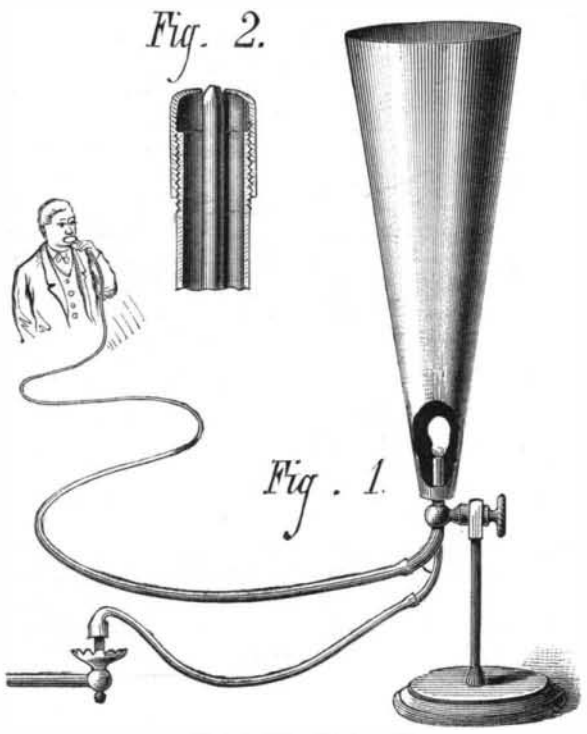
of special machinery. During the performance the music paper is unrolled from one cylinder and rolled upon another; and as music does not sound well when played backward, the mechanism is arranged so that while one piece is being played another is re-rolled.

Few persons are aware of the great number of notes in a musical composition; the number of holes in the music for this organ gives a striking illustration of this; for example, the music for the overture of "William Tell" contains 6,000 notes or holes. This is one of the 400 pieces contained in the present catalogue of Messrs. Needham & Son, and the number of pieces is being daily augmented.

THE SPEAKING FLAME.

BY GEO. M. HOPKINS.

During some of my recent experiments in acoustics, having occasion to investigate the characteristics of sonorous waves, I constructed a manometric flame apparatus after the plan of König, which, although it worked admirably and gave in the revolving mirror those well known and striking effects, did not possess the requisite qualities, although a very delicate diaphragm was employed; I therefore devised a peculiar form of annular burner, similar to those sometimes used in producing the oxyhydrogen light, but provided with an adjustable tip on the end of the outer tube, as shown in Fig. 2.



THE SPEAKING FLAME.

After connecting a mouthpiece with the outer tube, by means of a piece of rubber tubing, and connecting the inner tube with a gas burner in the same way, by making sound in the mouthpiece I succeeded in producing in the rotating mirror the clear, sharp-cut flames shown in Fig. 5, which were entirely satisfactory, and which will be treated further on.

In testing this apparatus I observed that the burner emitted low tones, like those made in the mouthpiece. By carefully adjusting the cap to the outer tube of the burner I succeeded, without a great deal of trouble, in getting the flame to reproduce distinctly any tone made in the mouthpiece. These tones were evidently produced by the minute and rapid explosions of the gas as it was relit after being extinguished by the round waves emerging from the annular orifice of the burner. This flame should not be confounded with the well known singing flames, as they each have an individual tone, whereas this flame will produce any note in the scale.

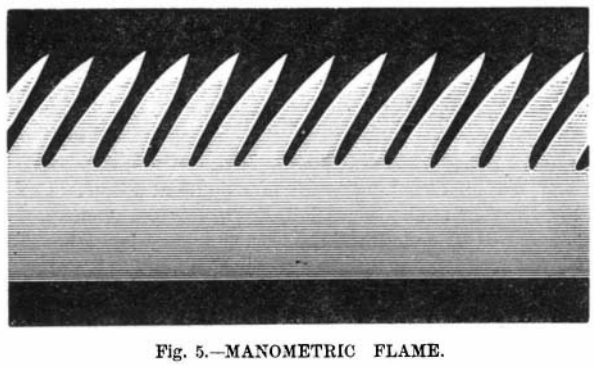
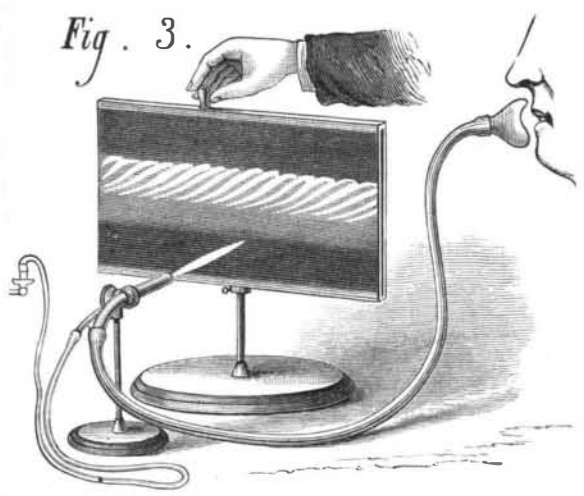


Fig. 5.—MANOMETRIC FLAME.

While sounds can be clearly heard without a resonator of any kind, yet they can be greatly re-enforced by applying a long funnel to the burner, as shown in Fig. 1. After having nicely adjusted the burner, I was greatly surprised to hear the flame reproduce a melody as loudly, clearly, and beautifully as the singing telephone, and with the characteristics of the singer's voice plainly distinguishable; but what was my astonishment when the flame made articulate sounds as words were spoken into the mouthpiece. Scarcely believing my own ears, I placed between the burner and mouthpiece thirteen feet of rubber tubing, and carried the tube through two walls, so that none of the sounds could possibly be heard from the mouthpiece; still the flame talked in an intelligible way. By a preconcerted signal I was most happily assured that at least three fourths of the sentences uttered in the mouthpiece and reproduced by the flame were understood.

To determine whether the articulation was wholly due to the flame, the gas was turned off, but no sounds from the



MANOMETRIC FLAME APPARATUS.

mouthpiece could be heard at the orifice of the burner. On relighting the gas, sounds were produced as before. The flame has a peculiar appearance when singing or talking; its ghastly blue and its weird sounds are suggestive of the supernatural.

Since discovering the sound-producing capabilities of the flame, I have observed many peculiarities, and some difficulties to be surmounted. All of the breath used in producing the sounds must enter the mouthpiece and be propelled through the tube and burner. An explosive sound at first extinguished the flame entirely; but a short slit cut in the rubber tube near the mouthpiece afforded an escape for the overpressure, so that a word beginning with an aspirate or a consonant could be pronounced without extinguishing the flame. Much depends on the direction of the wind as it escapes from the annular orifice. It should pass from all sides diagonally across the tip of the inner tube or gas burner.

When this burner is employed in producing manometric flames, the ordinary two-sided revolving mirror, shown in Fig. 3, is used. When it is revolved behind the burner, as shown in the engraving, it may be made to exhibit all of the phenomena of König's apparatus, and in addition to this some effects may be produced which are peculiar to this apparatus. Defects in the vocal organs show themselves in the character of the flame. While a clear voice or a musical instrument will produce the clear-cut flames shown in Fig. 5, a hoarse voice will produce a small extra flame between the bases of the others, and a "husky" or dry voice will produce a fuzziness at the sides and point of the flame. A trill, made by saying *t-r-r-r-r* in a high key in the mouthpiece, produces a flame which, in the revolving mirror, appears like that shown in Fig. 6, and by inclining the burner at a proper angle a figure will be produced which resembles a golden rope (Fig. 7) whose strands are fine or coarse as the pitch of the sound is high or low. In addition to these most beautiful flame figures, the waves (Fig. 8) are produced by making a loud tone of low pitch in the mouthpiece. The waves, which are fire tipped, are of a gorgeous blue, as is also the band from which they rise.

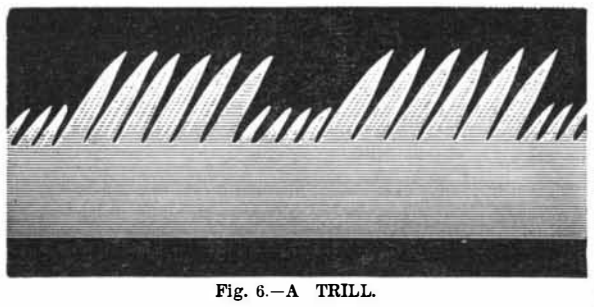


Fig. 6.—A TRILL.

A beautiful effect is secured by using the mirror shown in Fig. 4, which is simply a disk mounted on a small shaft, and arranged at a slight angle with the plane of rotation of the shaft, so that when it is turned it will "wabble" and produce a blue crown with golden tipped flames. By connecting the burner with a flute, as in the illustration, very sharp and clearly defined flame points will be formed.

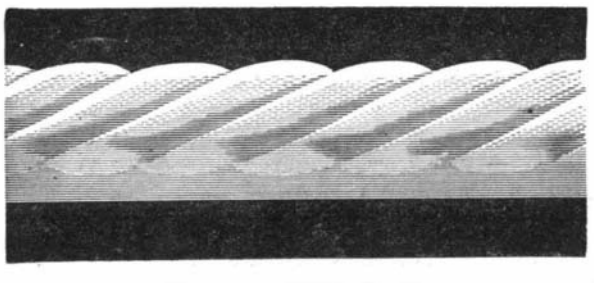
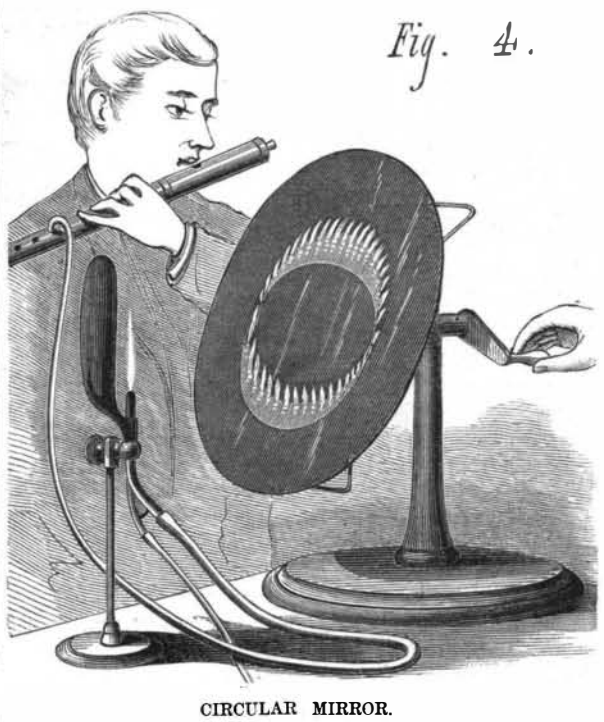


Fig. 7.—A GOLDEN ROPE.

In all of these experiments the band from which the flames spring, as well as more or less of the base of the flame, is of a beautiful indescribable blue.

The Silk Thread Electroscope.

To the Société des Sciences of Nancy, M. Rameaux recently introduced a very simple and sensitive electroscope. It consists of a fine fiber of white silk, fixed at one end by means of a little wax to any support, and free to oscillate in any direction under its point of attachment. A single thread would, of course, suffice for the ordinary purposes of electroscopy properly so called, but it is preferable to employ two near each other, taking care to space them so that they cannot foul each other during their swing, or influence each other reciprocally. One of the threads is charged by means of a glass rod with positive electricity. The other is charged by means of a stick of resin with negative electricity. Every body which attracts one of the threads so charged, and repels the other, is necessarily electrified. Its electricity is of the same sign as that of the thread which it repels. The sensibility of these electroscopes is greater, within certain limits, as the threads are made finer, longer, and less conducting. If the finest sewing silk of commerce be untwisted, each of the parts or strands obtained will make an excellent electroscopic pendulum, which, if about 2 feet long, is very handy, and suffices for almost all tests. White silk is preferable to colored. The motions of these threads, if well charged, are considerable, even when the bodies presented to them contain but slight charges of electricity. When the threads are not excessively fine, disturbances of the air do not destroy the observations so much as might be



CIRCULAR MIRROR.

supposed. M. Rameaux has found this arrangement in all cases more sensitive and sure than a carefully constructed gold leaf electroscope which he used for comparison. This system also recommends itself in several ways; for instance: 1. It is so simple that every one can construct and use it. 2. It costs nothing, no special support being necessary. The threads can be fixed to any projecting piece, as the edge of a table, the only condition being that they may hang freely. 3. It can be set up in a moment, and consequently is at once ready for any unexpected requirement; whereas a gold leaf electroscope long unused requires to be dried for hours. 4. It works perfectly, whatever the hygrometric state of the atmosphere. 5. It can be employed to show electric phenomena to a numerous auditory. With long thin fibers and highly electrified bodies the experiments are very telling.

Effect of Glycerine on Fermentation.

It is well for those who manufacture articles liable to decomposition to know that glycerine has the power of arresting fermentation to a remarkable degree. It is stated in the *Chemical Journal* that glycerine retards both lactic and alcoholic fermentations. One fifth of glycerine added to milk at a temperature of 15° to 20° C. prevents it from turning sour for eight or ten days. One half or one third of glycerine, at the same temperature, retarded the fermentation of milk for six or seven weeks.

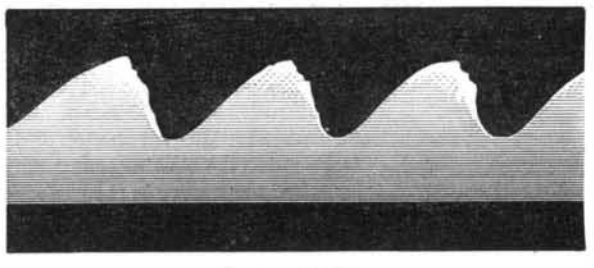


Fig. 8.—WAVES.

At higher temperatures larger quantities are needed to produce the same results. The formation of hydrocyanic acid from amygdalin and emulsin is also retarded by glycerine. It becomes thus very serviceable in preventing the spoiling of various lotions. For this reason it is not unusual to add a small quantity to the preparation known as milk of roses, and also to almond paste. With regard to cosmetics generally, the use of glycerine in small quantities may be recommended.

New Decorative Processes.

Electrotyping.—*La Nature* states that some specimens of metal work now on exhibition in the halls of the Academy are being greatly admired, and are mistaken by every one for silver, until the secretary explains that this effect has been obtained by M. Gaiffe in depositing a coating of cobalt on red copper by means of a battery It would seem as if this new conquest of electroplating might be applied to engraving; and to show that it may be, the author sends two proofs, one taken from an ordinary copper plate, and the other from the same plate "cobalted." The advantage of this process lies, first, in the durability of the cobalt, which allows of a great number of impressions, and, secondly, in the fact that the plate being exhausted, nothing is easier than to remove the cobalt without harming the copper, and then to cover it again with a new coating. Nickel, which is so readily applied to metals, will not admit of such a manipulation.

Decoration of Zinc.—Dr. L. Stille has recently described a chemical process for covering zinc with colored coatings. The articles of zinc are first brightened by scouring with quartz sand, moistening with dilute muriatic acid, putting them quickly in water, and then wiping them dry most carefully with white blotting paper. To insure success, however, it is necessary to employ zinc as free as possible from lead, and to have it bright like a mirror. When these conditions are fulfilled the metal may be coated with a variety of beautiful colors by immersion in a solution of alkaline tartrate of copper for a shorter or longer time, depending on the color desired.

Coloration of Metals.—The *Industrie Progressive* is responsible for the following statement: Metals may be rapidly colored by covering their surfaces with a thin layer of sulphuric acid. According to the thickness of the layer and the duration of its action, there may be obtained tints of gold, copper, carmine, chestnut brown, clear aniline blue, and reddish white. These tints are all brilliant, and if care be taken to scour the metallic objects before treating them with the acid, the coloring will suffer nothing from the polishing. On making a solution of 640 grains of lead acetate in 3,450 grains of water, and warming the mixture to 88° or 90°, it decomposes and gives a precipitate of sulphuret of lead in black flakes. If a metallic object be immersed in the bath, the precipitate is deposited upon it, and the color produced will depend on the thickness of the deposit. Care must be taken to warm the objects to be treated gradually, so that the coloration may be uniform. Iron treated in this way has the aspect of bluish steel; zinc, on the contrary, becomes brown. On using an equal quantity of sulphuric acid, instead of the lead acetate, and warming a little more than in the first case, common bronze may be colored of a magnificent red or green, which is very durable. Very beautiful imitations of marble may be obtained by covering the bronze objects, warmed up to 100°, with a solution of lead thickened with gum tragacanth, and afterward submitting them to the action of the precipitate spoken of above.

Gas Cloth.—"Gastuch," or gas cloth, is a name given by Dr. Hirzel, of Leipsic, to a gas and water tight stuff which he has recently patented. This is produced by placing a large smooth piece of so-called gutta-percha paper between two pieces of some not too coarse and dense material —*e. g.*, shirting (undressed)—and then passing the arrangement between heated rollers. The outer pieces of the shirting combine in the most intimate way with the inclosed gutta-percha to form material which is impenetrable by gas and water. It may be made still denser and more resistant by being coated on both sides with copal lac, for instance. The material is said to be well adapted to form gas-tight membranes for regulators of pressure, of compressed gas bags, or sacks for dry gas meters, as also dry gas reservoirs.

Iridescent Glass.—This beautiful product, which has been so successful, and the demand for which is still increasing, is now made, according to the *Revue Industrielle*, by burning chloride of tin in the furnace. There are thus produced fumes for which warm glass has great affinity, and which immediately produce an iridescent surface upon it. To heighten the tints a small quantity of the nitrates of baryta and strontia may be used. The irisation is completed during the working of the piece—either the blowing or moulding. Those pieces which it is desired to preserve in the perfection of iridescence are never placed in the furnace a second time.

Application of Galvano-plastic to Glass Decoration, by M. Alexandre (in *Moniteur de la Céramique*).—The process rests on the application of electro-metallurgy to the decoration of glassware, mirrors, etc., either for the exterior or interior decoration of houses, furniture, etc. The substance which serves for tracing the design on the glass is a metallic paste of good conducting power, mixed with a solvent and thinned with an essential oil. The design once executed on the glass, the latter is submitted to the action of fire in either a muffle or a furnace, and is not withdrawn until perfectly cold.

The glass is then immersed in a metallic bath and a galvanic current passed over it; by this means the metal in suspension in the bath is precipitated on the design. The glass is withdrawn as soon as the coating becomes as thick as required. Finally, if necessary, the metallic design is finished up by chiseling or other means, and is left thus; or, indeed, another layer of a like or different metal may be deposited on it.

Recent Contributions to the Germ Theory of Disease.

Among the important facts, says *Les Mondes*, that have been brought to notice in the medical world within the last three months, one of the most remarkable, without doubt, is the communication made to the Academy of Medicine by M. Pasteur, at the session of April 23. At this date, M. Pasteur made known to the Academy that there is a vibrio capable of producing septicæmia, just as bacteria produces carbuncle. He made known at the same time the conditions under which this vibrio exists, as well as the cause of its death.

The vibrio of septicæmia is killed by oxygen and pure air, but develops and multiplies in a medium of carbonic acid. Since air and oxygen kill the vibrio of septicæmia, it would seem that it ought never to follow in the train of wounds, for all wounds are always more or less in contact with the air, which is a deleterious element for these little organisms. But by dint of ingenious investigations, M. Pasteur has discovered that under certain determined conditions the vibrio can live and multiply in spite of its apparent contact with the air. Besides the vibrio of septicæmia, M. Pasteur announces that he has detected two others—one presenting nothing of interest to medicine, seeing that it is incapable of supporting the mean temperature of living man; the other, which accommodates itself very well to the temperature of the human body, is that which gives rise to purulent infection.

So, then, carbuncle, septicæmia, and purulent infection would be due to germs having characters perfectly distinct; and according as these germs are mixed in such or such proportion, we would obtain such or such infection. These views are not merely theoretical, but are confirmed by experiments which appear pretty convincing; for, according as he inoculates the germ of such or such a one of these maladies, M. Pasteur produces at will carbuncle, putrid infection, or purulent infection; and in mixing these different germs together he obtains an affection a little different from the three others, but which comes nearest to that which has furnished the most infecting germs.

This important communication from M. Pasteur was followed at the succeeding session of the Academy by a remarkable paper from M. Alphonse Guérin, on the different theories of purulent infection, and the means of remedying them. Space does not allow us to enter into the details of this able paper, but we can merely say that for M. Guérin, as for M. Pasteur, purulent infection is the product of germs. In aid of this opinion, M. Guérin cited the results of a long practice in the treatment of wounds—results which, gained by a method of treatment of his own, were extremely successful, and added another strong argument in favor of the theory of production of purulent infection by microscopic germs.

Theoretical Reformers.

Speaking of the swarm of confident but ill-informed theorizers who presumed to represent the workingmen of the country before the Congressional Committee for investigating the "labor question," in session in this city, the *Tribune* sarcastically, yet not unjustifiably, remarks that "it is a curious circumstance that the men who do not own a dollar of capital, and never, except upon compulsion, do a day's work at any kind of labor, are the ones who understand better than anybody else the relations of capital and labor, and are the most competent to adjust each to the other and to the State. Curiously enough, too, the men who own capital and the men who live by labor are so ignorant of the whole subject that they cannot be permitted to arrange their own business. The capitalist cannot negotiate with the workingman for the labor which makes capital productive, nor the workingman treat with the capitalist for the exchange of his labor for pecuniary reward, without the interference of other men who not only do not labor nor employ labor, but who have never studied this or any other question, and have hardly reflected soberly upon its most superficial aspects. And these latter are the ones who speak with authority."

It is a pity that so many political newspapers and politicians mistake the vaporings of such idle theorizers for the views of workingmen. Our sober-minded and practical artisans and mechanics—and they constitute numerically as well as industrially the real working class—are not given to such crack-brained schemes for inaugurating the millennium by government proclamation.

Printing in Japan.

The advantages possessed by the art of printing with movable types are incontestable. For Europeans, whose alphabet is composed of a small number of letters only, nothing is more easy than to form words. But it is a different thing entirely in countries which, like China and Japan, have a particular character to express every idea—every word. According to the correspondent of a journal from which we borrow these details, the complete collection of Japanese types comprises 5,000 characters, of which 3,000 are in constant use, and 2,000 are employed occasionally. These types are arranged in a Japanese composing room on shelves like the books in a library; the compositor is thus obliged to be continually on the go while collecting his types. The great number of their characters for printing has thus far prevented the Chinese and Japanese from corresponding by electricity; the telegraph, that instrument of civilization, having remained in the hands of foreigners. It is no wonder then that the telephone has been received in Japan with the greatest favor.—*Le Monde de la Science.*

An Interesting Discovery.

According to the Denver (Col.) *News*, Professor Snow, of the Kansas University Scientific Expedition, has lately made a most interesting "find," in Gove county, about three hundred miles east of Denver.

This discovery consisted of a giant reptile, or Saurian, so perfectly preserved as to exhibit a portion of the outer covering. Previously geologists had found hundreds of specimens of these Saurians with the bones alone remaining, so that this discovery of the outer skin is something entirely new to science. The Saurian in question was about thirty feet in length, and it might have been supposed that the external plates or scales would be of large size, as is the case with the living crocodiles and alligators. But, on the contrary, the Saurian scales are very small for an animal of such imposing dimensions, being no larger than those of an ordinary garter snake. The rock in which this fossil was found was of the cretaceous formation, unusually compact in texture, which probably accounts for the preservation of so perishable a portion. In order to reach the specimen it was necessary to remove about six feet of overlying rock, which required three days' labor of the Professor and his two assistants. In other respects the expedition has been very successful, having already shipped to Lawrence, for the university cabinets, upward of one hundred fossil fishes and many Saurian skeletons, besides six or seven thousand specimens of the living birds, plants, and insects characteristic of the plains.

New Mechanical Inventions.

Mr. Hulbert N. McConoughey, of Grant, Iowa, has patented an improved Attachment for any ordinary Seed Planter, for planting the seed in accurate check row by means of a smooth rope.

Mr Arthur R. Steel, of Letts, Iowa, has patented an improved Motor for running light machinery, such as churns, sewing machines, lathes, etc. It may be run by weight or lever at any desired speed, and conveniently rewound.

An improved Knife for Cutter Heads has been patented by Mr. Patrick C. McGrath, of Plattsburg, N. Y. The object of this invention is to furnish an improved manner of making planer knives and of securing them in place upon the cutter heads, which will enable the knives to be held firmly and securely in place, and readily set in or out, as desired, and which, at the same time, will enable the knives, when worn or broken, to be replaced at a comparatively small expense.

Mr. William T. Elliott, of Orange, Mass., has patented an improved Sewing Machine Shuttle, which is so constructed that the bobbin may be readily put in and taken out, and it will hold the bobbin securely, and will enable any desired tension to be given to the thread.

Chemical Analysis of the Sundew.

The sundew (*Drosera rotundifolia*), which has been made conspicuous, among the insectivorous plants, by the minute study bestowed on it by Darwin and other observers, has recently been analyzed by G. Lugan. The fresh plant was treated by the process know as dietheralysis. The author states (*Journal de Pharm. et de Chim.*) that the aqueous liquid obtained thereby contained glucose, various salts, and a crystallizable organic acid apparently peculiar to this plant; this was also obtained from the ethereal liquid by evaporating it and treating the residue with chloroform, which leaves it undissolved, along with wax and yellow coloring matter. On evaporating the chloroform, a greenish-brown resin was left, which had a strong and characteristic odor, was exceedingly acrid, and produced a burning sensation when applied to the skin. The author found the viscid exudation of the glandular hairs to be destitute of acid reaction, and was unable to obtain formic acid, which has been stated to be the principle by means of which the leaves convert albuminoid matters into peptones.

Poisoning by Peach Stones.

A fatal case of poisoning by peach stones, which is noted in the French papers as having recently occurred in Paris, should serve as a warning to families in which children are allowed to look after themselves for hours at a time. Probably very few adults themselves know how poisonous peach stones are. The victim of the recent accident in Paris secreted the stones of a number of peaches, and, obtaining a hammer, when left alone broke them open industriously and ate them; the result being that he was fatally poisoned by hydrocyanic (prussic) acid. Since the peach season is now upon us, it is as well to explain what quantity of poison the peach stone possesses. Writers on toxicology state that one ounce of the kernels contain about one grain of pure prussic acid, and this quantity, it is well known, is sufficient to kill any adult person. Even two thirds of a grain has very often proved fatal, and indeed may well be regarded as a fatal dose for any child.

The Population of the Earth.

The fifth publication of Behm and Wagner's well known "Population of the Earth," makes the number of the earth's human inhabitants for the current year 1,439,145,300, an increase of fifteen millions over the estimate of last year. The increase is attributed partly to natural growth, partly to exacter knowledge due to recent censuses. The distribution of the population among the grand geographical divisions is as follows: Europe, 312,398,480; Asia, 831,000,000; Africa, 205,219,500; Australia and Polynesia, 4,411,300; America, 86,116,000.