From the spherical triangle PZS, we have

cos. ZS = cos. PS cos. ZP + sin. PS sin. ZP cos. ZPS

but ZS = zenith distance = 90° − altitude

ZP = 90° − PR = 90° − latitude

PS = polar distance = 90° − declination.

therefore, by substitution

sin. *alt.* = sin. *decl.* sin. *lat.* + cos. *decl.* cos. *lat.* cos. ZPS . . . (B)

and ZPS is the hour-angle of the sun.

A comparison of the two formulæ (A) and (B) shows that the hour-angle given by the bead will be the same as that given by the sun, and proves the theoretical accuracy of the card-dial. Just at sun-rise or at sun-set, the amount of refraction slightly exceeds half a degree. If, then, a little cross *m* (see fig. 8) be made just below the sun-line, at a distance from it which would subtend half a degree at *c*, the time of sunset would be found corrected for refraction, if the central line of light were made to fall on *cm*.

The following list includes the principal writers on dialling whose works have come down to us, and to these we must refer for descriptions of the various constructions, some simple and direct, others fanciful and intricate, which have been at different times employed :—

Ptolemy, *Analemma*, restored by Commandine ; Vitruvius, *Architecture ;* Sebastian Munster, *Horologiographia ;* Orontius Fineus, *De Horologiis Solaribus ;* Mutio Oddi da Urbino, *Horologi Solari ;* Dryander, *De Horologiorum Compositione ;* Conrad Gesner, *Pandectæ ;* Andrew Schoner, *Gnomonicæ ;* F. Commandine, *Horologiorum Descriptio ;* Joan. Bapt. Benedictus, *De Gnomonum Usu ;* Georgius Schomberg, *Exegesis Fundamentorum Gnomonicorum ;* Joan. Solomon de Caus, *Horologes Solaires ;* Joan. Bapt. Trolta, *Praxis Horologiorum ;* Desargues, *Manière Universelle pour poser l'Essieu, &c. ;* Ath. Kircher, *Ars magna Lucis et Umbra ;* Hallum, *Explicatio Horologii in Horto Regio Londini ;* Joan. Mark, *Tractatus Horologiorum ;* Clavius, *Gnomonices de Horologiis.*

Also among more modern writers, Deschales, Ozanam, Schottus, Wolfius, Picard, Lahire, Walper ; in German, Paterson, Michael, Müller ; and among English writers, Foster, Wells, Collins, Leadbetter, Jones, Leybourn, Emerson, and Ferguson. See also Meikle's article in former editions of the present work. (H. G.)

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**DIAMANTE.** The Italian fresco painter, commonly known as Fra Diamante, was born at Prato about 1400. He was a Carmelite friar, a member of the Florentine community of that order, and was the friend and assistant of the more celebrated Filippo Lippi. The Carmelite convent of Prato which he adorned with many works in fresco has been suppressed, and the buildings have been altered to a degree involving the destruction of the paintings. He was the principal assistant of Fra Filippo in the grand frescoes which may still be seen at the east end of the cathedral of Prato. In the midst of the work he was recalled to Florence by his conventual superior, and a minute of proceedings of the commune of Prato is still extant, in which it is determined to petition the metropolitan of Florence to obtain his return to Prato,—a proof that his share in the work was so important that his recall involved the suspension of it. Subsequently he assisted Fra Filippo in the execution of the frescoes still to be seen in the cathedral of Spoletò, which Fra Diamante completed in 1470 after his master's death in 1469. Fra Filippo left a son ten years old to the care of Diamante, who, having received 200 ducats from the commune of Spoleto, as the balance due for the work done in the cathedral, returned with the child to Florence, and, as Vasari says, bought land for himself with the money, giving but a small portion to the child. The accusation of wrong-doing, however, would depend upon the share of the work executed by Fra Diamante, and the terms of his agreement with Fra Filippo. Fra Diamante must have been nearly seventy when he completed the frescoes at Spoleto, but the exact year of his death is not known.

See *Relazione delle Pitture di Fra Filippo nel coro di Prato*, by the Canon Baldanzi, Prato ; also the last edition of Vasari, Florence, 1848.

**DIAMANTINA**, formerly Tejuco, a town of Brazil, in the province of Minas-Geraes, is situated at an altitude of 5700 feet above sea-level, in a valley watered by affluents of the Jequitinhonha. Its streets are broad, and the houses are mostly of wood. The public structures include several churches, a theatre, barracks, three hospitals, and a school. The surrounding district is sterile, but is rich in minerals. The discovery of diamonds there was made in 1729. Population about 7000, or, with that of the neighbouring villages, 15,000. See BRAZIL, vol. iv. p. 224.

**DIAMANTINO**, a town of Brazil, in the province of Matto-Grosso, is situated close to the Diamantino river, about six miles from its junction with the Paraguay, at the foot of a high range of country, in 14° 24′ 33″ S. lat. and 56° 8′ 30″ W. long. The neighbourhood, which is infertile, yields diamonds and gold. Population about 5000.

**DIAMOND.** This gem, the most highly valued and brilliant of precious stones, is also remarkable for its history and its peculiar physical and chemical properties. Though not always accurately distinguished from other similar stones, it seems to have attracted notice at a very early period, especially in India, the chief source of supply in ancient times. The old Jewish doctors regarded the jahalom, the third in the second row of stones in the breast-plate of the high priest (Exod. xxxix. 11), as the diamond, and it is thus translated in the English and other versions. But as each stone bore the name of one of the tribes, and there is no reason to believe that any method of polishing such hard stones, still less of engraving letters on them, was then known, the identification cannot be accurate. Among the Greeks it is first mentioned about three centuries B.C. under the name of *adamas* (ἀδάμας), "the unsubduable," referring to its hardness and power of resisting fire. The same name was previously given to a metal highly valued from its extreme hardness for armour and weapons, and the twofold use of the term continued long both in Greek and Latin. The name of the gem in our own and most modern languages is derived from this old name, occurring in the form *diamas* in Albertus Magnus and other authors of the 13th century. Curiously enough, the French *aimant*, applied to the magnet, comes from the same term in its other signification of an ore or metal.

The fullest account of the adamas as a stone is found in Pliny, who says it exceeds in value all human things, and its use was confined to kings, and to few even of them. He mentions six varieties, the most remarkable being the Indian and Arabian, of such unspeakable hardness that when struck with a hammer even the iron and anvil were torn asunder—"ita respuentes ictum, ut ferrum utrinque dissultet, incudesque etiam ipsi dissiliant." It also resisted the fire, and could only be subdued and broken down when dipped in fresh warm goat's blood. Similar fables continued to prevail during the Middle Ages, and even yet have hardly vanished from popular belief. As an ornamental stone it was highly esteemed during the early times of the Roman empire, as some scandalous stories recorded by Juvenal testify, though only stones with naturally polished faces could be used. This fact is proved not only by the words of Seneca—"nec secari adamas aut cædi vel deteri potest"—and others, but from specimens of diamonds set in gold, with no artificial polishing, which have come down both from classic times and from the Middle Ages. This unworkable character long greatly limited both its use and its value ; and the more highly coloured rubies, and even emeralds and sapphires, were often preferred to it. It was only after Ludwig van Berquen (or Berghem, as he is often named) in 1476 discovered the mode of cutting and polishing it, that the diamond slowly regained the first place among gems. Even in the 16th century (1550), Benvenuto Cellini (*Trattato dell' orificerio*, cap. i.) assigns it only the third rank in value, estimating a perfect ruby of one carat weight as worth 800 scudi d'oro (each equal to about 4s.), a similar emerald at 400, an equal diamond at 100, and a sapphire at 10 scudi. In the same century the use of the diamond for cutting glass and engraving gems seems also to have become known.



The diamond always occurs in crystals of the tesseral or cubical system. Its most frequent forms are the octahedron, or double four-sided pyramid (fig. 1), the rhombic dodecahedron with twelve faces (fig. 2), and others with twenty-four (fig. 3), and forty-eight faces

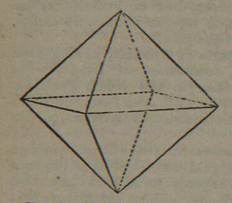

FIG. 1.—The Octahedron.

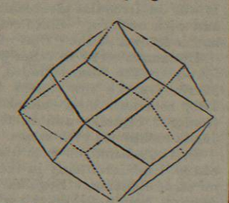

FIG. 2.—Rhombic Dodecahedron.

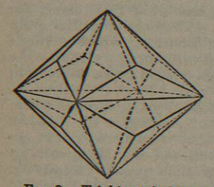

FIG. 3.—Triakisoctahedron.

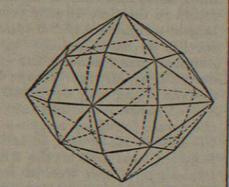

FIG. 4.—Hexakisoctahedron.

(fig. 4). The first form is most common in stones from India, the second in those from Brazil. Cubes also occur, but are rare, whilst the icositetrahedron has not been observed. Hitherto the diamond has been described as hemihedric, but Sadebeck from his own and G. Rose's researches shows it to be holohedric (in the Berlin *Monatsberichte*, Oct. 1876). The faces are often curved, strongly striated, or marked by stair-like inequalities, hiding the true form. Many of the crystals also are round almost like spheres (fig. 5), or the smaller ones like grains of sand. This does not arise, however, from attrition during transport by water, but is the original shape of the stones. Macles, or twin-crystals, specially of two octahedrons, are common, and the striæ due to this structure appear even on the polished facets. The diamond has a perfect cleavage parallel to the faces of the octahedron, and breaks readily both in this and other directions. Contrary to the old and still common opinion, it is rather brittle, and is easily injured by a slight blow or fall. Its hardness—10 in the mineralogical scale—far surpasses that of all other known stones, and was used even by the ancients to discriminate it from other gems. In specific gravity, 3·52 (or 3·515 to 3·525), it is considerably higher than rock crystal, but nearly the same as the topaz, which may thus be mistaken for it. According to Fizeau, it has its greatest density at − 42°·3 C., and below this begins to expand, a property seen in very few other solid bodies. Its expansion by heat is very small, the volume from the freezing to the boiling point of water only rising from 1·0 to 1·00000354. By friction it becomes positive electric. The so-called compact diamond or carbonado of the stone polishers, found as round grains or masses of one or two pounds weight in the washings near Babia, of a brownish black colour and sp. g. = 3·012 to 3·416, is porous diamond mixed with a small amount of other matter.

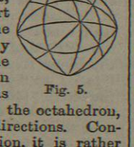

Fig. 5.

The optical properties of the diamond are also very remarkable. The purest stones, or those of the first water are highly transparent and colourless. But more generally it is less transparent, and shows various tints, specially white, grey, or brown ; more rarely blue, red, yellow, green ; and very seldom black. Such stones, when the colours are pure, are often highly valued. It is also distinguished by its brilliant adamantine lustre. Newton, two centuries ago, remarked its high refractive power, and from this conjectured that it was a substance of a peculiar nature. The index of refraction is 2·4135 for the red rays, 2·4195 for the yellow, and 2·4278 for the green. This high refractive power, and the strong reflection at both surfaces, render it seldom completely transparent, but give it the high lustre for which it is valued as an ornament. They also produce the numerous internal reflections seen in the interior of cut stones, all the rays of light falling on the posterior surfaces at angles above 25° being totally reflected. Like all crystals of the same system it possesses only simple refraction, but Dr (Sir David) Brewster found that many showed traces of double refraction by their action on polarized light. This he ascribed to a peculiar tension produced in the interior of the stone during its formation, and a somewhat similar explanation is still adopted.

Chemical character and composition.

In a history of gems published early in the 17th century, Boetius de Boot conjectured that the diamond was an inflammable body. Robert Boyle, who in 1664 described its property of shining in the dark, or phosphorescing after being exposed to the light of the sun, a few years later observed that a part of it was dissipated in acrid vapours when subjected to a high temperature. This combustibility of the diamond was confirmed in 1694 and 1695 by experiments with a powerful burning glass or lens made in the presence of Cosmo III., grand duke of Tuscany, by the Florentine Academicians. The experiment of the combustibility of the diamond when freely exposed in a strong heat has been often repeated, and its true character was proved by Lavoisier, who determined that the product was carbonic acid gas. Sir George Mackenzie converted iron into steel by powdered diamonds ; whilst Mr Smithson Tennant showed that the carbonic acid produced corresponded to the oxygen consumed. No doubt, therefore, now remains that the diamond is only pure carbon in the crystallized condition, and like it insoluble in acids.

Action of heat.

In regard to the action of heat on the diamond, various experiments have been made. Before the blowpipe it is infusible, and closely packed in powdered charcoal it can resist a very high temperature. But when oxygen is present it burns slowly at a temperature usually given at about that of melting silver. Gustaf Rose lately found that when air is excluded diamonds exposed to a temperature at which pig-iron melts, or to the strongest heat produced in the porcelain kiln, undergo no change ; but at a higher temperature, like that at which bar-iron melts, they begin, whilst retaining their form, to be converted into graphite. He further observed that when diamonds and graphite were exposed together in the same muffle, foliated graphite was far more difficult to burn than the diamond, but compact graphite was consumed more readily. In the current of air the diamond gradually became smaller and smaller, but retaining its brilliancy till it finally vanished

The faces also during burning became marked with peculiar triangular hollows, with their sides parallel to the edges of the octahedron. Seen in a strong light they appear as faces of an icositetrahedron, whilst other regular triangular impressions on the faces of natural crystals of diamond are produced by faces of the dodecahedron. (Rose, "Ueber das Verhalten des Diamants," &c., in Berlin *Monatsberichte*, June 1872).

India is the oldest, and was long the most celebrated, or rather the only, source of diamonds. They have been obtained from a wide district on the eastern side of the Deccan, extending from the Pennar river in 14° N. lat. to near the Sone, in Bundelkund, in 25° N. lat. In the south the chief mines were at Cuddapah, Karnul, and Ellore, near the Kishna, in Madras presidency. In this district some of the largest Indian diamonds were obtained, Golconda, however, not being a mine, but a fortress where the diamonds were collected. There were other mines near Nagpore, and east at Sambhalpur, on the Mahanuddy, and north at Panna, in Bundelkund. At all of these the diamond was sought chiefly in recent deposits, beds of sand and clay, or in some places a ferruginous sandstone or conglomerate, but probably none of them the original matrix. Heyne states that the diamond has hitherto been found only in alluvial soil, or in the most recent rocks; and that the stones are not scattered through the whole of these beds, but confined to one rather harder than the rest. The upper stratum, of 18 inches, consists of sand, gravel, and loam; next there is a deposit of stiff black clay or mud, about 4 feet thick; and next the diamond bed, which is distinguished by a mixture of large rounded stones. It is from 2 to 2½ feet thick, closely cemented together with clay. Sometimes this stratum is covered with calcareous tufa. Here shallow pits are excavated, of a few feet in diameter, in such spots as the practice of the workman may induce him to select; he sinks to a depth of a few feet, and searches the bed which he considers most promising for his purposes; and if he meets with little encouragement, he shifts his situation and proceeds elsewhere. Thus a great deal of the country may be turned to waste and neglected. The working was chiefly in the hands of certain tribes or castes, but was conducted on no regular plan, and afforded a very miserable livelihood. There has been little change since, and though mines still exist at Panna, Karnul, and a few other places, but comparatively few diamonds are found, and probably scarcely pay the expense of collecting them. Diamonds have also been long collected in Borneo, at Pontiana, near the south-east extremity of the island. They occur in a red clay along with gold and platina, and the rajah of Mattan is said to possess one weighing 367 carats, of the purest water, but uncut.

During the end of last and the beginning of the present century the supply of diamonds chiefly came from Brazil. They were first recognized in 1727 in the province of Minas Geraes, where they had been long used by the negroes as counters in playing cards. The principal mines are still in that province near Diamantina (formerly Tejuco), and near Diamantino in Matto Grosso. Mines have also been recently worked in the province of Bahia Other localities are enumerated in the article BRAZIL. The diamonds are chiefly obtained from the Cascalho, a loose, gravelly deposit mixed with red clay, and containing large lumps of quartz and grains of gold. This rock is probably derived from the itacolumite, a quartzose variety of mica slate, or metamorphosed sandstone, on which it often rests, and in which diamonds are also said to occur. When first brought to Europe the Brazil diamonds were regarded as inferior to those from India, but without reason. Though the mines are strictly watched as Crown property, the produce is not well ascertained. Martius estimated that in the forty-six years from 1772 to 1818 diamonds weighing about 3,000,000 carats, and worth £7,000,000, were exported. Mr Mawe stated the produce at 25,000 to 30,000 carats annually of rough diamonds, equal to 8000 or 9000 carats when reduced to brilliants. After his time it seems to have greatly decreased, the whole value from 1861 to 1867 being given at about £1,900,000; and the discovery of the Cape diamonds has further reduced the amount. The stones are mostly small, averaging little more than one carat, and very rarely exceeding twenty carats. The largest diamond from Brazil was long an uncut octahedron of 120 carats, but in 1854 a fine stone of 254½ carats was sent to London. It was an irregular dodecahedron, but of brilliant lustre and with no flaws. Since cut it weighs about 124 carats, and is known as the "Star of the South."

Diamonds occur in other parts of America, having been found in the Sierra Madre, south-west of Acapulco in Mexico; and a few also in Georgia and North Carolina. They have also been obtained in California, but all small (under 2 carats); and in the district of Arizona, where one is mentioned of 3 carats.

In 1829 diamonds were discovered on the European side of the Ural mountains in the gold washings near the iron mines of Bissersk. Engelhardt conjectured that they were derived from a dolomite rock, but others state that it is mica slate like that of Brazil. Only about seventy were found in the first twenty years, and all of them small, the largest weighing under 8 carats. The only other European locality is at Dlaschkowitz, in Bohemia, where a single diamond was found in the sand containing pyropes,—the one said by Murray to have been picked up in a brook in Ireland being very doubtful.

Not more important are those from Australia, where they were found as early as 1852, and again in 1859, on the Macquarie river. In 1869 they were discovered in the Mudgee, near one of the tributaries of the Macquarie, by gold-diggers, and worked for a time pretty extensively. They lie there in old river drift covered by basalt said to be of Pliocene age. They occur in a similar position in the Bingera diamond field. In both places they are sparingly distributed and small, the largest mentioned being under 6 carats.

Far more important are the diamond fields of South Africa. In 1867 a Dutch farmer obtained from a boer a bright stone which his children were using as a plaything. This stone was sent to the Cape, where its true nature as a diamond was recognized, and subsequently forwarded to the Paris exhibition and sold for £500. This valuable discovery soon led to further researches, and diamonds were obtained from various places near the Orange and Vaal rivers in Griqua Land West. They were first collected by washing recent alluvial or supposed lacustrine deposits, apparently the detritus of rocks in the vicinity, that are spread over the lower river valleys, but are now rather sought for in "pans," or "pipes," of a circular form running down into the inferior strata, or shale, and filled with a peculiar igneous rock, named diabase, or gabbro, often much changed near the surface. Throughout this rock, which has been penetrated to a depth of from 100 to 200 feet, diamonds are disseminated weighing from over 150 carats down to the 100th of a carat, or less. Many are entire, well-formed crystals, but a large proportion are broken and isolated fragments. Hence it has been inferred that the rock in which they now occur is not the matrix or mother rock in which they were originally formed, but that the "pipes" are rather channels by which volcanic matter has made its way to the surface, bringing the diamonds along with it from some inferior deposit. However this may be,



diamond-digging has become a regular branch of industry to a large population; and it is probable, though no very accurate estimate can be formed, that nearly fifteen million pounds sterling worth of diamonds have been obtained from this district since their discovery. The largest diamond from the Cape we have seen mentioned is the Stewart, of 288⅜ carats, found on the Vaal river in 1872. It was an irregular octahedron of the purest water, and 1¼ inch in diameter, and is of a light yellow since cut.

There has been much speculation regarding the mode of origin of these gems, but hitherto leading to no certain result. Newton conjectured that the diamond was "an unctuous substance coagulated;" Jameson thought it might be a secretion from some ancient tree, like amber; and Brewster also traced it to a vegetable source. Lavoisier, Guyton-Morveau, and others observed black specks when diamonds were burned, which were considered as uncrystallized carbon. Petzhold, in 1842, also supported this view, affirming that he had found vegetable cells in the ashes of diamonds. Goeppert, in his Haarlem Prize Essay, in 1863, supported the same view, both from supposed plant tissues and from other inclosures in diamonds, but admitted that the evidence was not free from doubts. Liebig and others have explained its origin by a slow process of decomposition in a fluid rich in carbon and hydrogen. On the other hand, the occurrence of the diamond in the itacolumite or mica slate, and more recently in or near igneous rocks, as at the Cape, has tended to favour the view that it owes its origin to heat or metamorphic action, as is the case with graphite But this, as graphite also shows, does not preclude the idea that originally it may have been, like amber, some peculiar vegetable product, subsequently altered and crystallized. It may here also be mentioned that all attempts to produce diamonds artificially have hitherto failed.

Diamonds are chiefly used and valued as ornamental stones, and for this purpose they are cut in various forms according to the original shape of the crystals. It is probable that the Indians knew some method of doing this at an early period, and it is said there were diamond-polishers in Nuremberg even in 1373. Berghem of Bruges has the credit of having first used, in 1456, their own powder for this purpose. He found that by rubbing two diamonds on each other their surfaces were polished and facets formed, and acting on this hint, he employed diamond powder and a polishing wheel. His countrymen continued to follow out the art with great success, but some two centuries ago the English cutters were the more celebrated. The trade then reverted to Holland, but is again returning to Britain, where many of the finest stones are cut. The method has undergone little change, and is still chiefly effected by the hand, partly by rubbing one stone on another, partly by a wheel and diamond powder. Where there are flaws or large pieces of value to be removed, they are occasionally cut by iron wires armed with the powder, or split by a blow of a hammer and chisel in the direction of the natural cleavage. The latter is, however, a dangerous process, as the diamond is very brittle, and many valuable gems have been thus destroyed. When reduced to a proper form, the facets are polished on a lapidary's wheel. The process demands not only great skill but much time and labour. The period required to reduce a stone of 24 or 30 carats to a regular form extended formerly to at least seven or eight months of constant work, and in the case of the Pitt diamond two years were needed; but the time is now greatly shortened by the use of machinery driven by steam. Jewellers have long cut diamonds in three forms—the brilliant, the rose, and tables. The *brilliant* is most esteemed, as giving highest effect to the lustre, and implying less reduction of the stone. It is, as it were, a modification of the primary octahedron, the most common form of crystal, and is shown in its first form in figs. 6 and 7, and with the full number

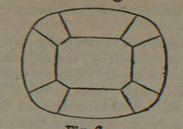

Fig. 6.

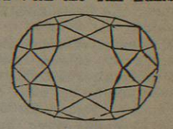

Fig. 8

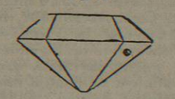

Fig. 7.

Fig. 9.

FIGS. 6–9.—Showing cutting of brilliants.

of facets in figs. 8 and 9. Figs. 4 and 6 show the upper surfaces, with the *table*, or principal face, in the middle, surrounded by the *bezil*, or upper faces, lying between its edge and the *girdle*, or common base of the two pyramids. The lower facet corresponding to the table is named the *collet*, and the whole portion below the girdle the *collet side*. The portion removed to form the table (generally $\frac{6}{16}$ths) and the collet ($\frac{1}{16}$th) is shown in fig. 10 Brilliants are [usually set open, both the upper or table side and the lower collet-side being exposed. The *rose* cut (upper view, fig. 11; lateral view, fig. 12) is given to stones which have too little depth to be cut as brilliants; it has the whole upper curved surface covered with equilateral triangles. The *table* diamond, figs. 13 and 14, the least beautiful, is adopted for broad stones of trifling depth,

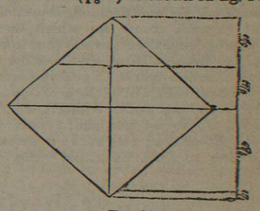

Fig. 10.

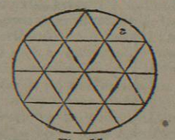

Fig. 11.

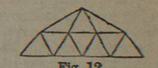

Fig. 12.

FIGS. 11 and 12.—Rose cut.

showing a series of four-sided facets above and below the girdle. Recently brilliants are cut in the *star* form

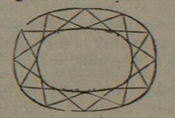

Fig. 13.

Fig. 14.

FIGS. 13 and 14.—Table diamond.

(taille à étoile), with the table above only one-fourth the diameter. and thus with less loss of weight. There

are also "mixed" or less regular forms used to suit the shape of the stone; and even splinters of diamond of $\frac{1}{100}$ carat are facetted. In all the forms the girdle ought to be perfectly smooth, as a rough edge often appears through some of the facets as a flaw, and injures the brilliancy of the stone.

The value of diamonds is determined chiefly by their size, purity, colour, freedom from flaws or stains, and the skill with which they are manufactured. Their weight is reckoned by the carat, of four diamond grains, originally an Indian weight. In England the carat is estimated as = 3·174 grains troy; but it varies in different places, being, according to Schrauf, in Amsterdam = 205·70 milligrammes, in Florence = 197·20, in London = 205·409, in Madras = 207·353, in Paris = 205·50, and in Vienna = 206·13. The usual rule is that the value of the stone increases with the square of the weight in carats, and assuming £8 or £10 as the value of a cut brilliant of first quality in water and shape, weighing 1 carat, a similar stone of 2 carats would be worth four (2 × 2) times £8 or £10, *i.e.* £32 to £40; one of 3 carats nine (3 × 3) times, or £72 to £90; and so in proportion. Fine brilliants, however, of the sizes most in demand sell much higher, or from £12 to £20 or more the first carat; whilst roses and tables are of considerably smaller value, and rough or uncut diamonds, generally sold in lots, fetch only about £2 or even less, the value being further diminished in all cases where the stones are "off colour," that is milky or tinted, or imperfect in other respects. Still more important is the state of supply and demand, especially for the largest and most valuable stones, for which there are often very few purchasers, and their price is thus lower than the rule would imply. Even political events affect the price by bringing many into the market, as at the time of the first French Revolution. In 1873 Cape diamonds were stated to be worth—yellows under 5 carats, 40s. to 50s.; above that weight, £3 to £4 per carat; pure white stones under 5 carats, £3 to £4; and above 5 carats, £4 to £7, or more according to form or lustre. Fig. 15 shows the size of

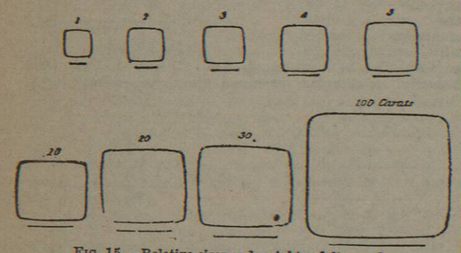


Fig. 15.—Relative sizes and weights of diamonds.

set stones round the girdle, the line indicating their depth, and the numerals the number of carats they may be expected to weigh.

Some diamonds are remarkable for their size or history. The largest undoubted diamond is the Orloff in the sceptre of the emperor of Russia, weighing 194¾ carats, and cut in the rose form, with a flat face below, resembling the half of a pigeon's egg. According to one story, it formed the eye of an Indian idol, and was stolen by a French deserter; another is that it belonged to Nadir Shah of Persia, and on his murder came into the hands of an Armenian merchant, who brought it to Amsterdam. In 1772 it was sold to Count Orloff for the Empress Catherine for 450,000 silver roubles (£90,000), with an annuity of 4000 roubles and a title of Russian nobility. Second to it is the Regent or Pitt diamond (fig. 16), bought by Mr Pitt, the governor of Madras, in 1702, for about £20,000. He brought it to London, had it cut as a brilliant at, it is said, a cost of £3000, and sold it in 1717 to the regent duke of Orleans, for Louis XV., for 2½ million francs, or £130,000; but it is estimated to be worth fully twice that sum. At the time of the first French Revolution it was sent to Berlin, but reappeared in the hilt of the sword of state worn by Napoleon I. It is considered as the finest and most perfect brilliant in Europe. It weighs 136¾ carats, but originally weighed 410 carats, and the fragments split or sawn from it when cut were valued at some thousand pounds. The third in weight is the Florentine, or Grand Duke, as it is named (fig. 17). It is of a fine yellow colour, oblong, and cut in rose. It is said to have been lost by Charles the Bold at the battle of Granson, and found by a Swiss soldier, who sold it for a few pence as a piece of rock crystal. It afterwards belonged to the grand duke of Tuscany, from whom it passed to the emperor of Austria. Its weight is usually given at 139½ carats, but Schrauf finds its exact weight 133·16 Vienna carats, and its specific gravity at 19° C. 3·5213. The Koh-i-noor (fig. 18), the largest belonging to the British Crown, has also a singular history, corresponding to that of the country of its origin. The Indian legend tells that it was found in one of the Golconda mines near the Kishna river, and worn 5000 years ago by Karna, one of the heroes celebrated in the *Mahabharata*. It passed through many hands to Baber, the founder of the Mogul dynasty, in 1526, and was shown by his successor in 1665 to Tavernier, the French traveller. He describes it then as of the shape of a half egg, and weighing 280 carats, having been thus reduced by an unskilled stone-cutter from 793⅜ carats, which it once weighed. In 1739 it passed to Nadir Shah, the Persian invader of India, who gave it the name of Koh-i-noor, or Mountain of Light, and from his successors in 1813 to Runjeet Sing, the ruler of Lahore. In 1849, on the annexation of the Punjab to British India, the Koh-i-noor was also surrendered and presented to the Queen in June 1850. It was exhibited in the Great Exhibition of 1851, and then weighed 186$\frac{1}{16}$ carats, but has since been recut, with doubtful advantage, in the rose form, and is now 106$\frac{1}{16}$ carats. Its lower side is flat, and undoubtedly corresponds to a cleavage plane. Hence it has been conjectured that it and the Russian Orloff diamond are portions of the original stone belonging to the Great Mogul, whilst a stone of 132 carats, obtained by Abbas Mirza at the storming of Coocha, in Khorassan, in 1832, may be a third fragment. This portion was long used by a peasant as a flint for striking fire. The three united would have

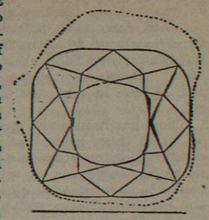

Fig. 16.—Pitt diamond.

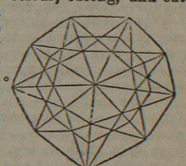

Fig. 17.—Florentine.

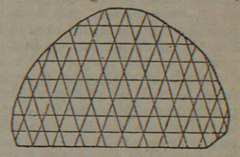

Fig. 18.—Koh-i-noor.



nearly the form and size given by Tavernier, and the Koh-i-noor would then surpass all known diamonds in its magnitude as in its eventful history.

It is not necessary to notice in detail other diamonds of smaller size, as the Sancy, of 53½ carats, once the property of Charles the Bold, like the Austrian, and afterwards of Louis XIV of France, but sold in 1830 for £20,000 to the emperor of Russia. In the Russian treasury are also the Shah of 86 carats, and the Polar Star of 40. Other noted ones are the Nassac of 89¾ carats (now recut, and 78$\frac{58}{64}$), the Piggot of 82½, and the Pasha of Egypt of 40 carats, which cost £28,000. Some are valued for other properties, as the Hope diamond, of a rare colour, a fine blue, and high brilliancy, estimated at £25,000, though only weighing 44½ carats. Red diamonds seem very rare, but there is a brilliant of 10 carats among the crown jewels of Russia, which cost £15,000, and in Dresden some very fine yellow stones, the largest of 29½ carats.

Perhaps even more important is the use of the diamond for cutting glass, for polishing gems and other hard bodies, and recently by engineers for boring machines used in forming tunnels and artesian wells. The glaziers' diamond is about the size of a pin's head, and is set in copper or brass. The curvature of the fracture faces gives a sharp edge that cuts and not scratches merely. Each costs about 12s. to 18s., and, as it will weigh only about $\frac{1}{60}$th carat, the price is higher than that used as gems. For polishing purposes the so-called "bort," *i.e.* stones so imperfect in form and quality as to be useless for ornament, are broken down and crushed into diamond powder. The carbonado from Bahia is also employed both for polishing and for boring machines. In the latter the stones are fixed in a ring of steel, made to revolve with great rapidity, and kept cool by a current of water, which also removes the detritus. In consequence its price has risen lately from about 1s. to 18s. or 20s. a carat.

The literature of the diamond is very extensive, and scattered through many works. Its history in ancient times is given by Pinder, *De Adamante*, Berlin, 1829; its general character in treatises on mineralogy and on precious stones—of the latter those by Jeffries, London, 1757, Mawe, ib. 1831; Emanuel, ib. 1865; and Streeter, ib. 1877; with the *Edelsteinkunde* of Kluge, Leipsic, 1860, and of Schrauf, Vienna, 1869, may be mentioned. More special are Murray, *Memoir on the Diamond*, London, 1831; Petzholdt, *Beiträge zur Natur d. Diamanten*, Dresden, 1842; Goeppert, *Ueber Einschlüsse in D.*, Haarlem, 1864; and many papers in the journals and transactions of scientific societies. For its mode of occurrence may be consulted:—in India, Heyne's *Tracts*, London, 1814; Ritter's *Erdkunde, Asien*, vol. iv.; and many papers by Voysey, Adam, Franklin, Blandford, and others; in Brazil, Mawe's *Travels*, London, 1812; Eschwege, Claussen, Spix and Martius, Gardner, Tschudi, &c.; for the Ural, Rose's *Reise*, vol. i., but with much general information; for Australia, Liversidge, in *Jour. Geol. Society*; for the Cape, many papers in the *Journals* of Geol. Society and the Society of Arts, and in the *Geological Magazine*, by R. Jones, Tennant, Dunn, Maskelyne, Flight, and Stow; and by Cohen in Leonhard and Geinetz's *Jahrbuch*. (J. NI.)

DIANA, who was at a later period reverenced as the Greek Artemis by the side of Apollo, was originally an independent deity of Italy, as, indeed is shown by the name, which is the feminine form of Janus. She is essentially the moon goddess, and presides over wood, plain, and water, as well as over the changes of human character, and the special functions of the female sex, also over chase and war. Diana was worshipped by the Sabines, but more especially by the Æqui, Hernici, and Latins, whose united sanctuary lay in the wooded hills of Algidus beyond Tusculum. Diana had also a sanctuary in Anagnia, the capital of the Hernici, and another in Corne, near Tusculum. But more celebrated than all these was the grove and sanctuary of Diana of Aricia, on the Lake of Nemi, which gave the name of Nemorensis to Diana. Here she was worshipped side by side with a male deity Virbius. After the destruction of Alba Longa this grove was for a long time the united sanctuary of the neighbouring Latin and Rutulian cities, until at last it was extinguished beneath the supremacy of Rome. The festival of the goddess was on the ides of August, the full moon of the hot season. She was worshipped with torches, her aid was sought by women seeking a happy deliverance in childbirth, and many votive offerings have rewarded modern excavations on the site. Another celebrated sanctuary of Diana was that on the slopes of Mount Tifata, near Capua, where she was worshipped under the name of Tifatina. This sanctuary was specially favoured by Sulla and at a later period by Vespasian. There were several ancient groves and sanctuaries of Diana in Rome, one in the Vicus Patricius between the Viminal and Esquiline, into which no man was admitted, another at the highest point of the Vicus Cyprius, another on the Cœliolus. But the most celebrated of all was the temple on the Aventine. This was originally a sanctuary of the Latin League, which accounts for the hill not being included in the original circuit of Rome, and for its being the refuge of the plebeians in political disturbances. The statue of the goddess was of the Ephesian type, the day of dedication was the ides of August, and the temple was especially frequented by slaves and their wives. Runaway slaves throughout Italy had a special dependence upon Diana. Such are the chief characteristics of the Roman Diana; but as early as 400 B.C. she began to be identified with the Greek Artemis, of which an account has already been given (see ARTEMIS). For fuller information see Preller, *Römische Mythologie*.

DIANO, or TEGGIANO, a town of Italy in the province of Principato Citeriore, 45 miles south-east of Salerno, on an isolated eminence, above the upper part of the valley of the Negro, or *Tanager*, to which it gives the name of Val di Diano. It represents the ancient Tegianum, a municipal town of Lucania, of which the ruins can still be traced at the foot of the hill; and it possesses a castle, several churches of some interest, and three conventual buildings. In 1497 it was strong enough to resist, under Antonio Sanseverino of Salerno, the siege undertaken by Frederick of Aragon. Population in 1871, 6224.

DIAPHORETICS (from διαφορέω, to carry through), such remedies as promote perspiration. In health there is constantly taking place an exhalation of watery vapour from the skin, by which not only are many of the effete products of nutrition eliminated, but the body is kept cool. Under exertion or in a heated atmosphere this natural function of the skin is increased, sweating more or less profuse follows, and, evaporation going on rapidly over the whole surface, little or no rise in the temperature of the body takes place. In many forms of disease, such as fevers and inflammatory affections, the action of the skin is arrested, and the surface of the body feels harsh and dry, while the temperature is greatly elevated. The occurrence of perspiration not unfrequently marks a crisis in such diseases, and is in general regarded as a favourable event. In some chronic diseases, such as diabetes and some cases of Bright's disease, the absence of perspiration is a marked feature; while, on the other hand, in many wasting diseases, such as phthisis, the action of the skin is increased, and copious exhausting sweating occurs. Many means can be used to induce perspiration, among the best known being baths, either in the form of hot vapour or hot water baths, or in that part of the process of the Turkish bath which consists in exposing the body to a dry and hot atmosphere. Such measures, particularly if followed by the drinking of hot liquids and the wrapping of the body in warm clothing, seldom fail to excite copious perspiration. Numerous medicinal substances have a similar effect, although the *modus operandi*

appears to differ in the case of several of them. Thus antimony and ipecacuan appear to produce their diaphoretic action by their nauseating and depressing or relaxing effects; while others seem to act as direct stimulants to the function of the sudoriparous glands of the skin, such as the well-known diaphoretics—Mindererus spirit (acetate of ammonia), guaiacum, nitrous ether, and the recently introduced drug, jaborandi. Opium acts powerfully as a diaphoretic, especially when in combination with ipecacuan, as in Dover's powder, or with antimony; and alcohol has similar properties. Diaphoretics are of great service in many diseases. When employed at the commencement of a catarrh or common cold they frequently check it, and thus prevent the evils which are so apt to follow this affection. In acute dropsy due to kidney disease, such as that which sometimes results from scarlet fever, the hot air or hot water bath is a valuable remedy, and even in dropsical accumulations of long standing, when diaphoresis can be induced, marked improvement in the symptoms generally follows. In certain circumstances, however, diaphoretics, particularly in the form of baths, may be unsafe, especially where there is any affection of the heart or lungs attended with embarrassed respiration; and in general in diseases where diaphoretics seem to be indicated, the physician is required to take into account the patient's whole condition in his selection of any one remedy for this purpose.

DIARBEKIR (or *Kara Amid*, the Black Amid), a city of Asiatic Turkey, the administrative centre of the pashalic of the same name, is situated 2050 feet above the level of the sea, on a mass of basaltic rock which rises abruptly to a height of 100 feet from the western bank of the Tigris, about 100 miles north-east of Aleppo, in 37° 55′ 30″ N. lat. and 39° 53′ 39″ E. long. It is about three miles in circumference, has a nearly circular form, and is encompassed by ancient and dilapidated walls of a very remarkable character. They are built of basalt, have in most places a thickness of 14 feet, vary in height from 30 to 40 or 50 feet, and are strengthened by upwards of 70 towers, some square and some round, which communicate with each other by two passages formed in the heart of the masonry. There are four gates, which are closed at night:—the Dagh Kapi, or Mountain gate, on the N.; the Rum Kapi, or Anatolian gate, on the W.; the Mardin gate on the S.; and on the E. the Kyöprü gate, which takes its name from the stone bridge that spans the Tigris. Both the gates and the walls bear numerous ornamental designs and inscriptions in Arabic and Cufic characters relating to their erection or restoration. The citadel, or *Itch Kaleh*, which stands in the north-east corner between the Dagh Kapi and the Kyöprü Kapi, commands the town; and a fine view of the valley of the Tigris is obtained from one of its towers, supposed to be the belfry of an ancient Christian church. Within the enceinte is the official residence of the pasha, but he has another mansion at some distance from the town in the vicinity of the military barracks. The interior of the town contrasts unfavourably with the massive and spacious character of its defences; it has only one street about 20 feet in breadth, the rest being mere lanes from 4 to 5 feet across. The houses are built of basalt in the lower stories and of dark-coloured brick above; and this, combined with the flat terraces of the roofs, gives a sameness and gloominess of aspect. The public buildings comprise upwards of 50 mosques large and small, 9 Christian churches, a Jewish synagogue, upwards of 20 baths, about 15 khans or caravanserais, and a good military hospital; but only a few are worthy of individual notice, though some of the minarets are richly sculptured, and several of the mosques preserve interesting traces of ancient work. The Ulu-jami, or Great Mosque, which was formerly a Christian church and perhaps originally the ancient palace of Tigranes, has an outer wall with two façades, each formed by a row of Corinthian columns surmounted by an equal number of a Byzantine type; the interior is divided into three portions, appropriated to as many Mahometan sects. The Hassan Pasha Khan, in the immediate vicinity of the mosque, is a fine building constructed of layers of white and black stone; but it is exceeded in size by the Ali Pasha Khan, which indeed is the largest in Asiatic Turkey. The town is supplied with water both by springs within the walls and by an aqueduct fed by a fountain at Ali-punar about two miles to the west; but in the heats of summer, which are sometimes exceedingly severe, these supplies become greatly exhausted and the water impure. In the last century Diarbekir was one of the largest and most flourishing cities of Asia; and as a commercial centre it still ranks second to Mosul, in the upper region of the Tigris and Euphrates. The principal trade routes are by Argana and Kharput to Samsun, by Sort, Bitlis, and Van, to Tabriz, by Mardin to Mosul, by Urfa and Aintab to Aleppo, and by means of kalleks, or inflated skins, down the river to Mosul and Baghdad. The bazaars are not much behind those of Baghdad, and display a rich variety of both Asiatic and European wares. Owing partly to the introduction of the latter, the manufacturing industry of the town has greatly decreased, and most of the 1600 cotton looms of which it could boast in 1816 have disappeared. Red and yellow morocco of the greatest repute throughout Asiatic Turkey is still produced, as well as copper vessels, pipe-heads, and goldsmith-work. The population, which was reckoned at 400,000 in 1750, was in the latter part of the century greatly reduced by war, and famine, and pestilence. In 1837 it was estimated by Southgate at from 13,000 to 14,000 souls; in 1856 it was found to be 27,430; and in 1873 it was stated by Cernik at 40,000, and by another authority at 60,000. The principal nationalities in the polyglot community are the Kurds and Armenians, but there are also numerous Turkomans, Turks, and exiled Bulgarians. The Mahometans and Christians are now pretty equally balanced in numbers. Besides representatives of the Armenian, Syrian, and Greek churches, there are Roman Catholics enough to support a church and convent, and a mission is maintained by American Protestants.

Diarbekir is the city which, under the name of Amida, became a Roman colony in 230 A.D. and received a Christian bishop in 325. Fortified by Constantius II. it was before long captured by Sapor the Persian king, after a siege of which a detailed account from his personal experience is given by Ammianus Marcellinus; and in the later wars between the Persians and the Romans it more than once changed hands. On its capture by the former in 502, it is said that 80,000 of its inhabitants perished. After having been from about the 11th century in the possession, by no means uninterrupted, of several Turkoman dynasties, it was finally captured by Selim, the first Sultan of the Osmanli Turks, in the year 1515, and since that date it has remained under the Ottoman rule.

See Sandreczy, *Reise nach Mosul und durch Kurdistan nach Urumia*, 1857; R. J. Garden's "Description of Diarbekir," in *Journal of Roy. Geogr. Soc.*, 1867; and Cernik, *Technische Studien Expedition durch die Gebiete des Euphrat und Tigris*, 1875.

DIARRHŒA (from διά, through, ῥέω, to flow), looseness of the bowels. The causes of this complaint are very numerous. As a primary affection it has been treated of under CHOLERA (*q. v.*) It is frequently a symptom or complication of other diseases, such as consumption or typhoid fever, and as such it will be mentioned in describing the various ailments in which it occurs.

DIAS, ANTONIO GONÇALVES (1823–1864), a Brazilian poet and historian, was born at the little town of Caxias, in Maranhão, with the charms of which he has made his readers familiar. From the university of Coimbra, in Portugal, he returned to his native country well-equipped with legal lore, and obtained an official appointment at Maranhão; but the literary tendency which was strong within him led him to try his fortune as an author at Rio de Janeiro. Here he wrote for the newspaper press, ventured to appear as a dramatist, and at last in 1846 established his reputation by a volume of poems—*Primieros Cantos*—which appealed to the national feelings of his Brazilian readers, were remarkable for their autobiographic impress, and by their beauty of expression and rhythm placed their author at the head of the lyric poets of his country. In 1848 he followed up his success by *Secundos Cantos e sex Tilhas de Frei Antão*, in which, as the title indicates, he puts a number of the pieces in the mouth of a simple old Dominican friar; and in the following year, in fulfilment of the duties of his new post as professor of Brazilian history in the imperial college of Pedro II., he published an edition of Berredo, and added a sketch of the migrations of the Indian tribes. A third volume of poems, which appeared with the title of *Ultimos Cantos* in 1850, was practically the poet's farewell to Rio de Janeiro and the service of the muse, for he spent the next eight years engaged under Government patronage in obtaining a personal acquaintance with the scientific institutions of Europe, was appointed on his return to Brazil a member of an expedition for the exploration of the province of Ceara, was forced in 1862 by the state of his health to try the effects of another visit to Europe, and died in September 1864 on board the vessel that was bearing him once again to his native shores. While in Germany he published at Leipsic a complete collection of his lyrical poems, which has since gone through several editions; the four first cantos of an epic poem called *Os Tymbiros* (1857); and a *Diccionario da lingua Tupy* (1858). To the publications of the Rio de Janeiro Geographical and Historical Institute he contributed a number of papers, among which the one on *Brazil and Oceania* has received special notice. A complete edition of the works of Dias has made its appearance at Rio de Janeiro. See Francisco Sutero in the *Rivistan Maranhense*, and Wolf, *Brésil Littéraire*.

DIAS, BARTOLOMMEO, a Portuguese navigator, the discoverer of the Cape of Good Hope, flourished towards the close of the 15th century, the date of his birth being unknown. He seems to have interested himself at an early period in geographical research, and to have been intimate with Martin Behem. In August 1486 he was appointed by King John II. to the command of a small expedition intended to carry on the work of exploration on the coast of Africa. After touching at various points on the western shore of the continent, and taking possession of them for his royal master, he sailed onward into the unknown sea and doubled the Cape without being aware of it. He touched land at the mouth of the Great Fish River. He now found that he had rounded the continent, and in his return voyage he sighted the promontory to which he gave the name *Cabo Tormentoso*, or *Cabo de todos los tormientos* (Cape of all the Storms). This was afterwards changed by the king for the happier title it still bears. Dias arrived in Lisbon in December 1487. He afterwards commanded a ship in the first expedition of Vasco da Gama, who sent him back to Portugal after they had reached the Cape Verd Islands. He held a similar position in the expedition under Cabral which discovered Brazil. On the return voyage the vessel he commanded foundered in a storm on the 29th May 1500.

DIATOMACEÆ. For the knowledge we possess of these beautiful organisms, so minute as to be undiscernible by our unaided vision, we are indebted to the assistance of the microscope. It was not till towards the close of the last century that the first known forms of this group were discovered by O. F. Müller. And so slow was the progress of discovery in this field of scientific research that in the course of half a century, when Agardh published his *Systema Algarum* in 1824, only 49 species included under 8 genera had been described. Since that time, however, the microscope has been greatly improved; and eminent naturalists in all parts of the civilized world have been induced to engage in the study of these forms. The result is that the number of known genera and species has been greatly increased; the species found in Great Britain and Ireland may be estimated at little less than 1000; and Rabenhorst, in the index to his *Flora Europæa* enumerates about 4000 forms which have been discovered throughout the continent of Europe. At a time when little was understood of the structure of these organisms they were generally known among botanists by the appellation of Bacillariaceæ; but almost all recent authors are agreed in adopting the later and more appropriate designation of Diatomaceæ.

Various opinions have been entertained as to the position to be assigned to these forms. The earlier observers referred them to the vegetable kingdom. Subsequent authors, including Ehrenberg, regarded them as animals; but in consequence of their analogy to other organisms acknowledged to be vegetable, as regards their general structure, and more especially their modes of reproduction, they are now almost universally included in the vegetable kingdom, and classified with the Monocellular Algæ.

The Diatomaceæ exhibit great variety in form. While some species are circular, as *Coscinodiscus perforatus* (fig. 1), others are of an oval outline, as *Surirella ovalis* (fig. 2)

FIG. 1.—Coscinodiscus perforatus. × 400.

FIG. 2.—Surirella ovalis. × 400.

Some are linear, as *Synedra radians* (fig. 3); others more

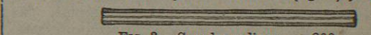

FIG. 3.—Synedra radians. × 200.

or less crescentic, as *Epithemia hyndmanii* (fig. 4); others

FIG. 4.—Epithemia hyndmanii. × 400.

again, are cuneate, as *Podosphenia lyngbyii* (fig. 5); some few have a sigmoid outline, as *Pleurosigma balticum* (fig. 6); but the prevailing forms are naviculoid, as *Navicula cuspidata* (fig. 7). They vary greatly also in their modes of growth,—some being free, others attached to foreign bodies by gelatinous stipes, the stipes being in some species very short, while in others they are of considerable length. In some genera the forms are simple, while in others the frustules are connected together in ribbon-like filaments, or form, as in other cases, zig-zag chains. In some genera the frustules are naked, while in many others they are inclosed in a more or less definite gelatinous investment, or frond.

FIG. 5.—Podosphenia lyngbyii. × 400.