

feet of gas per week for this purpose. With the object, in the first instance, of economizing fuel at my Middlesbrough works, I convert the coal into a rough gas of about 50,000 cubic feet per ton of coal. I have, through my engineer, patented a new gas generator, which is so constructed that both tar and ammoniacal liquor are caught in quantities as large as, if not larger than from coal carbonized in a retort. The generators each gasify about six tons of coal per day, and the admission of air is so dexterously controlled that the tar is not destroyed. By an arrangement of ejectors, compressors, and condensers, both tar and ammonia are eliminated from the gas and collected. The tar is, I admit, inferior in quality to that made in gas works. I am sure it will interest, though I doubt whether it will please you, to hear of this new source of tar.

While in this direction, I may inform you that Messrs. Pease, of Darlington, are now completing an extensive plant, on a French patent, which has been successfully at work in France for several years, by which they expect to catch the tar and ammonia from their coke ovens. Messrs. Baird, of Gartsherrie, the largest iron makers in Scotland, have also devised appliances whereby they condense tar and ammonia from the gases as they leave the blast furnaces. In Scotland coal and not coke is used for smelting iron, as is the case here.

What effect the advent of all this tar and ammonia into the market will have on the value of them, it is impossible to tell. For myself, I cannot say that I view the position unmoved and without trepidation. At this moment there is more tar made than is required for present known uses. Anthracene, for instance—the mainstay of the value of tar—which has for years maintained an average price of about £100 per ton, is now unsalable at £30 per ton. Carbolic acid again is even more unsatisfactorily situated, being without a market at one-fourth of the price of former years. But enough. What will happen, must. *Nous verrons.*

That coal tar—a dirty, repulsive-looking article—should have become such a prolific source of color and useful products is one of the most striking illustrations of modern scientific discovery coupled with commercial enterprise. Although of such youthful years, I have shown that it is the progenitor of a very large family indeed; and, unlike their parent, the offspring is often very beautiful, and always interesting.

Discussion followed.

Mr. Harding (Sunderland) said that last week he (Mr. Harding), by invitation, went to Messrs. Baird's works, and he there saw in active operation the process by which they obtained from the blast furnaces thirty pounds of sulphate of ammonia and fifteen gallons of tar per ton of coal thrown into furnaces. The difficulty attending condensation, owing to the gas evolved from the furnaces being twelve times the volume of the gas evolved in ordinary gas works, had been overcome; and, within twelve months, the firm would have the apparatus fitted to the whole of their furnaces. The estimated cost of fitting one furnace was £5,000, and this cost would prevent ironmasters, for many years, from carrying out the process; but the profit arising from the condensation of the gas amounted to no less than from £10,000 to £12,000 per annum for each furnace. The firm altogether had expended some £40,000 or £50,000, but they anticipated that within the next eighteen months they would be recouped quite £150,000. The sulphate of ammonia collected was, he might say, equal to any sulphate made in the United Kingdom. With regard to the tar, it made very good pitch and it had also a good oil, some of which he had now under distillation in his laboratory at Sunderland.

Mr. Sadler, in reply, said he believed that what Mr. Harding had stated was substantially correct. The Middlesbrough ironmasters looked upon the process named with very great fear. They were not involved in smelting the iron with coke, and they would be very clever indeed if they extracted ammonia and tar on their own premises.

TESTING THE COMMERCIAL VALUE OF CARBOLIC ACID.

By Dr. O. BACH.

Of the various methods in use for determining the quantity of phenol in crude carbolic acid, the one which depends on its conversion into sulphocarbonate, and which was first recommended by Schoedler (*Pharm. Centrall.* xiii, 225) and afterward by Nietsch (*Ann. Chem. Pharm.* xl, 587), cannot be employed because it is too tedious, and besides it is difficult to make the mono-sulphocarbonate. Shaking the acid with caustic soda solution leads soonest to the desired end. There is, however, this difficulty in the way—if it is shaken at once with the alkali, that in thick, sirupy, and dark colored liquids, it is difficult or impossible to distinguish the separate layers, and also that the oily layer of tar does not separate readily from the layer of carbolate of soda, even when it is put in hot water, and by doing this there is formed an intermediate layer—a sort of an emulsion—between the two, so that an accurate reading is impossible.

In addition to this it very frequently happens that the acid to be tested contains a considerable quantity of water, 20 per cent or more, which must lead to false results if direct readings are made, and hence it would be necessary to estimate the quantity of water.

To avoid these evils, and to be able to carry on an estimation of the water and phenol in the same sample at the same time, I proceed as follows: I distill 50 c. c. of the acid to be tested in a retort, continuing the distillation until solid hydrocarbons begin to form in the condensing tubes. The distillate is collected in a 100 c. c. burette, graduated in one fifth c. c. with a glass stopcock soldered to the lower end. Before beginning the distillation about 25 c. c. of a saturated solution of table salt is put in the burette, and the level carefully read and noted. If the acid under examination is free from water, the distillate will float on the brine as a clear layer, while in the other case the oil, water, and brine will form an emulsion. When the distillation is concluded, the burette is corked and gently shaken, when the oil separates quickly and sharply from the salt solution. The increase in the volume of this latter gives the number of cubic centimeters of water present in the acid, and from it the percentage is readily calculated.

To determine the quantity of phenol, it is necessary to remove the solution of salt as completely as possible, for when it is subsequently shaken with caustic soda, if there is any salt present the carbolate of soda separates in flocks, making an accurate reading difficult. After removing the cork and reading the volume of the oil, the stop-cock is very carefully opened to let the brine run out. If the cock is opened too far there is danger on the one hand that some of the salt solution will stick to the side of the burette, and on the other

that some oil will be lost when it reaches the narrow part of the burette. After the salt solution has all been removed the burette is filled to the zero-point with a soda solution of about 30° B., a cork inserted, and the mixture well shaken and left to settle. If the burette is free from grease, the oil separates quickly and sharply, and by turning the burette gently about its axis once the oil or water drops that adhere to the sides can be wiped off, so that in half an hour the number of c. c. of oil that remain can be read. The difference in the volume of the oil before and after shaking with soda equals the volume of phenol, which may be easily converted into per centages.—*Ch. Zeit.*

MICROCHEMICAL REACTIONS.

By Dr. A. TSCHIRCH.

THE microscope is specially useful for recognizing the characteristic properties of objects. For instance, it is impossible to distinguish the different kinds of starch without a microscope; but one glance through the lens will tell the name of the starch. The fibers used in spinning, though differing but little microchemically, are easily recognized by their morphological characters. Many adulterations of coffee, tea, spices, etc., are easily detected in this way. The distinction of hem and flax is difficult, but Cramer has succeeded in finding a characteristic and unerring guide in the long cells with red contents that accompany the bast cells of the hemp. The width and thickness of the beard of wheat and rye differ sufficiently to enable one to decide between them.

The domain of pure chemistry also possesses an essential aid in the microscope. The hæmatine reaction which is decisive for blood stains, the distinction between the different constituents of urinary deposits, between quinine and cinchonine, and even between strychnine and atropine, is easy and certain when the crystalline forms are viewed through a microscope.

THE STARCH TEST.

The earliest microchemical reaction employed was, indisputably, the iodine and starch test discovered by Stromeyer, which vies in sharpness with the barium test for sulphuric acid in inorganic chemistry. By this means it was possible, at an early date, to obtain an insight into the *topographical division* of the starches, and to recognize the cells and cell complexes in which this reserve of nutriment occurs, and the courses that it pursues.

THE CELLULOSE REACTIONS.

The iodo-chloride of zinc reaction, which colors pure cellulose a violet blue, and the iodo-sulphuric acid reaction, which dissolves it with a blue color, belong to the most important microchemical reactions. In these we possess an easy and practical method of distinguishing vegetable fibers from animal fibers, for only the membranes of plants exhibit the properties just mentioned, and these only with certain limitations. For example, membranes that are incrustated with lignine cannot be subjected to this test until the incrusting substances have been removed by maceration with nitric acid, alkalies, or Schulze's maceration liquid.

Another valuable reaction applicable only to pure vegetable cellulose is the solubility in the ammoniacal solution of copper oxide. This reaction was discovered by Schweizer of Zurich and fully described by him, after which Cramer followed it out further and described the peculiar changes of form observed when the objects swelled up.

SCHULZE'S MACERATION PROCESS.

After the iodine reaction the next important advance was Schulze's method of isolating single elements of tissues. His maceration process consists in treating the tissue with nitric acid and chlorate of potash, its object being to isolate the separate cells by dissolving out the intervening substances. It is intermediate between macro and micro chemistry.

Some time before, Pringsheim recommended nitric acid alone for this purpose, but his suggestion did not attract any attention as the publication was not easily accessible, and Schulze's process first found acceptance and renown. In technical microscopy this maceration process may be very extensively employed, for cases very frequently occur where single elements are to be examined in larger portion of tissue. But it must not be forgotten that measurements of the diameters of cells, such as bast cells, which have been subjected to maceration cannot be relied upon, because the reagent causes the cells to swell considerably.

This reagent is very useful for separating what Jönsson calls the *ophiur* cells which are found in tea leaves, and are characteristic of a number of camellias, but are totally wanting in the leaves generally used for adulterating tea. Also for isolating the bast cells from fibers that consist more or less of bundles. In addition to isolating cells, this reagent has another valuable property, namely, of dissolving and removing the strongly colored incrustations of the cell membranes, both of natural objects like cinnamon and cinchona bark, and of roasted articles like coffee, thus making the articles lighter in color—which is very important in testing coffee, for example. Ammonia and caustic potash have the same action. Unfortunately measurements cannot be made after treatment with any of these reagents, but in most cases a knowledge of the characteristic morphological distinctions is sufficient, but in a few cases—as in textile fibers—measurements are indispensable, and here the fibers must be picked apart with a needle.

CAUSTIC POTASH.

This is likewise a very important micro-chemical reagent. It has just been mentioned that one can employ it with good effect for clarifying the tissues. While the histologist renders whole tissues and even whole organs transparent (such as embryos) by the use of this reagent, it plays a still more important part in clarifying roasted mixtures, which, if they are not sufficiently transparent after treating with Schulze's maceration liquid, are easily made so by the use of potash. There are two methods of using it; Haustein's method consists in successive treatment with caustic potash and acetic acid, while Russow's makes use of alcoholic potash; which has the advantage that membranes do not swell up to such unshapely masses in this as they do in pure potash.

STARCH IN COLORED SUBSTANCES.

Böhm was the first to show that by combining the use of potash with the iodine reaction it was possible to detect small quantities of starch in colored substances where it would otherwise escaped detection, as in chlorophyll granules for instance.

THE SUGAR TEST.

One of the most brilliant achievements of micro-chemistry is Sachs' application to physiologico-histological investi-

gation of Trommer's sugar test, in which potash also plays a part. Sachs has proved that by means of this test both cane and fruit sugar, as well as other members of this group, such as dextrine, can be detected under the microscope even in the cells themselves, and with a little experience may be estimated quantitatively. The method used by Sachs is as follows: He first dips the section in copper sulphate solution, then washes it in water, and boils it for a short time in a dilute solution of caustic potash. The characteristic precipitate of red suboxide of copper is produced within the cells that contain sugar. This test, of course, requires some practice, for if the copper sulphate is not sufficiently washed out the black oxide of copper (cupric oxide) is precipitated and conceals the red oxide (cuprous oxide). On the other hand when the washing is carried too far the easily diffusible sugar passes through the cell walls by endosmosis into the wash-water, and can no longer be detected in the spot where it naturally occurs. Nevertheless we may hope, when this method is perfected, to get on the track of the migrations of the sugar, to which many of the phenomena observed in the changes in matter are to be referred.

TANNIN REACTION.

The peculiar red color that caustic potash imparts to cells that contain tannin of course leads us next to the test for tannin, which is also valued as a macro-chemical reaction.

STAINING.

The lengthy chapter of staining can only be mentioned here. It offers a well known and important aid in the study of animal tissues, and especially in the investigation of bacteria.

Most of the micro-chemical reactions known at present naturally refer only to substances that are not characterized by any chemical tests, and which are recognized only by the peculiar changes of color that they suffer when certain reagents are applied, while we are absolutely in the dark in regard to the nature of the colored substance which is formed during the reaction. There is still a large field left for investigators in pure chemistry—but for technical microscopy a knowledge of these color changes is at present sufficient.—*Chemiker Zeitung.*

POISONOUS LEAVES.

SOME of our most admired flowers, which we should least willingly banish from cultivation, are associated with green leaves of a very poisonous character. The narrow, long leaves of the daffodil act as an irritant poison; the delicate compound leaves of laburnum have a narcotic and acrid juice which causes purging, vomiting, and has not unfrequently led to death. The narrow leaves of the meadow saffron, or autumn crocus, gave rise to the utmost irritation of the throat, thirst, dilated pupils, with vomiting and purging. The dangerous character of aconite, or monkshood leaves, is doubtless well known, but each generation of children requires instruction to avoid above all things those large, palm-shaped leaves, dark green on the upper surface. Leaves of coarse weeds provide an abundant quota of danger, but frequently their strong scent and bitter or nauseous taste give timely warning against their being consumed. Of all our British orders of plants perhaps the umbelliferous order contributes the rank and most widespread elements of danger. The tall hemlock is everywhere known to be poisonous, and it is one of the most abundant occupants of the hedge. A peculiar "mousy" odor can generally be recognized on squeezing the leaves, which are deep green in color and trebly compound, the small lobes being lanceolate and deeply cut. It is said that the mousy smell can be detected in water containing not more than a fifty-thousandth part of the juice. Hemlock is both an irritant to any sore place and a general narcotic poison, producing headache, imperfect vision, loss of power to swallow, and extreme drowsiness, with complete paralysis of voluntary muscles and muscles of respiration. The water dropwort, too, a flourishing ditch plant; the water hemlock, fool's parsley, must be ranked among our most dangerous poisonous plants belonging to the umbelliferous order. The fool's parsley leaves are sometimes mistaken for genuine parsley, but their nauseous odor and darker leaves should prevent this. The nightshade order is another, with dangerous and often extremely poisonous leaves. Indeed, no nightshade can be regarded as safe; while the deadly nightshade, with its oval, uncut leaves, soft, smooth, and stalked, is in the highest degree to be avoided. Henbane and thorn-apple, again, with their large and much-indentated leaves, are conspicuous members of the "dangerous classes." Holly leaves contain a juice which is both narcotic and acrid, causing vomiting, pain, and purging. Even elder leaves and privet leaves may produce active and injurious irritation when eaten. With regard to treatment in cases of poisoning by leaves, if no doctor is at hand, produce vomiting till all offending matter is expelled, and, when considerable sleepiness or drowsiness has come on, give strong tea or coffee, and again bring on vomiting; then stimulate and rouse the brain in every possible mode.—*Land and Water.*

THE ASH AND ITS VARIETIES.

THE common ash (*Fraxinus excelsior*) and several of the North American kinds rank high as timber-producing trees, their wood, owing to its elasticity, being much sought after where strength and toughness are wanted. Apart, however, from their value in this respect, the different forms offered plenty of scope to the planter, some being large, noble looking trees, others comparatively small, and a few singularly grotesque. The recognized varieties of the common ash are many, some of the most distinct being the weeping kind (pendula) so often employed for forming arbors; of this there is also a golden form (pendula aurea), the bark of which is bright yellow, but in other respects, except being of somewhat weaker growth, it resembles the common weeping ash. Another kind (*F. excelsior heterophylla*), of which we append an illustration, is remarkable on account of the absence of leaflets, and instead one large, simple, deeply serrated leaf. It forms a tree nearly as vigorous as the common kind, and is often known by the name of the one-leaved ash (monophylla), certainly a better name than heterophylla, the leaves being seldom variable. Of this there is a form in which the leaf is deeply slashed instead of serrated. The cockscomb ash (*F. excelsior cristata*) has often a large proportion of the shoots curiously fasciated, especially at the points, where they spread out in a cockscomb-like manner. This is but a slow-growing tree, and frequently some of the branches die off without any apparent reason. A dwarf, bushy kind, *F. excelsior globosa*, assumes the shape of a small, round bush, and when grafted standard high has a mop-like appearance. Other varieties in addition to those