harsh to handle, and the green dye will look flat. No metallic salt must be present. The wool is then dyed in a clear solution of methyl green in water. For a yellower shade picric acid and acetate of zinc are dissolved in water in the following proportions: $\frac{1}{4}$ oz. picric acid, 95 grains acetate of zinc, and 13 gallons of water. After dyeing the wool yellow in this mixture, some acetate of soda is added, and the wool is dyed in the solution of $\frac{3}{4}$ oz. methyl green.

FAST RED WITH ARTIFICIAL ALIZARINE ON WOOLLEN YARN (22 LBS.)

Boil for ninety minutes with $3\frac{1}{2}$ lbs. sulphate of alumina and $17\frac{1}{2}$ ozs. tartar. Rinse well, and dye with 14 ozs. alizarine paste at 10 per cent, entering the goods in the cold beck, and raising gradually to a boil. If the spent alizarine beck is mixed with $17\frac{1}{2}$ ozs. sulphate of alumina, the same weight of bisulphate of soda, a little fustic, and indigo-carmin residues, a fine mode-brown may be produced.

[Chemical Review.]

PRACTICAL DYEING RECIPES.

Safflower Scarlet, 60 lbs.—Bleach; then boil, until quite dissolved, 3 lbs. of concentrated annatto with 1 lb. soap, 1 lb. common soda; add this to a bath of boiling water. Work yarns one hour, 10 turns, wash in 2 cold waters, and wring up. Add to a bath 1 bottle of safflower carmine, work yarns 4 turns, and lift; then add 6 gills of acetic acid; enter yarns again; work till all the color is taken up, wash off in 3 cold waters; add 1 lb. of cream of tartar in last water, wring and stove. Darker shade by using more wares.

Saffranine Pink, 60 lbs.—Bleach, then mordant in red liquor, No. 4. Wash well from this in two or three cold waters, and wring. Add to a warm water 1 lb. saffranine paste. Work yarns 5 turns. Wash off in cold water, and stove.

A good pink may be dyed with saffranine by putting on a good soap mordant in place of red liquor.

Saffranine Scarlet, 60 lbs.—Bleach; 2 lbs. concentrated annatto with 1 lb. soap, 1 lb. soda, until all are well dissolved; add this to a boiling water. Work 10 turns, wash in 2 cold waters, and wring up. Mordant in red liquor, No. 4, wash off in 2 waters, and wring. Add to a beck of warm water 2 lbs. of saffranine. Work yarn in this for 1 hour, 10 turns. Wash off in cold water, and stove.

Aniline Scarlet, 60 lbs.—Bleach; boil 3 lbs. of tannic acid. Put yarns down in this over night, using as mordant the tin mordant. Wash off in 2 cold waters, and wring up. Dissolve 6 ozs. of aniline scarlet, add this to a warm water. Work yarns one hour, 10 turns. Wash in cold water, and stove.

Another Scarlet, 60 lbs.—Bleach and mordant; then boil 3 lbs. turmeric, and 3 ozs. of aniline ponceau; add this to a hot water. Work yarns 10 turns, wash in cold water, and stove.

Common Scarlet, 60 lbs.—Bleach; boil 6 lbs. sumach; add this to a hot water. Work yarns 5 turns, and wring; mordant in tin. Wash in two cold waters and wring up. Boil 18 lbs. peach wood, 18 lbs. fustic, ground; add this to a hot water. Work yarns 10 turns, raise with 1 lb. alum. Wash in cold water, and stove.

For lighter shades the sumach may be dispensed with, and turmeric may be used in place of fustic.

Violet on Wool, 55 lbs.—Dissolve $4\frac{1}{2}$ ozs. of methyl violet of the suitable shade in water; add it to the beck, in which, further, 2 lbs. 3 ozs. of sulphate of soda must be dissolved. Boil up, cool, enter the wool, and dye at a brisk boil.

Navy Blue on Cotton Yarn, 11 lbs.—Boil 2 lbs. 3 ozs. St. Domingo logwood, and dissolve in the clear, hot decoction 26 ozs. curd soap. Steep the clean yarn in this liquor for two hours at 167° Fahr. Take out; add to the beck 26 ozs. copers; re-enter the yarn, and work till the color is even. Wash in cold water, and work in a fresh beck, with $17\frac{1}{2}$ ozs. of curd soap, at 144° Fahr., for an hour. Make up a boiling beck, with $2\frac{1}{2}$ ozs. of aniline blue soluble in spirit, and 2 lbs. 3 ozs. red liquor, at 10° B. Work the yarn in this at a boil till the shade is obtained, and finally rinse.

ANILINE BLACK.

By M. ANTONY GUYARD.

If to a normal mixture for aniline black, formed of 100 grms. water, 8 grms. hydrochlorate of aniline, 3.5 to 5 grms. chlorate of potash or soda, there is added about 1 centigramme of vanadous chloride or vanadate of ammonia, the liquid darkens in a few moments and deposits aniline black in abundance. In about 48 hours the reaction is almost at an end, and the liquid becomes thick, almost solid. This reaction is so delicate that 1 part of vanadous chloride or vanadate of ammonia can easily convert 1000 parts hydrochlorate of aniline into aniline black, and that in practice 500 parts of an aniline salt are readily turned into aniline black by one part of vanadous chloride or vanadate of ammonia. This important discovery renders it as easy to dye aniline blacks as to print them, and nothing equals the beauty of the blacks thus obtained. The power of the vanadium salts in producing aniline black is more than 1000 times greater than that of copper, and if we know the properties of vanadium this becomes easily intelligible. There is no metal which passes more easily from the minimum to the maximum state of oxidation, and returns more easily to the minimum again. If exposed to the slightest reducing influences, vanadic oxide becomes vanadous oxide, and if exposed to the fullest oxidizing agents, vanadous oxide is converted into vanadic oxide. Thus if vanadic acid is dissolved in hydrochloric acid, it is transformed into vanadous oxide, and if this latter solution is evaporated in the air, it is partly transformed into vanadic acid. On the other hand, if we bring vanadous chloride and chlorate of potash into contact, the latter is decomposed with evolution of chlorine, and the vanadous oxide is transformed into vanadic oxide, and reciprocally if we introduce vanadic oxide or an alkaline vanadate into hydrochlorate of aniline, the vanadic oxide is at once reduced to the state of vanadous oxide or chloride. The salts of nickel, cobalt, and chrome, in presence of about 1-5000 of a salt of vanadium aid in the formation of the black.

The lowest oxides of uranium, tungsten, and molybdenum yield alone very fine blacks. But the persalts of uranium, like the tungstates and molybdates, do not react. When the salts of uranium seem to form a black, as M. Pinkney believes he has observed, it is because the salt of uranium has been obtained from a pitch blende containing vanadium. The quantity of vanadium necessary to transform aniline into black is so small that it may be practically regarded as nothing. Hence we conclude that the presence of a metallic salt, though necessary in the formation of the black, forms no part of its composition. Vanadium aniline black is identical with copper aniline black, the one containing no vanad-

um, and the other no copper. M. Coquillion has obtained aniline blacks by electrolysis, and the author has obtained it more easily still by introducing into a very concentrated solution of chlorate of potash and of a salt of aniline, a few drops of hydrochloric acid. No metal intervenes here, but the hydrochloric acid decomposes the chloric acid, and the products of this decomposition react upon the aniline, which they transform into black. After a few hours the whole takes a form of a paste of well-characterized aniline black. This reaction is of no use in practice because the textile fibres would be destroyed by the concentrated acid liquids. It proves, nevertheless, that aniline black is the result of the action of the products of the destruction of chloric acid upon vanadium. The reaction of vanadium permits us to study with ease the action of the decomposition products of chloric acid upon a number of organic bodies, and upon the isomeres of aniline. Extract of logwood under the influence of chlorate of potash and a drop of vanadium salt is transformed into a yellow substance with which silk may be dyed a splendid gold-yellow. Under similar conditions the solution of hydrochlorate of toluidine (made with solid toluidine) is converted into a new substance, with which silk may be dyed a fine bronze with coppery reflection. Chloride of vanadium becomes indirectly the best reagent for aniline, and reciprocally the mixture of hydrochlorate of aniline and chlorate of potash is the best reagent for vanadium. It is merely requisite to evaporate suitably with a slight excess of hydrochloric acid the substance believed to contain aniline, and to add to it chlorate of potash and a drop of a weak solution of vanadous chloride to make the aniline black appear, whatever other substances are present.

On the other hand, we may always detect the presence of vanadium by concentrating the solutions, acidifying the hydrochloric acid, and treating with a normal mixture of salt of aniline and a chlorate. If aniline black is formed very rapidly in the cold, we may be sure of the presence of vanadium. The author gives the following conclusions:

1. Aniline black is merely emeraldine dehydrated.
2. A high temperature in the ageing rooms is necessary, not to form emeraldine, but to dehydrate it and convert it into black.
3. Emeraldine may be dehydrated even in the liquids in which it is formed by the application of heat. In a word, emeraldine is transformed into aniline black, just as the hydrated blue oxide of copper is converted by boiling into the anhydrous black oxide.
4. The essential character of hydrated aniline black (emeraldine) is to be completely destroyed by the yellow sulphuret of ammonium.
5. The essential character of anhydrous emeraldine or fixed aniline black is to be but slightly affected by the sulphuret of ammonium. This precious reagent enables us always to know whether emeraldine has or has not been transformed into black. The characters just pointed out are those of the blacks produced from pure aniline, which are by far the finest.
6. The blacks obtained from commercial anilines are formed of emeraldine, mauveine, violaniline and toluidine bronze.
7. By a perfect oxidation of the commercial anilines, the aniline is converted into emeraldine, and the toluidine into bronze, the mauveine and violaniline disappear almost completely, and the emeraldine, which is insoluble in acids and alcohols, may be separated from the toluidine bronze which is soluble in those menstrua.
8. We may find the amount of true aniline in the commercial aniline oils by precipitating it in the state of emeraldine and turning it into black.
9. Aniline black (typical) is dehydrated emeraldine, but in practice there are as many aniline blacks as there are mixtures of aniline and its homologues.
10. The liquid toluidines of commerce behave like mixtures of aniline and crystalline toluidine, and yield with chlorate of potash and vanadium mixtures of emeraldine and toluidine bronze.—*Bulletin de la Société Chimique.*

DOGWOOD FOR GUNPOWDER MANUFACTURE.

DOGWOOD (*Rhamnus frangula*) is supplied in bundles of long slender rods. The bundles are about six feet long, and should be thirty inches in girth at one foot from the thick end, and diminish about four inches in girth at the upper band. The wood must be perfectly free from bark, and clean. Great stress is always laid on the cleanness of the wood used for conversion into charcoal at Waltham Abbey; any traces of bark adhering to it constitute an impurity, and would condemn a supply sent in by a contractor. The specifications imposed on contractors provide that the wood shall be cut in the spring of the year. If this has been done when the sap is rising, the bark is easily removed, and the wood is left perfectly clean; but wood cut later in the year, or in winter, is perfectly as good, only in this case the removal of the bark is a much more difficult matter. To separate it the wood must be boiled, or if that is impracticable, the whole of the bark must be shaved off with a knife or spokeshave. Both boiled and shaved have been used at Waltham Abbey, but the great objection to both is that they do not keep so well when stacked as the spring-cut wood, going to decay much faster.—*British Trade Journal.*

SHALE OIL IN SCOTLAND.

THE Oakbank Oil Company, near Mid Calder, have worked the Calder shale-field for many years, and the works for the distillation of oil, etc., cover an area of 26 acres. No less than 60,000 tons of shale per annum undergo the process of distillation, while two million gallons of crude oil are refined and manufactured into burning and lubricating oils and naphtha and paraffine wax for candles; while sulphate of ammonia is also extensively manufactured from the shale. Among other matters of interest at the works, are the retorts invented by Mr. Henderson. Several of these have been erected and are working satisfactorily. They are considered a great improvement on the old vertical retorts, inasmuch as the spent shale, formerly considered useless, is applied to heating purposes, by utilizing the carbon contained in the material. Mr. Beilby's invention for the utilization of the acid tar for making ammonia, is also worthy of attention.

By a mechanical arrangement, the water issuing from the works is now separated, all that contains deleterious or chemical matter being diverted from the stream, the clean water only flowing into it. One result of this is said to be that trout are now as plentiful in the stream as before the works were commenced.

GLUCOSE FOR TANNING.

A NEW material for tanners which seems calculated to increase their profits once more to a reasonable level, and which bids fair to be extensively used for weighting leather and improving its color, is a preparation of glucose, which can be obtained at the rate of about 2½d. per pound. It is applied in a melted form to the partially dry leather, to the extent of say ten to fifteen per cent of its dry weight, although it is said to

injure its quality in some degree by separating the fibres. We understand some firms already consume from two to three tons of it per month, and as we can not assume that they make less than 18d. per pound profit upon it, this quantity alone represents an income of say £4000 to £6000 a year—not a bad sum in the tanning business. On the morality of the proceeding we make no remark. The use of sugar may be detected by chewing a small slip of the leather. Glucose has been employed with success as a substitute for the objectionable materials at present used in bating. Its price is moderate, and it will certainly remove all the lime without injury to the gelatinous tissue of the hide; but whether it will give the requisite softness and flexibility is a question we can not at present answer from personal experience.—*Curriers' Journal.*

[American Chemist.]

CHEMICAL NOTES.

By J. M. MERRICK, B.Sc.

Molasses-Sugar.—Sugar-refiners are often, to borrow a vulgar phrase, "stuck" with lots of second-boiling sugars, imposed upon them or the importers by foreign dealers, as first-boiling or "straight" sugars. These look well, and often polarize higher than an equally good-looking "straight" or first-boiling sugar; but when they come to be worked, they break down, and give an excess of molasses or syrup, and by no means the theoretical yield of sugar. To exhibit a ready means of detecting a second-boiling sugar chemically, or by polarization, would be a very valuable matter for chemist and refiner. As the defect in the second-boiling sugar lies in its greater readiness to go over into uncrystallizable sugar, it has occurred to me that a series of experiments in determining the comparative time required for the complete conversion into left-handed sugar of a good "straight" sugar, over a second-boiling sugar of the same class, might throw light on this problem, and pave the way to a method of analysis. It is needless to say that the experiments would have to be conducted with great nicety, and especially at absolutely identical temperatures.

Cream of Tartar.—The steadily increasing demand for this chemical, the supply remaining probably about the same, leads the manufacturers to leave in their product as much tartrate of lime as possible. I have recently analyzed samples with 12 to 14 per cent, while 6 per cent used to be a full amount. It seems obvious to me that this adulteration must especially injure the cream of tartar forming pharmaceutical preparations, by the substitution of 12 per cent of a substance which at best is inert or useless.

Lecture Experiment.—A rather pretty lecture experiment may be arranged to show the low temperature of a flame, by boiling in a long-necked flask a bit of phosphorus with five times its weight of lime. The flask should have a long tube fitted to it by a tight cork. As the phosphoretted hydrogen (probably carrying other phosphorous compounds) issues from the tube, it burns with a pale-green flame, and in this flame a common match may be held for a long time without taking fire. I have reason to think this experiment dangerous.

ON THE SPECIFIC HEAT OF MERCURY-VAPOR.

A. KUNDT and E. WARBURG.

THE quantity of heat contained in a gas is usually defined as the total energy of its molecules, and, if the molecule is looked upon as a material point, this energy consists alone in onward motion. Knowing the pressure exerted upon the unit of surface by a quantity of gas contained in the unit of volume, and knowing the increase in the pressure produced by increasing the temperature 1° , we can easily determine the quantity of heat used in thus raising the temperature 1° , the volume remaining constant. If all the heat which affects the vapor is transformed into energy of onward motion of the molecules, we can easily calculate how much heat *ought to be* required to raise the temperature of the unit of volume of a gas through 1° , the volume remaining constant. This latter calculated value is smaller than that found by experiment, and hence it is concluded that in reality some of the heat which is used in heating up a gas under ordinary conditions does some kind of internal work, and this is possible, inasmuch as the molecules of most gases are not material points, but consist of atoms. On studying mercury-vapor, it was found that the calculated and observed values above referred to were equal, and this result is in accordance with the commonly accepted view that the molecule of mercury is monatomic. According to the experiments here described, the molecule of mercury-vapor acts as if it were a material point.

ON THE DETECTION AND DETERMINATION OF NITROUS ACID IN NATURAL WATERS AND OTHER VERY DILUTE SOLUTIONS OF THE SAME.

P. C. PLUGGE.

AFTER a critical examination of Fresenius' method of obtaining a more concentrated solution of nitrous acid by distillation with acetic acid, the following conclusions are stated:

1. Fresenius' method is not adapted for quantitative determinations as proposed by Fischer.
2. The commercial so-called pure acetic acid always contains substances which are carried over with the distillate, and which are oxidized by the potassic permanganate solution. It should, therefore, not be used when it is intended to determine the nitrous acid by Kubel's method.
3. The reduction of nitrates as maintained by Kämmerer does not take place. There is, therefore, no reason for substituting acetic for sulphuric acid in the distillation of nitrous acid.
4. The portion of the nitrous acid which is not distilled over, is either entirely or in great part converted into nitric acid.

CONCERNING THE FLAME THEORY.

KARL HEUMANN.

THE fact that between a burner and its flame there always exists a space where there is no flame, has been explained by supposing that in this space the gas mixed with air before the burning commenced. It is here shown that such spaces exist wherever a cold body comes in contact with the flame; the space is the larger the colder the body is, and the greater its power of conducting heat. If a hot metallic body is introduced into a flame, the latter remains in contact with it. It follows that the cooling of the flame by the burner or by the body introduced into the flame, is the sole cause of the observed space.