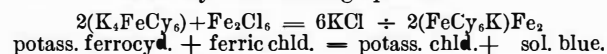


WASH-BLUE AND ITS ANALYSIS.

By H. D. DEBRUNNER.

THE different pigments sold as "wash-blue" chiefly consist of Prussian blue, or ferric ferrocyanide (FeCy_3), $\text{Fe}_4 + 18\text{H}_2\text{O}$; some of them, however, are prepared by immersing starch in cold solutions of indigo or anilin blue, by which process the pigment is absorbed. The latter kind is not very often met with; indeed, I think there is hardly any in our present market. The former kind of blue, however, on which I made a series of experiments, is found in almost every house, under varying names, often as a dry powder, put up in "patent boxes," sometimes, also, in solution.

Soluble Berlin blue, as the term is used in science, is not found in the market. I am referring to the blue precipitate formed on the addition of ferric sulphate or chloride to an excess of potassic ferrocyanide. The blue precipitate thus formed contains potassium, and is soluble in distilled water as soon as freed from adhering mother-liquor. Its formation is illustrated by the following equation:



It is precipitated from its solution by shaking it with such indifferent pulverized substances as baric sulphate, and the same effect is produced by hard water and salt solutions, which qualities render it unfit for wash-blue.

The only allied compound which finds application as wash-blue is insoluble in water, and is obtained by the addition of a solution of potassic ferrocyanide, $\text{K}_4\text{FeCy}_6 + 3\text{H}_2\text{O}$, to an equal quantity of copperas, $\text{FeSO}_4 + 7\text{H}_2\text{O}$, also dissolved, and subsequent treatment of the white precipitate ($\text{K}_2\text{Fe}_2\text{C}_{12}\text{N}_{12}$) with a mixture of nitric and sulphuric acids. The product of this process is insoluble in water; it will, however, readily dissolve in solutions of ammoniac tartrate, oxalic acid and potassic ferrocyanide. Only the latter two solvents are of practical importance. Oxalic acid should be used in proportion of about $\frac{1}{2}$ of the weight of the dry blue in order to dissolve it entirely. Since oxalic acid is a poison, it is doubtless preferable to substitute it by an equal amount of potassic ferrocyanide, thus obtaining a perfectly harmless product. For the manufacture of blue ink I should prefer the latter solvent already on account of its not corroding steel pens. The addition of the potassic ferrocyanide is done best when the previously formed and oxidized precipitate is sufficiently washed and of the consistency of a thick pulp (60 per cent. water). The mixture then is repeatedly passed through a mill, dried at about 120°F ., and ground, when it is ready for sale. 100 lbs. of potassic ferrocyanide thus yield 80 lbs. of dry blue (almost exactly the theoretical amount), which require about 12 lbs. of $\text{K}_4\text{FeCy}_6 \cdot 3\text{H}_2\text{O}$ to become soluble.

The pigment thus obtained forms a light, dark-blue powder, perfectly soluble in water; in lumps it possesses a handsome bronze tint. The color of the solution is a beautiful blue-violet, similar to the shade obtained by the action of ammoniacal vapors on the pure blue pigment. Sometimes, particularly if precipitated from very dilute "liquors," its solution shows fluorescence. It cannot be denied that the cost of this blue is higher than that of the one rendered soluble by oxalic acid. The "patent" boxes, however, it is sold in contain such homoeopathic quantities (average 60 grains, sold at ten cents) that the cost of package and label far surpasses that of the contents, still leaving a fair profit to the wholesale manufacturer.

The greater number of the "wash-blues" in the market contain oxalic acid, the detection of which is by no means so easy a matter as might be imagined. It is evident that on addition of calcic acetate not only calcic oxalate will precipitate, but also the Berlin blue, which thus becomes deprived of its solvent. The non-transparency of the solution (except on excessive dilution) neither facilitates a direct reaction. The method which I would propose, and which has given very satisfactory results, as well for the qualitative detection as for the estimation of oxalic acid, in this case is as follows:

About 10 grains of the blue to be tested are heated with caustic soda. The pigment thus becomes converted into sodic ferrocyanide and hydrated ferric oxide, while the oxalic acid will form sodic oxalate. The iron is filtered off and the filtrate acidified with dilute acetic acid. If oxalic acid is present, calcic oxalate at once will precipitate on addition of calcic acetate. As all the circumstances for the formation of ferric or a basic oxalate are present, it is advisable to dissolve the ferric precipitate in a few drops of hydrochloric acid; add sodic acetate and acetic acid to the cold solution, which, although assuming a red color, will not form a precipitate of basic acetate of iron except on boiling. On addition of calcic acetate, the oxalic acid can be recognized by the precipitation of calcic oxalate, and it may be estimated in the usual manner if a quantitative determination should be desired. Although I have never found oxalic acid in this ferric precipitate, I would recommend not to omit testing for it.

As to the detection of potassic ferrocyanide in wash-blue, I have seen the following test applied, viz.: A few drops of the concentrated blue solution are dropped on a piece of filtering paper and allowed to spread. Owing to the capillarity around the blue spot, a colorless wet zone will form, which, although being hardly of the breadth of $\frac{1}{16}$ th of an inch, will allow the detection of potassic ferrocyanide on adding to it a drop of a dilute solution of ferric chloride by means of a thin glass rod (formation of Berlin blue).

For information I should recommend the following tests: If potassic ferrocyanide is contained in a wash-blue, the aqueous extract of its residue on ignition will contain potassic cyanide (silver reaction AgCy); boiling with a drop of ammoniac sulphide and addition of a drop of ferric chloride (FeCl_3 —red color). As it takes a very low heat to decompose Berlin blue, said aqueous extract sometimes contains undecomposed potassic ferrocyanide. Test with ferric chloride.

Pure Berlin blue, ferric ferrocyanide (FeCy_3), $\text{Fe}_4 + 18\text{H}_2\text{O}$, loses, at 212°F ., 7.22 per cent. of water, a fact the manufacturers are well aware of, and therefore never allow the temperature of the "blue drying room" to exceed 100° to 120°F .

On ignition, depending on the intensity of heat, varying mixtures of ferric and magnetic oxide remain as residue. The loss on ignition, therefore, does not allow any conclusions on the quantity of blue present (for instance, in a mineral color), and an estimation of the ferric oxide, either by titration or weight-analysis will always be necessary. It is evident that this method would become incorrect if applied in the quantitative analysis of a blue rendered soluble by potassic ferrocyanide; it, however, can be successfully followed in the estimation of "oxalic acid blues." Wash-blue is hardly ever adulterated.

In order to ascertain the quantitative relation between the ferric oxide and the total quantity of blue, I prepared a pure sample by the same process as done on a large scale, and dried it slowly at 80°F . It corresponded to the formula

$2[(\text{FeC}_6\text{N}_6)_3\text{Fe} + 18\text{H}_2\text{O}] = 2368$, which will yield $7\text{Fe}_2\text{O}_3 = 1120$. 100 blue correspond to 47.290 per cent. oxide of iron. 1.00 gram of this pure ferrocyanide of iron lost on ignition 0.6058 = 60.58 per cent. of its weight. Actual residue = 0.3952 = 39.42 per cent. This residue then was dissolved, the Fe reprecipitated as $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$, and finally weighed as $\text{Fe}_2\text{O}_3 = 0.4750 = 47.50$ per cent., nearly the theoretical amount.

From these data the quantity of pure blue can be calculated. I have, however, found that the pure "commercial blues" dried at a somewhat higher temperature, contain less than $18\text{H}_2\text{O}$, yielding 49.75 to 50 per cent. of Fe_2O_3 , and consider it "practically correct" to multiply the quantity of Fe_2O_3 found, by two, in order to find the quantity of "commercial blue" present.

The numerous other blue pigments of this series, as, for instance, *Turnbull's blue* (ferrous ferri-cyanide ($\text{Fe}_2\text{C}_{12}\text{N}_{12}$), Fe_3), *chromate blue*, so called from potassic bichromate and sulphuric acid forming the oxidizing agents of the previous white precipitate, $\text{K}_2\text{Fe}_2\text{C}_{12}\text{N}_{12}$; *steel blue*, the product obtained on treatment of said white precipitate with hydrochloric acid, etc., are never used as wash-blue, and therefore out of the range of consideration. In this connection I desire to express my thanks to Mr. John F. Grossklaus, who kindly assisted me in these investigations.—*American Journal of Pharmacy*.

A NEW DEVELOPER FOR DRY PLATES—HYDROSULPHITE OF SODA.

THE chief advantages of this developer are: 1. Shortening of exposure. 2. Freedom from objectionable smell of the alkaline developer, with better keeping qualities. 3. Freedom from fog during a prolonged development, giving thus a very great latitude in the time of exposure.

If bisulphite of soda ($\text{NaO HO}_2\text{SO}_3$) be placed in contact with metallic zinc, a new substance is generated, viz., hydrosulphite of soda, with great reducing properties, which has been made use of by its discoverer, Dr. Schützenberger, in the dyeing trade, for the transformation of blue indigo into white indigo, which is soluble in an alkali. I will not enter into the theory of the preparation and uses of this substance, but only state its use in photography.

Prepare (A) a solution of forty per cent. of bisulphite of soda; (B) a solution of twenty per cent. of pyrogallol acid (the first in water, the second in alcohol); (C) a four-ounce bottle containing granulated zinc.

When wanted, pour solution A into the bottle C, the liquid filling up the interstices of the granulated zinc. Twenty minutes afterwards the reaction is complete. This solution keeps twenty-four hours only, for the absorption of the atmospheric oxygen gives an inverse reaction. The plate is wetted with water. Then put into a dish containing

Water	50 parts.
Solution of hydrosulphite of soda.....	50 "
Pyrogallol acid solution	4 "

In this the plate remains till completely finished with full printing density and every detail well out.

The time required for the development ranges from fifteen to seventy minutes. The exposure is considerably shorter than with the ordinary alkaline developer, but not quite so short as with Wortley's strong alkaline developer.

As soon as the hydrosulphite is mixed with pyrogallol acid the solution assumes a rosy tinge, but does not darken for at least eight hours, retaining all its developing properties, and this without fogging the shadows of the negative; so that detail may be "coaxed" out of an under-exposed negative without fear of a black veil covering the whole plate.

Collodion as well as gelatine dry plates may be developed by the hydrosulphite solution.

L. O. SAMMANN, C. E.

GENERAL METHOD OF ANALYSIS FOR THE TISSUES OF VEGETABLES.

By M. E. FREMY.

THE study of organic substances, so successfully pursued at present by a great number of chemists, should not cause us to overlook that of organized bodies, which are overlooked in these days, and which, nevertheless, are of great interest as revealing the compounds which are indispensable to the performance of the vital functions. The proximate analysis of vegetable tissues presents a difficulty which all chemists will understand, its objects being to determine the composition of a structure formed of insoluble elements in neutral solvents. The principal tissues of plants, after exhaustion by neutral solvents, are formed by the organic association of the following bodies: Cellulosic substances (cellulose, meta-cellulose, para-cellulose), vasculose, cutose, pectose, pectate of lime, nitrogenous compounds, and various mineral matters. Dilute cold hydrochloric acid decomposes the pectate of lime and sets at liberty the pectic acid, which is then easily determined by means of alkalies. Dilute boiling hydrochloric acid transforms pectose into pectin, which is precipitated by means of alcohol. Ammoniacal cupric reagent dissolves the cellulose. Boiling hydrochloric acid renders para-cellulose soluble in the ammoniacal cupric reagent. Bihydrated sulphuric acid dissolves the cellulosic substances. Dilute and boiling potassa dissolves cutose. Potassa under pressure effects the solution of vasculose. Dilute nitric acid renders vasculose soluble in alkaline solution.—*Comptes Rendus*.

OENOKRINE.

THIS is the name of a test paper sold in Paris for the purpose of detecting the fraudulent coloration of wines. With a genuine red wine the color produced is a grayish blue, which becomes lead-colored on drying. With magenta and other aniline colors it turns a carmine red; with ammoniacal cochineal, a pale violet; with elder berries, the petals of roses, etc., a green; with logwood and Brazil wood, the color of dregs of wine; with Fernambucca wood and phytolacca, a dirty yellow; with extract of indigo a deep blue. The manipulation required is very simple. A slip of the paper is steeped in pure wine for about five seconds, briskly shaken in order to remove the excess of liquid, and then placed on a sheet of white paper to serve as a standard. A second slip of the test paper is then steeped in the suspected wine in the same manner and laid beside the former. It is asserted that $\frac{1}{16}$ th of magenta is sufficient to give the paper a violet shade, whilst a larger quantity produces a carmine red. The inventors of the test paper, M.M. Lainville and Roy, are also said to have discovered a method of removing magenta from wines, without injuring their quality—a fact of some importance if it be true that several hundred thousand hectolitres of wine sophisticated with magenta are in the hands of merchants.

THE NEW STAR.

By PROF. C. A. YOUNG.

PROBABLY every one of our readers knows that occasionally new stars have appeared in the sky, remained visible for a short time, and then vanished. The earliest recorded instance was in the year 134 B.C., and the occurrence is said to have led Hipparchus to make his catalogue of the stars, the first ever constructed, and the corner-stone of our modern stellar astronomy. Another star appeared in the reign of the emperor Honorius, about 389 A.D. It was near α Aquilæ, and for some three weeks was as bright as Venus. A third is reported to have appeared in the reign of the emperor Otho, about the year 945; and a fourth in the year 1264. With respect to these last two, however, there is room for doubt whether the accounts may not really refer to comets; they are not satisfactorily definite.

The most remarkable and brilliant of all on record was the fifth, the famous star of 1572, in Cassiopeia. It was first seen by Tycho Brahe, on Tuesday, the 11th of November of that year, and was then brighter than Jupiter; for a week or so it increased somewhat in brilliance until it exceeded Venus, and could be seen with the naked eye in full daylight; then it slowly declined, and after sixteen months, in March, 1574, became invisible. At first its color was clear white, then it became yellow; afterwards ruddy like Mars, and finally of a leaden hue, like Saturn.

Hardly less remarkable was the sixth of these stars, which blazed out on the 17th of October, 1604, in the constellation Ophiuchus. When Kepler first saw it, it was as bright as Jupiter. It soon began to wane, like the star of 1572, but did not entirely disappear for a whole year. Kepler was of opinion that it was generated from an ethereal substance pervading all space, and he remarked that the luminous ring (the corona) observed around the dark body of the moon during the total eclipse of the sun at Naples, in 1605, was occasioned by the existence of the same substance around the sun, a remark which in the light of the newest observations seems almost like a divination.

The seventh of these temporary stars was observed by Hind, in 1848, also in the constellation of Ophiuchus. The star when first noticed, on April 28th, was of the sixth magnitude, just visible to the naked eye. In about a week it brightened up to between the fourth and fifth, and then dwindled away, vanishing from sight about the end of May. It is still visible with the telescope as a star of the thirteenth magnitude—more than three thousand times fainter than when brightest.

The eighth of these objects made its appearance in the constellation of the Northern Crown, on the 12th of May, 1866. It was then of the second magnitude, as bright as the Pole star, but in ten days ran down to the sixth, the limit of unaided vision; it has been watched ever since, and is now of the eleventh magnitude, or nearly five thousand times fainter than at its maximum. Dr. Huggins succeeded in getting an observation upon its spectrum, and found it marked with the bright lines of hydrogen, and one or two other lines which he could not identify.

The ninth phenomenon of this kind has just occurred. On the evening of November 24, 1876, Professor Schmidt, of Athens, distinguished for his researches upon variable stars, observed in the constellation Cygnus a new star of the third magnitude, which by midnight was well up toward the second. On the 20th, the last clear night preceding, no such star had been visible. He immediately telegraphed his discovery to Paris and Vienna, but the weather was very unfavorable, so that no observation could be made until December 2, when the star had already fallen to the fifth magnitude; by the 12th it had become invisible to the eye—of the seventh magnitude, according to Hind—and it is now (January 10th) not above the eighth. The position of the star is near ν Cygni, in right ascension $21^{\text{h}}.36^{\text{m}}.50^{\text{s}}$, and in north declination $42^\circ 16' 38.5''$, where none of the catalogues indicate any star at all; so that hitherto it cannot well have been brighter than the eleventh or twelfth magnitude.

On December 2d and 5th Cornu, the celebrated French physicist, obtained some very interesting observations upon its spectrum, using for the purpose the great equatorial of the Paris Observatory fourteen inches' aperture) and a direct vision spectroscopic, with a dispersive power about the same as that of the ordinary one-prism chemical spectroscopic; the star being already too faint to allow the use of greater power. He found the spectrum to consist of numerous bright lines and bands, standing out on a feebly luminous background which was almost interrupted between the green and the blue, so that the spectrum seemed at first sight to consist of two separate parts. If any dark lines existed they were too fine and faint to be seen with the power employed. Of the bright lines he succeeded in measuring pretty accurately eight, whose positions upon the scale of wave-lengths came out as follows, namely: (1), 661, (4), 588; (3), 531; (2), 517; (6), 500. (7), 493; (8), 451; (5), 435. The units of wave-length are millionths of a millimetre, and the prefixed numbers in parentheses denote the order of brightness. Three of these lines, (1), (7), and (5), are undoubtedly the lines C, F, and ν of hydrogen, whose wave-lengths are respectively 656, 486, and 434, the differences being no greater than would be expected in observations with such an instrument upon so feeble a light. Line (4) coincides with the sodium line D ($\lambda = 589$) within the limits of error; and line (2) presents a similar agreement with the mean of the "b" group ($\lambda = 517$) due to magnesium.

"But the most curious coincidence," we quote the author's words, "which I give here with much reserve, but which it will be interesting ultimately to verify, is the coincidence of the line (3), very bright in the spectrum of the star, with the green line ($\lambda = 432$; 1474 of Kirchhoff's scale) observed in the spectrum of the solar corona, and in the chromosphere; the feeble line (8) corresponds also to a band ($\lambda = 447$) of the chromosphere; one is led thus to think that the line (4) corresponds rather to the bright line of the chromosphere, D, ($\lambda = 578$), helium, than to that of sodium. If this interpretation be correct, the bright lines of the spectrum of the star comprehend exclusively the brightest and most frequent lines of the chromosphere. The following, in fact, according to Young's catalogue of the chromospheric lines (*Philosophical Magazine*, November, 1871) is the designation of the brightest lines, and their relative occurrence:

Wave-lengths,	656 (C), 587 (D ₂), 532, 517 (b), 486 (F), 447, 424 (A)
Relative frequency,	100, 100, 75, 15, 100, 75, 100.

"All the other bright lines have a relative frequency lower than 10 with the exception of the fourth bright line of hydrogen, h ($\lambda = 410$), whose relative frequency is represented by 100."

The case may be made even a little stronger; the only remaining line (6) corresponds to the mean of a group of

* λ is used as an abbreviation for the word wave-length.

lines ($\gamma = 493$ to 501) which, in the spectrum of the chromosphere, stand next to those already enumerated in frequency and brightness, as he would have seen if he had had before him the more complete catalogue of chromosphere lines published a year later. Resuming the quotation:

"To sum up, the light of the star appears to possess exactly the same composition as that of the solar envelope known as the chromosphere. Notwithstanding the great temptation there exists to draw from this fact inductions relative to the physical conditions of this new star, its temperature and the chemical reactions of which it may be the seat, I shall abstain from all comment and all hypothesis on this subject; I believe the facts necessary to arrive at a useful conclusion are wanting, or at least at a conclusion capable of verification. Whatever attractions these hypotheses may have, it is necessary not to forget that they are unscientific, and that, far from serving science, they greatly tend to trammel her."

This is undoubtedly true. It will not do to found a theory upon a single observation unsupported and uncontrolled by others. It is a pity that the news could not have been diffused more widely and rapidly among spectroscopic observers, for it is hardly to be expected now that we shall get from any other source observations suitable to compare with those of Cornu, and capable of corroborating or correcting them. Before coming to final conclusions we ought to hear from Huggins and Lockyer, Vogel and Secchi. The news did not reach this country until December 18th or 20th, when it was too late to do anything.

But even as the matter stands, the result is certainly most interesting and suggestive. It seems as if this most stupendous of all phenomena in the physical universe—this "conflagration of a world"—were likely to prove simply the same thing, on a larger scale, which in a small way is continually happening upon the surface of the sun. Whether the outburst in the two cases is due to similar causes we cannot tell.

In the solar eruptions the energy which operates is almost certainly internal; pent-up forces imprisoned within the body of the sun break out with more than volcanic violence. Is it so with the star? And if so, are we to think that some time our own sun may, as the result of forces now at work within his mass, blaze out in the same manner upon his attendant planets—the beautiful phenomena which we now observe with our spectroscopes, and admire from day to day, being only prelude to the great catastrophe, like the mutterings which precede the earthquake? Or rather, and perhaps more probably, is this sudden flashing into light due to an encounter between the star and some unseen mass met by it in its swift course through space? Or shall we ascribe the strange occurrence to some action as yet quite beyond the reach of reasonable speculation?

In the present state of science we cannot say; but such phenomena are at all events most impressive in their teaching of the intense activity which pervades the universe. Of the sun and stars we naturally feel that they at least are permanent and unchanging, eternally calm and far beyond all turmoil. But closer study reveals the falsity of this; we find that they rush through space more swiftly than cannon balls; they vary in their brightness and color, and flush and faint like maidens. And yet, for the most part, their visible changes are such as can be detected only by patient and minute observation, because we who watch them are so small and far away, and our scale of time and magnitude so insignificant. Such an event, therefore, as we have been considering, may well arrest attention.—*Boston Journal of Chemistry.*

METHODS OF VENTILATION.*

MR. PRESIDENT.—In reporting upon the systems of ventilation, I have endeavored to obtain the results of experiments and experience of men of undoubted authority, such as Prof. Pettenkofer, Dr. Grassi, Pecllet, Morin, and many others.

While much ingenuity is exercised, and the means employed to accomplish ventilation are various, the systems upon which they are based are known first as that of natural or spontaneous ventilation; second, of ventilation by aspiration or extraction; and third, that of propulsion or mechanical ventilation.

Natural ventilation is based upon the difference of the outer and inner temperature, and consequently also upon density of the interior and exterior air. To produce a sufficient velocity in the evacuating and supply flues so as to insure an efficient renewal of the air, the difference of temperature must be considerable. The primary force which produces motion in spontaneous ventilation is the difference of specific gravity of two columns of air. In the same degree that this difference of temperature is lessened between the inner and outer air, the velocity of the current will be reduced. Should the exterior air be equal in temperature to that of the interior of a building, no movements of air will take place.

Degen (*Handbuch der Ventilation und Heizung*) states that by a difference of from 30° to 40° a sufficient ventilation may be secured: a result that may be obtained in winter, but not in the spring, summer, or fall. "In these seasons," the same author says, "the system of natural ventilation has been found to be insufficient; and if a constantly operative ventilation is required, it will be necessary to employ mechanical means to secure it." It seems necessary in these seasons to employ machinery to set the air in motion: the opening of windows will not be sufficient. Pettenkofer found that through a window-opening of $9\frac{1}{4}$ square feet, a supply of only 14 cubic metres of air was received during one hour, and by the entire open space of an ordinary window, the requisite quantity for two persons only could be obtained (60 cubic metres per hour being considered necessary for one person). To demonstrate how variable the results are of natural ventilation, I need only refer to some of the experiments of Dr. Pettenkofer made during the months of March, October and December. At 19 different trials he found the changes of air in the same room, of which he was the only occupant, to vary from 66.3 to 1009.8 cubic feet. In the former case there was no difference between the exterior and interior temperature, while in the latter the difference was 19° . In addition to the above, Pettenkofer made 220 experiments in the Lying-in and in the General Hospitals at Munich, by request of the Bavarian Government. The ventilation of these buildings was based upon the natural system; he found during 100 experiments that it was entirely inoperative, and during 100 other experiments the action in the flues was the reverse of that which it was intended they should have.

This, then, seems to demonstrate the insufficiency of the system where a permanently active change and an unvarying supply of air are required, as in hospitals, asylums, prisons, schools, etc. In connection with this system, I wish to add yet that the velocity of the current of the exterior air exerts a marked influence upon the ventilation of a building, as it has been found that much more fuel and heat is required when it is cold and windy than during calm cold weather.

The second system is that of aspiration or extraction. This system has perhaps nowhere had a fairer trial than at the Hospital La Riboisière at Paris. This hospital was completed in 1854. The authorities, being very desirous that it should be well heated and ventilated, prepared a programme containing the conditions which should be fulfilled by proposals which were to be invited. The programme according to Dr. Grassi (*Etude comparative des Deux Systèmes de Chauffage et de Ventilation établis à l'Hôpital La Riboisière*), contains the following thirteen conditions:

1. A constant temperature of 15° in the wards during the whole year by day and night.
2. A temperature of 15° during the whole year, in the daytime only, in the offices and rooms.
3. A temperature of 10° the whole year by day and by night on the stairs of the pavilions of the sick.
4. A constantly operative ventilation by warm air in winter and by cold air in the warm season; the supply of fresh air to be at least 20 cubic metres per hour and per bed in the wards.
5. A ventilation during the daytime only of 10 cubic metres per bed in the private rooms of each pavilion.
6. A ventilation in the waterclosets sufficient to prevent under all circumstances the development of bad odors, and without creating currents which might prove injurious to the patients.
7. The ventilating apparatus to possess a surplus of power sufficient to produce in some or all of the wards twice the amount of ventilation before prescribed, in case it should be found necessary during a great epidemic to increase the number of beds.
8. The ingress openings of the fresh air flues to be of sufficient transverse section to admit the air into the wards with but little current, and at a temperature not exceeding 70° .
9. The air must enter the wards in the requisite degree of moisture, susceptible, however, of being changed at pleasure.
10. An especial contrivance for cooling the air artificially when necessary during seasons of great heat.
11. The apparatus for the general heating, or special apparatus, to furnish a sufficient quantity of warm water to answer all requirements of the wards, and to maintain an efficient temperature in the hot closets of the ward kitchens.
12. In every kitchen of the basements, either in connection with the warming apparatus of the kitchens of the upper stories or separately, provision must be made for maintaining an active fire.
13. The heating and ventilating apparatus to be contrived so as to admit of being gradually put in operation in all parts of, or to be discontinued in any portion of, the buildings; besides, the apparatus must permit the lowering or raising of temperature of the wards.

A commission composed of scientific men of accepted authority, and presided over by the well-known physicist and chemist Régnault, examined the various proposed plans and methods, and decided in favor of forced or fan ventilation, as proposed by Thomas and Laurens of London. This decision created a general dissatisfaction and strong opposition. This method had not been in use in Paris. The system of aspiration, so well contrived by Léon Duvoir, had produced favorable though not entirely satisfactory results; but its advocates so strongly attacked the decision of the commission, that a second one was formed, composed mostly of architects, under the presidency of Gen. Morin. The latter made the proposition, assented to by his associates, to heat one half of the number of pavilions by the system of aspiration as proposed by Léon Duvoir, and the other half by the system of propulsion as proposed by Thomas and Laurens. The demand upon the ventilation was increased from 20 to 60 cubic metres per hour and bed for both systems.

It has been conceded that the operation of these two systems was investigated in a most thoroughly scientific and impartial manner by Dr. Grassi during a period of two years. In the experiments of the system of aspiration he put to himself several questions, which, in the opinion of Pettenkofer, were answered with scientific precision. Among these were first: Is the amount of air which passes through the extracting chimney equal to the amount of fresh air supplied by the flues intended for this purpose? By measuring with the anemometer he found that 93 cubic metres of foul air passed through the chimney per hour and per bed, while only 31 cubic metres of fresh air came in during the same time through the fresh air flues instead of 60 cubic metres as prescribed, and the difference of quantity was supplied by the doors and windows.

Dr. Grassi found during various experiments an analogous result. Question second: Is the system of aspiration uniform during the entire year?

The result of his experiments obliged him to answer this question most decidedly in the negative. The motive power being the difference of temperature of the extracting chimney and that of the open air, and as this difference was at times more, and at other times less, so also he found the ventilation to vary. Consequently the system of aspiration was declared by Dr. Grassi to be faulty and insufficient.

In connection with the system of aspiration the construction of the ventilating shafts, flues, and chimneys is of great importance. I have learned by experience that it is not sufficiently observed by people who have such matters in charge, whether the movements of air are produced by static pressure or by suction.

It is ultimately the general pressure of the atmosphere which produces the movements of air, whether in consequence of the disturbed equilibrium, or by a vacuum created by suction. A chimney-flue does not act as a bellows; and the general expression "suction of the air" by means of a chimney shows most unmistakably the erroneous conception of aerostatic laws by laymen in physics. Physicists have furnished the most decisive proofs that the so-called draught in a chimney is not produced by the tendency of the warmer columns of air to rise within it, but by the pressure of the colder lower strata of air; for the same reason that causes oil to rise in the water.

The third system, that of propulsion, being in use in the other half of the La Riboisière Hospital buildings, was submitted to the same careful test by Dr. Grassi. While the programme demanded a supply of only 60 cubic metres per hour and bed, he found that in the pavilion nearest the fan

132 cubic metres were furnished per hour and bed, in the second 126 cubic metres, in the third and last 88 cubic metres were furnished, or an average supply of about double the quantity demanded.

Grassi tested also the barometric pressure of the air in the wards in comparison with that of the open air, and found the former less compressed than the latter, so that considerable additional air passed into the wards by the joints of the windows and doors. Notwithstanding the excessive supply of air, no draughts or unpleasant currents were perceptible a few feet from the openings.

It was also found that in the wards ventilated by this system the carbonic acid was only 11 per thousand, while in the former it was 2.5 per thousand of the volume of air.

Dr. Pettenkofer, who was commissioned by the Bavarian Government to examine the ventilation in use in the public buildings in Paris and London, has verified the conclusions of Dr. Grassi, and states in his report that the experience and tests made at La Riboisière were perfectly convincing as to the superiority of the system of propulsion or mechanical force in ventilation, and recommends it as the only reliable method.

As it has been a point of considerable dispute and discussion whether a fan should be placed so as to extract the foul air, or to force in the fresh air, Dr. Pettenkofer gives the results of experience as well as investigation of this matter at the Hospital Beaujon in Paris. Here the fan was originally placed in a chamber in which all the foul air flues terminated, and contrived so as to extract the foul air, leaving the supply of fresh air to take care of itself. This, however, proved a complete failure, and it was found necessary to change the position of the fan, and reverse its operation so as to force in fresh air.

Dr. Pettenkofer closes his report with the opinion that the natural system of ventilation is irregular and accidental, and not to be recommended. As to the system of aspiration, he says that it cannot be denied that a good ventilation may be attained by it, but it is more or less irregular, and will vary with the difference of temperature in the extracting chimney and that of the open air. He refers to Pecllet as having given the clearest and most convincing proofs of this in his report of the ventilation of Mazas Prison. He concludes by recommending forced ventilation as the only reliable method, inasmuch as the requirements of our lungs are constantly the same, that it is our duty to employ the means by which we will insure the supply of this demand. He says that it is of the utmost importance to furnish a sufficient supply of fresh air, and when this is done but little attention need be paid to the expulsion of the foul air.

Pecllet, who devoted a lifetime to the study of physical science, who has sometimes been called the father of the new science of applied physics, and whose works are perhaps the most authentic on everything that appertains to the phenomenon of heat, has expressed almost the same views as Dr. Pettenkofer. (The views of Pecllet have been cited in Dr. Parke's "Practical Hygiene.")

Gen. Morin in his latest work upon heating and ventilation gives the results of investigations in these matters in several of the manufacturing establishments of Paris, where the atmospheric impurities produced were very great, "as showing that the recent trials seem to demonstrate that the system of ventilation by propulsion was the most effective." A German author in reviewing Gen. Morin's work, and noticing this passage, says, "The advocates of this method could not desire a better method than this, as it comes from a hitherto most strenuous opponent of that system."

Dr. Seifert of Dresden, to whom was awarded the first prize by the Imperial Academy of Vienna for an essay on the construction of Asylums for the Insane, and who visited the institutions of Germany, France, England, and other countries, arrived also at the conclusion that mechanical ventilation was the most perfect.

The convention of Superintendents of American Asylums for the Insane, declared by resolution in 1851, and re-affirmed the same in May, 1853, that forced ventilation or the use of a fan was the only method to be recommended for their institutions.

HEALTH AND SEWAGE OF TOWNS.

In a recent address, the Chairman of the Society of Arts, London, said:

How to deal with our sewage, and how to get rid of the nuisance at the smallest possible cost, and with the greatest advantage to health, is a difficulty which still confronts us. Exaggerated notions at one time prevailed as to the fertilizing value of the sewage, and there was a popular belief that, in lieu of a burden on the ratepayer, it would become a source of wealth to each town. Scheme after scheme was propounded on this supposition, but only disappointment followed. Chemical analysis, it is true, showed certain valuable fertilizing constituents and fostered delusion, no account being taken of the cost at which they could be secured, even if any process had been discovered by which they could be made available. Experience, however, has led to the entertainment of more sober views, and the public are now beginning to learn that profit must not be looked for. Our health and comfort demand that the nuisance must be got rid of in some way or other, and at any reasonable cost; and if by some method of treatment a return can be obtained to diminish this cost, so much the better. We are no longer permitted to pollute our streams with it, and other means must be adopted for the removal of and dealing with our sewage. Experience would seem to show, and our conference enforced this lesson, that perhaps a profitable as well as healthful way of dealing with sewage is to apply it to the land; but, unfortunately, it is not every locality that can supply, at a reasonable price, land suited for the purpose, either in soil or position. There are, doubtless, various processes for treatment of the sewage, chemically and by precipitation, which result in the production of a good effluent, generally sufficient to meet the requirements of the Act, but the precipitant, sludge, or solid matter produced, is but of little value, and must not be reckoned upon as giving a return in money covering the outlay for works and cost of carrying out the process. At Leeds, I understand, where, probably, a larger amount of practical experience has been obtained on an extended large scale than in any other town, the difficulty has been to get rid of this sludge or solid matter; and it is only within the last few weeks that arrangements have been made with a contractor to purchase it and take it away at 12s. per ton, a sum totally inadequate to defray the cost of treatment. All that can be looked for in any case, wherever the water-carried sewage is applied to land, or treated by any known process, is that, under the most favorable conditions, some small return may be obtained in diminution of the necessary cost of getting rid of the nuisance.

* [Report on Methods of Ventilation, read at the Third Annual Convention of the American Public Health Association, at Baltimore, by Carl Pfeiffer, Consulting Architect of the Health Department, New York.]