is of the greatest value. The general principle is that the compounds which the *d-* and *l*-form give with a different active compound, for instance *d* producing *dd* and *ld,* are by no means antipodes and so exhibit the ordinary differences, *e.g.* in solubility, which allow separation. It was in this way that Pasteur split up racemic acid by cinchonine. This method has since been applied to the most various acids; bases may be split in an analogous way artificial conine was separated by Ladenburg by means of *d-*tartaric acid, and one of these antipodes proved to be identical with natural conine. Aldehydes and ketones on the other hand may be split up by their combinations with an active hydrazine, &c., and so this method is by far the most fruitful.

The formation of a racemic compound built up from *dd* and *ld* has also been observed in the so-called partial racemate. An example is the racemate of strychnine. It is in this case also that the transi­tion-point forms the limit of possible separation, determined by Ladcnburg and G. Doctor to be 30°. Such partial racemic com­bination however occurs only in exceptional cases, else it would have invalidated this method, as it did spontaneous separation.

A different way of using active compounds in producing antipodes consists in the so-called asymmetric synthesis. The method consists in the introduction of an active complex before that of the asym­metric carbon; both stereo-isomers need not then form in the same quantity. W. Marckwald and A. McKenzie, who chiefly worked out this method, found, for example, that the salt of methylethyl­malonic acid, C(CH3) (C2H5) (CO2H)2, with the active brucine forms on heating the corresponding salt of *d-* and *l-*methylethylacetic acid C(CH3) (C2H5)H(CO2H), with the *l*-antipode in slight excess.

5. *Configuration of Stereo-isomers.—*The conception of asymmetric carbon not only opens the possibility of determining when and how many stereo-isomers are to be expected, but also allows a deeper insight into the relative position of atoms in each of them. The chief indication here lies in the configuration of the meso-type, already given for mesotartaric acid ; the corresponding alcohol, the natural sugar erythrite, which produces this acid by oxidation, consequently corresponds to

In the glutaric acids, HO2C∙(CH∙OH)3∙CO2H, the structural symmetry again leads to meso-forms

They are respectively obtained by the oxidation of ribose and natural xylose, stereo-isomers of the formula COH(CHOH)5CH2OH ; the latter produces active tartaric acid and so decides that the second formula is that of the corresponding trioxyglutaric acid, the first remaining for that obtained from ribose.

In such and analogous ways the configuration of meso-types may be fixed with absolute certainty. The decision is more difficult in the case of antipodes. For tartaric acid it is certain that the *d-* and *l*-forms correspond to but which of the two represents the ordinary *d*-acid is unknown. Emil Fischer proposed to decide provisionally in an arbitrary way and admit for the *d-* the first formula. Then we may conclude that the natural malic acid, which may be obtained by the reduction of *l*-tartaric acid, is while the natural xylose, which produces Z-tartaric acid by the substitution of CO2H for CHO·CHOH, corresponds to

The results obtained in these and analogous ways have proved to be of value in the study of enzymes, *e.g.* such complex organic substances as zymase in yeast, which is able to produce in small quantity an unproportioned large amount of chemical change, in this case the transformation of the sugar glucose, C6H12O6, into alcohol and carbonic acid

C6H12O6 = 2 C2H6O + 2CO2.

These enzymes have an extremely specific action, producing, for instance, the change in ordinary natural glucose, but not at all in its artificial antipode, and so they are often valuable means of isolat­ing an antipode from the inactive mixtures or racemic compounds; this method has indeed been used for the isolation of the glucose- antipode from the artificial racemic form. The fundamental fact here is due once more to Pasteur, but Emil Fischer added that sugars are acted upon by zymase in an analogous way if their configuration shows a certain amount of identity. For example yeast acts on and we observe that the three formulae agree indeed in the lower four-carbon chain. This particular behaviour led Fischer to the expression that the enzyme-action on given substances needs a corresponding feature as "lock and key.” There are indications that in the synthesis by enzymes, of which examples have been realized in fats, sugars, glucosides and albuminoids, an analogous behaviour prevails.

6. *Mutual Transformation of Antipodes.*—Thus far we have supposed the molecule to be stable with atoms in fixed places, as may be the case at absolute zero ; in reality, at ordinary temperatures, atoms probably are endowed with movement, and this may be supposed to take place along the fixed places just mentioned as centres, which movement can go so far as to lead to total trans­formation, the one stereo-isomer changing over into the other. These cases may be considered now.

As a general rule the liquid, gaseous or dissolved antipode is in itself unstable, tending to be transformed into inactive complexes. Temperature may accelerate this, and, as a rule, sufficient heat will produce the loss of optical activity, half of the original compound having changed over into its optical antipode. This transformation has been often used for preparing the latter, as was first done by Le Bel with the optically active amyl alcohol, HC(CH3)(C2H5)(CH2OH), rendering it inactive by sufficient heating, and separating from the obtained complex the stereo-isomer. Walden found that in some cases analogous transformations take place at ordinary temperature, as for instance with *d*-phenylbromacetic acid, which within three years totally lost its considerable rotative power ; this transformation has been termed “ autoracemization." It explains that till now the most simple compounds with asymmetric carbon have not yet been obtained in antipodes; active CHClBrF might be obtained by treating chlorobromofluoracetic acid with potash, but autoracemiza- tion, which especially shows itself when halogens are linked to the asymmetric carbon, might, without special precautions, lead to an inactive mixture of antipodes.

When two asymmetric carbons are present, four stereo-isomers are possible, which may be represented by:—

(I) A+B, (2) -(A+B), (3) A-B, (4) -(A-B),

(1) and (2), as well as (3) and (4), being antipodes. The stable form will be in this case also the inactive mixture, corresponding in the solid state either to (1), (2) or (3), (4). In the last case, suppose the primitive compound is (1), the first step towards stability may be the production of (3), so that practically one stereo-isomer changes over into another of a different type. Such has, for instance, been proved by Bechmann for *l*-menthol,

which on heating produces a form rotating in opposite sense, though not the antipode. Probably H and CH3 in the lower asymmetric carbon have changed places. A further treatment at high temperature might prob­ably produce the inactive mixture of this mentnol and its antipode.