

media otherwise suitable. Protopectinase activity of solutions was highest in the pH range 8.0–9.0, was rapidly lost at temperatures above 50–60° C., and was reduced by concentrations of phosphate higher than 0.02 M. The enzyme was partially purified by precipitation in 60 per cent acetone at pH 6.0. Protopectinase solutions also contained an enzyme which reduced the viscosity of solutions of various pectic substances. The properties of this enzyme were, in general, similar to those of protopectinase. When activity of enzyme solutions was measured by the liberation of reducing groups, pectate solutions were more rapidly degraded than were solutions of a high methoxyl pectin, particularly in the early stages of the reaction. Partition chromatography of the products formed showed that pectate and pectin were degraded in different ways. Although the pathogen readily secreted protopectinase in potato extract, potato tubers were not readily parasitized. In contrast, *Fusarium avenaceum*, which readily attacked tubers, secreted little protopectinase in potato extract.

S. C. Gupta has examined the production of pectolytic enzymes by *Pythium de baryanum*. Among other things, he observed that the incorporation of sodium chloride in a synthetic medium stimulated the pectolytic activity of cultures of *Pythium de baryanum*. The chloride ion appeared to be mainly responsible for this effect; on the other hand, presence of the calcium ion depressed enzymic activity. Glucose, fructose and mannose were about equally suitable for growth and enzyme production. Sucrose, if used as sole carbohydrate source, gave good mycelial growth but poor enzyme production; but if a small proportion was replaced by glucose, enzyme production was as good as on glucose itself. Galactose gave very poor growth and negligible enzyme production. For optimum production of pectolytic enzyme, glucose (or fructose or mannose) requires to be autoclaved in a somewhat alkaline medium—very conveniently with the dipotassium hydrogen phosphate or potassium phosphate of the nutrient medium. A yellow to brown coloration (due to caramelization) is produced in the process; but the stimulating factor is not bound up with the colouring substance. The same stimulating effect on enzyme production was obtained by adding to the nutrient medium a small quantity of glucose which had been dry-heated at 150° C. for 20 min. Partition chromatographic analysis suggested that the stimulating substance was probably glyceraldehyde, though it is not excluded that other breakdown products of sugars may also play a part.

CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND

REPORT FOR 1954–55

THE fifty-fourth annual report of the Executive Committee of the Carnegie Trust for the Universities of Scotland, covering the academic year 1954–55*, records an increase in the numbers of students from 1,408 to 1,502, chiefly in science and medicine, to whom assistance was given with their class fees, the amount expended increasing

* Carnegie Trust for the Universities of Scotland. Fifty-Fourth Annual Report (for the Year 1954–55) submitted by the Executive Committee to the Trustees on 20th February, 1956. Pp. iv+72. (Edinburgh: Carnegie Trust for the Universities of Scotland, 1956.)

from £22,007 to £24,232. Problems created for the Trust by the bursary awards made by local education authorities in terms of the Education (Scotland) Act are by no means solved, and the Executive Committee directs attention to the, apparently, growing assumption of many students that the Carnegie Trust grant is to be applied for as an addition to the education authority bursary whatever be the value of that bursary. Strongly emphasizing its declared intention to limit its assistance in this direction to holders of local education authority bursaries whose circumstances, taken as a whole, appear genuinely to warrant additional help, the Executive Committee expresses its desire for a proper appreciation of this policy and the reasons for it on the part of directors of education, university advisers of studies and similar officials.

Expenditure on the Trust's research scheme totalled £33,155, and its various features were maintained. Three senior scholarships and fifty-three scholarships were awarded or renewed, some being supplements to scholarships and bursaries gained from other sources, and twenty-three of these were used for postgraduate study outside the parent university. The high value of this part of the programme is stressed in the report, as is that of the scheme, inaugurated in 1950, which affords annually ten members of university staffs, more than thirty years of age, the opportunity of study abroad. Eleven such awards were made in 1954–55, three being in scientific subjects, two in medicine and one in African studies. Besides the annual grant made to the Royal Society of Edinburgh and to the *Scottish Historical Review*, eleven learned societies in Scotland were assisted in the publication of their transactions and journals; in addition to an immediate grant of £2,000 to the Scottish National Dictionary, the Scottish Dictionaries Joint Council was invited to submit plans by which £20,000 could be used for ensuring substantial developments within a reasonably short period, and this sum has been placed at the Council's disposal. Repayments by former beneficiaries declined slightly from £1,921 from thirty-six former beneficiaries to £1,868 from thirty-three beneficiaries.

Besides particulars of grants made under the ninth quinquennial distribution, October 1, 1952–September 30, 1957, there are appended the terms of the scheme for the endowment of postgraduate study and research and a summary of reports received from the advisers to the Trust on the work of investigators under the research scheme during 1954–55. In the mathematical, physical and engineering section, the fellowships of R. Giles on quantum field theory at the Institute of Theoretical Physics, Copenhagen, and of D. Chisholm on the flow of two-phase mixtures at the University of California are stressed as outstanding. K. M. Swanson's work on nuclear magnetic resonance was again successful, and in connexion with J. V. Thomson's work in fluid dynamics it is suggested that the Scottish universities should co-operate to provide an electronic computer with the strong support of the Carnegie Trust.

In the chemistry section, J. S. S. Reay, working on organic ammonium derivatives of montmorillonite, has noted interesting relations between the molecular volume of the ammonium ions and the adsorptive capacity for hydrocarbons. J. M. Beaton's work at the Royal Technical College, Glasgow, has been instrumental in establishing the constitution of taraxerol; also, by establishing the orientation of the carboxyl group in glycyrrhetic acid, he has com-

pleted the determination of its stereochemical configuration and has effected the first direct conversion of a member of the ursane triterpenoid group into an isomer of the oleanane group. Miss H. Kerr's successful work on the algae of the highest life zone of the shore at the Marine Station, Millport, and G. K. Wallace's work, in the Anti-Locust Research Centre Laboratory of the Entomology Department, Oxford, on the influence of light and of observable objects on the movements of locusts, are also noted, as well as that of Dr. S. M. Marshall and A. P. Orr on the distribution, anatomy, reproduction, development and life-cycle of the small crustacean *Calanus finmarchicus* (Gunnerus). Continuing his gravity

survey in Scotland, Dr. J. Phemister covered the whole of Fife and Scotland south of the Forth-Clyde, and W. G. Jardine continued his researches at Cambridge on the relation between shore-lines and river-valley development, with particular reference to the Southern Uplands. D. H. Mackenzie commenced a structural and petrological study of the granite and associated rocks of Mid-Strathspey, and D. I. Smith a similar study of the third ring dyke complex of Ardnamurchan.

The usual lists of publications by fellows, scholars and recipients of grants and of awards under the research scheme during the year are also appended, together with the financial accounts.

FLOW OF VISCOUS LIQUIDS IN BRANCHED TUBES

WITH REFERENCE TO THE HEPATIC PORTAL VEIN

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THE existence of independent stream-lines within the hepatic portal vein¹ may account for the localization of disease processes within certain parts of the liver². Before conclusions drawn from animal experiments can be applied to man, however, anatomical and physiological differences need to be considered. In different species, the tributaries and branches of the vein vary with respect to diameter and angle of junction; moreover, the relative rates of flow and viscosity of the circulating blood probably show species variations. To investigate the significance of these differences, experiments have been carried out on non-turbulent flow for the following typical junctions: a minor branch leaving a straight main tube; a minor tributary joining a straight main tube; and major and minor tributaries uniting to form a main tube. The aim has been to determine the region of the main stream which feeds the branch in the first case, and the region of main stream receiving from the tributary in the second and third cases. Some answer can then be given to the question: What are the chances that particles (bacteria, malignant cells, etc.) suspended in the blood leaving an organ and entering the portal vein will be eventually directed into a particular region of the liver?

The liquids used were (1) water and (2) 40 per cent glycerine in water (specific gravity 1.100), referred to below as 'glycerine'. The viscosities of these liquids at room temperature (19°–21° C.) were (1) 1.0 and (2) 3.5 centipoises, approximately that of human blood³. The tubes were of 'Perspex', cut and drilled as necessary, and cemented together so as to give sharp internal edges at the junctions. Unless otherwise stated, the internal diameters of the main tube and the wide and the narrow branches or tributaries were 10, 8 and 6 mm., respectively. The lengths of all the tubes from the junction were sufficient to ensure that the steady parabolic velocity profile was usually at least 99 per cent developed. By means of a large opal lamp and a lens, the system under investigation was projected on to a white screen and measured at a magnification of $\times 8$. Corrections for optical distortion were applied. No elaborate investigation of the scaling of tube dimensions has been attempted, but it appears that the results are valid

for other dimensions of tubes if the ratio of diameters remains unchanged. When flowing in tubes of diameter exceeding 0.4 mm., blood can be regarded as a continuous medium⁴.

For flow into a branch from a straight main tube, the apparatus is shown in Fig. 1a. Flow-rates were adjusted by constricting the two exits. The position of a stream-line in the main tube was shown by a fine line of coloured liquid (Evans blue) from a quill tube, the position of which was controlled by a micrometer screw. When the rates of volume flow, Q_s in the branch and Q_m in the lower part of the main tube, were steady, the position of the coloured stream-line was adjusted until it just failed to enter the branch. The distance x of this critical stream-line from the wall of the main tube was measured (Fig. 1a). Graphs of Q_s/Q_m against x were drawn, x being expressed as a percentage of the diameter of the main tube. Some results are shown in Fig. 2. Each curve is the result of thirty or more observations and is probably accurate to ± 5 per cent. The results were independent of the total flow-rate. It was concluded that, for a given value of Q_s/Q_m , the chances that particles in the main tube remote

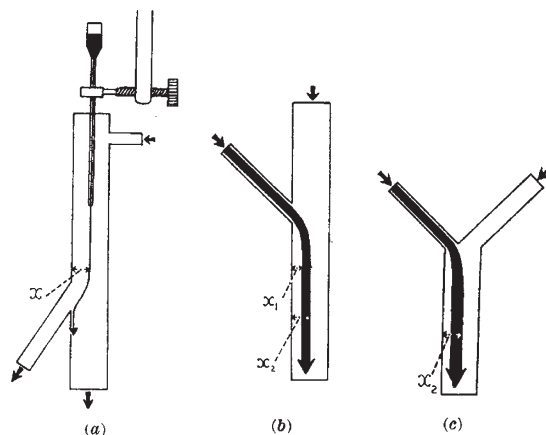


Fig. 1