet long. The roots composing this mass varied in size from one-sixteenth to one-fourth of an inch in diameter; and the proportion I found to be as follows: fibers one-sixteenth of an inch in diameter composed thirty per cent.; fibers one-thirtieth of an inch in diameter, sixty per cent.; fibers one-fourth of an inch in diameter, four per cent. The mortar used in cementing the joints of this pipe was in perfect condition, and no cracks were discovered to allow the roots to enter the pipe, but a closer examination revealed the mystery. The fine fibers, one-sixtieth of an inch in diameter, had grown through the solid mortar, and increased within the pipe to the size and length described.

This drain was then relaid with similar mortar joints, but the roots still continued to obstruct the pipe, making it necessary to remove it in 1877, 1879, and 1881.

When this drain was relaid for the third time, in 1881, I recommended bituminous paving cement to be applied to the joints after having been prepared in the usual manner with mortar, to prevent if possible further trouble from roots; but they obstructed the drain for the fourth time the present season, and when the pipe was removed, about twelve feet of it was found filled with roots, which entered at only a few joints, where the mortar had been imperfectly covered by the cement with a thin coat painted over the mortar joints. Wherever the cement was soft the roots grew through it, but were killed; wherever the coating of cement was only one-eighth of an inch thick but hard, it killed the roots but was not penetrated by them. I tested roots that grew through the soft cement, with a microscope, and also placed them in water of a mild temperature, where they remained for two weeks without any sign of vitality appearing.

This drain was relaid again in July last, and I then treated it in a thorough manner with a bituminous concrete, which will now be described. When relaying the pipe this season, the sockets only were filled with mortar, in order to present as little mortar surface as possible to be covered with the concrete, preferring to apply the concrete on the glazed surface of the pipe rather than on the mortar. The bituminous concrete was composed of N. Y. Coal Tar Chemical Co. paving cement, known to the trade as No. 5, mixed with fine gravel; No. 4 paving cement and fine sand would have been preferable—the proportions used being seven gallons of paving cement to forty cubic feet of fine gravel. This proportion should be varied according to the fineness of the gravel or sand. The paving cement and gravel were heated separately to about 220° Fahrenheit; then thoroughly mixed, and applied at a temperature of 200° Fahrenheit. Before applying this mixture the pipe was painted with crude coal tar without heating, to make the concrete adhere more readily to the pipe. The tar can be applied with a brush or rag tied on a stick. The concrete was then put on around the joints not less than three inches in thickness, extending four inches each way from the ends of the hubs, covering the surface at each joint eight inches longitudinal of the pipe, the ground having previously been dug away from under the joints and pipe for less than three inches. This concrete was packed thoroughly around the pipe by ramming with wooden rammers. Great care should be taken to pack the concrete thoroughly while warm. No filling of the trench should be done until after the concrete has become hard. This concrete was applied to the drain for seventy feet, with manholes at each end to enable it to be readily examined in the future.

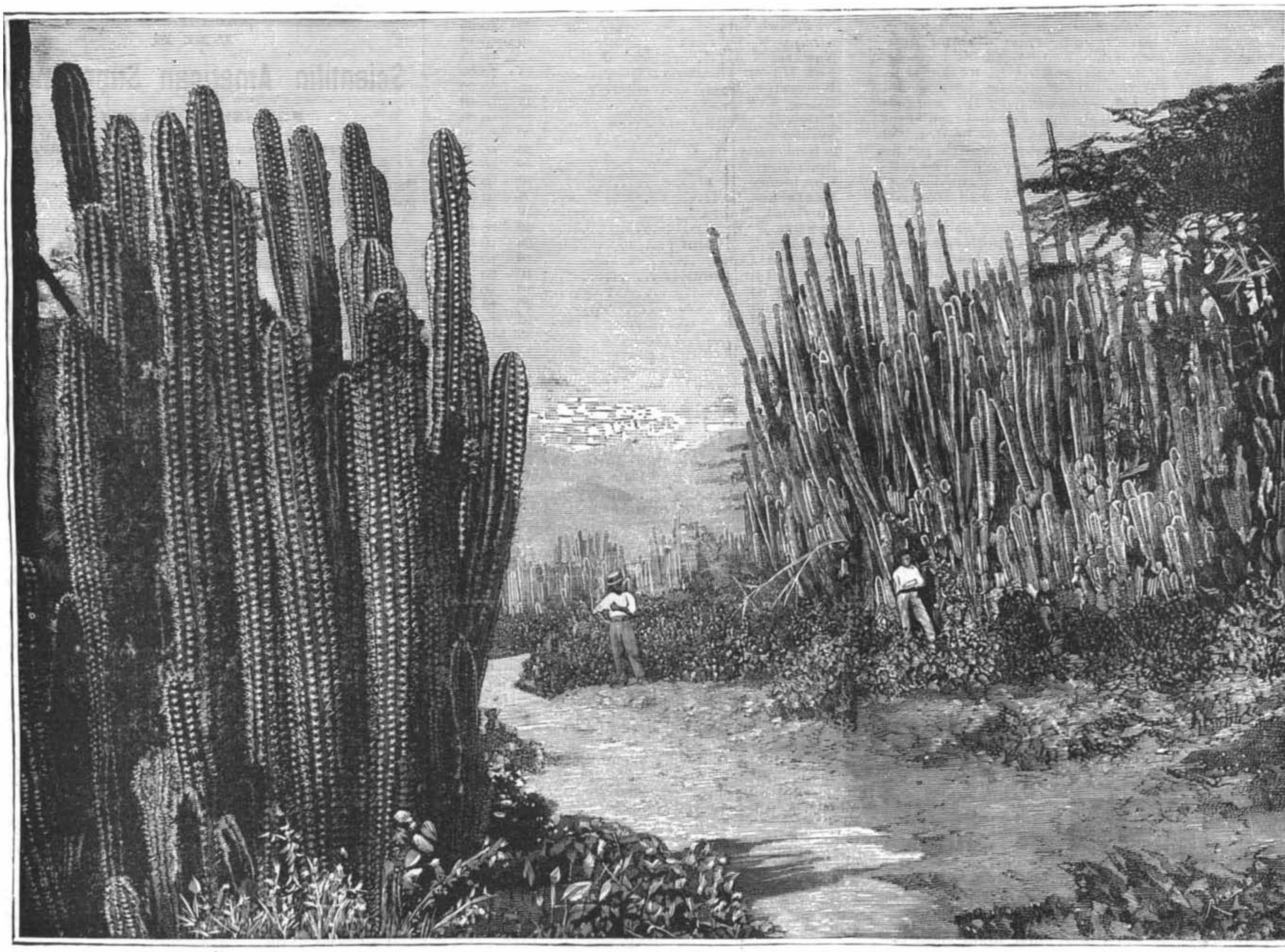
The partial success obtained in the first imperfect trial ha induced me to believe that the latter experiment will be successful; and also that the carbolic and cresylic acids, naphthaline, and the basic oils contained in the paving composition, when applied in the manner described, will effectually prevent the ingress of any roots into drains. Time will determine whether my conclusions are correct.—*Engineering News.*

A GROUP OF CACTUS IN JAMAICA.

IN the temperate zones, although some species of the cactus are known, like that of the *nopal* in the Mediterranean region, which is the *Opuntia vulgaris*, there is little idea of the powerful development which these singular plants acquire in the tropics, especielly in equatorial regions. The *cactaceas*, so named by the modern botanists, until within the last two years constituted only relatively one genus, and its different species were not well defined; but later discoveries made in the Antilles, Ecuador, Guatemala, and other South American countries have led naturalists to constitute a family divided into two tribes according to the form of their flowers, and subdivided into various classes whose names are *mamillaria*, *melocactus*, *echinopsis*, etc., belonging to one genus, and *rhisalis*, *opuntia*, and simple *nopal* to the other.

In Jamaica these plants acquire gigantic dimensions, while between their prickly spines they throw out solitary flowers, large, beautiful, and of most vivid colors, which perish in a few hours.

Recently we have received the photograph which we reproduce in our engraving. It represents a group of colossal cactus in the interior of Jamaica, and shows a fair sample of the powerful vegetation of this tropical country.—*La Ilustracion Espanola.*



A GROUP OF CACTUS IN JAMAICA.

ICELAND.

By J. STARKIE GARDNER, F.G.S.

THE utter disappearance, with the most trifling exceptions, of the dwellings and even public buildings of the Anglo-Saxon period, which must have been one of relatively high civilization, has been a subject of wonder to moderately well informed people like myself.

I had the opportunity a short time since of traversing Iceland in many directions. The country is civilized, and has a history in many respects like our own, yet nowhere was the slightest trace of any occupation to be seen. A brief note of the more salient points in its early history will render apparent how closely its civilization must have resembled our own in Saxon times; and if the styles of building were equally similar, we shall be at no loss to understand why no traces of them remain.

Iceland was colonized in the middle of the tenth century, and so rapid that Harold, in order to check its too rapid growth, imposed a fine of four ounces of silver upon all immigrants. A Saxon bishop arrived in the year 981, and in 984 the first church was built. In A.D. 1000 the whole country was converted to Christianity; Benedictines and Augustinians settled, and a tribute was paid to the Roman See. It was not until 1261 that the inhabitants put themselves under the protection of Norway, and there is every reason to believe that prior to that date their civilization equaled any which obtained among their relatives settled in England. Their manners, customs, mode of life, were probably identical, and of these their scalds have left an almost uninterrupted record from the golden age of Harold, *aux beaux cheveux*, to late historic times. We have, in addition to direct evidence that these have never undergone much change, collateral evidence to show that the habits and customs of the population are still substantially the same as they were in the tenth and eleventh centuries. The ordinary Icelander has no towns and no centers of reunion; he lives alone, whether priest or peasant, and when he meets his distant neighbors it is by accident. The people, though nominally under Denmark, have never been called on to supply either soldiers or sailors to the Danish services, and until quite lately no one ever thought of wandering outside his native land. There are even now no roads or bridges, and the country consists entirely of narrow valleys, separated by mountains or hills averaging 1,200 to 2,000 feet high, each valley being the bed of a torrent, often difficult and even dangerous to ford. The Norse language, which was carried to Iceland by the colony of noble families who first settled there, was spoken with conservative elegance, free from any mixture of foreign idiom. While, in course of ages, it became modified on the mainland, it was preserved in the interior of Iceland in all its native purity, so that even as early as in the twelfth century the language of the ancient sagas was spoken of as Icelandic. Under the primitive conditions and habits obtaining in this isolated country, it has remained undefiled and pure, indeed there is no priest or peasant at the present day in Iceland who cannot understand perfectly the language of even the most ancient of the sagas. The relationship between modern Icelandic and the Saxon element of the English language is still to be traced, for, though marked by wide divergences of spelling, a great number of common words, when slowly pronounced, can be mutually understood, and a glance at the names on a map will indicate the kind of community that exists. Another example of the small amount of change that has taken place in the habits of this people is seen in the collection of native work in the museum at Reykjavik. The wood-carving, and more especially the needlework, would not, from its style, be assigned to a later date than the twelfth century, yet much of it has been executed in, and is actually dated of, the eighteenth century. Patterns originated in the days of Harold, and used in the Bayeux tapestry and contemporary works, have been faithfully adhered to, and handed down from generation to generation without the smallest change in style. The costume of an Icelander even now, except at trading stations, is of home-made frieze of a uniform brownish tint. The women display a somewhat greater variety of color, but all alike wear a peculiar black fez cap and long tassel. They have a gala dress, handed down as heirlooms in families on account of its costliness, the head-dress of which is a small white Phrygian bonnet, the lapel of which is stuffed and stiffened like the crest of a helmet, decorated silver frontlet and ornaments, from which depends backward a long lawn or lace veil. This dress must be of extreme antiquity. Other instances of the conservancy of the Icelander might be adduced were it not almost superfluous to do so here, the dwelling house being the point in view. The probability is great that the Icelander has been as conservative in the plan and build of his dwelling as he has been in his language and his art.

Nothing can, in fact, be well imagined that could have modified it, for Iceland remained so isolated until the introduction of steam, that when Sir Joseph Banks, P.R.S., visited it toward the close of last century, money was almost unknown, and traffic was entirely carried on by means of bartering coarse home-spun cloth, dried fish, etc.

The typical Icelandic house, or *bœr*, as it is termed, is constructed either entirely of earth or of earth and rough stones in layers, and has a turf roof, made waterproof by a lining of birch bark or straw. It is far, however, from a mere earth cabin, and has an intricate arrangement. Very little wood is used in its construction, as the country is destitute of timber, for it is not only costly but difficult to transport from the seaports in a land where any approach to a wheeled vehicle is unknown, and the balks or logs have to be dragged over mere tracks at the heels of the sturdy little ponies through whom locomotion is alone possible. The rafters and lintels, however, are of wood, obtained somehow, and the floor of beaten earth. A well arranged dwelling consists of seven houses side by side, each under its own peat roof, and with walls four or five feet thick. Those toward the center are the largest and loftiest, consisting of two floors, with one room to each. These are the dwelling rooms, and possess but one door in common. The entrance opens on to a dark and low ante-room (*bœardyr*) on the left of which is the guest chamber (*gestaskali*). The inmates usually sleep in lofts under the roofs, reached by ladders, and sometimes situated over the cow-house for warmth. Not infrequently, however, the dwelling room (*badstofa*) is in rear of the other buildings, and is reached by a long dark passage 50 to 80 feet in length. It is a large and gloomy apartment lighted only by small holes in the side or roof, around which turf bunks are arranged, as in emigrant ships, in which the family and servants of both sexes sleep. The kitchen is a much smaller apartment, some flat stones on the ground serving as a stove, while a hole in the roof, with the sides carried up to promote draught, acts as window and chimney. The kitchen may be on the right of the ante-room or in rear, and there may be two state rooms in front, though this is very rarely the case. The bed in the guest chamber occupies a niche in the wall facing the front window. The low house at one extremity is the cattle shed, and at the other a storehouse or smithy. A dairy and store or tool house complete the row, these latter being windowless, while the guest room is provided with a small glazed window. In the better class of priest's or farmer's house, and every priest is a farmer save on Sunday, one room at least is wainscoted, and it is obvious that wood would be less a luxury if its cost were brought within the means of the builders. With this exception, the Icelandic house described may differ but little from that inhabited in England by the well-to-do Anglo-Saxon farmer up to the Norman invasion. The absence of any stove or fire, except in the kitchen, leads to the exclusion as far as practicable of the outer air and a crowding together for the sake of warmth. The smoke in the kitchen is generally beaten down into the apartment, and the odor is very unpleasant and everything exceedingly dirty. In the matter of keeping out wet, the Icelandic building also leaves much to be desired. Externally the frontage, if boarded, as is sometimes the case in more recently erected buildings, is rather imposing; but the simpler and smaller houses, mere cabins, may be almost ridden over unintentionally when descended upon from the slope of a hill, owing to their grass-green roof and low elevation. Every farm stands in an inclosed piece of ground, surrounded by low turf walls called the tun, or town, which provides the winter's hay, while elsewhere cattle and sheep seem allowed to browse at will.

There are, of course, stone buildings in the capital for the use principally of the Danish officials; the Danish trading stations are ordinary wooden houses. Here and there a rich man, who has combined trading with farming, has had a complete house shipped from Europe; but these have all been erected recently, and are so exceptional that there are probably not half a dozen over the entire island, whose area is somewhere about the same as Ireland. There is nowhere any trace of the ruins of ancient buildings, and the only piece of old masonry existing seems to be the circular bath of Snorri Sturluson, the celebrated saga writer of the thirteenth century. The older churches are of turf and wood, and of no architectural interest, though sometimes gaudily painted inside. There are no other public buildings, and even the Icelandic Parliament was held *al fresco* in the historic plain of Thingvallir, the deputies being housed in tents.—*The Architect.*

UNDERGROUND WATER AND THE MOISTURE OF THE SOIL.

By FR. HOFMANN.

THE author contends that, in order to understand the distribution of moisture in the soil, we must distinguish three strata which differ in their power of receiving and giving up water. The upper layer, or "evaporation zone," depends on the weather, and is exposed to the greatest fluctuations in its proportion of moisture. After persistent drought it may take up the entire rain of six or even twelve months, so that not a drop passes into the lower strata. This zone is the more important in a sanitary point of view as it is exposed to contamination from above, to the direct invasion of pathogenous fungi, and to both the highest and the lowest temperature. The middle stratum, which the author terms the "transit zone," has a tolerably constant proportion of water, depending on the size of the soil capillaries. Evaporation has no influence upon this region, and an influx from above modifies its proportion of moisture only in so far as the water which penetrates it traverses the capillaries more or less rapidly according to their size. According to the thickness of this stratum, its quantity of water may be very considerable, equal to the downfall of several years. The lowest stratum is called the zone of the capillary groundwater level. It begins at the surface of the subterranean waters, and its moisture depends on the nature of the capillary intervals. The author concludes that all impurities, organic or inorganic, placed upon the surface remain in the upper zone, and cannot be washed down into the subsoil waters, even by heavy rains.

WATER METERS.

THE Minneapolis *Tribune* gives the following list of rates for metered water per gallons:

	Cts.	Cts.
Meriden, Conn.	10	to 25
Boston, Mass.	20	to 30
Lawrence, Mass.	20	to 20
Taunton, Mass.	12½	to 25
Springfield, Mass.	15	to 30
New Bedford	12½	to 15
New York City	20	to 35
Albany, N. Y.	10	to 40
Newark, N. J.		to 15
New Haven, Conn.	15	to 30
Worcester, Mass.	15	to 30
Utica, N. Y.	25	to 50
Titusville, Penn.	12½	to 30
Syracuse, N. Y.	20	to 40
Schenectady, N. Y.	20	to 50
Rochester, N. Y.	10	to 50
Providence, R. I.	20	to 30
Pawtucket, R. I.	6	to 30
Portland, Maine	30	to 50
Oswego, N. Y.	20	to 40
New London, Conn.	20	to 30
Hartford, Conn.	16	to 30
New Britain, Conn.	10	to 30
Jersey City	10	to 20
Burlington, Vt.	20	to 50
Dayton, Ohio	15	to 50
St. Paul, Minn.	25	to 50
Cincinnati	15	to 15
Detroit	20	to 20
Brooklyn	25	to 25
Minneapolis	10	to 20

AN ABSOLUTE STANDARD OF LIGHT.

IT will be remembered that during the Paris Electrical Exhibition of 1881, M. Violle suggested as a standard the light radiated by a square centimeter of platinum at the fusing point, or in other words, at its point of solidification. The Congress which then sat recommended the Carcel lamp, of the Dumas and Regnault type, as a secondary standard, and the International Conference has now definitely adopted the Violle light as the primary standard. M. Violle has since determined the value of the Carcel lamp in terms of his proposed standard. By different methods he finds the normal value of the Carcel "bec" is $\frac{1}{2{\cdot}08}$ of the platinum standard; and surface for surface, the intrinsic light of the latter is about eleven times greater than that of the Carcel flame. M. Violle has also compared his standard with electric incandescent lamps, which from their color and constancy are easily compared with the platinum light. A Swan incandescence lamp was fed by thirty Kabath accumulators; a resistance box being inserted in circuit to regulate the current. Every minute an observer noted the current strength, i, and the fall of potential between the terminal, e, and the photometric values of the light were also determined. Comparison between the electric lamp and standard was effected by means of a Bunsen photometer having a range of 4 meters. The rays of the platinum emitted vertically were bent horizontally by means of a mirror at an angle of 45 deg. For eighteen experiments the value of the light reflected from the mirror was found to be 7·023 carcels. The normal carcel was found by this method to be $\frac{1}{2{\cdot}07}$ of the light reflected, which agrees well with the prior value. The experiments led M. Violle to the conclusion that the platinum at its fusing point fulfills the conditions requisite in an absolute standard of light, resting as it does on a definite physical phenomenon. The standard chosen is readily comparable with existing standards, and the unit can be multiplied by increasing the surface in fusion.

REDUCTION BY ELECTROLYSIS.

M. NIAUDET has recently been experimenting with some success on the reduction of chloride of sodium, or common salt, into its components, chlorine and sodium, by means of the electric current; and as both of these products are very valuable, the former for bleaching, the latter for chemical purposes, it is to be hoped that his further experiments will be crowned with perfect success. Mr. Sommer, a Californian electrician, has also devised a method of reducing lead from its ores by electrolysis. Salts of lead in solution submitted to the electric current yield a deposit of lead on the negative electrode and peroxide on the positive electrode. Mr. Sommer arranges to amalgamate the lead before it oxidizes or deposits. His process consists in placing a layer of mercury in a glass test tube (20 to 40 grammes), then a quantity of dilute chlorhydric acid (15 to 20 per cent. of H. C. L.). Into the tube is then placed a gramme of lead ore pulverized, which falls to the surface of the mercury. An electrode of lamp carbon is then dipped into the mercury, and one of graphite into the acid. The current of four Daniell or Meidinger or two Bunsen or Grove elements passed through the combination, while the test tube is kept at 70 deg. Cent., serves to effect the reduction. Sulphureted hydrogen is disengaged at the negative pole, and hypochlorous acid at the positive pole. At the end of five hours the reduction is complete, and the mercury being taken out, washed, and weighed, shows that the lead has been amalgamated. It is necessary to have the positive electrode of graphite and the negative of lamp carbon.

THE LIQUEFACTION OF GASES.

DR. D. TOMMASI.—The author has come upon the following passage in the *Antologia di G. P. Viesseux* (vol. xxvii., A.D. 1827): "Perkins has submitted water and other liquids to powerful pressure, employing a bronze cylinder in which worked a steel piston. The cylinder was 34 inches in length; its internal diameter is 1½, and its external diameter 13¼ inches. The greatest pressure exerted by means of this apparatus was 2,000 atmospheres. Compressed air in contact with mercury began to be liquefied at 500 atmospheres; at 1,000 atmospheres the mercury filled two-thirds of the space previously occupied by the air, and small liquid drops began to appear. At 1,200 atmospheres there was seen over the mercury a transparent liquid occupying $\frac{1}{600}$ of the space previously taken up by air. Ethylen began to be liquefied at 40 atmospheres, and at 1,200 it was entirely reduced to a liquid." Dr. Tommasi raises the question whether the air operated on by Perkins was absolutely dry.

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