VII. SUMMARY OF RESULTS.

The purpose of this research was to prepare and to study simple aliphatic disulphocarboxylic acids.

The most simple example is *disulphoacetic acid.* It was prepared by oxidation of formylmethionic acid with hydrogen peroxide in acetic solution:

$$CHO.\,CH(SO_3H)_2 + O \rightarrow CO_2H.\,CH(SO_3H)_2.$$

The disulphoacetic acid crystallizes with 2½ mol. of water (m.p. 85—86°). By heating at 130° it decomposes into carbon dioxide and methionic acid:

$$CO_2H.\,CH(SO_3H)_2 \rightarrow CO_2 + H_2C(SO_3H)_2.$$

Three disulphobutyric acids are described, viz. β,γ-, α,γ- and α,β-disulphobutyric acid.

In order to obtain β,γ-disulphobutyric acid, *γ-sulphocrotonic acid* was prepared. This unsaturated acid is not known in chemical literature. It arises by the action of γ-chlorocrotonic acid with sulphite:

$$CO_2NH_4.\,CH : CH.\,CH_2Cl + (NH_4)_2SO_3 \rightarrow CO_2NH_4.\,CH : CH.\,CH_2SO_3NH_4.$$

The free acid, several salts, the dimethyl ester and the dichloride are described. By addition of bisulphite to γ-sulphocrotonic acid, *β,γ-disulphobutyric acid* is formed. The velocity of this reaction at 80° was measured.

$$CO_2NH_4.\,CH : CH.\,CH_2SO_3NH_4 + NH_4HSO_3 \rightarrow CO_2NH_4.\,CH_2.\,CH(SO_3NH_4).\,CH_2SO_3NH_4.$$

The same disulpho acid is also formed by the action of two molecules sulphite with one molecule γ-chlorovinyl acetic acid:

$$CO_2NH_4.\,CH_2.\,CH : CHCl + (NH_4)_2SO_3 + NH_4HSO_3 \rightarrow CO_2NH_4.\,CH_2.\,CH(SO_3NH_4).\,CH_2SO_3.\,NH_4.$$

The free β,γ-disulphobutyric acid gives a dihydrate melting at 95°.

α, γ-Disulphobutyric acid is formed by sulphonation of *γ-sulphobutyric acid,* which can be obtained by the action of sulphite with γ-bromobutyric acid:

$$CO_2NH_4 . CH_2 . CH_2 . CH_2Br + (NH_4)_2SO_3 \rightarrow CO_2NH_4 . CH_2 . CH_2 . CH_2SO_3NH_4.$$

This monosulphocarboxylic acid contains ½ mol. of water and melts at 93—93.5°.

Our hope to obtain α-sulpho-γ-bromobutyric acid by sulphonation of γ-bromobutyric acid (for the preparation of α, γ-disulphobutyric acid) was not fulfilled, because this reaction gave α-sulpho-γ-oxybutyric acid. Neither could α,γ-disulphobutyric acid be obtained by addition of bisulphite to α-sulphovinylacetic acid.

The sulphonation of β-sulphobutyric acid gives a mixture of a saturated and a unsaturated disulphocarboxylic acid with four carbon atoms. Catalytic reduction of this mixture yields the *α, β-disulphobutyric acid.*

The three disulphobutyric acids were separated into their enantiomorphs by means of the strychnine salts. The strychnine salt of the dextrorotating component of β, γ- and α, γ-disulphobutyric acid is the least soluble. The salts of α, β-disulphobutyric acid show a rotation opposite to that of the free acid.

	$[M]_D$salt	$[M]_D$acid
α, β-disulphobutyric acid	− 6°	+ 16°
α, γ- „ „	7°	9°
β, γ- „ „	50°	60°

The racemisation was examined; only for the two acids, which have a sulpho group fixed to the α-carbon atom, a decrease of the rotation is noticed.