

extrinsic or *immediate* practical value. Nor will science itself be treated with the highest respect while scientific men in general pursue money and trading in knowledge so much more earnestly than knowledge itself. We are all apt to be blinded by the prospect of immediate personal gain, and fail to perceive the deep-seated sources of greater good which lie latent in increased fundamental knowledge. The idea that immediate personal gain is always the greatest good, and that money is essentially more valuable and a greater source of happiness than knowledge, are only worthy of the darker ages; the greater good, however, takes a longer time to grow. Great good *must* come from new truth, even when we cannot see the way; new facts are the origin of human progress, and great truths are the parents of great uses; there can be no inventions without the facts upon which to base them, and the progress of mankind is greater in proportion as the facts discovered are more comprehensive; for instance, out of the simple qualitative fundamental fact of magneto-electric induction has arisen the dynamo-electric machine and all its world-wide uses. Other similar examples might easily be adduced.—*Chem. News.*

THE COPPER MINES OF SPAIN.

THE British Vice Consul at Huelva, in his trade report for the past year, says that the great strides in prosperity made by the province of Huelva during the last twenty-five years are due to the scientific development of its enormous mineral wealth. It is not, however, the first time that that mining district has been the scene of great activity, for the large masses of ore in its mountains furnished quantities of highly-prized metal to the old nations of the Mediterranean. According to history and tradition, the Phœnicians were the first known people to work the Huelva mines, remains of their workings, ovens, coins, and other articles having been found in most of the mines. After the Phœnicians came the Romans, and during their dominion in Spain mining operations were greatly extended, as is proved by the great amount of scoriae to be found in every mine. This is calculated to be in all 20,000,000 to 25,000,000 tons, showing that immense quantities of ore must have been extracted during the centuries of Phœnician and Roman work, until it ceased with the invasion of the Vandals. It is not apparent that either the Goths or Moors worked the Huelva mines, so that they have practically been idle for fourteen centuries, for the little that was done during the last and first half of this century can hardly be taken into account. The first great impulse was given by the foundation, between 1866 and 1875, of large foreign companies. The mines began to be thoroughly opened out, railways were constructed to the port of Huelva, and magnificent shipping piers were built in the river. Other companies then followed, and a period of great activity set in, completely altering the aspect of the province and of the port. The copper pyrites, or cupreous sulphur ore, composed of about 48 per cent. sulphur, 44 per cent. iron and 8 per cent. copper, is the principal ore mined in the district, and contributes very considerably to the copper production of the world. By far the greater part is sent to Great Britain, although large quantities are sent to Holland and Germany; France and the United States are also consumers, and a small quantity goes to Denmark. British vessels convey nearly all the copper pyrites, but a good many cargoes have been shipped to Germany in German steamers. The pyrites sent to the United States is of the poorer class, containing about 1.25 per cent. of copper only on the average, and is shipped principally to Philadelphia and New York. The ore is also partly treated at Huelva by smelting, which produces the regulus, containing about 30 to 40 per cent. of copper, and by precipitation on to pig iron in large tanks, giving cascand or precipitate with 60 to 95 per cent. of copper, according to treatment. The iron pyrites is what is called pure—that is to say, it contains 44 per cent. of iron and 52 per cent. of sulphur, but no copper, and it is extracted from one mine only. Besides the considerable quantities shipped to Great Britain, there is a large consumption in France, Germany, and the United States; it is, as a rule, friable and not hard and compact like copper pyrites.

DICKSONIAS.

THE fine examples of these plants which are to be seen at the Earl's Court exhibition recall to mind the splendid specimens that were shown at the last international show. Tree ferns now, for some reason, have lost their fascination. I am told that the fine plants that used to exist near Dublin, in Mr. Bewley's garden, have disappeared too. This is a great pity. A large trade was at one time done with the antipodes in tree ferns. The safest and surest way of getting them home alive was in the ships that came home laden with wool, and I have bought several hundreds at various times so brought home. From inquiries that have been made of me from time to time I am inclined to think these plants will again be in demand. The best size in which to import these stems is from 4 ft. to 6 ft. in height. These should be straight and sound, so that when potted they have no holes in their sides needing patching up, which I have heard many people advocate being done with Sphagnum moss. This should never be resorted to, for it makes a faulty and rotten stem at the best. These plants when brought home in a dry state should have their stems well soaked without letting a drop get into the crown, and they should be let stand in a shed or shady part of the conservatory or greenhouse, keeping the stems sprinkled; here they will soon begin to push roots. Upon the first signs of movement the plants should be potted, using fair-sized pots, which should be well drained. The best soil to pot them in is equal parts of good fibrous loam and peat, making the whole tolerably sandy. The stems should be potted very firmly, and they may be stood in a shady place in a house until their crowns have developed. The stems must be kept well sprinkled, but none should be given the crowns until they begin to push up fronds. I do not like the system of placing these plants in the stove to force their growth. Of course, I here allude to the greenhouse kinds, as those from warm regions differ in their requirements. When the fronds begin to grow, the atmosphere must be kept moist, and the plants should be syringed gently over-

head at least twice in the day, morning and evening, and an occasional dewing in the middle of the day will do them no harm if the sun does not shine upon them. This will prevent the thrips gaining a lodgment on them. The following are the best known kinds:

D. Arborescens.—This is a rare plant in cultivation, and it has always been so. I have frequently in years gone by had branched stems and plain ones introduced, but never got them to live, and I am inclined to think it was from keeping them too warm. This plant is found peculiar to the island of St. Helena, where it grows from 6 ft. to 18 ft. high, the crown densely clothed with long amber-colored silky hairs; the fronds attain a length of 6 ft. It was upon this species the genus was founded, and I cannot agree with those authors who join with these arborescent kinds such plants as the *Denstædtias*, which have creeping rhizomes.

D. Antarctica.—This is the commonest tree fern in this country, and certainly the most useful. I have no doubt that in many parts of Ireland and in the west of Scotland and England it would succeed if suitable protection was afforded it. In the indoor cool fernery it forms a magnificent object. The fronds are beautifully arched, dark green on the upper side, paler beneath, the crown furnished with ferruginous hairs. Native of Australia.

D. Fibrosa is said by many to be the New Zealand form of the last named species, but under cultivation there are slight differences—the stem is always shorter and the fronds have a rigid appearance, which the true *D. antarctica* has not. It is neither so effective nor so beautiful as the last-named plant, but it may be grown in a collection with much advantage.

D. Squarrosa.—This is the Table top Fern. The stems are slender and black, the fronds being very rigid and deep green on the upper side, paler below. It is a very handsome species from New Zealand.

Besides the above there are *D. Berteroana* from Juan Fernandez, and *D. Sellowiana* from South Brazil. Both these species, I believe, I have seen in the nurseries of Messrs. Veitch, of Chelsea. There are one or two others which I have only seen in a small state and cannot say much of, but they certainly are worth



DICKSONIA ANTARCTICA.

seeking for and adding to a collection. They are *D. Deplanchei* from New Caledonia, *D. lanata* from New Zealand, *D. Youngia* from New South Wales, and *D. Brackenridgei* from the island of Samoa. The last I have not seen, but I am told it is very near to *D. Berteroana*.—*Wm. Hugh Gower, The Garden.*

SPONTANEOUS CONVERSION OF ISOPRENE INTO CAOUTCHOUC.*

By WILLIAM A. TILDEN, D.Sc., F.R.S.

ISOPRENE is a hydrocarbon which was discovered by Greville Williams many years ago among the products of the destructive distillation of India rubber. Later, in 1884 (*Trans. Chem. Soc.*, xlv., 410), it was observed by myself among the more volatile compounds obtained by the action of a moderate heat upon oil of turpentine and other terpenes. It is a very volatile liquid, boiling at about 36°. Its molecular formula is C_5H_8 , and it forms a tetrabromide, $C_5H_4Br_4$, but no metallic derivatives, like the true homologues of acetylene.

Bouchardat (*Comptes Rendus*, lxxvii., 654, and lxxxix., 361 and 1117) observed that when isoprene is heated to a temperature near 300°, it gradually polymerizes into a terpene which he called di-isoprene, but which is now usually called *dipentene*. This compound boils at 176°. A quantity of colophene similar to that which is produced by the action of heat upon turpentine is formed at the same time.

When isoprene is brought into contact with strong acids, aqueous hydrochloric acid for example, it is converted into a tough elastic solid, which has been examined by G. Bouchardat and by myself; it appears to be true India rubber.

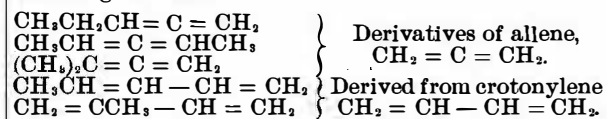
Specimens of isoprene were made from several terpenes in the course of my work on those compounds, and some of them I have preserved. I was surprised a few weeks ago at finding the contents of the bottles containing isoprene from turpentine entirely changed in appearance. In place of a limpid colorless liquid the bottle contained a dense sirup, in which was floating several large masses of solid of a yellowish color. Upon examination this turned out to be India

* Paper read before the Philosophical Society of Birmingham, May 18, 1892.—*Chem. News.*

rubber. The change of isoprene by spontaneous polymerization has not to my knowledge been observed before. I can only account for it by the hypothesis that a small quantity of acetic or formic acid had been produced by the oxidizing action of the air, and that the presence of this compound had been the means of transforming the rest. The liquid was acid to test paper, and yielded a small portion of unchanged isoprene.

The artificial India rubber, like natural rubber, appears to consist of two substances, one of which is more soluble in benzene or in carbon bisulphide than the other. A solution of the artificial rubber in benzene leaves on evaporation a residue which agrees in all characters with a similar preparation from Para rubber. The artificial rubber unites with sulphur in the same way as ordinary rubber, forming a tough elastic compound.

The constitutional formula of isoprene is not known with certainty, but it must be selected from the five following formulæ:



It is obvious that compounds such as these containing doubly linked carbon may polymerize in a variety of ways, and in the present condition of our knowledge of the constitution even of isoprene, it would be idle to speculate as to which out of the numerous possible arrangements would correspond to the constitution of caoutchouc.

THE CONSTITUENTS OF EUCALYPTUS OILS.

By H. HELBING and Dr. F. W. PASSMORE.

THE conflicting statements that are continually made concerning eucalyptus oils, especially those employed for medicinal purposes, render it desirable the principal points in their chemical composition should be clearly indicated, as far as known, in order to avoid confusion, and also to place one in position to judge for himself of the veracity or falsehood of statements that are constantly published, not only concerning eucalyptus, but other essential oils that come into universal use.

Although it cannot be denied that the publication of misleading representations has greatly retarded the progress of knowledge concerning the chemistry of essential oils, the subject is undoubtedly one that has taxed to the utmost the skill of experienced investigators, and it is no discredit that older chemists were unable to accomplish a task that has only been rendered practicable by the resources of the modern laboratory. The enormous amount of literature that characterizes the subject is sufficient evidence of the labor that has been expended in such investigation; but the greater part of the results were rendered invalid through the inability of the investigators to obtain either pure products or characteristic derivatives of the compounds entering into the composition of essential oils. Exceptions must be made in favor of the researches of Berthelot, Tilden, Gladstone, Armstrong and a few others, but even these, valuable as they are, were of so isolated and disconnected a character they did not greatly aid in extension of general knowledge.

The merit of having first introduced a systematic course of investigations into this dark chapter of chemistry, and the satisfaction of seeing valuable fruits from the enterprise and stimulus given to further research in the same direction, must be accredited to Wallach, with whose name is associated a host of others whom he inculcated with his ideas and methods. It is therefore obvious that a consideration of the chemistry of the constituents of the essential oils in general would practically involve little more than a recapitulation of Wallach's researches during the last decade, and as this has been so recently and admirably done by Wallach himself in an address delivered before the Berlin Chemical Society (February, 1891), we shall only attempt to deal with those facts that have direct bearing on the chemistry of eucalyptus oils.

TERPENES.

Like all essential oils, those from the different species of eucalyptus contain varying quantities of terpenes. The terpenes, as may be recognized from the termination "ene," are hydrocarbons, and although generally reckoned among the aromatic series, present certain peculiarities that distinguish them from ordinary aromatic hydrocarbons, although their molecules are undoubtedly correctly represented by the ring structure. These differences are very apparent from their unstable nature and the readiness with which they are convertible one into another, or into bodies of allied composition, by the influence of chemical reagents, or by physical conditions.

This instability has been the chief difficulty necessary to overcome in securing in condition of purity for purposes of characterization and comparison, for so readily are the changes effected, and so closely do many of the terpenes approximate each other in physical characteristics and behavior toward chemical reagents, that it has been frequently found what was regarded as a definite compound was but a mixture, and that the supposed process of purification had effected the decomposition of the original substance. In consequence, nearly every fresh investigation of essential oils at one time led to the fancied discovery of a new terpene that differed in some minor detail from any that had been previously isolated; thus the number of terpenes appeared to be "legion."

Systematic research has now, however, reduced the number of terpenes proper (that is to say, those represented by the formula $C_{10}H_{16}$, which are recognizable by some specific chemical test) to about nine or ten, although all these have not yet been obtained in an absolutely pure state, and consequently the identity and nomenclature of some have been disputed. There is little doubt, however, that at least nine isomerides do exist, and possibly more, but experience has taught the existence of new terpenes should only be accredited when very distinct and corroborative proofs are forthcoming. But besides the true terpenes there is a far larger class, mostly polymerized of the substances represented by the formula $C_{10}H_{16}$, which are also included under the general appellation of ter-

penes, the extreme limits of which are reached in colophony and caoutchou.

The terpenes that have been recognized as constituents of the eucalyptus oils are, however, three or four of the best known, viz., pinene, phellandrene, limonene and possibly dipentene; all occur in connection with polyterpenes of highest boiling point and greatest specific gravity, which at present have been little investigated, and may be either original constituents or only produced by the process of resinification, which, to certain extent, obtains to any and all essential oils during distillation and storage, especially when exposed to the influence of light and air.

Pinene, phellandrene and limonene are capable of existing in two optical modifications; that is to say, they are capable of rotating a ray of polarized light, either to the left or right, owing to the presence of an asymmetrical carbon atom in their molecules, around which the other atoms tend to revolve in either a levogyre or dextrogyre direction, and so produce the twisting of the ray observed. Dipentene in some respects bears the same relation to dextro and lævo-limonene as does inactive tartaric acid to the two active modifications of this acid. It is inactive, and both limonene and pinene are convertible into it at high temperatures, as well as by the action of acids, while it also results from the decomposition of some of the oxygenated terpene derivatives, like eucalyptol. Although pinene, phellandrene and limonene are all capable of existing in two optically active modifications (as well as in the apparently inactive form, consisting of an equal mixture of the two active forms), only one or the other of these modifications occurs in the eucalyptus oils. Dextropinene and lævo-phellandrene are always met with, while so far as our experience serves, the limonene of eucalyptus oils is also of a lævo-rotatory character.

Although the physical and chemical characteristics of the terpenes more commonly met with are now definitely determined, the nature of the chemical tests, while furnishing unmistakable results with the pure substance, requires they shall be applied with the utmost care and skillful manipulation, in order to obtain positive proof of the presence of a terpene. Pinene boils at 160° C., and has a specific gravity 0.858 at 20° C.; phellandrene boils at about 170° C.; while limonene and dipentene boil at 175° C., and possess the specific gravity 0.846 at 20° C. It is evident, therefore, that the boiling points of these isomerides are too near to permit of very satisfactory separation by fractional distillation, though it may be observed that those eucalyptus oils containing much pinene commence to distill at a lower temperature than oils that are completely free from it—supposing the other constituents are the same—while the first fractions, and generally the oil itself, have a dextro-rotatory action.

In the examination of oils for medicinal purposes, whether distilled from *Eucalyptus globulus* or any of the Mallee species so rich in eucalyptol, the popular impression that such oils should have a lævo-rotatory action appears to possess some warranty, from the fact the lower boiling fractions containing pinene have been removed, and the percentage of eucalyptol, which boils at about the same temperature as limonene and constitutes the active principle of the oil, has been consequently increased in the selected distillate. It will be seen upon consideration, however, that very much depends on the manner in which the distillation is conducted, and upon the proportion of other constituents in the oil, as to which fraction will contain the most eucalyptol; and consequently, if the distillation has been intelligently conducted, this factor will also determine the rotatory power of the distillate. As a matter of fact, although the majority of oils that we have examined exhibited a lævo-rotatory action, yet extremely good oils containing a large amount of eucalyptol have been met with, that possess a dextro-rotatory action; but in all cases the optical activity of good oils has been found comparatively low, as might be expected when the largest constituent is itself inactive.

Pinene and limonene may be recognized by their respective compounds with bromine, and also with hydrochloric and hydrobromic acids. If anhydrous hydrochloric acid gas be led into an absolutely dry solution of pinene in petroleum ether that is kept well cooled, one molecule of hydrochloric acid is absorbed, and a solid hydrochloride, $C_{10}H_{16}HCl$, separates, that melts at 125° and boils at 207° C., which, on account of its camphoraceous odor, has been called artificial camphor.

Limonene, under the same condition, also yields a hydrochloride of the same formula, which is, however, a liquid that boils undecomposed only under reduced pressure. If water be present during the reaction, however, further changes take place, and, as with pinene and dipentene, dihydrochloride of dipentene, $C_{10}H_{16}2HCl$, is obtained; this compound crystallizes out from solutions of the terpenes in moist solvents, like ordinary ether or glacial acetic acid when hydrochloric acid is added, and forms a solid melting at 50° C., boiling under 11 mm. pressure at 115° C.

The bromine compounds afford a still better means of distinction between these hydrocarbons, as pinene only combines with one molecule of halogen to form the dibromide, $C_{10}H_{16}Br_2$, melting at 170° C., while dipentene and limonene both add two molecules of bromine, yielding tetrabromide of the formula $C_{10}H_{16}Br_4$, melting at 104° C. and 124° C. respectively. Other very characteristic compounds of the terpenes are also formed with nitrosyl-chloride, and also by the subsequent reaction of the resulting compounds with aromatic amines; but these bodies are more suited to the study of the chemical constitution of the terpenes than for purposes of recognition and identification.

Phellandrene is perhaps the easiest of all the terpenes to identify, as it forms a very characteristic compound with nitrous acid—phellandrene nitrite, $C_{10}H_{16}N_2O_2$. When the solution of phellandrene in ligroin or an oil containing phellandrene is treated with concentrated solution of sodium nitrite and then a few drops of glacial acetic acid added, very voluminous crystals of phellandrene nitrite speedily form, that when purified by recrystallization from chloroform and methyl-alcohol melt at 104° C.

Ample means are therefore placed at the disposal of the analyst for arriving at definite conclusions with regard to the qualitative composition of the terpene hydrocarbons of eucalyptus oils; nevertheless, it will be

difficult to arrive at more than an approximate idea of the respective amounts. As the terpenes practically all have the same value as diluents and conservatives of other constituents of the oils, this defect is immaterial, since the replacement of one by the other only slightly affects specific gravity and volatility of the oil—perhaps its odor. It is said that phellandrene was first discovered in eucalyptus oil by Gildermeister, and found to be a notable constituent of oil of *Eucalyptus amygdalina*; further, that it possesses special medicinal value; but without definite evidence, it can scarcely be accepted that one terpene differs much from its isomerides in this respect. Undoubtedly all the terpenes possess some antiseptic and invigorating properties that may render them useful as inhalants and deodorizers, but if the principal virtues of eucalyptus oils are to be attributed to these constituents, it would be more practical and economical to employ turpentine at once. It is, however, among the oxygenated carbon compounds that will be found the chief active principles of the medicinal oils, as well as the odoriferous principle of the perfume oils.

CAMPHORS.

Eucalyptol, the stearoptene of the eucalyptus oils, is the constituent on which the eucalyptus products depend for their medicinal value, hence it is obvious a large percentage is regarded as a *sine qua non*. There are in market eucalyptus oils that contain 40, 50 and even higher per cent. of eucalyptol, yet claims made in this respect must be received with great caution, owing to the loose manner in which the term *eucalyptol* is applied. The pure chemical eucalyptol, which is identical with *cineol* and *cajeputol* (the latter constituents of *oleum cinæ* and *ol. cajeputi* respectively) is a solid at -1° C. and boils at 176° C.; it has a specific gravity of 0.923 at 16° C.; is optically active, and possesses a specific refractory power $R = 1.45839$.

Eucalyptol, $C_{15}H_{26}O$, has some points in common with camphor, $C_{15}H_{26}O$, and resembles the latter somewhat in odor, but it is not for this reason that it bears the terminal "ol," as is sometimes suggested. "Ol" in chemical nomenclature is now generally recognized as the suffix peculiar to alcohol, and was no doubt given to eucalyptol in the first instance because the oxygen atom in it was thought to be combined in the form of a hydroxyl group, whereas it has lately been shown that it occupies a very curious position as a connecting link between two carbon atoms, which cause it to behave in some respects like a hydrocarbon. As eucalyptol is not an alcohol, the suffix "ol" is incorrect in strict significance, and hence it has been proposed to alter to "ole," and as a result, in many new text-books of chemistry, *eucalyptole* or *cineole* will be frequently found replacing eucalyptol and cineol.

The estimation of eucalyptol in essential oils may be effected by more than one method. The most simple, and in our experience the most reliable under certain conditions, is crystallization out of the oil at low temperatures. The oils richest in this constituent, such as the "mallee," will frequently become almost solid when placed in a mixture of ice and salt, but in poorer oils greater difficulty is experienced in effecting the separation, for since such necessarily contain more terpenes, which latter act as solvents of eucalyptol and prevent its crystallization, such an oil must be cooled considerably below the solidifying point of eucalyptol in order to insure separation of the latter, and if much terpene is present even a temperature of -16° to -18° C. is not sufficient. Here concentration must first be effected by submitting the oil to fractional distillation and collecting the fractions (boiling within several degrees of the boiling point of eucalyptol, for example, between 172° and 180° C.), from which the stearoptene may then be removed by refrigeration, and the liquid filtrate, if necessary, again redistilled and refrozen. Very good and constant results can be obtained in this manner with most eucalyptus oils, but it is necessary the crystallizable substance thus obtained be carefully examined, and its physical and chemical character determined positively to be those of eucalyptol ere it is decided to be such.

Other methods for the isolation of eucalyptol are based on the preparation of its compounds with halogen and halogen acids. The formation of the bromine addition product, $C_{15}H_{26}OBr_2$, is a very characteristic reaction, and the rapid separation of a crust of red crystals when bromine vapors are allowed to pass over a film of eucalyptol affords a very useful and reliable test.

The preparation of the hydrochloride is also comparatively easy, since on passing a current of dry hydrochloric acid into a solution of eucalyptol in ligroin, or into a eucalyptus oil diluted with ligroin, which must be kept well cooled, the whole of the eucalyptol is precipitated in the form of a crystallized hydrochloride, $C_{15}H_{26}OHCl$. This would, therefore, form a very ready method for estimation of eucalyptol in eucalyptus oils, but for the unfortunate fact eucalyptol is not the only substance occurring in eucalyptus oils that can be precipitated under the above conditions; and again, if the conditions as to temperature and freedom from moisture are not strictly adhered to, the eucalyptol will be decomposed and dipentene dihydrochloride formed. To obtain trustworthy results, it would, then, be necessary to regenerate the original substance from the precipitate by removal of the hydrochloric acid with anilin or sodium acetate, and to examine the product obtained.

In some oils, notably that distilled from *E. amygdalina*, neither the refrigeration nor hydrochloric acid method yields evidence of the presence of eucalyptol, which, although contained in the oil, is extremely difficult to separate on account of the extraordinary solvent action of some other constituent, possibly phellandrene. Its isolation was first effected from such oils in the form of the hydrobromate, by a process analogous to that employed in preparing the hydrochloride; and, like the latter, it is very hygroscopic, when pure melting at 56-57° C.

A final method that may be employed is the formation of cineolic acid by oxidation with potassium permanganate, but the process is rather tedious and requires an excessive amount of material. Cineolic acid melts at 196° C., and passes over in an anhydride form. Recently it has been claimed that terpene hydrate was to be found to the extent of 2 or 3 per cent. in commercial eucalyptus oils, and obtained in large glistening crystals melting at 115° C., of the composi-

tion $C_{10}H_{20}O_2$, H_2O . The discovery, if true, is the more interesting because terpene hydrate also gives crystals when heated with gaseous hydrochloric acid, which might easily be confounded with those obtained from eucalyptol; therefore is further manifested the importance, already emphasized, of careful examination of the product obtained by any of the methods recommended for the separation of eucalyptol, ere its character is definitely pronounced upon.

ALDEHYDES AND KETONES.

It is no doubt to these and to the class of bodies known as alcohols and esters that the eucalyptus oils derived from different species acquire their distinctive odors, although in the medicinal oils they exist in mere traces. Aldehydes and ketones may be easily recognized and isolated from other constituents by means of their characteristic compounds with sodium bisulphite. On shaking the oils with a concentrated aqueous solution of this salt, the aldehydic and ketonic compounds crystallize out and can be readily removed by filtration, washed with ligroin, and the original substance obtained by treatment of the bisulphite compound with dilute acids or alkalies, shaking the resulting solution with ether or some similar solvent.

Thus far little has been done in the way of determining the chemical composition and constitution of these bodies, although some of the perfume oils, as *Eucalyptus maculata* var. *citriodora*, contain large quantities. Citral, $C_{15}H_{24}O$, is the aldehyde which is best known, and besides being found in the higher boiling fractions (about 220° to 240°) of several eucalyptus oils, forms an important constituent of citron oil, to which it communicates its peculiar aroma.

The investigations of Semmler have established the near relation of citral to constituents of other perfume oils and also to the hydrocarbon cymene; in fact, by the oxidation of geraniol (occurring in geranium oil) with chromic acid, citral is obtained, and by further oxidation with oxide of silver, geranic acid, so that geraniol and citral and geranic acid stand in the simple relation to each other of primary alcohol, aldehyde and acid.

Another aldehydic or ketonic constituent of eucalyptus oils (notably of *E. dealbata* and *E. maculata*) that has attracted some attention is citronellol, also an important constituent of citronella oil.

Still another class of aldehydes sometimes met with in inferior eucalyptus oils are a serious source of danger if intended for inhalation or other medicinal purposes, since they possess properties like those of the lower aldehydes of the fatty series, and therefore irritate the mucous membrane of throat and lungs, inducing cough.

As eucalyptus oil is recommended in the treatment of tuberculosis, diphtheria and other throat and lung affections, too great stress cannot be laid upon the presence of even traces of these bodies. They distill over with the first fractions of the oil, and may be easily recognized in them by means of the bisulphite test. Whether these compounds are natural constituents, or whether they are produced by careless distillation and decomposition of other substances, is at present an open question; but it should be borne in mind that oils that are not carefully distilled are known to acquire a "retort" odor, while the dry distillation of various organic substances yields formic aldehyde and acrolein among their decomposition products.

ALCOHOLS AND ESTERS.

Among the higher boiling fractions of eucalyptus oils, small quantities of esters, compounds of organic acids with alcohols, have been recognized, but little information is available with respect to the extent of their occurrence or their nature. They may, however, be investigated as regards their acidic constituents, by saponifying the oils with alcoholic potash at the temperature of the water bath, and examining the alkaline liquors for organic salts by acidifying and extracting the acid. In this way the presence of acetic and butyric acids may be recognized, which in the form of their esters no doubt contribute to determine the aroma of their respective oils.—*Bulletin of Pharmacy, London, England.*

TESTING BEESWAX FOR ADULTERANTS.

By C. SHERRAD.

FEW articles of commerce, as extensively used, are more susceptible to easy and successful sophistication than beeswax. This is especially true when paraffin or ceresin, or both, is made the adulterant. Other adulterants, as water, kaolin, starch, flour, resins, fatty bodies, gypsum, etc., were not considered in the tests made, from the fact that they are rarely or seldom employed for the purpose named. Various methods for the detection of paraffin and ceresin have been suggested and applied, most prominent of which is the one given by Allen in his Commercial Organic Analysis.

The results obtained by the application of the sulphuric acid test, as detailed by Allen, led to some doubt as to its reliability in two particulars; the first being the possibility of failure to decompose all the beeswax at the temperature and in the time specified.

Second, this being true, whether or not some of the paraffin or ceresin might not be destroyed under the conditions which insured the complete decomposition of the beeswax.

The sulphuric acid test is carried out by heating five grammes of the sample to 130° C. in a capacious flask with 50 c. c. of concentrated sulphuric acid. Charring takes place, and sulphur dioxide and other gases are evolved, causing the fluid to froth considerably. After about ten minutes the mixture becomes almost solid, when it is allowed to cool, the acid removed by washing with water and the residue treated with a little cold alcohol to remove adhering water. The filter containing the black residue is then exhausted with hot ether, preferably in a Soxhlet's tube, when the ether yields the hydrocarbon wax on evaporation. It should be weighed and then again treated with sulphuric acid and the residue exhausted with ether as before, as a little beeswax is liable to escape decomposition during the first operation.

In applying this test it is necessary, in order to obtain as nearly a uniform temperature as possible, to stir the solution almost constantly after it has attained the temperature of 130° C. In this way the tempera-