GLYCERINE; ITS PREPARATION AND USES IN THE ARTS.

By DR. A. BERGHAUS.

As already mentioned, its use in medicine is now more restricted than formerly, but it has not been entirely superseded by other things, as indicated by our previous reference to its preventing the precipitation of heavy metals by alkalies and their use for dissolving digestive ferments (like pepsine). The cellular organs which contain these ferments are cut up fine, the blood washed out with water, and glycerine poured over them. Dr. Wittich, in a communication to the Berlin *Klinischer Wochenschrift*, says that the glycerine standing over the mucous membrane of the stomach possesses an energetic digestive action, if a few drops of it are put in a 0.2 per cent. solution of salt. The diastatic action of the glycerine extract is no less energetic on the pancreas, the submaxillary, and the mucous membrane of the smaller intestines, as well as the peptic action of the pancreas on fibrine. Absolute alcohol precipitates the ferment mixed with albumen and peptones, but when recovered from the filtered precipitate each exhibits its own characteristic action in water as well as in dilute sulphuric acid.

This method of preparing pepsine for therapeutical use is to be recommended for its simplicity. It is only necessary to keep a clean dissected stomach in glycerine in order to have a supply of the active pepsine always ready on hand.

FOR VACCINATION.

In regard to the action of glycerine upon vaccine lymph, R. H. Paulcke, of Leipsic, says in his "Jahresbericht" that "the compact coagulum which is quickly formed in animal lymph, and which contains most of the active constituents, often gets so hard that it is difficult to blow it out of the quill entirely, and in such cases it must be made porous with a bristle. At the station it is customary, if the lymph shows an unusual tendency to coagulate, to add one part of pure glycerine to five of vaccine to make it keep and render it possible to blow it out. If this addition is not stated on the label, there is no glycerine in it. . . . Before using, it is advantageous to moisten vaccine which has dried on the spatula with pure glycerine and water, rubbing it up with the point of the lancet to loosen it, and then rub the spatula over the wound with gentle pressure, for the blood that oozes out is not sufficient to dissolve the vaccine matter. . . . The glass plates are partially filled with liquid vaccine, and partially with solid tissues from one or two calf pustules. The total contents are carefully mixed with one drop of glycerine and pure (undistilled) water for a few minutes to a thin paste, with which at least four persons can be vaccinated at once."

FOR MICROSCOPY.

Glycerine is indispensable for making microscopic preparations, owing to its property of rendering tissues transparent, and protecting the finished preparation from drying out. It is worthy of consideration whether glycerine can be used in finishing flax and hemp yarn.

Barreswill recommends a mixture of pulverized clay and glycerine for modeling clay, as it stays plastic for an indefinite time whether hot or cold.

MODELING WAX.

In 1880 Iwan Wasiliewitch Plantanoff, of Moscow, patented a preparation for making ornaments, busts, etc. The glycerine was mixed with glue or gelatine, and steam passed in until it dissolved, and then wax or resin was put in and melted, and some mineral color added.

PRINTERS' ROLLERS.

De la Rue was the first to propose making printers' rollers from glue and glycerine instead of glue and molasses. He recommended for this purpose to dissolve glue in glycerine, at the temperature of boiling water, and then proceed as usual. This preparation is adapted to use for flexible and elastic moulds.

GLYCERINE BLACKING.

In the last number of the *Wochenschrift des Gewerbe Vereins in Bamberg*, is a formula for glycerine blacking:

Lamp-black. 1,500 or 2,000 parts.
Burned bones. 250 "
Glycerine 2,500 "
Sirup (or molasses)*. 2½ "

These four ingredients are intimately mixed and then 85 parts of gutta-percha are warmed in an iron or copper kettle until nearly melted, then 320 parts of olive oil are added, and when this is dissolved, 32 parts of stearine are put in. This solution is added to the previous one while still warm and well mixed, then 160 parts of gum senegal dissolved in 750 of water are added. It may be perfumed with 15 parts of oil of lavender or rosemary. It is diluted for use with three or four parts of water, and gives a beautiful polish, is entirely free from acid, and its glycerine keeps the leather soft and pliable.

As glycerine never dries, it is much used in copying ink, stamp ink, and for keeping bladders soft. Wooden vessels of all kinds, if dipped for a few minutes in glycerine, or repeatedly painted over with it, and exposed all summer, empty or full, to wind and sun remain water tight, and the freshest wood shows no signs of shrinkage. Wooden hoops saturated with glycerine were as pliable after three months' exposure to the sun and air as when fresh.

Glycerine being soluble in water and alcohol, its use is limited to vessels for holding fats, oils (kerosene, turpentine, etc.), and dry substances. As glycerine does not change, there is no danger of its imparting a bad taste or odor to substances in contact with it. On the contrary it seems to have a preservative effect on fats, as in the case of butter kept for a long time in wooden vessels saturated with glycerine. The use of glycerine is particularly advantageous for wooden-hooped vessels that have to be stored away unused for several months at a time.

IN THE ESTIMATION OF GLUCOSE.

Its property of dissolving hydrated oxide of copper in the presence of caustic soda has recently been utilized in the preparation of a substitute for Fehling's solution for the quantitative estimation of grape sugar. It is prepared by Julius Löwe as follows: 16 grammes of pure (crystallized) sulphate of copper are dissolved in 64 c.c. of water, and to this solution there is slowly added, to prevent heating, 80 c. c. of caustic soda lye, spec. grav. 1.34 (about 113 grammes), and then with frequent shaking 6 to 8 grammes of pure official glycerine, or until complete solution ensues, which can be

readily recognized by the deep blue color of the liquid. If a soda solution of the given strength is not at hand, a definite volume of any soda solution is taken, and enough of it added to a solution of pure sulphate of copper until the hydrate is formed and the liquid has an alkaline reaction. As much more of the same soda lye is then added as was required to produce this effect. The glycerine is then added as before, until the solution is complete. If the quantity of grape sugar is to be determined from the quantity of precipitated cuprous oxide, the presence of sodium sulphate in the solution is a disadvantage, as it is difficult to wash it out of the filter. For this purpose a solution free from sodium sulphate is prepared as follows: Pure and finely pulverized sulphate of copper is dissolved in ammonia, and then caustic soda is slowly added until the solution is quite turbid and a dense light-blue hydrate of copper begins to separate. This hydrate can be easily and completely washed with cold water, and dissolves, when dried at 30° C. (86° Fahr.) or over sulphuric acid, rapidly and quickly in caustic soda solutions in the presence of glycerine.

The hydrate prepared in this way has a constant composition, and hence it can be used in making a copper solution with a known percentage of copper. Julius Löwe found the following proportions suitable for its preparation: Six grammes of copper hydrate are mixed with 6 or 8 grammes of glycerine, and 50 c. c. of distilled water, and then 40 c. c. of caustic soda solution, spec. grav. 1.34, are added, when solution follows rapidly if shaken. It is subsequently diluted to 450 c. c. as may be desired or required.

ITS USE IN WEAVING.

Weavers use a dressing made of 5 parts of dextrine, 12 parts of glycerine, 1 part of sulphate of alumina, and 30 parts of water, to keep their yarn soft, and it is no longer necessary for them to work in damp cellars and basements, which injured the health, as they can now work in the light, dry, and well aired rooms of the upper stories of the house.

IN PLASTERS AND PILLS.

In making plasters in tablets, the apothecary casts them in paper capsules; but in some cases the paper adhered very firmly when cold. To prevent this the capsules are now rubbed with glycerine first. If pulverized gum tragacanth is triturated with 3 parts of glycerine, and the mixture allowed to stand a few hours, a tenacious adhesive mass is obtained that makes a good excipient for pills.

AS A CEMENT.

By rubbing up glycerine and litharge together Hirzel obtained a cement that hardened soon and was well adapted for vessels that hold benzole, ethereal oils, etc. Pollack recommended the same as a durable cement for iron and stone. He says that it hardens rapidly, and hence must be used quickly. According to his statements, it can be used to fasten iron on iron, to cement stones together, and to attach iron and stone together. This cement is not attacked by strong acids. Finally, the more water the litharge absorbs, the more durable the cement; dry litharge does not hold well. C. Rost further states that the cement resists both concentrated and diluted acids, also alkalies, ether, alcohol, benzole, carbon disulphide, etc. He also says this mixture can be used in preparing a foundation for steam engines and other machines. When considering what are the constituents of glycerine cement, we are struck by its action toward acids as stated in these communications. In this respect Pollack's observations do not agree with those of Rost.

Prof. Theodor Morawski at Brunn subjected the glycerine cements to a careful investigation, in the first place in the endeavor to explain this remarkable conduct of the product obtained from the glycerine and oxide of lead, and also to ascertain the real cause of its hardening. There was still a third inducement for him to undertake this problem, namely, it seemed *a priori* probable that on heating this cement the lead would enter into combination with the glycerine, and hence there was reason to expect that in the course of such an investigation our knowledge of the metallic compounds of glycerine would be extended. We will only mention here that the supposition that the hardening process was to be explained by the formation of a lead glycerine compound resembling a salt was fully confirmed.

SOLUBLE STARCH.

The action of starch toward glycerine is peculiar. If six parts of pulverized starch are triturated with 100 parts of concentrated glycerine, and the mixture heated with constant stirring, the starch granules first swell up, according to K. Zulkowsky (*Berlin Berichte*, 1880, p. 1395), and at about 130° C. (268° Fahr.) it forms a tenacious transparent paste which becomes a thin fluid at 170° C. (338° Fahr.). If heated to 190° C. (374° Fahr.), potato starch passes very quickly into a soluble modification, but wheat starch requires an hour. If the liquid is now cooled to 120° C. (248° Fahr.), and then poured into two or three times the quantity of strong alcohol, the precipitate allowed to settle, the liquid drawn off, and more alcohol added, the precipitate grows denser. It is then to be filtered through muslin and washed with alcohol until all the glycerine is removed. This starch dissolves readily in water, can be easily preserved in closed vessels, its aqueous solution is colored a beautiful blue by iodine and is therefore useful in iodometric investigations. If dried, it loses its solubility, and must therefore be closed up soon after washing. Its aqueous solution turns the plane of polarization strongly to the right, $\alpha(\gamma) = +206.8^\circ$.

IN DYEING.

Gros-Renaud says that warm glycerine (75° to 81° C.) dissolves large quantities of aniline violet, and that its solvent power is greater than that of alcohol, or acetic acid. If glycerine, whether diluted with water or not, is warmed to 56° or 62° C. (133° or 144° Fahr.) and gum arabic put in, the latter dissolves rapidly and the solution keeps perfect for a long time. In Turkey red dyeing it is advantageous to extract the madder with glycerine.

PERFUMES.

Glycerine has a great power of absorbing odors, and as it does not itself get rancid when pure, can be used to carry perfumes. Let us imagine that the odoriferous portions of plants, such as blossoms and leaves, are shut up in a long tin box without being crushed, and the interstices filled with glycerine, and finally, when all the air has been expelled by frequently filling up with glycerine, the box is soldered up and left for a year in a cellar; now if we open it and press out the glycerine we shall have a slightly colored liquid, which is the bearer of the most delicate perfumes. This would be of great importance to perfumers where the odors will not stand distilling. We have odors of intoxicating power like those of the jasmine and of linden flowers,

but they cannot be distilled. When jasmine flowers are distilled in steam, we get a distillate with an unpleasant smell that has not the slightest resemblance to that of the jasmine. In such cases it has been customary to use pure olive oil, but this is liable to get sour; hence glycerine is far better in such cases. Musk, which is not so easily taken up by oil, imparts its odor to glycerine perfectly.

This method is very good, but has this disadvantage, that it takes so much time. Camille Vincent, of Paris, proposes to use methyl chloride for obtaining the perfume of flowers. In the first place, to remove the small quantity of the bad smelling substance which adheres to the methyl chloride, it is purified by treating it in the gaseous state with concentrated sulphuric acid. The apparatus used in extracting the perfume from flowers consists of a vessel in which the flowers are digested, of a holder for the purified liquid chloride of methyl, of a closed vessel to catch the latter when it has been impregnated with the perfume, and finally of an air pump that serves a double purpose, first to rarefy the air, secondly to force the volatilized methyl chloride into the worm, where it is condensed again by cold. The flowers are subjected to the action of the liquid methyl chloride for two minutes, and it is then run into the third vessel above mentioned. This operation is repeated several times with fresh methyl chloride. Finally, the liquid absorbed by the flowers is removed by rarefying the air in the digesting vessel, and leading it into the condensing apparatus. The last portion is driven out by a current of steam. The impregnated methyl chloride in the third vessel is volatilized by warming to about 30° C. (86° Fahr.) and reducing the pressure to half an atmosphere. The perfume is left behind mixed with fatty and waxy substances. To obtain the perfume in a perfectly pure state this mass is treated with cold alcohol. We would add, 2,200 lb. of flowers can be exhausted daily by this process.

FOR GAS METERS.

As glycerine does not freeze, even at the temperature where mercury does, and does not get rancid, it is useful for filling gas meters. Fabian made some experiments to determine the freezing point of glycerine and water, and made out the following table:

Specific gravity.	Degrees.		Per cent. by vol.	Freezing points.
	Beck's.	Baume's.		
1.024	4	3.5	10	— 1¼° C. + 30° F.
1.051	8	7	20	— 2° C. + 27½° F.
1.075	12	10	30	— 6¼° C. + 20¾° F.
1.105	16	14	40	— 17° C. + 1° F.
1.117	18	15½	45	— 26¼° C. — 15¼° F.
1.127	19	17	50	— 31¼° C. — 24¼° F.
1.159	23	20	60	— 33¾° C. — 28¾° F.
1.179	26	22	70	} Did not freeze at — 35° C., or — 31° F.
1.204	29	25	80	
1.232	32	28	90	
1.241	33	29	94	

In our German winters the thermometer rarely sinks to — 25° C. (— 13° Fahr.); it is quite safe to use glycerine of 15° or 16° Baumé, or specific gravity 1.113 to 1.121, which contains about 45 per cent. of anhydrous glycerine. In most cases a glycerine of 12° to 14° Baumé offers sufficient security, at least if the meter is at all protected. As the water gradually evaporates, it should be replaced by glycerine until finally a point is reached where the glycerine becomes so concentrated that it is no longer necessary to fill it up. Although glycerine is less mobile than water, it has no bad effect on the revolution of the drum. Bonnet, director of the gas works in Augsburg, found that 24 gas meters which been filled with glycerine, lost in four months, January and April inclusive, only 0.54 per cent. by volume. After four or five years' use in a meter, the glycerine gets so impure that Kunath recommends to purify it by putting in cast iron turnings, 10 per cent. by weight, and letting it stand from five to eight weeks, with frequent shaking for the first two weeks. A heavy sediment is formed, from which the liquid can be easily poured off.

NITROGLYCERINE AND GUN-COTTON.

The largest consumption of glycerine is in the manufacture of nitroglycerine, that most important of all explosives. While all other technical branches have been undergoing improvements, the art of making explosives has maintained until very recently a remarkable stability. The powder used in the late Franco-German war, and the explosives used in boring through Mont Cenis, had almost the same composition as those that found their first extensive use in the great wars of the fifteenth century, and the powder with which Martin Weigold made his first attempts at mining in Saxony in 1613. But that which had been for centuries a standard still seems within a few years to have been aroused by the rapid advances made in civil and military arts. It is scarcely fifteen years since black powder was almost exclusively employed for blasting, while to-day a great portion of this domain has been wrested from it, and the indications are that at no distant day it will be supplanted by some other substitute as a projectile force, if all the innumerable attempts to find other mechanical mixtures of substances that by their combination shall form explosives are to be looked upon as unsuccessful yet.

A new era in the history of explosives began with the discovery of a series of substances which had the power of instantaneously evolving a considerable quantity of gases, without combining with other substances, and thus producing energy by explosion. In 1828 Pelouze made the discovery that cotton could be converted into an explosive substance. In 1846 Schönbein, having discovered a practical method for effecting this conversion, made public his discovery of gun-cotton. The enthusiasm with which gun-cotton was taken up soon led to experiments on a very large scale in nearly all the important states of Europe, but a series of horrifying explosions, which were attributed to the unavoidable spite of the new explosive, caused the abandonment of its manufacture almost everywhere after a few years. The upward flight of a Vienna storehouse containing 25 or 30 tons of gun-cotton in the summer of 1865 seemed like a final salute of honor over the grave of this new discovery. England alone, with her characteristic tenacity, continued the study, through a committee appointed for the purpose, of a preparation that had so many excellent qualities. Thanks to the labors of the gifted director of the chemical department at Woolwich, Prof. F. A. Abel, and his assistant, Dr. Brown, the preparation and use of gun-cotton seems to have reached a stage which secures for it incontestably the highest place among all explosives, for many war purposes.

* We give this as printed in the original, but suppose it to be a typographical error and intended for 2,500 parts instead of 25 parts.—*Translator*.

It is an interesting fact that simultaneously with the publication of Schönbein's discovery, a young Italian named Sobrero, working in the laboratory of Pelouze, at Paris, discovered an explosive which after standing a similar fight to gun-cotton is to-day the basis of the most powerful explosive and one that finds extensive use. Nitroglycerine, for that is what Sobrero named his explosive, soon after its discovery exhibited its enormous power in many accidental explosions. The substance met with no practical use, because it was exceedingly difficult to find any simple method of exploding it with certainty. Alfred Nobel, one of the most prominent chemists of the present day, was the first who succeeded in discovering a simple method of exploding any quantity of nitroglycerine. With this discovery of Nobel, which was at once the starting point and culmination of the whole development of the modern explosive art, the path was broken for a rapidly increasing use of nitroglycerine, but it was suddenly brought to a standstill by the large number of fearful accidents caused by its explosion while in transport. Most States enacted iron laws against its manufacture and transportation. It would have soon been forgotten if Alfred Nobel (1867) had not discovered a method of utilizing its enormous explosive force and removed its dangerous character. By absorbing the nitroglycerine with some pulverulent substance, he converted the liquid explosive into a solid form that was easy to transport and use. The explosive thus prepared, *i. e.*, a porous pulverulent substance saturated with liquid nitroglycerine, was called *Dynamite* by Nobel. In the short space of one year its use spread so that a large number of factories, some of them equal in production to the largest government powder mills, were scarcely able to supply the demand for dynamite. The following figures, which only represent the factories under control of the discoverer, give the best idea of the rapid increase in its consumption. The number of cwt. made in these establishments was as follows:

Year.	Cwt.	Year.	Cwt.
1867.....	220	1872.....	27,000
1868.....	1,560	1873.....	41,000
1869.....	3,700	1874.....	62,400
1870.....	8,480	1875.....	80,000
1871.....	15,700		

In the year 1876 the total consumption of dynamite had already exceeded 5,000 tons, a quantity corresponding in power to about a quarter of a million cwt. (50,000 tons) of black gun-powder. The relation of these numbers will be better understood when we say that the total annual production of powder in the four large military countries of Europe is only about half a million cwt. The new explosives, gun-cotton and nitroglycerine compounds, are used very extensively in mining, in building streets, railroads, and harbors, demolishing wrecks, destroying forests, and breaking up unwieldy masses of iron. Dynamite is now considered an indispensable material of war in equipping the armies of nearly all large Continental countries. Gun-cotton, too, has attained the first rank for marine torpedoes.

Every hundredweight of dynamite exploded throws out on an average 20 to 30 cubic klusters of rock. Hence the quantity of rock torn loose from the earth annually now amounts to the enormous quantity of two or three million klusters. The labor costs on an average 20 marks (\$5) per klaster, a saving of at least 25 per cent., or 5 marks per klaster. Hence the substitution of dynamite for blasting powder effects an annual saving of ten or fifteen million marks (\$2,500,000), and we get our ores and coal that much cheaper, and make our tunnels and cuttings for so much less.

Pischof's extensive experiments have shown that it takes three times as much powder as it does nitroglycerine to move the same weight of rock, and as the cost of boring is also saved, the total saving amounts to 35 or 45 per cent. More recent experiments in Germany and America not only show an equal saving, namely, 40 per cent. in Saarbrück, 38½ per cent. at the Eureka mine, and 30 per cent. at Dittweiler, but official experiments, as at the Siegen iron mine, have shown that the effect of dynamite was six or seven times that of powder.

Of the numerous patents we will only mention a few very recent ones: J. A. Lanferey and J. L. Renard in Chartres propose to use nitrocellulose made from straw; Hellhof, of Berlin, nitrates the crude oils of coal tar; J. Engels, of Kalk, near Deutz, has described a portable arrangement for making explosives with nitroglycerine in.

PRODUCTION AND PRICE OF GLYCERINE.

As the use of nitroglycerine, the best of all explosives, increases, the price of glycerine has advanced. The quantity of glycerine made in the eight glycerine making countries of Europe is as follows:

France.....	8,800,000 pounds.
Germany and Austria.....	3,300,000 "
Holland.....	1,980,000 "
Russia.....	1,980,000 "
Belgium.....	1,760,000 "
Italy.....	880,000 "
England.....	660,000 "
Spain.....	440,000 "

Gebe & Co.'s circular of last April said "that the price of glycerine had risen fifty per cent., which was due to the fact that the total production of France and Russia had been contracted for, for a whole year in advance. In 1879 the export of France amounted to 7,564,339 lb., while the imported, mostly from Belgium, about 800,000 lb. The greater part of her export, namely, 4,147,754 lb., came to the United States. Belgium received about 1,300,000 lb., part of it for other countries, and Germany about 825,000 lb.

"The consumption of glycerine is increasing in every trade, but the same cannot be said of its sources. The consumption of glycerine in pharmacy and in dyeing and printing is inappreciable in comparison with its main use for making nitroglycerine. For example, enormous quantities will be required for the Panama Canal and for tunneling La Manche."

The amount consumed will be still further increased when they begin cutting through the Corinthian and Transindian isthmuses. In their trade report of last September the same firm said: "Within the last year glycerine has had the most important advance of all chemicals, and in all probability will play a still larger role in the next few years. Since the beginning of this year the article has risen about 100 per cent. in price, and although a certain fluctuation was noticed, still there is a tendency, and we might almost say necessity, for a still further rise, while the other products made simultaneously, the stearic and oleic acids, have sunk to such a low price that the relation between the two might almost be called uneconomical. The supply of these last named now in stock in France and Holland, the principal countries where they are made, is sufficient to last to the end of next year.

The situation is just the opposite of what it used to be; the article that was formerly a worthless by-product, the glycerine, now receives almost exclusive attention. Whether this method is quite rational we will not discuss. So long as it is not feasible to make pure glycerine from the waste lyes of the soap factories, nor substitute any other liquid for it in filling gas meters [dry meters have almost entirely supplanted wet meters in this country.—Ed.], whereby a large quantity of glycerine would be released from use and thrown on the market, after suitable purification, that could not fail of exerting a strong pressure on the price for a time—until something of this sort occurs, a further increase of price cannot be prevented, since the chief use of glycerine, *i. e.*, for making nitroglycerine, will bear a high price.

"Germany holds a peculiar position with respect to glycerine. With the exception of a few small factories in Alsace, which will soon be compelled to stop, none of any consequence is made in Germany. The reason is that we scarcely produce enough of the raw fats from which it is made, for other uses, and there is high import duty on them. In contrast with this France is estimated to produce four and a half million kilos., and Russia about 40,000 pud of crude glycerine. As the glycerine is free of duty, there are a large number of factories in Germany that work it up. In the gas industry the use of glycerine for meters must gradually be abandoned, and a return made to alcohol, which was formerly twice as dear as glycerine, but is now but half so dear, while it removes the water from the gas more strongly than glycerine."

Although these statements of Gebe & Co. are correct in general, we must contradict one point—that pure glycerine has not been made successfully from the spent lyes of soap makers. It has been done, as already stated, and patents have been granted for utilizing it.

FOR PRESERVING FOOD.

Important progress has been made in another direction, for glycerine is being used more and more as a preservative agent. In 1880 H. Hager published in the *Pharmaceutische Centralhalle* his recipe for a "Preservative for Meat Inspectors," consisting of 1 part of amylic alcohol, 2 parts ethylic alcohol, 4 parts glycerine, and 12 parts of water, and we must concede to it a large field as a preservative, provided chemically pure glycerine is used, for only too frequently glycerine is intentionally adulterated.

ADULTERATION.

Owing to the high price that it now commands, a sugar solution is often added, as it cannot be detected by taste or looks. For this purpose either a solution of uncrystallizable cane sugar (sugar house sirup) or a glucose sirup is employed. This adulteration can be detected, according to Pohl, by means of polarized light. Pure glycerine is optically inactive, while sugar solutions turn the plane of polarization either to the right or left according to the origin of the sugar. Hence it is only necessary to fill the tube of the polarizing saccharometer with the glycerine to be tested, and notice whether it causes any change in the ray of light.

TESTING GLYCERINE.

Dextrine and sugar can be detected in glycerine, says Hager, by molybdate of ammonia and nitric acid; the slightest trace of sugar gives on boiling an intensely blue color; with dextrine the test is not so delicate, as it only gives a greenish color.

C. Palm proposed to estimate the quantity of cane or grape sugar in glycerine by shaking it with chloroform, in which both kinds of sugar are insoluble, while the glycerine dissolves with the greatest ease. This proposition was, however, found to rest on an error, as was subsequently found. Glycerine is no more soluble in chloroform than the sugars. Nevertheless it is possible to separate the glycerine and sugar perfectly by means of chloroform, as it causes the sugar to separate in a solid form, while the glycerine floats on the surface of the chloroform and can be washed off by the aid of the latter. The sugar can then be weighed.

TESTS FOR GLYCERINE.

The action of glycerine upon the skin, on sores, and on wounds should be mild and gentle; but for some time past complaints have been accumulating against it, that when repeatedly rubbed on the skin it causes pustules, that it causes violent burning when applied to wounds, and may cause inflammation, even when the glycerine contains a good deal of water, or has been diluted before using. There was no reagent for distinguishing this irritating glycerine from the milder glycerine, nor could any cause for this difference in effect be discovered. Finally Hager succeeded in obtaining a good test. If equal volumes of rectified sulphuric acid, spec. grav. 1.83, and pure commercial glycerine were put in a test tube, a rise of temperature would be noticed; a slight brown color would sometimes, but not frequently, be observed. The mixture is clear, and the most that can be seen are a few air bubbles caused by shaking. Any glycerine that acts this way is mild, and suitable for use in medicine, or as a cosmetic. The irritating and useless glycerine shows a different reaction, for as soon as it is shaken with sulphuric acid there is a evolution of gas like the generation of carbonic acid in a clear solution. After the gas has all escaped and the liquid all got quiet, a fresh evolution of gas takes place whenever it is shaken. This can be repeated several times in a like manner. One kind of glycerine examined by Hager kept up a stronger evolution of gas than the others. From 100 grammes of glycerine he collected about 6 c. c. of gas, and on closer examination found it to consist of carbonic oxide and carbonic acid. After absorbing the latter with caustic potash, more than half the volume remained, so that he assumed that there was not only an oxalate, but also some formate must have been present in this irritating glycerine. The oxalic acid was detected by boiling not too small a sample of the glycerine with a solution of chloride of calcium and ammonia, when it got turbid and deposited some oxalate of lime. The formic acid was detected by mixing the glycerine with a solution of silver and letting it stand for a long time in the cold, when it reduced the silver as a black powder. Strong traces of ammonia as well as oxalic acid were found in some kinds of irritating glycerine.

All the irritating samples examined by Hager were found upon inquiry to have been purified chemically, and put on the market as chemically pure. Those of milder properties had all been purified by distillation. All the glycerine tested, of both kinds, was neutral to test paper.

This shows the necessity for using only distilled glycerine for medicinal purposes and as a cosmetic.

There is still more necessity for testing the purity of glycerine when it is to be used for preserving wine and beer. If glycerine has no nutritive value, as shown by J. Munk in the *Medicinische Centralblatt* (1880, p. 68), and is not able,

like cane sugar, to prevent destruction of the albuminoids and hence cannot be called nutritious, nevertheless it is indispensable and invaluable as a preservative in beer and wine, provided that unadulterated glycerine purified by distillation is always employed.

The celebrated firm of F. A. Sarg's Son & Co., in Vienna, has justly said: "Every wine that contains an excess of tartaric acid can be sweetened by the addition of 3¼ or 4½ parts of glycerine to 1,000 of wine. The glycerine must be previously mixed with a small quantity of wine and this added to the rest. Since glycerine itself is incapable of fermentation, there is no danger of changing or spoiling the wine by this addition; on the contrary, the wines keep better and soon get ripe for bottling, as the glycerine precipitates the less soluble constituents, and those which are not precipitated remain permanently dissolved, so that it is almost impossible for the wine to get turbid after it is bottled. Thick and stringy wines, when glycerine mixed with equal parts of alcohol or brandy is added to them, become as thin and limpid as at first, because it precipitates the excess of proteins to which this property is due. Glycerine is always formed by the alcoholic fermentation of sugar, and is therefore a natural constituent of wine, so that the addition of glycerine is not only permissible but rational."

What is true of wine also holds good of beers. V. Griessmayer published the following method (*Bierbrauer*, 1880) for estimating glycerine in beer, especially in the darker beers: 100 c. c. of beer is carefully evaporated on a water bath at about 75° C. (167° Fahr.) with 5 grammes of magnesium hydrate. Before the residue is perfectly dry it is triturated with 50 c. c. of absolute alcohol, filtered, and the residue washed with another 50 c. c. of alcohol. The filtrate is mixed with three and a half times its volume of absolute alcohol to precipitate the maltose and parapeptone. The filtrate is left 12 hours for the ether to evaporate. The alcoholic solution that is left is put in a tared glass capsule and evaporated on a water bath to a sirup, then dried 12 to 24 hours *in vacuo*. The residue is extracted with about 20 c. c. of absolute alcohol, the solution filtered off from the cholestearine, fat, etc., washed with 10 c. c. absolute alcohol, evaporated on a water bath, dried under an air pump, and weighed as glycerine. For light beers that have but little parapeptones, the first thick residue mixed with magnesia is extracted with absolute alcohol, filtered, evaporated to a sirup, dried under an air pump, then mixed with equal parts of absolute alcohol and ether, violently stirred with a glass rod, filtered through a very small filter that is washed with the same mixture, evaporated carefully, and the process completed under the air pump.

Very recently C. Barbsche has described a reagent for glycerine in the *D. A. Apotheker Zeitung*, saying that up to the present time it has been quite difficult to detect glycerine with certainty, and that in the presence of sugars and other organic substances the operation was not only difficult but very tedious. Two drops of carbolic acid, even when diluted four or five thousand times, will give a distinctly blue color with one drop of ferric chloride solution, but on the addition of 6 or 8 drops of glycerine it disappears again. If glycerine is already present in the solution, no blue color appears at all. This method leaves nothing to be desired either in simplicity, delicacy, or reliability. Alkaline liquids must be slightly acidified before using this test.

We give these methods for detecting glycerine in beer, because, having found it in beer, we can drink the latter without running any danger of introducing into the system along with the beer some substitute that will injure us.

It will now be clear why no glycerine except that purified by distillation should be employed for improving and preserving wine and beer, and it should be obtained from manufacturers having an established reputation—good advice for all who have to use glycerine.—*Translated from a monograph published by R. Pohl, Berlin, 1882.*

FLUORIC ACID.

In the transactions of the Academy of Sciences, at Berlin, for 1768, is contained a memoir by Margraaf on fluor spar. This able chemist found that when the above mineral was distilled with sulphuric acid a volatile acid vapor was disengaged which deposited a white earth on coming in contact with water; he also remarked that the retort in which the distillation was carried on was corroded and worn into holes by the process. Three years after, Scheele published a valuable essay on the same subject, in which he proved that fluor spar consisted of lime combined with a peculiar acid, many of the properties of which were investigated by him with great success. Priestley then took up the subject, confining his attention for the most part to the action of fluorine acid in the state of gas. Since the date of these last experiments but few additions have been made to our knowledge of this acid and its various combinations.

The distinguishing property of fluorine acid is that when dry and in the state of gas it readily combines with silicic acid, and still retains its elastic form; hence arises the peculiar and almost insurmountable difficulty of obtaining this substance in a state of purity.

Fluoric acid is procured from fluor spar; for this purpose a quantity of the mineral, being reduced to a fine powder, is to be mixed in a thick glass retort with an equal weight of concentrated sulphuric acid; upon the application of a gentle heat the sulphuric acid will combine with the calcareous base of the spar, and fluorine acid gas will at the same time be liberated, and may be received in the mercurial pneumatic apparatus in the usual way. If the heat applied to the retort is somewhat considerable, and the gas is rapidly produced, the retort will give way in the space of a minute or two, being eaten into holes by the action of the acid; if the process is conducted cautiously and at as low a temperature as possible, the retort may be made to last a considerable while longer. The gas thus produced, while confined over mercury, is perfectly colorless and transparent; it has a pungent, suffocating odor like muriatic acid, produces immediate death to animals which are immersed in it, extinguishes the flame of a candle after having previously tinged its flame of a green color, and changes certain vegetable blues to red. Its specific gravity is considerably greater than that of atmospheric air, but has not been obtained with any accuracy. If this gas is mixed with atmospheric air, a white vapor similar to but more copious than that occasioned by the muriatic acid gas in the same circumstances is the result; this appearance is partially occasioned by the combination of the acid with the moisture of the air, but principally by the deposition of silicic acid, which takes place at the same time. The earth is in like manner deposited if the gas is received in water, and this experiment, according to the circumstances under which the acid is disengaged, exhibits a variety of singular and interesting appearances. As soon as a bubble of gas passes from the beak of the retort in-