

used for fluoroscopy permanently at the bottom of their wooden cone, but, on the contrary, as M. Villard has well shown, to mount them upon a slide or upon hinges and expose them to the broad daylight during the entire time that they are not in service. This is a very simple method of preserving them forever in a perfect state.

For the above particulars and the illustrations we are indebted to La Nature.

DISCOVERY OF NEW CHEMICAL ELEMENTS.

By CLEMENS WINKLER.

IN his studies of the relative frequency of the different elements composing the crust of the earth, Mr. F. W. Clarke supposes that to a depth of ten miles below the level of the sea the composition of the ground is the same as is given by the examination of the surface strata and the depths which we have reached. The mean specific gravity of these strata is 2.5, or not quite half the density of the earth as a whole. Including the oceans and the atmosphere, the exterior crust of the earth is composed half of oxygen and one-fourth of silicon, while the other fourth is represented by other elements—aluminum, 7 per cent.; iron, 5.10; calcium, 3.50; magnesium, 2.50; sodium, 2.20; and potassium, 2.20 per cent. Some of the elements of which the numerous compounds have long been very obvious to the human ken are, therefore, from the point of view of their quantity, of very little importance; thus, hydrogen stands for only 0.94 per cent. of the general composition of the crust of the earth, carbonic acid for 0.21 per cent., phosphorus for 0.09 per cent., and nitrogen for 0.02 per cent. These elements, which are the constituents of immense seas and form the basis of life, therefore furnish only a minute fraction of the mass of the ten-mile-thick ring contemplated by Mr. Clarke. Since the soundings thus far made indicate that they do not exist or hardly exist at greater depths, we have a right to say that so far as regards quantity they may almost be neglected, in considering the mass of the whole globe. The content in chlorine does not exceed 0.15 per cent., yet the common salt alone held in the oceans is sufficient to cover all the continents and bury the highest mountains.

We perceive from this showing how little the impression the outer surface of our globe gives us corresponds with its real nature as we judge of it from its mean density. There cannot be the least doubt that the internal parts of the globe are composed of different substances from those which appear in the external strata.

But, while the elements of light specific weight or great volatility, which, like hydrogen and nitrogen, exist in large quantities around us, constitute only a very minute part of the constituents of our globe considered as a whole, we presume that the elements called rare only enter in an infinitesimal degree into the general composition of the earth; the more so, because, so far as we as yet know, these elements are not found at great depths. I, at least, do not know that the heavier metals—gold, silver, lead, etc.—have ever been found in the materials extracted from deep soundings or volcanic ejections. After the mighty eruption of Krakatoa, for example, I sought in vain for these elements in the cinders cast out, which probably came from great depths. The supposed discovery of a new element in the ancient lavas of Vesuvius has been found to be erroneous.

Elementary bodies seem to multiply as we approach the surface of the globe. Two hypotheses suggest themselves in explanation of the fact: that of displacements of cosmical matter and that of the new formation of elements on the surface.

The displacements of cosmic materials are incessant; falls of meteorites furnish a particularly striking example of them, but it is probable that as to quantity the cosmical dusts are of more importance. Yet neither the meteorites found at various points nor the dust collected by Nordenskiöld in the ice fields of the polar regions, the extra-terrestrial origin of which cannot be doubted, contain the rare elements of the earth. The hypothesis of an increase by accretions from without appears to lack foundation.

The new formation of elementary bodies seems to be still less probable; at most it might be explained by the possibility, often indicated but never established, of a new reduction of bodies heretofore supposed to be simple. Spectrum analysis, it is true, reveals to us transformations which are gradually going on in the matter of the fixed stars, but they are only of known substances becoming converted into other substances equally known. Moreover, the conditions of temperature and aggregation of the fixed stars and those of the earth cannot be compared.

It is evident that the increase of simple bodies in the outer strata of the earth is only apparent. It should be recognized, besides, that science has made greater progress, and this progress cannot be without influence on the discovery of new substances. The first electrolytic decompositions accomplished by Davy with an inferior voltaic pile made known at the beginning of this century the existence of metallic radicals in the salts and the earth of which there had not been before the slightest suspicion; while Moissan, by the employment of the powerful currents now available, has been able to disengage fluorine—hitherto almost unknown—from its combinations. Spectrum analysis has cast light on a whole series of elements of characteristic spectra. The presence of one of these elements, helium, had been demonstrated in the sun before it was known that it likewise entered into the composition of our globe. The conclusions drawn by D. Mendeleef from the periodical law have also led to the discovery of several elements, the existence of which was indicated by theory before the chemist had isolated them. I mention, first, scandium, discovered in 1879 by Nilson in exomite, gadolinite, and yttrite. This metal, the oxide of which exists only in quantities of a few grammes, and which no person, perhaps, other than the author of the discovery has had in his hands, possesses considerable scientific importance, because its atomic weight of 44, as determined by Nilson, is precisely that indicated by Mendeleef for ekabor, an element the existence of which was predicated by the periodic law.

In 1794, Gadolin had separated from the gadolinite

of Ytterby an earth which he called the earth of Ytter, and which was afterward known under the forms of erbia, terbia, and yttria proper. These earths were found in a considerable number of rare minerals, but the oxides extracted from these minerals exhibited different natures and aspects, presenting themselves rather like mixtures in which the separation of the different constituents was attended by considerable difficulties, for the different elements gave no very distinct reaction. It was necessary to recur to spectrum analysis and to the determination of atomic weights, and to try to isolate them by repeated fractionations, under the action of sulphate of potassium or of ammonia, or else by the partial decomposition of the nitrates by heat. The bulk of these analyses, the results of which are not, however, entirely clear as yet on some points, have been performed within the last quarter of a century, and, besides securing more precise knowledge of scandium and yttrium, have revealed the existence of numerous other rare elements, the reduction of which does not seem impossible; among which we cite erbium, holmium, thulium, dysprosium, terbium, gadolinium, samarium, decipium, and ytterbium.

Cerium, lanthanum, and didymium have been the object recently of very attentive researches having a practical end in view—the constitution of mantles for incandescent gaslights. Didymium has been long suspected of not being a simple substance; but Carl Auer von Welsbach, the inventor of this method of illumination, is entitled to the credit of having succeeded, in 1855, in separating didymium into its two elements of praseodymium and neodidymium. The utilization of monazite afterward permitted the preparation of the salts of these remarkable metals in larger quantities, and the practical use of them.

The existence of metacerium, announced by M. Brauner, does not yet appear to be fully established, nor that of russium, which M. Crushchov has found associated with thorium in some zircons and in monazite, and the atomic weight of which is calculated at 220. The jargonium of Sorby, the austrium of Linne-man, the norvegium of Dahll, the actinium of Phipson, the idumium of Websky, the masrium of Richmond and Off, and an unknown element which M. K. J. Bayer thought he had found in French bauxite, have returned to nothingness. We mention also merely as a matter of curiosity a kosmium and a neokosmium, deriving their names not from Cosmos, but from Kosmann, who took out a patent for the preparation of their oxides.

Gallium was discovered in August, 1875, by Lecoq de Boisbaudran in the blende of Pierrefitte, through two very distinct lines in the violet of the spectrum of that mineral, which, however, as afterward appeared, contained only a slight proportion of the new metal—not exceeding 0.0001 per cent.—while in the richer blende of Bernbryer it amounted to 0.001 per cent. The preparation of gallium in any considerable quantities was attended with great difficulties on account of the want of a proper mineral to be practically submitted to the extraction process, and none has as yet been found. Still, the study of the new metal was very interesting, in view of the theoretical speculations of Mendeleef. Scandium and germanium had not yet been discovered, and there was therefore nothing to justify or confirm the conclusions drawn from the law of periodicity. As early as 1869, Mendeleef had affirmed the existence of simple bodies still unknown, the atomic weights of which should be comprehended between 65 and 75; he had even gone so far as to describe in detail the properties of the three hypothetical elements—ekaboron, eka-aluminum, and ekasilicon. We can imagine the interest attached to the question whether the properties of gallium corresponded with the anticipations of the Russian chemist.

At first the correspondence did not seem to exist; the determinations made on the small quantities of gallium that could be obtained gave the specific gravity the unexpected value of 4.7. But as many of the properties of the new metal—such as the precipitation of its solutions by carbonate of barium, its tendency to form basic salts, and its capacity of forming alums—denoted a relationship with aluminum, Mendeleef had no hesitation in declaring that the new element appeared to correspond with the one the existence of which he had indicated in 1874 as similar to aluminum, and which he had called eka-aluminum. A new determination, made with considerable quantities of gallium obtained by electrolysis, brought the value of the specific gravity up to 5.9, which corresponds exactly with the value calculated by Mendeleef for the hypothetical eka-aluminum. The specific heat (0.08) was afterward found to correspond with Mendeleef's estimate, and the justness of his previsions was established. It was, therefore, shown to be reasonable to deduce from the properties of known elements those of others still unknown, but the existence of which is anticipated. Mendeleef had not expected so quick a confirmation of his previsions; but his triumph was destined to be still more complete, for to gallium were afterward added scandium (ekaboron), discovered by M. L. F. Nilson in 1875, and germanium (ekasilicon), discovered by me in 1886.

The discovery of germanium, predicted under the name of ekasilicon by Mendeleef, bears a resemblance to the discovery of the planet Neptune, the existence of which had been shown by the calculations of Adams and Leverrier. That discovery was not due to a concurrence of favorable circumstances or to a happy accident, but was the result of researches inspired by theoretic previsions, and the concordance between the predicted and the real properties was so great that Mendeleef regarded the discovery of germanium as an important verification of the periodic law. On only one point—that touching its formations in nature—did germanium completely fail expectations. The search for it would be more likely made as an oxide in the rare minerals of the north, along with titanium and zirconium, than as a sulphide accompanying similar compounds of arsenic and antimony in gangues of silver-bearing minerals. This fact, with the comparative rarity of its mineral, argyrodite, has contributed no little to delaying the elucidation of its real character. For myself, I was at first inclined to regard it as ekantimony, while Mendeleef, after my first incomplete communications, thought it was ekacadmium. At the same time, M. Von Richter expressed the conviction that germanium was nothing else than the long ex-

pected ekasilicon, a conclusion that was justified by the correspondence of atomic weights.

The success of the bold speculations of Mendeleef permits the affirmation that the elaboration of the periodic system constitutes a great forward step for science. In the course of only fifteen years all the predictions of the Russian chemist have been confirmed. New elements have come to fill the vacant spaces in his table, and there is every reason to hope that a like fulfillment awaits the rest of the natural system.

Yet the two elements last discovered, argon and helium, do not seem to present any relation with the periodic system. The physical properties of argon are very distinct; its characteristic spectrum distinguishes it with great certainty from all other substances; but chemically the gas manifests an extraordinary indifference, and it has not so far been possible to make it enter into the usual compounds with other elements. This peculiarity, and the impossibility of introducing a simple body of the molecular weight of argon (39.88) into the periodic system, have given occasion to all sorts of hypotheses concerning the gas; and the question of its relations has not yet been answered.

Another most interesting discovery is that of helium, which was made by Prof. Ramsay, in 1895, while examining the mineral cleveite for argon, when, besides the spectrum of argon, he observed another bright line not belonging to that spectrum, which Mr. Crookes recognized as identical with the line D³ which Prof. Lockyer had observed in 1868 in the spectrum of the solar chromosphere, and which he attributed to an element not yet known on the earth—helium. The same line was afterward found in the spectra of other fixed stars, and the conclusion was drawn that helium exists in large quantities outside of the earth. On our planet it seems, however, to be very rare, and may even be ranked among the rarest elements. Yet it has been almost discovered several times. Palmieri observed the line of helium in his researches on the lava of Vesuvius, but did not push the matter further; and Hillebrand in 1891 obtained, in the spectrum of the gas formed by uranite, lines which were presumptively those of helium.

Since its discovery, helium has been found in a considerable number of minerals, generally associated with uranium, yttrium, and thorium; in mineral waters and in extremely small quantities in atmospheric air. Next to hydrogen, it is the lightest of the gases, and from this peculiarity Stoney draws an explanation of the fact that these two elements exist only in very small quantities in a free state on the earth, while they are diffused in enormous masses through the universe. The relatively small force of the earth's gravitation does not furnish an adequate counterpoise to the velocity of their molecules, and they escape from the atmosphere of the earth, unless they are restrained by chemical combination. They then collect around the great centers of attraction constituted by the stars, in the atmosphere of which they exist in large quantities.

The study of the spectrum of helium is extremely important, because it gives interesting data concerning the nature of distant celestial bodies. It also, as the labors of Runge and Paschen have shown, suggests doubts concerning the elementary character of the new substance. Whatever it may be, if we have to suppose that helium is composed of two gases (Mr. Lockyer has proposed the name of asterium for the second), one of the two gases probably has a boiling point very near the absolute zero, and in any case below -264° C.; for the master in liquefaction of gases, M. K. Olszewsky, has not up to this time succeeded in provoking a change of state of helium, and he proposes to use this gas for filling gas thermometers for measuring extremely low temperatures. Helium has shown itself thus far as refractory as argon to all chemical combination, and so great an uncertainty reigns over the position to be attributed to it that I pass by the hypotheses that have been set forth with respect to the matter.

It is not impossible that the discovery of these two new elements, argon and helium, may give occasion for a remodeling or a transformation of the periodical system—a remodeling by means of which some uncertainties and even contradictions now existing will undoubtedly be removed. Thus, for example, the atomic weight of tellurium, as recently determined by B. Brauner and Ludwig Standenmaler, does not enter at all into the periodical system; on the other hand, the existence in this substance of a foreign element, such as the austrium suggested by B. Brauner, does not seem to be established. As to the much agitated question whether and to what extent the atomic weight of nickel differs from that of cobalt, I believe I have given a satisfactory answer, and have refuted the hypothesis of Gerhard Krüss and F. W. Schmid of the existence in one of the substances of a third element which has been called gnomium.

The rapid glance which we have cast over the discovery of new elements during the last twenty-five years shows that researches have been pursued in this direction with great activity, and with the return of considerable results. Yet the speculations for which these researches have given occasion with respect to the possibility of an ultimate decomposition of apparently simple bodies, and reciprocally respecting the progressive development of the primitive substance and the formation of many of the present elements, may be considered very uncertain. I mention among these Mr. Lockyer's hypothesis of the dissociation of the elements within the solar atmosphere. Hypotheses of this kind must remain hypotheses so long as we do not succeed in splitting a substance unequivocally regarded as simple, or in transforming some element into another; yet they need not be considered wholly inadmissible. Something unexpected may happen at any time that will open to science new roads of investigation. — Translated for The Popular Science Monthly from the Revue Scientifique.

The Boston and Albany road has sprayed 114 miles of its roadbed with oil this season, or from Boston to a point 15 miles beyond Springfield. It is intended to carry the work as far as Chester, or 126 miles from Boston, before the work is postponed. Eighty-two tanks of 6,000 gallons each were used. It is estimated that only one-third that amount will be required to sprinkle the same ground next year.

ENGINEERING NOTES.

The improvement in train service in England is shown by the fact that in 1884 there were but seven trains making runs of 100 miles or more without intermediate stops. In 1896 it had grown to 58, and the present year it has reached 78. A complete list of these trains with their speeds was recently published in Engineering.

A good deal can happen in two minutes. This brief space of time made all the difference between the "St. Paul" coming safely into New York Harbor and spending ten days on the sands off Long Branch. To stop the "Etruria," whose displacement is 9 680 tons, horse power 14,321, and speed 20'18 knots an hour, two minutes and forty-seven seconds are required, and during the process of stopping the ship will forge ahead 2,464 feet, or nearly half a mile. The United States cruiser "Columbia," with a displacement of 7,350 tons, 17,991 horse power, and a speed of 22'8 knots an hour, can be stopped in two minutes and fifteen seconds, and within a space of 2,147 feet. In each case the vessel is supposed to be going at full speed and the stoppage produced by reversing the action of the propeller.

The largest single contract ever let for an open hearth steel furnace plant was closed on September 24 between the Riter-Conley Company, of Pittsburg, Pa., and the Alabama Steel and Shipbuilding Company, Ensley, Ala. The contract calls for ten 50-ton "Wellman" rolling furnaces, the general dimensions being approximately 21 feet wide, 37 feet 6 inches long, with a total height above foundations of about 22 feet. The contract embraces everything complete above foundations, including steel castings, hydraulic cylinders, and all plate and structural work for casings, binding, pedestals, etc. The work requires approximately 400 tons of steel castings alone, while the total tonnage of steel work and all is nearly 2,000. The work is to be erected complete at the new steel works at Ensley, the foundations being already finished. A gas producer house and a storage bin, 18 feet wide by 343 feet long, both of steel construction, are also included in the contract.

It is not always possible to prevent steam boilers scaling, but when it occurs it is said to be easily removable by a method devised by M. Savreux, a French engineer. The following is his prescription: Rake out the fire, and let out the water only in small quantities, replacing such quantity by cold water, so as to keep the boiler filled. When quite cold, let all the water suddenly out. A great deal of the deposit will come away with it, and the remainder can be readily removed by scraping and brushing. But the cleaners have to be quick about it, for the deposit soon hardens and again sticks to the iron. At a works in Amiens the fire was let out on Saturday night; during two hours on Sunday the boiler was filled with cold water; Wednesday the boiler was polished; Thursday the water was again changed, and the same on Saturday. Sunday the water was let out, and the boiler promptly cleaned. This method is, of course, only applicable where there is a reserve boiler.

A mechanical achievement of some importance is being accomplished at Adelaide, West Australia, viz., the making of about nine miles of steel pipe, from 15 inches to 26 inches in diameter, after a new design of rivetless, longitudinal joint. Each section is 26 feet long, with but four pieces—two locking bars and two plates. Each plate is cut with square ends after passing through a train of leveling rollers, following which a planer with four cutters on a sliding table cuts the two longitudinal edges parallel, and sixteen rollers, eight on each side, carried by the bending rolls, upset the edges in a dovetail of uniform width and depth. Thence the plate goes through a hydraulic press, which upturns the edges, after which it passes through rolls that bend it into a half circle, two of these being placed in grooves, in locking bars, and temporarily clamped together. The pipe is next subjected to hydraulic pressure of 50 tons per inch on an expanding mandrel, the grooves closed, and the usual asphalt coating applied. The pipe is jointed in the trenches with steel rings and lead.

Segmental wire guns, to the number of 50, and costing \$500,000, have been ordered by the War Department from the Brown Segmental Gun Company, of Reading, Pa. They include twenty-five 5-inch and twenty-five 6-inch guns. The Army and Navy Journal says that army ordnance officers protested against the contract on the ground that "there never had been a successful test of this gun." The Brown Segmental Gun Company answers this charge by saying that a 5-inch segmental tube wire gun, 44 calibers long, was some years ago turned over to Gen. Flaggier for test. Though the contract called for a maximum chamber pressure of 50,000 pounds per square inch, 192 rounds were fired from this gun, with 43 rounds at pressures from 50,000 to 60,000 pounds, and 6 rounds with pressures ranging from 60,000 to 82,850 pounds per square inch. The gun survived this severe treatment, though the lining tube finally yielded; and this tube was only considered good for 150 rounds at 50,000 pounds pressure, instead of 192 shots. The company considers this a very successful and thorough test of the qualities of the wire-wound gun.

Prof. Ihlseng, of the State College, Pennsylvania, gives an interesting explanation of the difference between anthracite and bituminous coal, so far as the gases are concerned, his opinion being based on the supposition of all coal beds having been originally formed on a horizontal or flat bed. The anthracite beds, he assumes, were placed under enormous pressure, or side pressure, by the contraction of the earth's crust during the cooling stage, thus forming the coal basins as now seen at the foot of the mountains; such an enormous pressure resulted in forcing the explosive and other gases out of the anthracite beds to the seams and crevices of the veins and to the fissures, seams, and pores of the rock strata. This compression has been so great that gases in the anthracite region are sometimes found with the mighty pressure of 17,000 pounds to the square inch. On the other hand, the bituminous beds have not been subjected to such a disturbance and pressure, and the coal, therefore, retains the gases which it contained originally. White damp, Prof. Ihlseng shows, is produced by imperfect combustion, while black damp is produced by perfect combustion, and destroys life by being devoid of sustaining elements.

MISCELLANEOUS NOTES.

A church is being erected in St. Louis for the St. Francis de Sales congregation which, according to the St. Louis Post-Dispatch, will have the highest steeple in this country. The top of the spire will be 378 feet from the ground. The tower structure will consist of stone walls 6 feet thick at the bottom, on a base 50 feet square, and it will cost \$225,000.

The official report of the mineral resources of the United States issued by the United States Geological Survey gives the production of copper for 1897 as 491,638,000 pounds, which is valued at \$54,080,180, this being an increase of about 7½ per cent. over the previous year. Of aluminum the production is given as 4,000,000 pounds against 1,300,000 pounds for the previous year, the value for 1897 being estimated at \$1,500,000.

The 250 foot tower erected in 1893 on top of the Tower Hotel at Sixty-fifth Street and Stony Island Avenue, Chicago, within a stone's throw of Jackson Park, is now being taken down. As a financial venture the tower was a failure, and the elevator in it ran only a few days after it was opened to the public. Since the Fair, however, it has remained as one of the most conspicuous landmarks. All that now remains of the "White City" is the art gallery and the German building.

In order to avoid over-production in acetylene generators, in which the pressure of gas lowers the water from the carbide, from moisture remaining after production should be stopped, it has been proposed in a communication to the French Society to steep the calcium carbide in hot concentrated solution of glucose, says The Electrical World. In the subsequent production of acetylene a sucate of lime is formed by the action of the glucose, the calcium and the oxygen, which stops the generation almost immediately on the cessation of the water supply.

Austria-Hungary is making an interesting experiment to open up new channels for its trade. A steamer, the "Poseidon," fitted up as a floating exhibition of the products of the monarchy, will soon leave Trieste for the chief ports of the Levant, the Red Sea, Hindostan, the East Indies, China, and Japan. Its arrival will be extensively advertised beforehand at each port, and commercial travelers on board will try to secure orders for the exhibitors and to find capable agents at the points touched. The government has granted a subsidy of 50,000 florins to assist the enterprise.

It appears from recent consular reports that American-made goods, such as cut glass, cotton, bicycles, and other articles, are gaining in favor in Europe. For instance, it is stated in these reports that American silk is being sold in Lyons, the real silk center of France, and that French manufacturers are buying it in large quantities, especially silk of the grades used for lining purposes, to take the place of that formerly imported from Austria and Germany. The demand for American pearl goods and cut glass is increasing because of superiority in quality. Canned goods and bicycles also share in the popularity. From the Ghent consular district a report on the commerce for 1896 says the cotton mills are employing more and more American cotton. The demand for the raw material is annually increasing by reason of the larger number of spindles set in motion. The importation of American hardware on the market shows considerable increase. The introduction of American bicycles was also marked during 1896, and with present quotations United States manufacturers will strongly compete with their foreign rivals.

Before a meeting of the Royal Society of Edinburgh, held recently, Mr. T. C. Baillie read a paper on the thermal conductivity of nickel. The value he obtained by use of Forbes' method was 0.117. What was believed to be a better value—namely, 0.103, was obtained by a new method, which had the great merit of giving an experimental value of the thermal conductivity directly, without requiring the specific heat to be known. A short bar had its one end kept at a steady high temperature as in the Forbes experiment. To the other end a small cap was attached, through which a steady stream of water was passed. The temperature of the water was taken just as it entered the cap and just as it left it. The quantity of water passed in a given time being known, the amount of heat lost from the end of the bar to the water was calculated in terms of the specific heat of water. By means of thermometers set at intervals along the bar, the gradient of temperature was indicated, and a good approximation to the value of the gradient at the position occupied by the cap could be calculated. These measured quantities, the gradient and the heat lost, give at once the conductivity.

Some new and important regulations of the trade in artificial mineral waters in Hungary are reported by Consul Chester of Budapest. According to these, licenses to manufacture artificial mineral waters may be issued only to druggists or chemists holding diplomas. The erection of factories for such manufacture will be permitted only after expert examination. The local authorities are expected to care for the regular medical supervision of such factories. The names of domestic or foreign natural mineral waters may not be made use of. It is also forbidden to use the same bottles, jars, capsules, corks, stamps, or trade marks for artificial mineral waters as for natural mineral waters of similar composition, and the word "artificial" must be marked in large letters on all vessels containing artificial mineral water. In connection with this ordinance of the Hungarian minister it may be pointed out that mineral waters form one of the principal articles of export to the United States from Budapest and the surrounding locality. Under the United States tariff law of 1894, says the consul, owners of mineral springs in foreign countries were obliged to certify that the water exported by them to the United States was in no way prepared by manufacture. As such certificate was required at the production of each invoice of water, the people of the United States were in some degree protected against artificial imitations of the genuine Hungarian bitter waters. Under the United States tariff law of 1897, however, natural and artificial waters are admitted under like conditions of payment of duty, and a certificate of origin has been dispensed with.

SELECTED FORMULÆ.

Waterproof Gelatine Paper.—In waterproof gelatine paper the paper is coated on both sides with a solution consisting of—

Gelatine..... 1 part.
Water..... 4 "
Glycerine..... 1 "

Coagulate the gelatine and immerse the paper in a solution of 750 c. cm. of formal in 5 liters of water. The paper thus treated is, after drying, impervious even to steam.

Photography in Hot Weather.—The photographer meets with various difficulties at all times, but perhaps more troubles crop up in the summer than at any other season of the year. One of the difficulties of the photographer in the hot weather is to produce a perfect negative. When I say perfect, I mean one that is entirely free from any signs of fog or frilling. The dark room is often small—too small, in fact, for the quantity of work that has to be done in it. In the hot weather, even if well ventilated, it often becomes stuffy and close. The consequence is that the temperature of developers and other solutions comparatively small in bulk gets rather high. Now to develop a plate with a solution of a temperature much above 60° F. is almost sure to produce a frilled and chemically fogged negative. A plan which I have found very effective in reducing the temperature of the dark room is to place in it a bucket or other large vessel filled with cold water. The water partly absorbs the heat, and makes the room far more comfortable to work in. The bottles containing developers and other solutions are placed in a large vessel containing cold water, which soon lowers the temperature of the various solutions. The fixing bath should be made up fresh every day. This insures getting a cold solution. It should not be used any stronger than 1 in 4—stronger solution tends to produce frilling. Extra bromide should be used in the developer; two or three drops of a 10 per cent. solution to each ounce of developer, in addition to the quantity generally used, according to exposure.—Amateur Photographer.

Copying Inks, Black and Violet.—The following, if good materials are used, and care is taken in the manipulations, will give an excellent black copying ink: Into a clean jar put 425 parts of Aleppo galls, coarsely powdered, and pour over them 4,500 parts of water, and 56 parts of glycerin. Set aside to macerate for ten days, with frequent stirring up from the bottom. Dissolve 70 parts of gum arabic in sufficient water and add to the liquid. Dissolve 170 parts of crystalline iron sulphate, c. p., in sufficient hot water, and add the solution to the foregoing. Let the whole now stand fourteen days longer, with an occasional agitation, and then strain off. Add 150 parts of loaf sugar, and dissolve. Finally filter. This is the best black ink made, and is exclusively used in all the correspondence of the Bank of England. If the ink does not copy freely enough, add a little more sugar, or a trifle of glucose. A good violet copying ink has the following formula:

Extract of logwood..... 80 parts.
Oxalic acid..... 1 "
Alum, in fine powder..... 6 "
Glycerin..... 2 "
Potassium dichromate..... 1 "
Wood vinegar..... 10 "
Rain or distilled water..... 180 "

Mix the glycerin and water, and in 160 parts of the mixture dissolve the first three ingredients, and in the remaining fluid dissolve the dichromate. Let the solutions stand twenty-four hours, then mix them. After letting the mixture stand another day, put it into a copper kettle and bring to a boil. While boiling, add the wood vinegar, let the boiling continue for one minute, then remove from the fire and let cool down slowly. Let stand until all sediment is thrown down, then decant carefully and fill into bottles. This ink flows freely, and does not mould.—National Druggist.

Perfuming Pastils.—By the slow combustion of certain gums, woods, etc., a fragrant odor is diffused through the air, this result being due in large measure to the evaporation of some of the odorous principles unchanged. A convenient way, long practiced, to attain the end indicated, is to mix ground woods, etc., with potassium nitrate, bind into a mass with mucilage and form into little cones. These when dry burn slowly on being ignited, never breaking into flame, and the heat being thus minimized, volatilization of a portion of the odorous matters present with some products of decomposition is accomplished. The potassium nitrate furnishes the oxygen by which the combustion is sustained; the mass would not burn without a draught except for this aid. Piesse, in his Art of Perfumery, points out that during the slow combustion of the woody matters when used in pastils, products are formed which are unpleasant in odor, and to remedy this defect he proposed using charcoal as the base of the pastil, adding to it essential oils, and assisting combustion, as usual, by potassium nitrate. The carbon dioxide produced by the burning of the coal has no odor, and destructive changes involving the production of one would be limited to the oils. For the kind of pastil advocated by Piesse the following recipe is a type:

Willow charcoal..... 4 ounces.
Potassium nitrate..... 3 drachms.
Oil of thyme..... 15 minims.
Oil of caraway..... 15 "
Oil of rose..... 15 "
Oil of lavender..... 15 "
Oil of clove..... 15 "
Oil of sandal..... 15 "

Tragacanth mucilage, a sufficient quantity. Beat together into a stiff mass, which form into pastils. Pastils are commonly made of conical shape, about three-quarters to one inch long and three-eighths of an inch at the base. This base is made square and level, so that the pastil will easily stand upright. It is ignited, of course, at the small end, the flame, if any, blown out, and combustion then proceeds slowly. It is scarcely necessary to say that in use the pastil should be so placed as to avoid all risk from fire—a risk which may be overlooked sometimes on account of the inconspicuousness of the combustion. Great heat is generated, however, and the ignited mass should be placed in a candlestick or similar contrivance.—Druggists' Circular.