appear to be absent from our extracts. The absence of tyrosine is unexpected, but not that of glutamine[2].

It is believed that this is the first time that the presence of β-alanine and γ-amino-butyric acid has been reported in fruits. The large amount of γ-amino-butyric acid is of particular interest, since in previous work on the nitrogen metabolism of the apple[2] a high proportion of the soluble nitrogen appeared in the 'rest-nitrogen' fraction, that is, it was not estimated either as 'amide-nitrogen' or 'amino-nitrogen'; in addition, the apple was found to be poor in 'basic-nitrogen'[5]. It is probable that a considerable proportion of the 'rest-nitrogen' may have arisen from γ-amino-butyric acid since, under the conditions of the usual Van Slyke α-amino-nitrogen determination employed in the work mentioned, only a portion of the γ-amino-group would react[6].

In conclusion, we should like to express our thanks to Dr. C. E. Dent for a sample of pure γ-amino-butyric acid.

A. C. HULME
W. ARTHINGTON

Ditton Laboratory,
East Malling, Kent.

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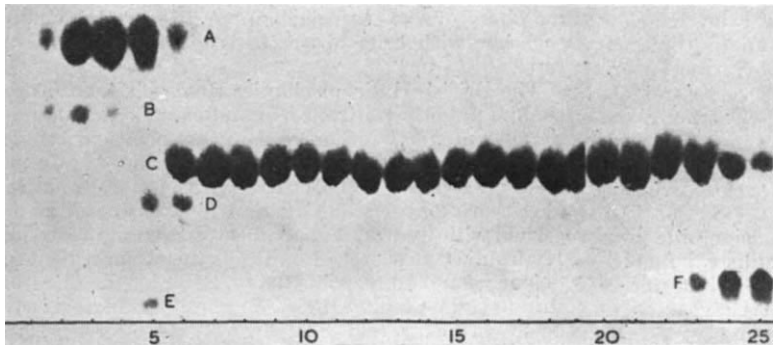
Isolation of γ-Amino-butyric Acid from Beetroot (*Beta vulgaris*)

A GENERAL method for the isolation of amino-acids and organic bases by displacement chromatography using synthetic cation exchange resins has recently been described[1–3]. The immediate object of the present work, which was readily achieved, was to apply this technique to the preparation of glutamine in quantity from the aqueous extract of red beet-roots. During the course of the fractionation, a ninhydrin-reacting substance was observed which was identified by paper chromatography as γ-amino-butyric acid. The primary fractionation on 'Zeo-Karb 215'[3] yielded a range of common amino-acids which appeared in the effluent in the order expected from the experiments on protein hydrolysates. In addition, paper chromatograms[4] carried out on the successive fractions of the effluent showed the presence of a large amount of glutamine and smaller amounts of asparagine, γ-amino-butyric acid and β-alanine. Ninhydrin spots due to γ-amino-butyric acid have been observed on paper chromatograms of extracts of a number of plant and animal tissues[5–7], but the direct isolation of the amino-acid by conventional methods has proved difficult.

In all, fifty-eight fractions, each of 250 ml., were taken during the primary fractionation. Fractions 1–6 contained aspartic acid, glutamic acid, serine and threonine; 7–16 included glutamic acid, asparagine, glutamine and alanine; 17–34 contained almost entirely glutamine, but with small amounts of alanine (these two substances form a mixed band under the conditions employed); 35–48 showed diminishing amounts of glutamine and contained a basic substance which did not react with ninhydrin. This base gave a brown coloration when sprayed with iodine reagent[8] and has now been isolated; but its identity remains to be established. Fractions 49–56 contained small amounts of valine, cystine, phenyl-alanine, histidine and β-alanine, together with larger amounts of leucine and γ-amino-butyric acid. The position of γ-amino-butyric acid in the effluent fractions showed that it was more strongly adsorbed than leucine but less so than histidine.

For the isolation of the γ-amino-butyric acid, fractions 52–54 (750 ml.) were bulked and evaporated under reduced pressure. Some leucine and cystine were removed in a series of small crops, but the concentrated mother liquor could not be induced to crystallize from water, ethanol or acetone. A further purification was achieved by fractionation through a smaller 'Zeo-Karb' column containing 50 gm. of resin using 0·15 *N* aqueous ammonia as the displacement developer. The fractions collected, each of 25 ml., were analysed on a paper chromatogram using butanol – 10 per cent acetic acid. The accompanying illustration shows a reflex photograph of the ninhydrin-developed paper chromatogram. Fractions 8–22, which showed γ-amino-butyric acid only, were bulked and evaporated under reduced pressure to about 5 ml. The syrup obtained yielded needle-shaped crystals upon the gradual addition of ethanol to a final volume of 60 ml. 2·54 gm. was obtained, and a further crop, after evaporation, yielded 0·47 gm. The crystalline material, when run side by side with synthetic γ-amino-butyric acid (kindly provided by Dr. C. E. Dent), gave identical R_F values in phenol – ammonia, butanol – 10 per cent acetic acid mixture and collidine. It melted with decomposition at 193° (uncorrected). References in the literature[9,10] give a range of values from 190° to 200° (found: C, 47·0; H, 9·0; N, 13·8. Calc. for $C_4H_9O_2N$: C, 46·6; H, 8·7; N, 13·6 per cent). The *p*-toluene-sulphonyl derivative melted at 135–136° (uncorrected). Thomas and Goerne[11] reported a melting point 135° for this substance. The yield was 3·01 gm. of γ-amino-butyric acid isolated from 40 lb. of trimmed beetroots representing 0·016 per cent of the fresh weight. Allowing for small amounts remaining in the mixed fractions, the minimum amount



A paper chromatogram of successive effluent fractions (reflex photograph). (*A*) leucine(s); (*B*) valine; (*C*) γ-amino-butyric acid; (*D*) β-alanine; (*E*) cystine; (*F*) histidine

present in the fresh beetroot was probably about 0·02 per cent.

I should like to express my gratitude to Dr. S. M. Partridge for his advice and constant encouragement, and to Dr. C. E. Dent for a gift of γ-aminobutyric acid.

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R. G. WESTALL

Low Temperature Station for Research in Biochemistry and Biophysics,
University of Cambridge and Department of Scientific and Industrial Research.
Nov. 22.

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HYDROMECHANICS AND HYDRAULICS RESEARCH IN GREAT BRITAIN

AT the annual general meeting of the British Hydromechanics Research Association, Sir John Anderson was re-elected president, and a council of eighteen elected with Mr. G. A. Wauchope (Gwynne Pumps, Ltd.) as chairman and Mr. E. Bruce Ball (Glenfield and Kennedy, Ltd.) deputy chairman. The chairman reported to the meeting that during the past year it had become evident that, in addition to the facilities at the proposed laboratory at East Kilbride of the Mechanical Engineering Research Organisation, it was desirable for the Association to have its own research station in which individual research problems could be tackled. This would in no way compete with the government laboratory at East Kilbride, which would probably concentrate on long-term generic problems.

In the second annual report of the council, covering the period October 1948–September 1949*, it is stated that the negotiations with the Harlow Development Corporation for the building of the research laboratory and offices of the Association, about 12,000 sq. ft. in area, have been successful. It is expected that the laboratory will be among the first buildings to be erected in the new satellite town of Harlow, Essex, and it is hoped that the laboratory will be completed this year. Housing accommodation for the staff will be available.

During the year under review, considerable progress was made in building up an industrial income sufficient to earn a government grant; but uncertainty existed until the very end of the year as to whether the minimum required income would be attained. In consequence, though slightly more than £16,500 was finally obtained, development was somewhat retarded. It is considered that, in order to cover adequately the extensive field of interest of the Association, a team of twenty qualified research engineers will be required eventually with a corresponding expenditure of some £60,000 a year. At present the staff consists of the director of research, Mr. L. E. Prosser, and four research engineers and a library assistant.

A list of the ordinary, and associate, members of the Association is given in the annual report. It comprises thirty-six manufacturing and user members, and thirty-six consultants and academic workers. The corresponding figures for the previous year were thirty-one in each group. The very small increase in membership is to be deplored and indicates that, while industrial firms admit that active research is essential to progress, they are reluctant to foster it. Tribute is paid to the British Electricity Authority, which is giving substantial financial support to the Association.

Two visitors, Brigadier R. A. Bagnold and Prof. L. Rosenhead, entrusted to make an impartial appraisal of the scientific work of the Association, were appointed by the Department of Scientific and Industrial Research, and close liaison has been maintained with the Mechanical Engineering Research Organisation, the Admiralty, and the Information Department of the Ministry of Supply. Six research committees, on which some forty well-known hydraulic experts serve, and an information service advisory committee assist the director of research in his work, and details of some of the sixty technical problems which have been dealt with during the year are given in the report. Subjects on which work is in progress include: pressure surges in pipe lines, design of suction inlet sumps of centrifugal pumps, valve behaviour in reciprocating pumps, and seals and glands. One research committee has been investigating pipe friction formulæ and has arrived at conclusions which probably will be recommended shortly for general acceptance. Quantitative information concerning friction at pipe-line fittings can be of considerable economic importance, as it is not always appreciated how much loss can be caused by unsuitable fittings.

Since November 1948, the Association has issued at regular bi-monthly intervals an abstract bulletin, containing sixty to seventy informative abstracts of current literature on hydraulics, details of translations of foreign papers available through either the Association or other organisations, and information concerning the technical notes circulated to the members of the Association. A list of these notes together with brief abstracts is given in the annual report.

The British Hydromechanics Research Association, though directly controlled by industry, is, in common with some forty other research associations, under the ægis of the Department of Scientific and Industrial Research. Together with the Mechanical Engineering Research Organisation, it is mainly concerned with hydraulic machinery and equipment. The Hydraulics Research Board of the Department of Scientific and Industrial Research, under the directorship of Sir Claude Inglis, is more concerned with basic problems and has devoted its efforts to the investigation of tidal and river problems, though it is considerably hampered by lack of a permanent laboratory and adequate facilities.

* British Hydromechanics Research Association. Second Annual Report, October 1948 to September 1949. Pp. 24. (79 Petty France, London, S.W.1.)