

of shoots (Fig. 1 right). A control chromatogram of alanine, glycine, homoserine, and its lactone was prepared also. (Fig. 1 left).

Because no spot of the lactone of homoserine is found on the chromatogram (Fig. 1 right) it is clear that homoserine is present mainly as the amino acid and not as the lactone in pea seedlings. As the free amino acids had been extracted from the seedlings with ethanol solution without the addition of acid, which causes lactone formation, and without allowing the amino acids at any stage of the separation to be subject to alkaline conditions which may cause the cleavage of the lactone ring, the result is conclusive. The result obtained by Staron *et al.* is possibly due, at least in part, to the fact that during the separation of the amino acids they have acidified the concentrated solution, after the evaporation of ethanol, to pH 2.3. The purification of the acid solution with Permutit 50 may have contributed further to the formation of lactone. However, quantitative lactone formation cannot even then be expected.

One interesting observation is found in the report of Staron *et al.* They state that the pea seedling has an antifungal effect on yeast (*Sacch. cerevisiae*) and believe that this is due to the lactone of homoserine. They followed the lactone formation during the germination by determining the inhibition of the growth of the yeast. As homoserine is, however, found mainly as the free amino acid in germinating pea seeds, its lactone can hardly be the antifungal factor in question. In germinating seeds of different plants many various antimicrobial substances are formed.

This research has been financed in part by a grant made by the United States Department of Agriculture, Agricultural Research Service.

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Received April 6, 1965.

Acta Chem. Scand. **19** (1965) No. 4

Scandium Manganese(III) Oxide, a Compound Isotypic with LuMnO₃

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A new type of structure of ferroelectric ABO_3 compounds has been reported by Yakel, Koehler, Bertaut, and Forrat,¹ when *B* is trivalent manganese and *A* is a trivalent ion of the set yttrium, holmium, erbium, thulium, ytterbium, and lutetium. The ferroelectric properties of these compounds have been investigated by Bertaut, Forrat, and Fang.² The structure is hexagonal (probable space group $P6_3cm$) and the unit-cell parameters are, *e.g.* for LuMnO₃, $a = 6.042 \text{ \AA}$ and $c = 11.37 \text{ \AA}$.

In order to investigate if this structure type is stable even for a smaller trivalent ion than lutetium, a solution in nitric acid of scandium and manganese, with the molar ratio 1:1, was evaporated and the residue was heated at 800°C in air (*cf.* Ref. 1). X-Ray powder photographs were taken in a Guinier focusing camera using $CuK\alpha_1$ radiation. The powder pattern could be interpreted assuming a hexagonal unit cell with the unit-cell parameters $a = 5.830 \pm 0.001 \text{ \AA}$ and $c = 11.179 \pm 0.002 \text{ \AA}$.

Single crystals were made, according to Yakel *et al.*,¹ by heating a mixture of scandium oxide and manganese(III) oxide, with the molar ratio of 1:1, in a bismuth oxide flux at approximately 1100°C in air. Rotation and Weissenberg photographs were taken, using $CuK\alpha$ radiation, for a crystal rotated around [001] and [110] of the hexagonal cell. The unit-cell parameters of the single crystal, obtained from rotation photographs, were $a = 5.84 \text{ \AA}$ and $c = 11.17 \text{ \AA}$. By comparing the structure factors, derived from the observed intensities, with those calculated from the parameters for LuMnO₃, as given by Yakel *et al.*, it was seen that the compound formed is isotypic with LuMnO₃.

In the least-squares refinement of the structure of LuMnO₃, Yakel *et al.* obtained physically unacceptable values for some components of the temperature factors of the oxygen atoms. According to Yakel *et al.*, the cause for these anomalies may be, *inter alia*, an incorrect anomalous-dispersion correction or an incorrect assignment of the

space group. The X-ray scattering properties of scandium, make scandium manganese(III) oxide more suitable for obtaining accurate information of the crystal structure type of these compounds and a determination of the crystal structure of scandium manganese(III) oxide is in progress.

This investigation forms a part of a research program financially supported by the *Malmfonden-Swedish Foundation for Scientific Research and Industrial Development* and the *Swedish Natural Science Research Council*.

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Received April 12, 1965.

On the First, Naturally Occurring Amino Tricarboxylic Acid, Isolated from the Mushroom *Lactarius helvus*

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In the course of studies¹⁻³ on the soluble nitrogen compounds in the mushroom *Lactarius helvus*, a new amino acid, formerly called amino acid B, has been isolated in pure form and characterized in some detail. This compound, which on the paper chromatogram gives a yellow-brown spot with ninhydrin, was shown to be acidic on the basis of its mobility at pH 5.6 on paper electrophoresis.¹

The isolation of the amino acid B was performed in a similar manner to that described earlier by Casimir and Virtanen.¹ It was separated moderately well from the other amino acids on a Dowex-1 column using 1 N acetic acid as eluant instead

of 1 N hydrochloric acid.¹ After further purification on a cellulose powder column, eluting with BuOH:AcOH:H₂O (12:3:5), the amino acid B was crystallized from a mixture of BuOH-EtOH-H₂O by evaporating off the ethanol and water slowly at reduced pressure. The compound B has no defined melting point, but begins to darken and decompose above 200°C. Elementary analysis gave the empirical formula C₁₂H₁₇NO₇. (Found: C 48.50; H 5.83; N 4.98; O 39.67. Calc. for C₁₂H₁₇NO₇ (287.26): C 50.17; H 5.97; N 4.88; O 39.99). An α-amino and neighbouring carboxyl group determination according to Linko⁴ gave the following values: N 4.7; CO₂ 15.8. Calc. for C₁₂H₁₇NO₇: N 4.88; CO₂ (for one carboxyl group) 15.35. A titration of the compound B in ethanol with ethanolic sodium hydroxide (phenolphthalein as indicator) gave an equivalent weight of 96.5. If we assume that the molecule contains three carboxyl groups, the equivalent weight would be 287.26/3 = 95.75. On catalytic hydrogenation one mole of hydrogen was consumed per mole of the amino acid B. The compound B shows no absorption in the UV-region, so that the double bond is not conjugated with the carboxyl groups. No keto group was present. The empirical formula C₁₂H₁₇NO₇ shows that the molecule must contain a ring, since only one double bond is present.

On the basis of the NMR-spectra, the original amino acid B and its hydrogenation product contain no methyl group, but two olefinic protons are, however, discernible. A peak occurs in the area expected for a proton on a carbon atom attached a carboxyl group $H-C-COOH$.

The mass spectrum of a derivative of the amino acid B, which was obtained by the conversion of the amino group to a hydroxyl group with nitrous acid followed by treatment with diazomethane, is presented in Fig. 1. As can be seen, the highest mass number occurs at $m/e = 312$. If we assume that all the three carboxyl groups have been esterified and the amino group exchanged for a hydroxyl group, the derivative would have a molecular weight of 330 (C₁₂H₂₂O₈). The difference between the values of 330 and 312 is 18 mass units. It is, however, very common that organic molecules containing hydroxyl groups have no molecular peak in their mass spectra because of the ease of elimination of water from the molecular ion.