a more drastic oxidation with potassium permanganate yields acetone and 0-methyladipic acid..

l-7‰d⅛oZ,C10HijOH or(CHa)2CιCH∙(CH2)2∙CH(CHa)∙(CH2)2∙OH, or 2-6 dimethyl-0.ctene-2-0l-8, occurs in the essence of geranium and of rose. It is a structural isomer of citronellol (P. Barbier and L. Bouveâult, *Comptes rendus,* 1896, 122, pρ. 529,673; *Bull, Soc. Chim.,* iqoo, [3], 23, ρ. 459), and its inactive form has been synthesized from ethyl heptenone. It is an oil of strong rose odour, which boils at 110o C. (10 mm.). Chromic acid mixture oxidizes.it to' rhodinal1and rhodinic acid, whilst by drastic oxida­tion it yields acetone and ß-methyladipic acid.

*• Geraniol,* Cι0H∏OH, or (CH8)2CιCH∙(CH2)2∙C(CH8) ιCH∙CH2OH, 2∙6 dimethyl-0ctadiene-2∙6-0l-8, is found in the oils of geranium, citronella, neroli, petit-grain, spike, ylang-ylang, and in Turkish and German rose oil. It is prepared from tne oils by treating them with .alcoholic potash and then fractionating *in vacuo.* The geraniol fraction is then mixed with freshly dried calcium chloride and the mixture allowed to stand *in vaçuo* at a low temperature, when the compound C10H18O∙CaCl2 separates out. This is washed with absolute ether and finally decomposed by water, when pure geraniol is liberated (O. Jacobsen, *Ann.,* 1871, 157, p. 232; J. Bertram and E. Gildemeister, *Jour; prak. Chem.,* 1897 (2), 56,· ρ. 507). It may also be prepared by reducing the corresponding aldehyde (citral) with sodium amalgam. It is. a colourless, pleasant-smelling oil, which boils at 2300 C. Oxidation converts it into citral and geranic acid, (CH8)2CzCH√CH2)2∙C(CH8) i.CH∙CO2H. By shaking it with 5 per cent, sulphuric acid it. yields terpin hydrate, and when heated .with .concentrated alcoholic potash to 150o C. it is con­verted into dimethylheptenol (P. Barbier, *Comptes rendus,* 1899, 128, ρ. no). Geraniol may .be converted into linalool by distilling a faintly alkaline solution of acid geranyl phthalate with steam.

I, *Nerol,* CioHj7QH, was obtained in 1902 from neroli oil by A. Hesse and O. Zeitscheí *(Jour, prak. Chem.,* 1902 (2), 66, ρ. 481); it also is found in petit-grain oil. It boils at 226-2270 C. (755 mm.), and has a distinctive rpse odour. It is inactive and is to be regarded as a stereo-isomer of geraniol. It does hot form a compound with calcium chloride. It combines with four atoms of bromine to form a characteristic tetra.bromide. It is. formed (along with other products) by the action of-acetic acid on linalool (O. Zeitscheí, *Ber.,* 1906, 39, p. 1780) and also by the reduction of citral-Z>.

LτnαZooZ,C1oH17OH,or(CHj)2CzCH√CH2)2∙C(CHl)(OH)∙CH=CH2, is 2∙6-dimethyloctadiene-2∙7-ol-6.. d-Linalool was first found in coriander oil, and Z-linalool in oil of linaloe. It is also found in oil of bergamot, petit-grain, lavender, neroli, spike, sassafras leaves and lemon, either in the free condition or as esters. It is a pleasant­smelling liquid which boils at 197-19ρ0 C. (according to its source). The inactive variety can be prepared from geraniol, this alcohol on treatment with hydrochloric acid yielding a mixture of chlorides, which when digested with alcoholic potash are transformed into t-linalool (F. Tiemann and F. W. Semmler, *Ber.,* 1898, 31, p. 832). It is oxidized by chromic acid to citral. When shaken for some time with dilute sulphuric acid it yields terpin hydrate.

*Citronellol;* C10H18O, .js the - aldehyde of citronellol. It is a con­stituent of many essential oils, and was first discovered in citronella oil by F. D. Dodge *(Amer. Chem. Jour.t* 1889, if, p. 456); it is also found in eucalyptus oil and in lemon-grass oil. It is a dextro­rotatory liquid which boils at 203-2040 C. It is readily reduced by sodium amalgam to citronellol, and oxidized by ammoniacal silver oxide to cιtronellic acid. Potassium permanganate oxidizes it to acetone and βτmethyladipic acid. It forms, a dimethyl acetal, C10Hι8(θCHs)2,t which on oxidation with potassium perman­ganate yields a dioxydihydro-citronellaldimethyl acetal,

CH8∙C(CH2OH)(OH)∙(CH2)8∙CH(CH8)∙CH2∙CHO,

which must possess, the above composition, since on further.oxida­tion by chromic acid it yields a keto-aldehyde of the constitution CH8CO(CH2)8∙CH(CH8)∙CH2∙CHO .(C. D. Harries and O. Schau­wecker, *Ber.,* 1901, 34, p. 2981); this reaction leads to the formu­lation of citronellal gs a dimethyl-2∙6-0ctene-i-al-8. Citronellal is readily converted into an isomeric cyclic alcohol *isopulegol* (∆8(9)- terpen0l-3) by acids.or acetic anhydride (F. Tiemann, *Ber.,* 1896, 29, p. 913). It combines with sodium bisulphite, giving a normal bisulphité and also a mono- and dihydrosulphonic acid.

*Geranial* (citral), Cι0HιδO, is the aldehyde corresponding to geraniol. It occurs’in the oils of. lemon, orange, lemon-grass, citronella, bay, verbena, and in various eucalyptus oils. It may be obtained from the oils by .means of its bisulphite compound, provided the operation is carried out at low temperature, other­wise loss occurs owing to the formation of sulphonic acids. Syn­thetically it may be produced by the oxidation of geraniol with chromic acid mixture, orbý distilling a mixture of calcium formate and calcium geraniate. Its aldehydιc nature is shown by. the. facts that it forms an alcohol. on· reduction,' and that on oxidation it yields an acid (geranic acid) of the same carbon content. The i>osition of the ethylene linkages in the molecule is proved by the ormation of addition compounds, by its products of oxidation (acetone, laevulinic acid), and by the fact that on warming with potassium carbonate solution it yields methyl heptenone and acetaldehyde (F. Tiemann, *Ber.,* 1899, ,32, ρ. 107). On fusion with potassium bisulphate it forms para-cymene. It combines with ß-naphthylamine and pyruric acid, in alcoholic solution, to form the characteristic citryI-0-naphthocinchonic acid, C28H28NO2∙ JH2O, which is useful for identifying citral. The crude citral ob­tained from essential oils is a mixture of two ethylene stereo­isomers which are designated as citral-α and citral-ò (F. Tiemann and Μ. Kerschbaum, *Ber., 1900,* 33, p. 877). Citral-α boils at 110—1120 C. (12 mm.) and citral-⅛ at 102-1040 C. The structural identity of the two forms has been confirmed, by C..Harries *(Ber.,* 1907, 40, p. 2823), who has shown that their ozonides (prepared from the citrals by the action of ozone on their, solution in carbon tetrachloride) are quantitatively decomposed in both cases into acetone, laevulinic aldehyde and glyoxal. Lemon-grass oil contains 73 per cent, of citral-α and 8 per cent, of citral-Ô. Citral combines with sodium bisulphite to form a normal, bisulphite compound, a stable dihydrosulphonate, an unstable dihydrosulphonate and a hydromonosulphonate (F. Tiemann, *Revue gén. de chim. pure et appl.,* I, 16, ρ. 150). Citral condenses readily with acetone, in the presence of alkalis, to form pseudo-ionone (see *Ionone,* below).

The compounds of the citral series are readily converted into cyclic isomers by acids, the ring closing betwreen the first and sixth carbon atoms in the chain. Two series of such compounds exist, namely the *a* and *ß* series, differing from each other in the position of the double linkage in the molecule. The constitution of the α-series is determined by the fact that , on oxidation they yield isogeronic acid, which can be further oxidized to β9-dimethyladipic acid; the 0-series in the same way yielding geronic acid and αα-dimethyladipιc acid. The cycZocitrals themselves cannot be obtained direct from citral by the action of acids, since under these conditions para-cymene results, but they are prepared by boiling citrylidenecyanacetic ester with dilute sulphuric acid and subsequent hydrolysis of the cyclic ester with caustic potash (F. Tiemann, *Ber.,* 1900, 33, p. 3719), or citral may be condensed with primary amines to the corresponding aldehydeimino com­pounds, which are then isomerized by concentrated acids, the amine group being hydrolysed at the same time (German Patent, 123747 (i9θi))∙

*Ionone,* C18N20O. By condensing citral with acetone F. Tiemann *(Ber.,* 18g3, 26, p. 2691) obtained pseudo-ionone (1), an oil of boiling-point 143-1450 C. (12 mm.), which on boiling writh sulphuric acid is converted into a mixture of the isomeric α- and 0-iononea (2 and 3)

’ (1) (CHj)2C : CH ■ (CH2)3 · C(CHj) : CH · CH : CH · CO · CH8

C(CHi)2 C(CHa)ι

HjC∕z∖cH · CH : CH ■ CO · CH» HiG×∖c · CH CH · CO · CHl

cs,H.JwlC∙CH. ωH1C<. Λ∙6h>

CH CH1

α-Ionone is an oil.which boils at 127-1280 C. (12 mm.) and possesses a characteristic violet odour.. The ∕3-compound boils at 128-1290 C. (10 mm.) and possesses a similar odour. They are largely used in perfumery. An isomer of ionone is irone, the odoriferous principle of the iris root. It boils at 1440 C. (16 mm.). When heated with hydriodic acid and phosphorus it yields the hydrocarbon irene, C18H18 (F. Tiemann, *loc. at.}.*

Sesquiterpenes

*Cadinene,* Cι5H2<, is found in the oils of cade (from the wood of *Juniperus oxyeldrus),* cubeb, patchouli, galbanum, cedar-wood and juniper. It may be obtained by fractionating oil of cade, con­verting the crude hydrocarbon into its dihydrochloride and decom­posing this by boiling with aniline. It is an oil which boils at 274-2750 C. and decomposes on exposure. *Caryophyllene* is found in oil of cloves and in oil of copaiba balsam. Various other sesqui­terpenes have been described, *e.g.* zingiberenc (from essence of ginger), cedrene (from oil of cedar-wood), santalene (from oil of sandal-wood), humulene and clovene.

Of. the sesquiterpene alcohols pure *santalol,* Ci6H2βO, has been obtained from essence of sandal-wood by conversion into the acid phthalic esters and saponification of these by potash (Schimmel &Co., *Bulletin,* April 1899, p 41). A mixture, of two alcohols is thus ob­tained, one boiling at 165-1670 C. (13 mm.) and the other at 1730 £. They are distinguished by their different optical activities, one being practically inactive, the other strongly laevo-rotatory (see also Μ. Guerbet, *Comptes rendus,* 1900, 130, p. 417 ; *Bull. Soc. Chim.,* I9∞ (3)» 23, p. 540). Caryophyllene alcohol is obtained lrom oil of cloves; by elimination of water it yields clovene, Cι6H24, a liquid which boils at 261-2630 C.

Many di- and tri-terpenes have been described, but as yet are not thoroughly characterized.

*References.—*Gildemeister and Hoffman, *The Volatile Oils* (Mil­waukee, 1900); R. Meldola, *The Chemical Synthesis of Vital Pro­ducts* (London, 1904); F. W. Semmler, *Die aetherischen Oele* (Leipzig, 1906); G. Cohn, *Die Riechstoffe* (Brunswick, 190^); J. Μ. Klimont, *Die synthetischen und isolirten Aromatica* (Leipzig, 1899); and F. Heusler, *Die Terpene* (Brunswick, 1896). For camphor see A. Lapworth, *Brit. Assoc. Rep.* for 1900, and O. Aschan, *Die Kon­stitution des Kamphers* (Brunswick, 1903). (F<ι G. P.\*)