

sition to imprisonment at its pleasure, and to recite once a week for three years the seven penitential psalms—reserving to itself the privilege of moderating, commuting, or taking away in whole or in part the penalties and penances. But it is also a fact that the same Pope Urban VIII., who before had settled upon Galileo a pension for life of 100 crowns a year, and on his son Vincenzo a similar pension of 60 crowns, immediately commuted the sentence pronounced on the 22d of June by the Inquisition, and that on the 6th of July following Galileo left Rome for Sienna, where he remained with one of his most intimate friends, Archbishop Piccolomini, until his return home, in December, to his villa at Arcetri. "Here he spent," says the celebrated Protestant Encyclopedist Rees, "the residue of his days, prosecuting his studies and observations, and communicating the result of them occasionally to the public; AND HERE HE WAS VISITED BY PERSONS OF THE PRINCIPAL RANK AND CHARACTER AT FLORENCE."

Arcetri was only about a mile from Florence, and not far from it was the Convent of St. Matthew, where Galileo's two daughters were cloistered nuns, and where he often went to see them, to enjoy their conversation and their many proofs of tender filial affection. "Thus the last years of the philosopher were spent," says the Very Rev. Canon Murphy, "not, as has often been asserted, moping about the gloomy precincts of a prison, but among the amenities of a charming villa," and in converse and communication with his friends. "He was comforted and strengthened in the hour of death by the last sacraments and by the proper blessings, and his eyelids were closed by the hands of his affectionate son and of his cherished friends, Torricelli and Viviani."

As to the assertion that Galileo "was refused burial in consecrated ground," it is or should be well known that his body rests in the Cathedral of Santa Croce, at Florence, "along with some of the remains of the most eminent men of modern Italy."

B. S. C.
Notre Dame, Indiana, March 13, 1879.

THE TAILS OF COMETS.

PROF. BREDIKHNE, of St. Petersburg, writes Mr. Proctor in the *Newcastle Weekly Chronicle*, has made some interesting researches into the evidence respecting the tails of comets. He shows reason for believing that these appendages may be divided into three distinct classes, according to the different relations between the attractive and dispersive power of the sun. The latter power he considers to be, in all probability, modified by the different properties of the particles of which the tail is formed. There are few subjects of inquiry more difficult and perplexing than the phenomena of comets' tails. The evidence seems unmistakably to point in some cases to a true repulsive action excited by the sun, and yet nothing seems harder to understand than the possibility that the sun should exert such a power in so energetic a manner as to produce the amazingly rapid extension of tail matter seen in certain cases. Thus the tail of Newton's comet seen after the comet had made its nearest approach to the sun, must have been thrown out in less than a day (probably in less than a few hours) to a distance of more than ninety million miles. Under the sun's gravitating power, tremendous though that power appears, the comet, with all the velocity it had already acquired, took more than four weeks in traversing the same distance. Tyndall's ingenious attempt to explain the formation of comets' tails as due to the actinic energy of rays which have passed through the comet's head, fails to account for the phenomena presented by many long-tailed comets. Professor Tait's sea-bird analogy, by which the formation of a comet's tail is compared with the coming into view of a flight of sea-birds, as the plane of their array comes to coincide with the observer's eye, would never have been advanced by anyone familiar with the history of the most important comets, or even with the history of any one of the great comets which have been visible for more than a few days. What Sir John Herschel wrote more than forty years ago has never yet been invalidated, viz., that the phenomena of comets can only be explained by assuming the existence of an intense repulsive force, excited by the sun on the thin material raised by his heat from the surface of comets approaching him from interstellar space.

CONSTITUTION OF NEBULÆ.

In the "Investigations upon the Height of the Atmosphere and the Constitution of Gasiform Cosmical Bodies," A. Ritter deduces the following law: "If, in consequence of increase or diminution of heat, the radius of the gaseous globe undergoes a change, the temperature of its center also changes; but the product of the radius into the central temperature is constant." If p , v , T , respectively, designate the pressure, specific volume, and absolute temperature of a definite, minute portion of the body, $pv^{\frac{1}{2}} = \text{constant}$; $Tv^{\frac{1}{2}} = \text{constant}$; $\frac{T}{p} = \text{constant}$. Since Neptune's orbital radius is about 6,000 times as great as the sun's present radius, according to the above law the sun's central temperature is now about 6,000 times as great as when, according to the Kant-Laplace hypothesis, the sun was expanded to the orbit of Neptune. Of the whole work which has been performed by gravity during that immense interval, more than four-fifths is still stored within the sun's mass in the form of heat.—*Ann. der Phys. u. Chem.*

TREATMENT OF FISTULA IN ANO.—A NEW METHOD.

By I. J. SUGGS, M.D., of Texas.

SOME years since I was called in consultation in case of fistula in ano. After examining the case, I conceived the idea of introducing a tube into the rectum so as to prevent the action of the sphincter, and thereby allow the fistula to heal. It was agreed to. I had a silver tube made as follows: 3 inches long, about 1½ inches in diameter at the point, larger at the base, flared some small holes in the base so as to confine it with a bandage. Made an obturator similar to that of a speculum uteri. After having the

bowels well evacuated the tube was introduced and confined with a T bandage, the obturator removed and a plug of cotton introduced, the fistula well cleansed and a diluted tincture of iodine injected. Five days after the operation the tube was removed and the fistula perfectly cured.

I have not had a case of fistula since in which to try again the above treatment.—*Southern Medical Record.*

RINGWORM.

DR. JNO. V. SHOEMAKER, in a paper read before the American Medical Association on "Ringworm in Public Institutions," states that, while treating a large number of cases of ringworm, which occurred in one of the public institutions for children in Philadelphia, he scraped some of the scales from the scalp of one of the children, and also from the chest of another, and applied them to the bodies of two cats. For three days no change was perceptible on the parts upon which the scales were placed; on the fourth a small meal like patch was detected upon one, and on the other the hairs began to fall out. The fifth day the patches assumed the characteristic circular form, and the affection continued to spread rapidly until spots the size of a large coin were almost denuded of hair. Scales from the patches of one of the cats were reinoculated on a healthy portion of the scalp of one of the children and thigh of another, with the effect of producing the circumscribed spots of ringworm. Two specimens were now prepared, one from the inoculated child, the other from one of the cats, and revealed under the microscope fungi of a luxuriant growth, threads being present in large quantities.

Ringworm owes its origin to a vegetable parasite, the *Trichophyton tonsurans*. It generally commences among those that are improperly cared for, and, as it is exceedingly contagious, it spreads rapidly to those coming in contact with the infected. The fungus has a predilection for the strumous and debilitated, and flourishes upon them luxuriantly.

Among the fifty cases afflicted on the occasion referred to the author found that a large percentage were the children of subjects of chronic disease, worthless and confirmed drunkards, and inmates of charitable institutions or almshouses. The affection frequently has its origin in the lower animals, and is transmitted from them to children and adults. A number of cases are on record in which it has been communicated directly from cows, calves, oxen, horses, and cats to individuals, and then to other members of the same family. A well-marked example of its direct transmission from a cow to an individual came under the author's notice and treatment a short time since. The experiments on cats, noted above, are also additional strong proof that the fungus can be transmitted from lower animals to children, and from individuals to animals, and also verify the fact that the scales of the scalp are capable of producing by inoculation ringworm on other parts of the body.

Dr. Shoemaker states that his observation has been that, when the affection attacks the body and is not complicated, it is easily cured; but when it involves the head it is a most tedious and unmanageable disease, owing to the mischievous influence of the hair. He believes, however, that the failure to promptly eradicate the disease in the majority of cases in public institutions is due to negligence, want of patience, and the inability on the part of nurses and attendants to properly understand the orders of the physician.

ELEPHANTIASIS AND FILARIA.

A RECENT number of the *Lancet* contains a lecture, by Sir Joseph Taylor, on *Elephantiasis arabum*, or "elephant leg," in which the author gives the most recent views as to the cause and proper treatment of the disease. This malady is one seldom met with outside the limits of tropical and inter-tropical countries, and occurs in the latter generally near the coast, where the malaria and sea air mingle. Notwithstanding its common name, which is derived from the supposed resemblance of the parts affected to the limb of an elephant, the disease is not confined to the leg, but may attack other parts of the body. It is totally distinct from leprosy (*Elephantiasis Græcorum*), with which, owing to its name, it is sometimes confounded. They are unlike in symptoms, as in nature, and have nothing in common, although they may coexist. Dr. Taylor thinks it would be well to abandon elephantiasis as a generic name for leprosy. The ordinary form in which the disease occurs is hypertrophy of the integument and subjacent areolar tissue of some part of the body, especially of the legs and external genital organs, and the affected parts often obtain an enormous size. The skin is formed into hard, rough masses or folds, in appearance not unlike the skin of an elephant's leg. The feet and toes are sometimes almost hidden under it, and scrotum and labia form enormous outgrowths, often of great weight, accompanied by large tumors, with white, milk, or chyle-like contents. From the male patient such tumors have been removed weighing upward of 100 pounds. The disease affects both sexes and all ages. No race is altogether exempt, but the dark-skinned seem more liable to suffer than the fair. Men suffer in larger proportion than women. The period of life between twenty and forty is that most prone to be affected. Waring states that the lower animals are not exempt; even birds have been known to suffer from a swelling of one or both legs, which, though unaccompanied by fever, was in all respects similar to the hypertrophy of elephantiasis. It appears that the disease does not, of necessity, shorten life, though no doubt dangerous ulceration and even gangrene may occasionally supervene.

The malady is found in India, the Malayan Peninsula, China, Arabia, Egypt, the West Indies, South America, in some parts of Spain, and, probably sporadically, all over the globe, excepting, perhaps, the extreme northern and southern regions.

Various causes have been assigned for the disease in the regions where it prevails. Air, water, food, and, as it is frequent near the sea coast, eating fish, have been credited with it. The presence or vicinity of certain forms of vegetation, geological formations of soil, have each or all been regarded as causes. Certain climatic conditions—humidity, heat, malarious influences, combined with poor living—seem to be concerned as predisposing causes; and it has frequently been observed that removal from the locality checks, while return to it reproduces the disease; and now, according to Lewis, Manson, Bancroft, and others, the presence of *Filaria* in the blood and lymph is considered to be largely concerned in the causation—at all events, this parasite is frequently associated with, if not the cause of, the disease. It cannot be denied that the causal relation of the nematode worm to elephantiasis and other morbid conditions has some show of probability, although more information must be obtained before a decided opinion can be formed. The discovery

by Dr. Manson that the mosquito, as an intermediary host, is instrumental in propagating the filaria, and consequently the disease is important and worthy of careful consideration in both an etiological and sanitary point of view. In connection with this it is interesting to learn that Dr. Manson, in China, considers that the geographical distribution of elephantiasis is much the same as that of the mosquito. Further investigation may confirm or it may reject these views, but we cannot but recognize the importance of the discoveries, though the precise import of their causal relations to elephantiasis or other diseases is still *sub judice*.

THE CHEMISTRY OF PLANTS.

By R. WARINGTON.

GERMINATION.

THE seed is a storehouse of concentrated plant food, intended to nourish the germ till the root and leaf are developed. In the seeds of the cereals, and of many other plants, the chief ingredient is starch. Another class of seeds, of which linseed and turnip-seed are examples, contain no starch, but in its place a large quantity of fat. A seed generally contains a considerable amount of albuminoids; its ash is rich in phosphoric acid and potash.

For germination to take place, moisture, oxygen, and a suitable temperature are necessary. Under these conditions the seed swells, oxygen is absorbed, a part of the carbonaceous ingredients is oxidized, heat is developed, and carbonic acid evolved. During these changes the solid ingredients of the seed gradually become soluble; the starch and fat are converted into sugar; the albuminoids are converted into amides—as asparagin, probably also into peptones. With this supply of soluble food the radicle and plumule are nourished; they rapidly increase in size, emerge through the coats of the seed, and, if the external conditions are suitable, soon commence their separate functions as root and leaf. The process of germination may be easily studied in the ordinary operation of malting barley.

Seeds buried too deeply in the soil may not germinate for lack of oxygen. If germination takes place the plumule may fail to reach the surface, the store of food in the seed being exhausted before the layer of soil is penetrated, and daylight reached.

THE SOURCES OF PLANT FOOD.

The Atmosphere.—We have already stated that the whole of the carbon of plants is obtained from the carbonic acid present in the atmosphere; 10,000 volumes of air contain about 3½ volumes of carbonic acid, or about 1 lb. of carbon in 3,500 cubic yards of air.

The atmosphere also contains a very small and variable quantity of ammonia. Schiessing found from 1 lb. in 6,000,000 cubic yards, to 1 lb. in 119,000,000 cubic yards. The quantity is greatest, according to the same experimenter, in warm southerly winds. The ammonia of the air is perhaps directly absorbed by plants to a small extent, but is rendered available chiefly through absorption by the soil, and by means of rain, which brings it in solution to the earth.

The atmosphere also furnishes a small amount of nitric acid. The nitrogen and oxygen of the atmosphere combine under the influence of electric discharges, nitrous acid being formed; this is converted into nitric acid by the action of ozone, or peroxide of hydrogen. This formation of nitric acid in the atmosphere is the only original source of combined nitrogen on our globe the existence of which has been placed beyond dispute.

The total amount of nitrogen, in the form of ammonia and nitric acid, annually carried to the soil by rain, varies in different years and places. The average of many experiments in Germany gives 9.45 lb. of nitrogen per acre. The average of two years experiments at Rothamsted gave 7.47 lb.

Rain also furnishes small quantities of alkaline chlorides, especially in the neighborhood of the sea. At Cirencester the chlorides are equal to about 30 lb. of common salt per acre per annum; further inland the quantity is smaller.

The Soil.—All soils have been produced by the disintegration of rocks; the character of the soil largely depends on the character of the rock from which it has been formed. The principal ingredients of soils are sand, clay, carbonate of calcium, and humus; as each of these preponderate the soil is said to be sandy, clayey, calcareous, or peaty.

Sand is either composed of pure quartz (silica), or consists of fragments of more complex minerals—mica, for example. When the former is the case, the sand will supply no plant food; but in the latter case the gradual decomposition of the mineral will slowly increase the ash constituents available for the plant.

Clay is a silicate of aluminum, and if absolutely pure would furnish nothing to the plant; it always, however, contains some potash. Clay has the important property of absorbing and retaining phosphoric acid, ammonia, potash, lime, and other substances necessary for plant nutrition.

The calcareous matter of soils supplies lime to the plant; limestone will also generally contain phosphoric acid. Carbonate of calcium is beneficial to the soil in many ways. It preserves the particles of clay in a separate coagulated condition, thus making heavy soils friable and pervious to water. It enables clay to exercise its absorbent power on various salts, which would otherwise escape its action. It also promotes the decomposition of vegetable matter, and the nitrification of the nitrogen which it contains.

The humus, or decayed vegetable matter of soils, has its origin in the dead roots, leaves, etc., of a previous vegetation. It is the only nitrogenous ingredient of soils. A black soil, rich in humus, is sure to be also rich in nitrogen; a soil destitute of humus will contain scarce any nitrogen. The relation of these ingredients of soil to water and heat must be briefly noticed.

Of all soil ingredients sand has the least, and humus the greatest capacity for retaining water. Light sandy soils thus suffer most from drought, while applications of farmyard manure, and the ploughing in of green crops, increase the water-holding power of a soil.

Dark-colored soils absorb the greatest amount of heat from the sun's rays, and light-colored soils least. The presence of humus is thus favorable to soil warmth. Quartz sand is an excellent conductor of heat. A soil rich in sand will thus be warmed or cooled to a greater depth than a soil containing but little sand. Water has a powerful effect in cooling a soil, partly from its high specific heat, and partly from the immense consumption of heat during its evaporation. A wet soil is thus much colder than a dry one. The drainage of wet land thus results in a greater warmth of the surface soil, and consequently an earlier growth in spring.

The proportion of plant food present in soils is very

*The Cyclopaedia, or Universal Dictionary of Arts, Sciences, and Literature, by Abraham Rees, D.D., F.R.S., F.L.S., S. Amer. Soc. London, 1819. In 33 vols., accompanied by 5 vols. of steel engravings. A rare and valuable work, to which I have had access in the Library of the University of Notre Dame, Ind. It was published to subscribers at 60 guineas (about \$300), secured to the heirs, and considered so complete and perfect that no second edition was to be or has been published. Nearly if not all the eminent men of the day were contributors to this publication, the list of their names filling nearly a page of the preface to the work. Among these it may suffice to mention Abernethy, Sir Humphry Davy, Mackay, Landseer, Flaxman, Bonnycastle, Pond, Lawrence, Donovan, Cavallo, etc.

small, even when the soil is extremely fertile. The surface soil (first 9 inches) of a pasture may contain 0.25 of nitrogen per cent., while soil of the same depth from a good arable field may yield 0.15 per cent., and a clay subsoil 0.05 per cent. A good surface soil may contain 0.20 per cent. of phosphoric acid, or not unfrequently a smaller quantity. Potash varies much, rising to 1.0 per cent., or none in some clay soils.

The weight of soil on an acre of land is, however, so enormous, that small proportions of plant food may be very considerable quantities. Nine inches depth of arable soil (clay or loam) will weigh, when perfectly dry, about 3,000,000 or 3,500,000 lb. A pasture soil will be lighter, the first 9 inches weighing, when dried and the roots removed, about 2,250,000 lb. Supposing, therefore, a dry soil to contain 0.10 per cent. of nitrogen, phosphoric acid, or potash, the quantity in 9 inches of soil will be about 3,000 lb. per acre.

A large part of the elements of plant food present in soils is in such a condition that plants are unable to make use of it. A soil may contain many thousand pounds of phosphoric acid or of nitrogen, and yet be in a poor condition, while a small dressing of readily available food, as superphosphate or nitrate of sodium, will greatly increase the fertility.

The nitrogen contained in humus is apparently not in a condition fit to serve as plant food; cereal crops at least are unable to appropriate it. By the action of an organized ferment present in the soil the humus is oxidized, and its nitrogen converted into nitric acid. Nitrification only takes place in moist soil, sufficiently porous to admit air, and at moderate temperatures. It is also necessary that some base should be present with which the nitric acid may combine; this condition is usually fulfilled by the presence of carbonate of calcium.

The fragments of rock present in soil, as stones, gravel, and sand, are as a rule of little value to a plant, the elements of plant food which they contain being in too insoluble a condition to be attacked by the roots. These fragments of rock are slowly decomposed by the mechanical action of frost, and by the chemical action of water, and their contents are thus gradually made available to the plant. The solvent power of the water in a soil is greatly increased by the carbonic acid, and perhaps also by the humic acid it holds in solution. Water containing carbonate of calcium in solution is especially capable of attacking silicates.

If water is allowed to drain through a soil, it carries with it a part of the readily soluble matter which a soil contains. The substances chiefly removed by the water will be the nitrates, chlorides, and sulphates of calcium and sodium. When heavy rain falls these substances are washed into the sub-soil, and partly escape by the nearest outfall into the springs, brooks, and rivers. When dry weather sets in evaporation takes place at the surface of the soil, the water of the subsoil is brought again to the surface by capillary attraction, and the salts it contains are concentrated once more in the upper soil, forming in some rare instances a white crust of salt upon the surface.

Of these readily soluble salts the nitrates are of the greatest importance as plant food. The quantity of nitrates in a surface soil will vary greatly, depending on the richness of the soil in nitrogen, the extent of recent washing by rain, and on whether the soil is a bare fallow or under a crop. Where a crop is growing the nitrates will be kept nearer the surface, the evaporation of water from a growing crop being far greater than from a bare soil. The nitrates will also be constantly taken up by the roots, and employed as plant food. The loss of nitrates by drainage is thus far less when the land is under crop than in the case of a bare fallow.

Phosphoric acid, potash, and ammonia are very rarely found in drainage water. If a solution containing phosphoric acid, potash, or ammonia is poured on a sufficiently large quantity of fertile soil, the water which filters through will be found destitute of these substances. This retentive power of soil for phosphoric acid, potash, etc., is of the utmost importance in agriculture. The action is a complex one. All salts are doubtless retained to some extent by soil through mere mechanical adhesion; salts thus feebly retained, as nitrates and chlorides, can be removed by thorough washing with water. Other substances are, on the contrary, retained by chemical affinity; these are not removed by washing, or to but a small extent. The ingredients of the soil which exercise a chemical retentive power are the hydrates of ferric oxide and alumina, the hydrous silicates of aluminum, and humus.

Ferric oxide is a common ingredient of soils; to it the red color of many soils is owing. To the presence of ferric oxide the retention of phosphoric acid is chiefly due, an insoluble basic phosphate of iron being produced. Alumina acts in the same manner. Ferric oxide and alumina have also a retentive power for ammonia and potash, but the compounds formed are more or less decomposed by water. To the hydrous silicates the permanent retention of potash and other bases is probably chiefly due. Humus has a great absorbent power for ammonia. Other bases, as magnesia and lime, are retained by soil, but in a less powerful manner than are potash and ammonia.

Soils destitute of carbonate of calcium take up very little potash or ammonia when these are applied as salts of powerful acids, as, for instance, chlorides, nitrates, and sulphates. When carbonate of calcium is present the potassium or ammonium salt is decomposed, the base is retained by the soil, while the acid escapes into the drainage-water united with calcium. The presence of carbonate of calcium may thus greatly increase the retentive power of soil for bases.

There can be little doubt that the plant food contained in soil which is capable of being taken up by roots, exists either in solution (as, for instance, nitrates), or in the states of combination just referred to—that is, in union with ferric oxide, hydrous silicates, and humus. Different crops have very different powers of attacking these various forms of plant food.

The operations of tillage and drainage serve in several ways to increase the amount of plant food which is at the disposal of a crop.

By tillage the surface soil is kept in an open, porous condition. By this means the evaporation from the surface is lessened, capillary attraction being diminished, and the land consequently suffers less from drought; the water-holding power of the surface soil is also increased. A more important result of tillage is that the soil is thoroughly exposed to the influence of the air. Soils containing humus or clay will absorb ammonia from the atmosphere, and the soil is thus enriched with nitrogen. The organic remains of former crops and manuring are also oxidized by the atmosphere, the nitrogen being converted into nitric acid. The rocky fragments which a soil contains, as fragments of silicates or limestone, will be more or less disintegrated by the combined action of water and air, assisted by the products arising from

the oxidation of vegetable matter, and a portion of the insoluble plant food is thus brought into a state suited for assimilation by the roots of crops.

By drainage the various chemical actions we have just mentioned are carried down to a greater or less extent into the subsoil, for as the water level is lowered the air enters from above to fill the cavities in the soil. By drainage also the depth to which roots will penetrate is increased, for roots will not grow in the absence of oxygen, and rot as soon as they reach a permanent water level.

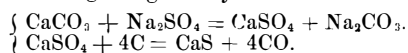
Paring and burning is occasionally resorted to as a means of increasing the available plant food in a soil. It consists in burning the surface soil in heaps, which are then spread over the land. If the soil contains limestone it is easy to see that the phosphates of the limestone may become more available by the complete disintegration which attends the conversion into lime. If limestone and fragments of silicious rocks are present, the silicates will be attacked by the lime at a high temperature, and a part of the potash liberated from its insoluble combinations. To produce the best results it is essential that the burning should take place at a low temperature. This treatment of paring and burning is a very extreme one, and can be recommended only in few cases; it must be attended with an entire loss of the nitrogen in the soil burnt.—*Agricultural Gazette*.

MANUFACTURE OF PHOSPHORUS.*

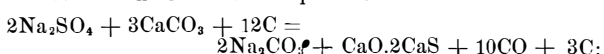
By JAMES READMAN.

THE author remarked at the outset that his communication contained nothing absolutely new, but was simply an account of the practical aspects of the phosphorus manufacture. Various mineral phosphates are now used in the manufacture of phosphorus; bone ash is no longer remunerative, on account of its high price. Among the varieties of mineral phosphates are, Canadian phosphate, German or Nassau phosphate, Charleston phosphate, and Sombro phosphate. The first stage in the manufacture of phosphorus is to decompose the calcium phosphate completely in a large cylinder with sulphuric acid of 110° to 115° Twaddell, with constant agitation. The calcium sulphate is then filtered off, and the filtrate is evaporated to about 80° or 90° T., and then allowed to cool. It contains over 25 per cent. of P_2O_5 . It is then mixed with coarse wood charcoal, and dried in a muffle furnace. The proportion of charcoal to liquor is 1 to 5. This substance contains the phosphoric acid in a partially insoluble state, so that it is different in its properties from meta-phosphoric acid. The mixture is then transferred to retorts of Stourbridge clay, capable of holding 30 to 40 lbs. The malleable iron pipe, through which the phosphorus distills is then luted on, and the heat is raised to bright redness. The phosphorus distills over, and is condensed in water. It only remains to cast it in moulds, when it is sent to market. Mr. Readman, in contradiction to the usual assertions in text-books, called especial attention to the fact that mono-calcium phosphate is not used as a source of phosphorus, for the calcium takes up valuable room, and the compound requires a much more intense heat to effect its decomposition. Redonda phosphate of aluminum is regarded by the author as the future source of phosphorus, but as yet no attempt to procure phosphorus from it has been peculiarly successful.

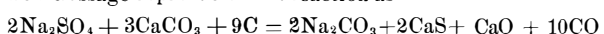
The President read a paper on the "*Leblanc Soda Process*." He gave an historical résumé of the process of alkali manufacture, mentioning that before Leblanc brought out his process it was very probably carried on as a secret process in England. The various reactions imagined by different investigators to take place were then alluded to. Among these the following was given by Dumas:



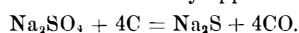
It was afterward supposed that an oxysulphide of calcium was formed in virtue of the equation—



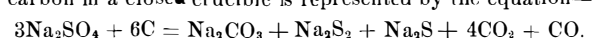
and Gossage represented the reaction as—



The author then gave an account of his own researches on the subject. As it is impossible to arrive at any definite conclusion by operating on the large scale, for different samples of black ash, even when drawn with the greatest possible care from the same charge, show the most varied composition, the reaction was simplified, sodium sulphate and carbon being heated together in small quantity; the proportions and temperature were varied in each experiment. Some preliminary experiments were made, and proved that sodium carbonate is formed, especially at a red heat. At a higher temperature very little Na_2CO_3 was produced. The reaction evidently approximated to—



At 1,250° F. the reaction between sodium sulphate and carbon in a closed crucible is represented by the equation—



In an open crucible the excess of sulphur is burned off, and it is probable that if more carbon were added all the sulphate of sodium would be converted into carbonate. On raising the temperature the Na_2S_2 and Na_2CO_3 are decomposed, and the only products are $Na_2S + CO$.

CHEMICAL NOTES.

MICROSCOPICAL PROPERTIES OF AMBER.—By O. HELM (*Arch. Pharm.*).—The clear yellow amber has no peculiar appearance when examined under the microscope; but if the opaque or white amber, cut into thin sections, be examined by a power of 200–500 diameters, round cavities, varying in size, are observed in the interior. The cavities in the milk white amber are the smallest; in the opaque yellow sort they are larger; while in the less dense quality the cavities present the appearance of a mass of soap bubbles. Water appears to be contained in the cavities, for if amber which has been laid in water for some time be exposed to an increased temperature, the weight of the specimen diminishes, from which it would appear that moisture can diffuse through the substance of the amber, and the insects which are inclosed in the substance are perfectly dry, owing to this diffusion. This peculiarity is turned to account by the amber merchants, who, to clean the amber, soak the pieces in boiling oil, whereby the cavities contract, and press out their contents, as water, lime, iron, etc. This process renders amber spe-

* Read before the Philosophical Society of Glasgow

cifically heavier, transparent, and filled with innumerable small scale-like fissures.

Besides containing sulphur in the form of pyrites, amber likewise contains sulphur combined organically, and to the amount of 0.26 per cent. in the clear yellow sort, 0.38 in the dark, 0.34 in the bone-colored, and 0.27 in the brownish red weathered coating of the last named kind. This sulphur is contained for the most part in the bitumen which is insoluble in alcohol or ether.

The author considers that the sulphur was introduced into the amber during the tertiary period, the origin being one of two, either the reduction of sulphates originally present in the interior, or that the sulphur has diffused itself into the resin from outside. In the first case the sulphate would be reduced to a sulphide, which in its turn would be transformed into an organic sulphide, and accompanied by the production of a metallic carbonate. The evidence of the original appearance and structure of the amber still existing unaltered renders the above internal chemical change improbable. It is therefore more likely that sulphureted hydrogen, or some other easily decomposable sulphide, has been formed in the neighborhood of the amber, and that this passing by diffusion into the interior than combines with the amber.

GEDANITE, A NEW FOSSIL RESIN.—By O. HELM (*Arch. Pharm.*).—Up to the present time the substance known as "unripe amber" has been considered to be amber, but the author shows that it differs totally from true amber in its composition, and he has given it the name of gedanite. Gedanite has a hardness of $1\frac{1}{2}$ –2, breaks easily, and has a sp. gr. of 1.058–1.068. It does not contain succinic acid, and when heated in oil, it swells up and becomes like caoutchouc. Ether dissolves 40–52 per cent., and alcohol 18–25 per cent.; and of the residue left by evaporation of the alcohol, ether dissolves 20–24 per cent. The portion soluble in alcohol softens at 100°, and melts at 105°, and then resembles mastic. The ash amounts to 0.06 per cent., and consists of lime, silica, sulphuric acid, and ferric oxide. Sulphur organically combined appears also to be present, and, like amber, gedanite is negatively electric. Its composition is C 81.01, H 11.41, O 7.33, S 0.25. Gedanite therefore differs from amber in having a lower melting point, a smaller amount of oxygen, in being less hard, and more easily soluble in ether, and in the absence of succinic acid; and it differs from copal and other resins in containing sulphur organically combined, in having a higher melting point, and being less soluble in various liquids, and in its amber-like color when heated.

REACTION BETWEEN MERCURY AND HYDROCHLORIC ACID GAS.—By BERTHELOT (*Compt. Rend.*).—13.5 grammes of mercury and 48 c.c. of pure and dry hydrogen chloride were sealed in a tube and heated to as high a temperature as was possible for one hour. On opening the tube it was found that rather more than 1 c.c. of hydrogen had been formed, or about $\frac{1}{2}$ th of the hydrochloric acid gas had been decomposed.

FORMATION OF AMMONIUM NITRITE.—By A. V. LOSECKE (*Arch. Pharm.*).—The author has corroborated Schönbein's statement that the evaporation of water in air produces ammonium nitrite, and gives the results of experiments to determine the conditions of its formation. It is found that ammonium nitrite is always formed when water evaporates freely, and the lower the temperature the larger is the quantity produced; but the formation is prevented if the evaporation takes place in a narrow-necked flask. In another series of experiments, it was observed that 1 liter of water, evaporated to a small bulk, yielded ammonia equivalent to 0.148 part in 100,000 parts of water; 1 liter, evaporated to small bulk at 40–50°, yielded ammonia equivalent to 0.5823 part of nitric acid per 100,000 of water; and lastly, 5 liters of water, allowed to evaporate spontaneously, yielded ammonia equivalent to 2.9608 nitric acid per 100,000 parts of water. This last experiment shows the influence that the evaporation of rainwater and dew can have on the nourishment of plants; and it has been found that if a leaf be moistened and allowed to dry, nitrous acid is produced, and that in dew from leaves ammonium nitrite can be easily detected. These experiments, therefore, explain the introduction of nitrogen into plants, which, Boussingault says, cannot occur directly. Ammonium nitrite can also be detected in snow and rain alone without contact with leaves, but then only in very minute quantities. The water used in the experiments was ascertained to be free from ammonia, and also from nitric and nitrous acids.

CHROMATES AND DICHROMATES.—By L. SCHULERND (*Jr. Pr. Chem.*).—The results of the investigation show that only monad metals are capable of forming dichromates, and that as lithium forms a dichromate, we have here an additional proof of the monatomicity of this element. Potassium chromate and dichromate produced identical precipitates in solutions of barium salts, although the wet precipitate from the dichromate was rather darker in color; but the dichromate described in *Handb. der Chemie*, as formed when barium chromate is dissolved in a chromic acid solution, could not be obtained; the calcium salt behaves similarly. Hot water withdraws chromic acid from the red silver dichromate. From neutral thallium carbonate, potassium dichromate precipitates a mixture of the chromate with the dichromate, whereas in acid solutions the dichromate only is formed. Lithium chromate, produced by the addition of lithium carbonate to chromic acid, crystallizes in yellow prisms with 2 mols. of water; this is driven off at a temperature of 130°. The dichromate, which crystallizes with 2 mols. of water, forms hard, almost black, thick plates; the crystalline water is driven off at 130°, and at a high temperature the crystals melt and give off oxygen.

NEW COMBINATIONS OF HYDROCHLORIC ACID WITH AMMONIA.—L. TROOST.—The author remarks that hydrochloric acid and ammonia have hitherto been obtained only in the proportions which form sal-ammoniac, analogous to common salt. No hydrochlorate of this chloride has yet been discovered, nor an ammoniac hydrochlorate with excess of base. He has discovered a great number of curious compounds, formed by dry ammonia with hydrochloric acid, hydrosulphuric acids, and other acids, both mineral and organic. He takes ammoniacal gas absolutely dry and free from every trace of compound ammonias, saturates it with pure dry hydrochloric acid, and submits the sal-ammoniac thus obtained and distilled in a close vessel to the action of a large excess of gaseous ammonia, refrigerating to different degrees. He thus obtains two well-defined compounds, characterized by their point of fusion, their crystalline structure, and their tension of dissociation. The former of these, tetra-ammoniac hydrochlorate, $HCl.4NH_3$, melts at +7°, and its crystals depolarize light powerfully. The other compound, hepta-ammoniac hydrochlorate, $HCl.7NH_3$, melts at –18°.