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GRAPE SUGAR AND GLUCOSE.

By O. LUTHY.

THE MANUFACTURE OF GLUCOSE AND GRAPE SUGAR.

GRAPE sugar was first manufactured in France, in the year 1809, from grape juice. During the time of the notorious continental blockade, ordered by Napoleon, the prices of sugar (of which only one kind, namely: colonial or cane sugar, then was known, commercially,) went up so high, that cheap substitutes were eagerly looked out for. The grape juice was neutralized by powdered chalk, and rapidly boiled down to a thin syrup of 20° B. It was then cooled and filtered to free it from the lime salts it had deposited, and further evaporated to 32° B., in which state, as it is said, it was used extensively, especially in hospitals instead of sugar. Boiled down to 45° B., this syrup will, on cooling, deposit large quantities of granular grape sugar, which may be separated from the adhering syrupy fruit sugar, by draining in sugar moulds, or better by centrifugal machines: 1,000 parts of grapes yield 800 parts of must, 200 parts of syrup, 140 parts of raw grape sugar, 60 to 70 parts of pure grape sugar.

About the same time, Kirchhoff, a chemist in St. Petersburg, found that starch by boiling with water and a little sulphuric acid was changed into sugar. This discovery created a great sensation, because it was believed that this starch sugar would replace cane sugar. It was soon experienced, however, that there was a great difference between the two, starch-sugar being less sweet and less soluble than colonial sugar, and its manufacture didn't become so important as was anticipated; so much the less, as in the same period and by the same cause (the continental decree), the beet-sugar industry got a great impulse and gradually ripened to its present success.

As a substitute, however, for Indian syrup (colonial molasses) the starch syrup, prepared either by the acid or malt process, became favored and was manufactured in large quantities (best molasses because of its bitter and salty taste is not well fit for the table; it is turned into alcohol.) By the time, also, the solid starch sugar which was found to be identical with grape sugar came into use, especially for the improvement of wine-must in bad seasons. It then was employed also in making fruit wines, and at last in manufacturing wine wholly artificial. In beer-brewing it is also largely used as a substitute for barley. In the year 1874, in Germany, 47 factories turned out over 11,000 tons of starch or grape sugar, and nearly 15,000 tons of starch-syrup or glucose (Wagner's Jahresbericht.) From other countries no statistics were obtained; no doubt, the amount would be doubled, if France, Belgium and Holland were included in the report.

The process, by means of which glucose and grape sugar are manufactured nowadays from starch, is not quite so plain as it might first appear. When we add to a boiling hot thin starch-paste a small quantity (about two per cent. of the starch) of sulphuric acid (oil of vitriol), previously diluted with water, it becomes at once liquid; the starch is rendered soluble, changed into *amiduline*, as this new body is called. By further boiling this is gradually converted in *starch-gum* or *dextrine*, a substance which, when dry, resembles gum arabic, and which is applied in the arts in a great many ways as a substitute for that substance. If the boiling continues sufficiently long, the solution becomes sweet, the gum dextrine by degrees is turned into a new body again, and at last, when the conversion is complete, we find nothing else in the solution besides a sweet body, which behaves exactly like grape-sugar, and the original amount of sulphuric acid which has remained unchanged. On the time spent in boiling, and on the quantity of acid used, it depends whether the conversion is more or less complete; whether the starch is turned wholly into grape sugar or only partially, in which case more or less gum dextrine, and even amiduline (soluble starch merely) is left mixed with the sugar. If we apply from one to two per cent. of acid only, and boil but for a few hours, the result is a product which is still rich in gum dextrine, preventing, by its viscous properties, the admixed grape sugar from crystallizing, and which product consequently refuses to become solid. It is what is commercially called *glucose*. If we, however, raise the amount of acid to two-and-a-half or more, even four per cent., and boil for eight or ten hours, the final result will be a fine granular *solid grape sugar*.

When the conversion of the starch into glucose or grape sugar is brought to the desired degree, we next have to extract and remove the acid. This is done by means of powdered chalk or slacked lime. The sulphuric acid combines with the lime, forming sulphate of lime, which deposits, leaving the solution sweet. After subsiding the liquor is filtered and the water boiled away, until glucose or sugar is left in the proper finished state. We see from these outlines that the manufacture of glucose and grape sugar is divided in three principal processes, namely: conversion, neutralization and evaporation.

1. *Conversion*.—The boiling of the starch with the acid water is effected on a small scale in a copper kettle on a naked fire, or in extensive factories in large wooden tubs by means of a large copper steam coil. The proper quantity of water is first heated to boiling, then the requisite amount of sulphuric acid (oil of vitriol), previously mixed with three to five times its weight of water, is added; and whilst the liquid is kept boiling continuously, the starch, which has been mixed with water to a milky consistency, is gradually poured in. The flow of the starch milk is so regulated that the liquor in the tub never cools below boiling, and never becomes cloggy or pasty.

To every 100 pounds of dry starch take 40 gallons of water in all, and 1 to 2 pounds sulphuric acid for glucose, and from 2½ to 4 for grape sugar. When all the starch is added, the boiling is continued until the desired degree of conversion has taken place. Glucose will require about 2½ or 3 hours, grape sugar from 5 to 9 hours. From time to time a sample is drawn to be tested. This is done at first by means of a solution of iodine (prepared by dissolving equal parts of potassium iodide and iodine, in enough water to get a coffee brown colored solution,) and afterwards by strong alcohol. When the proof ceases to turn violet or red on the addition of a few drops of the iodine solution, the starch is converted into gum dextrine and grape sugar, and the boiling may now be discontinued if glucose is to be prepared. If solid grape sugar is intended, the boiling must go on until the alcohol test is satisfactory. A spoonful of the liquor is poured into a test tube, and shaken up with about five times its bulk of strong alcohol. The gum dextrine being insoluble in alcohol will render the mixture turbid if present, whilst grape sugar alone will remain dissolved on the addition of alcohol, the mixture thus being clear; therefore the boiling is continued until all dextrine is completely con-

verted into grape sugar, when the alcohol test will not become milky any longer.

Instead of an open kettle or tub for boiling the acid starch mixture, a closed "converter" is used in many large factories. This is a strong cylindrical vessel of boiler iron, lined with lead inside, and provided with a perforated steam coil for heating, with pressure gauge, thermometer, safety valve, etc. Water, acid and starch are introduced and heated as before; but after all the starch is in, the converter is closed, and then by means of high-pressure steam the heat is raised to 320°, when the pressure inside will be about 90 pounds. This temperature is kept up until conversion is complete. It is claimed for this process that the conversion is done in less than half the time of the old way, and that it is more entire, the resulting grape sugar being free of gum, and of a purer, finer taste.

2. *Neutralization or Separation of the Sulphuric Acid from the Sugar Solution*.—When by a sufficiently long boiling the desired degree of conversion into either glucose or grape sugar is accomplished, the sulphuric acid must be removed from the liquor. This end is reached by the addition of carbonate of lime (or technically, powdered chalk, marble or limestone). This is decomposed by the acid, which combines with the lime and expels the carbonic acid gas, which causes the liquor to foam. Chalk or marble must be ground to the finest degree possible, and must be added in small quantities (handfuls) only at a time, in order to prevent overflowing, the liquor being constantly stirred until the last addition causes no more effervescence or bubbling. For every pound of oil of vitriol applied, one pound of carbonate of lime is required, but since chalk, marble or limestone are not pure carbonate of lime, and an excess of them is of no harm, rather more, say 1½ pounds to every pound of acid applied, may be taken. The chalk or marble powder is best stirred up in water to a milk before it is poured into the liquor.

As a neutralizing agent slacked lime has also been recommended and used. It has two advantages over chalk: it is cheaper, and can easily be made into the finest milk. Its application is somewhat difficult, however, and dangerous to the resulting sugar, as it is not very easy to ascertain when just enough is added, and the least excess of it will color the sugar yellow or brown. Another quite serious trouble with lime is caused by the large quantities of magnesia it often contains—25 to 35 per cent. are quite usual in the different kinds of lime made and sold in the United States along the Atlantic coast. Lime combines with sulphuric acid to make sulphate of lime, which is almost insoluble, and subsides nicely from the liquor on standing. Magnesia, however, forms sulphate of magnesia, or Epsom salts, which, as everybody knows, has a bitter taste. As this salt is very soluble, it does not deposit but remains in the liquor, and will give the resulting glucose or grape sugar that bitter aftertaste so often noticed.

After the neutralization of the liquor is effected, it is drawn off from the converting vat or kettle into a tub or tank below, and allowed to settle for 24 hours. This tank should be surrounded by a bad conductor, and well covered, in order to prevent the cooling of the liquor, as fermentation will otherwise soon set in and turn it sour. When the sediment has pretty well subsided, the clear liquor is drawn off and boiled down (or evaporated, as chemists express themselves more elegantly). The sediment or mud is poured into filtering bags, which, after draining, are subjected to pressure.

The remainder in the bags is good for manure.

3. *Evaporation and Purification of the Liquor*.—The thin liquor has next to be boiled down to a syrup. This may be accomplished in a shallow copper kettle over a low fire, or better by means of a steam jacket or coil. Modern demands as to color and flavor, however, are so great that a vacuum pan can hardly be dispensed with. The evaporation is carried on to about 25 or 30° B.=45 or 55 saccharometer per cent., when the solution has acquired the consistency of a thin syrup, and is now quite turbid again by the separation of sulphate of lime, which had been dissolved. To get rid of this the syrup is drawn off again into subsiding tubs, and allowed to settle for a few days, or it is filtered through a layer of sand. To remove the last trace of dimness and color, bone charcoal filters are provided. They consist in cylindrical tanks, rather high, with sieve bottom, spread with a cloth and filled with granular bone-black.

In large establishments these filters are of sheet or cast iron, from 2 to 6 feet wide and more, and from 10 to 30 feet high. For small manufacture wooden ones, such as old whiskey barrels, will answer for the purpose right well; one head is removed, and the other provided with a number of small holes to serve as false bottom. It is covered with a suitable blanket, and filled with bone charcoal of the same quality as used in sugar refining in general. The thin liquor is poured upon, and slowly and evenly passing through the animal charcoal, leaves all color and mud behind, and runs off white and clear, the bone charcoal absorbing impurities and coloring-matter. When its power is exhausted, it is washed with boiling hot water, dried and reburnt, and may then be used over again for a great many times.

The clear decolorized thin syrup is drawn back into the vacuum pan and boiled down. If the conversion was done with a view of making starch-syrup or glucose, the boiling is continued till the syrup gauges hot 40° B., when the product is ready for the market. On cooling it will form a very heavy (45°) thick syrup, clear and colorless, or almost so, of an agreeable pure taste, sweet and mucilaginous at once. It should not deposit any crystals on standing, and shouldn't turn sour or mouldy.

In the other case, if grape sugar is intended, the boiling is discontinued when the contents of the pan gauge 38° or 40°. They are then also drawn off in crystallizing tanks, and allowed to cool and congeal. The resulting crystalline mass is freed from syrup by strong pressure, after which it is remelted and cast into moulds; or, if a less pure article is desired, the syrup is evaporated in the pan (to about 44°) till on cooling it hardens completely. It is run into packing boxes directly, and, while cooling, stirred occasionally to promote the formation of a uniform grain.

The manufacture of grape sugar from *pulp* (the waste of starch manufacture), *savo-dust*, *rags*, etc., which is sometimes spoken of, has never acquired any practical shape. Not only is the required amount of acid a very large one (one pound and more to every pound of rags), but the resulting product is so impure that it could never be used for sweetening purposes. It might be put to fermentation, and by distilling turned into alcohol—if we hadn't purer and cheaper raw materials for the same product.

MANUFACTURE OF GLUCOSE BY MEANS OF MALT.

During the germination of grains in the process of malting, a peculiar body (or mixture of bodies) is formed, named *diastase*, which has the mysterious power (similar to sul-

phuric acid) to turn starch into grape sugar and dextrine gum, at a temperature of 140° to 165°. Such grains, which have been made to germinate by soaking in water and spreading in thin layers on floors for from six to fourteen days, and then were dried to interrupt growing, are known everywhere by the name of *malt*, and used extensively in brewing and distilling, for the conversion of the starch into sugar in the process of *mashing*.

For the conversion of every 100 parts of starch, from 5 to 10 parts bruised malt are required, with 350 to 400 water. Water and malt are heated to 140° to 155° F.; then the starch added, previously stirred up with water, and with constant stirring the temperature is raised to 160° and 165°, and kept there for some time to increase the amount of sugar. When the conversion is complete the heat is raised to boiling, the wort skimmed and filtered and then boiled down. The resulting syrup is very gummy, light-brown colored, and has a peculiar taste, by no means disagreeable, resembling that of malt. However, it is subject to souring and moulding, and very much so; when, instead of starch, corn meal directly is applied.

It remains to say something of the different uses of glucose and grape sugar. The largest quantity of grape sugar is probably consumed for the purpose of improving wines. This is done on the following principles:

When the proportion between the chief constituents of the must, sugar, acid, and water are such that no good wine would result on fermentation, these proportions are altered and improved by the addition of grape sugar. When in a bad season the must is poorer in sugar but richer in acid than in a good one, by the addition of the proper quantity of grape sugar and water the equilibrium is restored.

In countries wherein the grape juice acid is always in excess, certainly this method of improvement (called after its inventor, Gall's method), is generally taken advantage of. Another way of using grape sugar in preparing wine was taught by Petiot. The husks of the grapes, after expressing the juice, still contains enough extractive matter (acids, salts, etc.) to make a tolerable good wine when fermented together with a solution of sugar of proper strength.

Gall's method is almost always applied in making wines from fruits, as currant, gooseberry, etc., wine, the acid predominating always in these fruits. Also in the manufacture of artificial wine (of which a very large quantity is consumed in this country) grape sugar plays an important part. In beer-brewing also an enormous quantity of this sugar is worked up. We state on the authority of Prof. Wagner, in Wurzburg, Bavaria, that to every three cwt. of malt one cwt. of potato-sugar is employed. A large quantity also of this sugar by heating is turned into "sugar coloring," originally used for coloring cordials, etc., then to imitate rum or cognac, and to give whiskey its proper much esteemed color; and where the erring of taste has gone far enough, also lager beer receives its dark color by burnt sugar. That glucose and grape sugar are also largely employed in fruit preserving, confectionery, etc., I hardly need to mention here.

As with commercial cane sugars, so also with glucose and grape sugar; there is a great difference in quality, and no easy way of establishing their real value. Pure taste, absence of color, perfect transparency, and great density are the points by which glucose may be judged. Pure grape sugar should be perfectly white, opaque, of a dry large grain, and, like glucose, have a pleasant taste.

There seems to prevail quite a popular prejudice that neither strong glucose nor hard grape sugar can be made from corn starch, but that potato starch is required, and that corn, containing an oil, produces a disagreeable flavor. A more unfounded superstition than this is hardly possible, for there is as much difference between the "potato sugars" of different European manufacturers as there is between "potato sugar" on one hand and "corn sugar" on the other; and as to the corn oil, I am of the opinion that it is pretty well removed during the preparation of the starch. The potato sugar manufacturer has quite a similar foe to battle with. During the conversion of potato starch, such an unpleasant odor is disengaged with the steam that (as Otto reports) a starch-sugar factory in Braunschweig, Germany, had to be removed out of town as a public nuisance.

By looking to a complete conversion, a most careful separation of the acid, and a proper use of bone charcoal, the difficulties in manufacturing glucose and grape sugar are overcome.

CHRYCOLIN, A NEW YELLOW DYE DERIVED FROM RESORCIN.

By F. REVERDIN.

THE coloring matter of which we are about to speak, and which we have prepared since March this year at the works of MM. P. Monnet & Co., at Geneva, is formed by the simultaneous action of phthalic and sulphuric acid upon benzyl-resorcin.

Benzyl-resorcin is obtained very readily either by causing the chloride of benzyl to act upon resorcin in presence of a small quantity of zinc-powder, or by heating an alkaline and alcoholic solution of resorcin with chloride of benzyl, or, lastly, by heating to about 150° in the oil-bath, a mixture of 1 molecule of resorcin and of 2 molecules of chloride of benzyl.

The most simple manner of preparation consists in adding the chloride of benzyl, little by little, to the melted resorcin; a large quantity of hydrochloric acid escapes, and the mass becomes a reddish-brown. When all the chloride of benzyl has been introduced it is heated to 150° in the oil-bath in a flask fitted with an ascending condenser until the escape of hydrochloric acid is at an end. The product of the reaction is poured into water, boiled to expel the last traces of chloride of benzyl, let settle, and decanted.

The compound thus obtained is a strongly-colored oil, very thick, insoluble in water, in which it sinks; it distils at a very elevated temperature, with partial decomposition. It dissolves in alcohol with a yellow color; the solution has a decided green fluorescence. Benzyl-resorcin is soluble also with a yellow color in benzol, chloroform, and ether.

Preparation of Chrycolin.—The following method dispenses with the previous preparation of benzyl-resorcin: We heat in the oil-bath to 130° to 140° in a retort of enamelled cast-iron.

Sulphuric acid 460 grms.
Common phthalic acid 1 kilo.

The latter substance is transformed, in this operation, into phthalic anhydride. We then introduced into the retort:

Resorcin 1 kilo.
Sulphuric acid 460 grms.
Chloride of benzyl 1 kilo.

and heat gently in the water-bath. The heat may be removed when hydrochloric acid begins to escape, and the reaction continues spontaneously. When no more hydrochloric acid is evolved, which may ensue in three or four hours, the reaction is completed by heating for 12 hours in the oil-bath to 135° to 145°. It is then let cool, the solid product of the reaction is broken up and dissolved in dilute caustic soda. It is well to boil for a considerable time. When the residue no longer diminishes in volume, we filter and precipitate the acid coloring matter by means of hydrochloric acid. The precipitate is washed with cold water, dissolved in the quantity of carbonate of soda needful to saturate the acid, and evaporated to dryness. The soda-salt of benzylated fluorescein constitutes chrysolin.

Chrysolin appears, as a mass, with green metallic reflections, but is red-brown when reduced to powder. It is soluble in water and alkalies; its solutions, which present a magnificent green fluorescence, are precipitated by acids in yellow flocks. It yields bromated, iodated, and nitro-derivatives, which are all beautiful coloring matters.

Chrysolin may be fixed directly upon silk and wool. Wool, however, is preferably mordanted in a beek of acetate of lead and alum. Cotton is mordanted with sulphate of alumina and dyed at a hand-heat.

The shade of chrysolin approaches that of turmeric, and it resists the action of light well.

Yellow coloring matters may also be obtained by replacing the chloride of benzyl with the chlorides, bromides, and iodides of the fatty series. Methyl-resorcin, prepared by heating under pressure the resorcinate of soda in alcoholic solution with chloride of methyl, yields also a yellow coloring matter.—*Moniteur Scientifique*.

LABORATORY NOTES.

By T. A. EDISON.

HARD rubber or vulcanite, placed for several weeks in nitrobenzol, becomes soft and pliable like leather, and easily broken.

2. The vapor of chloral hydrate is a solvent of cellulose. I have found the corks of bottles containing the crystals eaten away to the depth of a quarter of an inch, the cork being resolved into a black semi-liquid. Certain kinds of tissue paper are partially dissolved in time, if thrown in a bottle containing the crystals.

3. A very difficult substance to dissolve is gum copal. I have found that aniline oil dissolves it with great facility.

4. Hyposulphite of soda is apparently soluble to a considerable extent in spirits of turpentine. Large crystals of "hypo" melt down to a liquid after several weeks, and if the bottle be shaken, partially disappear. The turpentine smell nearly disappears.

5. The vapors of iodine, in the course of several months, will penetrate deeply into lumps of beeswax.

6. If to a solution of bisulphide of carbon there be added twice its bulk of potassic hydrate in sticks, and the bottle be well sealed, the whole will, in two months, become an intense reddish, syrupy liquid, with scarcely any free bisulphide of carbon.

7. Some substances in solution form crystals or deposits on the sides of the bottles containing them, generally above the water line. Among such solutions in 100 c. c. of rain water may be mentioned a 14-grm. solution of acetate of uranium, 8-grm. do. of proto-acetate of copper, 5-grm. do. acetate of morphine, 10-grm. do. of formate of copper, 20-grm. do. of tannate of iron. These deposits invariably take place on that part of the bottle most exposed to light. This phenomena may be due to heat, but deposits or films occur in some solutions within the liquid as well as above it—especially noticeable with tannate of iron, the film of which adheres strongly to glass.—*American Chemist*.

NEW METHOD OF DETERMINING PHOSPHORUS, ARSENIC, SULPHUR, CHLORINE, BROMINE AND IODINE IN ORGANIC SUBSTANCES.

By M. G. BRUGELMANN.

THE method proposed by the author consists in burning the organic matter in a current of oxygen and in condensing the products by an incandescent layer of pure lime, or of soda lime in the case of the determination of bromine and iodine. We operate in a tube of Bohemian glass open at both ends, of an internal diameter of 12 m.m. Here are introduced successively—First, a leaf of platinum of the width of 2 centimeters, rolled in a spiral, and forming a plug. Second, a layer of lime in granules, or soda lime, which is heaped lightly so that it may occupy all the diameter of the tube; a length of 10 centimeters is given to this layer, which is quite sufficient to retain completely the elements to be determined. Third, a second bed of platinum of a width of 6 centimeters rolled into a spiral; when the body in question contains phosphorus or arsenic, this spiral should be replaced by a layer of fragments of very small infusible glass. Fourth, a layer of asbestos of a length of 15 centimeters; this layer is indispensable to prevent explosions when we are operating upon volatile bodies or on substances emitting at a temperature slightly elevated combustible gases or vapors. Fifth, the substance introduced directly into the tube, or contained in a small boat or vial, may be in large pieces. Finally, the tube is closed by the stopper holding a very narrow tube (diameter 0.5 m.m.), through which the oxygen is transmitted; the extremity of the tube remains open. The total length of the tube is from 40 to 50 centimeters. We commence by heating the first half of the layer of lime, then oxygen is caused to enter, whilst the other half is raised to redness; at this moment we commence the combustion of the substance. The oxygen ought always to be in excess in the tube, so that the products arriving on the lime are entirely burnt; in any case the lime should not blacken. The speed of the current of oxygen is liable to variations, but on the average 100 c.c. may enter per minute.

If we burn volatile matters or substances which are decomposed at a low temperature, giving off vapors, we cannot always prevent explosions, even on heating with great precaution; in this case we commence the combustion in a current of air, and only turn on oxygen at the moment when we have driven by heat all the substance into the layer of asbestos. Substances rich in phosphorus are mixed with three times their weight of lime and placed in a large platinum boat. When the combustion is finished we break the tube at the place where the layer of asbestos touches the platinum spiral, we remove with care the smallest particles of asbestos, we clean the outside of the tube, and we heat the contents with water to clean it completely; then we add gradually nitric acid until the whole is in solution; in this way we only employ a slight excess of nitric acid. It is well understood that the tube and boat ought to be rinsed carefully in weak nitric

acid. In this solution the haloid elements are precipitated in the state of chloride, bromide, or iodide of silver, where they are determined volumetrically by Volhard's process by means of two standard solutions of sulphocyanide of ammonium and nitrate of silver, ferric sulphate serving as an indicator. Let us add, however, that a part of the iodine is found in the state of free iodine and of iodic acid, and ought to be brought back previously to the state of hydriodic acid by the addition of sulphurous acid until the liquid is decolorized.

Sulphuric acid is determined as sulphate of barium, or else volumetrically by a standard solution of chloride of barium; after the method of Wildenstein, which the author has modified slightly. Finally, the phosphoric or arsenic acids are volumetrically determined with nitrate of uranium. The lime and soda-lime are employed in the form of grains whose diameter exceeds 1 millimeter; they ought to be free from chlorine, sulphur, phosphorus, iron and aluminum. The author describes the preparation of pure lime and soda-lime; for this latter he employs 4 parts of pure lime and 1 part of pure soda prepared from sodium.

The method seems to us to present a great interest for determining chlorine, sulphur or phosphorus in substances which are poor in these elements, such as vegetable and animal products; it enables us, in fact, to burn in a short time a large quantity of matter (about 20 grms. in two hours).—*Zeitschrift für Analytische Chemie*.

ALUMINIUM NITRIDE.—Mallet has made some experiments with the object of ascertaining whether aluminium resembles iron in being capable of combining with carbon. When heated to very high temperatures with carbonate of soda, a metallic carbide was not formed. Small yellow crystalline particles, as well as crusts of yellow color, were observed on the surface or in the cavities of the aluminium regulus, and these proved to be a nitride of that metal. When amorphous the substance is pale yellow, when crystalline it is honey-yellow and transparent. The crystals are lustrous, brittle, and less hard than glass; they are not directly decomposed by water, either hot or cold, but by long exposure to moist air they become sulphur-colored and opaque, and finally crumble to a white powder (alumina), ammonia being given off. They are decomposed by acids and caustic alkalis. The composition of the pure substance was found to be;

Aluminium.....	66.16
Nitrogen.....	33.84
	100.00

which corresponds with the formula Al_2N_3 .—*Ann. der Chem.*

A NEW CARBO-HYDRATE IN MILK.—Ritthausen has found in milk a carbo-hydrate which is not milk sugar. It occurs only in small quantities, and is easily soluble in water; its solution forms with a small quantity of the copper solution and potash the well known blue liquid; when boiled for a long time, a little cuprous oxide is deposited; if the liquid be previously boiled with a little sulphuric acid the application of a gentle heat is sufficient to cause a copious reduction. Alcohol throws down a flocculent precipitate from an aqueous solution of the substance. When evaporated to dryness, either by the application of heat, or at ordinary temperatures over sulphuric acid, its solution leaves a gum-like viscous residue, in which the granular, non-crystalline substance can be recognized. This reaction shows that the body under consideration is not milk sugar.

ON MIXING EMULSIONS.

I HAVE for some time past been occupied in experimenting on a means whereby emulsions can be made in large quantities, and at the same time getting a perfect division of the nitrate of silver.

The agitation of the emulsion does not present any difficulty when made in small quantities; but when manufactured on a large scale it is inconvenient to obtain the necessary agitation. In order to remedy this I have had recourse to a mechanical contrivance constructed by M. Aloerginat, and of which the following is a description:

A is a bar of iron which is fastened to a wall, and from which projects two brackets, B B, and on each of these arms are rings, C C C. From these rings are suspended four

rods, D, terminated at each end by a ring or hook. These rods support the platform, E, on which the bottle containing the solution is placed. F F are supports for said bottle. The whole should be so arranged as to swing easily.

The oscillating movement is obtained by means of a small hydraulic motor used for sewing machines, and which need not possess any great power. The motor is connected by means of H. A very slight degree of force is sufficient to oscillate a great quantity of emulsion when once it has been set in motion. I have under these conditions made a large quantity of emulsion, the results of which have been highly satisfactory.

I may say, after what has been published by M. Andra, that I have introduced without precaution the bromized colloid in the hot alcoholic solution of nitrate of silver, without troubling myself about the precipitate.

The precipitation of emulsion with hot water is very easy; but I think it ought to be remarked that the precipitate

should be submitted to slight pressure. It intensifies its effect, but very good results have been obtained when the emulsion has simply been drained and dried.

In order to render the desiccation more rapid, and at the same time more complete, I dry the precipitate in blotting-paper, and introduce it under a bell-glass, together with a dish containing some concentrated sulphuric acid, and make a vacuum. The product resulting from this operation is flaky, but it dissolves readily in alcohol and ether, and furnishes a fine film free from defects.

The emulsion should be introduced while wet into a dish containing alcohol (forty degrees), and in a few hours placed again in concentrated alcohol. This second bath serves to remove all traces of water. It should then be dried as before, and the emulsion ought to be dissolved in the ethereal-alcoholic mixture. If it be preferred that the emulsion should be kept in powder it is dried rapidly, and can easily be dissolved.

In conclusion, I must say that during the recent hot weather I have modified the proportions of alcohol and ether indicated for emulsions. I use sixty per cent of alcohol and forty per cent of ether. This modification I found necessary.—C. BARDY, in *Bulletin de la Société Française de Photographie*.

THE LATE W. H. FOX TALBOT.

ONE by one our photographic fathers are departing. Following the other two members (Niepce and Daguerre) of that grand old trio to whom photography owes its existence, Mr. William Henry Fox Talbot, F.R.S., at the ripe age of seventy-seven, "rests from his labors," having died at his family residence, Lacock Abbey, Wilts, on Monday, the 17th instant.

Mr. Talbot was born in Dorsetshire, in 1800, and up to the age of thirty-three he passed his time very much in the manner one expects of a man of cultivated scientific and artistic tastes, and possessing the means of indulging in those tastes to the fullest extent. At that period it was customary for those who traveled abroad, and whose desire to make sketches of scenes met with in foreign travel transcended their ability to execute them skillfully, to carry with them a camera lucida—a small prismatic instrument which, when fixed to a table, enables any one to draw with accuracy the particular scene to which the instrument is directed. It was when amusing himself in sketching, by the aid of this instrument, the scenery on the shores of the Lake of Como, in 1833, that Mr. Talbot first experienced a strong desire to make science a handmaid to art, and to find some means by which the beautiful transcripts of nature to be seen in the camera obscura—which instrument he also utilized in connection with art—might by chemical agency be made to record themselves, if not in colors, at least in light and shade. To accomplish this object Mr. Talbot set himself to consider whether it could be effected by any of the chemical processes then known. Now what, at that epoch, was known? Thanks to Scheele, certain properties possessed by chloride of silver when exposed to light had been discovered and recorded. Writing just one hundred years ago (*Traité de l'Air et du Feu*, 1777) that *savant* says: "It is well known that the solution of silver in acid of nitre poured upon a piece of chalk and exposed to the beams of the sun grows black. The light of the sun reflected from a white wall has the same effect, but acts slowly. Heat without light has no effect on this mixture." Scheele also discovered that it was the violet and blue rays of the spectrum that this change was due, and not to the more luminous yellow or red rays.

Various applications of this discovery were made by Wedgwood, Davy, and others, the chief result obtained being the production of profiles upon white leather that had been washed with nitrate of silver, this being produced by allowing the shadow of a rigid body to fall upon the leather when placed in the sun. But no means of fixing these shadow pictures were known, hence the pictorial results of these two experimentalists had to be kept shut up in a drawer. At this stage of such peculiar scientific knowledge Talbot entered the field of research.

The various steps through which Mr. Talbot's earliest experiments were conducted may be summarized as follows: First, he tried simple nitrate of silver solution brushed upon paper and dried, but this was found to darken too slowly. Next, he spread chloride of silver upon moist paper, but this also proved unsatisfactory. He then discovered that

the best way by which to prepare chloride of silver was by double decomposition, the paper being first impregnated with common salt and afterward with nitrate of silver. He discovered in the course of these experiments that in order to obtain the highest degree of sensitiveness with this preparation there must be an excess of nitrate of silver allowed to remain in the film. On paper prepared in this manner Mr. Talbot obtained numerous pictures of flat objects—such as leaves, lace, and analogous objects—by superimposing them upon the sensitive paper and then exposing them to light. But by means of a modification of this process—that is, by giving two successive coatings of chloride of silver with nitrate in excess, and making use of the paper while in a moist condition—images were at length obtained in the camera obscura, although a long exposure had to be given. This was accomplished in 1835, and an account of the experiment will be found in the *Philosophical Magazine* at that period.