Table 3. Rise of Non-Protein Nitrogen per 100 c.c. Plasma or 100 mgm. Fibrinogen (in mgm.)

Clotting substrate	Recalcification	Human thrombin added
Human plasma pre-adsorbed with barium carbonate but containing traces of prothrombin	0·36 ± 0·18	
Human plasma without detectable prothrombin	0·10 ± 0·27	0·31 ± 0·19
The same plasma with prothrombin preparation added	0·54 (0·32–0·70)	
Prothrombin-free fibrinogen	0·02 (from −0·01 to +0·05)	0·19 (0·10–0·30)
Crude fibrinogen with prothrombin added	0·16 (0·05–0·38)	

These observations led to the following conclusion[11]: "The protease causing this increase of non-protein nitrogen is activated under strictly the same conditions as are essential for the conversion of prothrombin to thrombin". The simplest conclusion, that the thrombin-protease is identical with thrombin, was not drawn from this statement, though it was much discussed in our laboratory. The coincidence of rise of non-protein nitrogen with clot formation, however, is not a definite proof of the identity of substances acting.

We have found the asymptotic time-curve regularly with thrombin preparations containing beyond any doubt a 'fibrinolysin'. The 'fibrinolysin' is not preformed in the eu-globulin solution, but in traces, which differ in preparations from different species. It is the addition of calcium ions which induces the activation of the fibrinolysin: this observation was made some time ago by Ferguson, Travis and Gerheim[13], who stated: "the protease impurity always shows up best in recalcified thrombin mixtures". This activation can be demonstrated without difficulty with eu-globulins from hen plasma. Lysis of the clot after recalcification takes 7 hr. (on the average); the same eu-globulin clotted with thrombin of hen plasma origin does not show the beginning of the lysis until after 96 hr.

Moreover, the rise of non-protein nitrogen in a fibrinogen solution (recalcified or clotted with a crude thrombin preparation) does not show the expected increase parallel to the visual appearance of the fibrinolysis.

In eu-globulin material it is only slightly higher after complete fibrinolysis (for example, 0·31 mgm. non-protein nitrogen per 100 mgm. fibrin after an incubation of 4 hr.); but nevertheless it is considerably smaller than the non-protein nitrogen found by Lorand[2] in the clotted, but not liquefied, fibrin material. These discrepancies must be caused by differences in the size of the degradation products, some being precipitated, the others not, by the Pincussen reagent or by Lorand's procedure.

The fibrinolysis effected by different fibrinolysin preparations (we have made observations on the preparation of Silva and Rimington[14] and on that of Kaulla[15]) gives a greater increase of non-protein nitrogen (0·93–1·17 mgm. nitrogen per 100 mgm. fibrinogen) and differs in this respect from the thrombin protease.

We agree we have no definite experimental evidence against the protease nature of thrombin; but we do not feel the results accumulated so far are adequate for this far-reaching assumption. We believe rather that our purest 'fibrinolysin-free' thrombin preparations contain a protease which is responsible for the asymptotic rise of non-protein nitrogen during clot formation. [July 25.

Note added in proof. In the meantime, we have succeeded in obtaining a powerful preparation of the thrombin-protease. This protease gives an asymptotic or roughly asymptotic time-curve of the non-protein nitrogen if added in traces to a concentrated fibrinogen solution; if added in excess to diluted fibrinogen solutions, it causes fibrinolysis and a high progressive rise of the non-protein nitrogen. This protease represents the active form of the relatively inert or inhibited fibrinolysin found by Guest and Ware in their purest thrombin preparations[16].

[1] Bailey, K., Bettelheim, F. R., Lorand, L., and Middlebrook, W. R., *Nature*, **167**, 233 (1951).
[2] Lorand, L., *Nature*, **167**, 992 (1951).
[3] Kowarzyk, H., and Szercha, M., *Acta Biologiæ Experimentalis*, Supp. **15**, No. 16 (1949).
[4] See Pincussen, L., "Mikromethodik" (Leipzig, 1930).
[5] Szercha, M., *Przeglad Lekarski*, **3**, 741 (1947).
[6] Krzyszton, Z., *Przeglad Lekarski*, **5**, 311 (1949) (English summary).
[7] Buluk, K., *Przeglad Lekarski*, **5**, 439 (1949) (English summary).
[8] Kowarzyk, H., Szercha, M., Buluk, K., and Krzyszton, Z., *Sprawozdania Wroclawskiego Towarzystwa Naukowego*, **3**, 268 (1948).
[9] Kowarzyk, H., Szercha, M., Buluk, K., and Krzyszton, Z., *Sprawozdania Wroclawskiego Towarzystwa Naukowego*, **4** (1949) (in the press).
[10] Olearczyk, J., *Przeglad Lekarski* **6**, 761 (1950).
[11] Kowarzyk, H., Buluk, K., and Olearczyk, J., *Acta Physiologica Polonica*, **1**, 69 (1950) (English summary).
[12] Kowarzyk, H., *Szpitalnictwo Polskie*, **3**, 217 (1950).
[13] Ferguson, J. H., Travis, B. L., and Gerheim, S. B., *Blood*, **3**, 1130 (1948).
[14] Rocha e Silva, M., and Rimington, C., *Biochem. J.*, **43**, 163 (1948).
[15] Kaulla K. N., v., *Nature*, **164**, 40 (1949).
[16] *Science*, **112**, 21 (1950).

STRUCTURE OF COMETS AND THE FORMATION OF TAILS

A PAPER on "The Structure of Comets and the Formation of Tails"[1] has been published by Dr. R. A. Lyttleton, which continues his investigations described in a previous paper, "On the Origin of Comets"[2]. It was suggested in the latter communication that comets were formed during the passage of the sun through a cloud of interstellar dust, the particles converging to the accretion axis where collisions destroyed their transverse velocities. In the more recent paper it is shown that the self-gravitation of comets is negligible in comparison with the differential force due to the sun, except at very great distances from the sun, and the particles composing them move in independent orbits.

As was shown in the earlier paper, during the perihelion passage the whole comet will turn inside out, particles on one side of the orbital plane crossing to the other, and contraction in the neighbourhood of perihelion perpendicular to the orbital plane should take place. Observational evidence supports this view because the nuclei of comets are actually known to contract considerably as the bodies approach perihelion and to expand again as they recede from the sun. Collisions between the particles will take place, and a rough estimate shows that for a comet of mass 10^{19} gm. about 10^{14} gm. would be involved in collisions at each return to perihelion. The relative velocities of the colliding particles depend on the orbital speed and the general size of the comet when it is at a great distance from the sun, but can be taken to be of the order $\frac{1}{4}$–$\frac{1}{2}$ km./sec., and such velocities are sufficient to pulverize the colliding particles. As a result of these collisions a range of small-sized particles would be formed, and those with dimensions of the order of 10^{-5} cm. would be driven off from the comet by the sun's radiation pressure ; in this way a comet would produce tails indefinitely at each return to perihelion.

One important effect may be mentioned. Differences of period in the particles must result in their distribution around the orbit of the comet, and in some cases these particles are responsible for meteor streams. In addition, collisions could lead to a resistance which would have effects similar to the Poynting–Robertson effect, though differing quantitatively, thus decreasing the perihelion distances of comets and accelerating their velocities.

This is described in a paper by H. P. Robertson, under the title, "Dynamical Effects of Radiation in the Solar System"[3]. Poynting showed that the absorption and re-radiation of solar radiation by small bodies produced a tangential drag, decreasing the angular momentum of the particles and causing them to spiral inwards towards the sun ; and Robertson examined the problem from the point of view of relativity. He obtained expressions for the retarding force which differed from those of Poynting and Larmor, and he admitted that the values caused by the drag could not be reconciled at the same time between the various elements. Lyttleton suggests that the further mechanism provided by his theory, combined with the Poynting–Robertson effect, might partly solve the difficulty that Robertson met in dealing with Encke's comet. It is hoped that Lyttleton will pursue this important subject later.

[1] *Mon. Not. Roy. Astro. Soc.*, **111**. 3 (1951).
[2] *Mon. Not. Roy. Astro. Soc.*, **108**, 6 (1948) ; see also *Nature*, **164**, 119 (1949).
[3] *Mon. Not. Roy. Astro. Soc.*, **97**, 436 (1937).

ELECTRONIC TELEPHONE EXCHANGES

A TELEPHONE exchange is basically a switch or aggregate of switches, by means of which two subscribers are connected together for the conduct of a telephone conversation. A manual exchange system is one in which human operators carry out the interconnexions between the subscribers ; but the idea was conceived some sixty years ago that this work could be conducted automatically by means of electromagnetic switches operated by impulses sent by the subscriber initiating the telephone call. This conception has been developed notably in the past thirty years or so ; and about half a dozen systems of automatic telephone exchange have achieved large-scale use in different parts of the world. During this period of development the thermionic valve amplifier, or repeater, has also been applied and has become a normal piece of equipment in any trunk or long-line telephone system. More recently, attention has been given in Great Britain and other countries to the possibilities of automatic telephone exchanges constructed with electronic switches, in order to determine whether exchanges cheaper and more reliable than the present types using electro-mechanical switches may thereby be produced.

At a meeting of the Institution of Electrical Engineers on March 13, a very interesting paper entitled "Electronic Telephone Exchanges" was read by T. H. Flowers, of the Post Office Research Station, Dollis Hill. The author approached his subject in a broad manner, and did not merely limit his theme to a simple problem of replacing a number of electro-mechanical switches by the corresponding valve assemblies carrying out the same individual functions. The paper considered the problem of line interconnexion anew from first principles, and then discussed some of the practical forms which electronic exchanges might take, the possibilities and characteristics of such exchanges, and—very briefly—the questions of cost and reliability. The multiplex switching arrangements required can make use of carrier-frequency or pulse techniques to obtain frequency- or time-division systems respectively. At the reading of the paper a demonstration was given of the operation of a model three-line exchange using trains of pulses for interconnexion, line-signalling and speech transmission between the subscribers' installations. Speech frequencies of 300–4,000 c./s. can be transmitted with a pulse-repetition frequency of 10 kc./s. for the trains of pulses. For a switch dealing with a hundred channels, the time-spacing between the channels is then 1 μsec., and a pulse width of 0·3 μsec. is desirable. As Mr. Flowers points out in his paper, transmission gain and loss, variation of loss, and distortion are features of electronic connector switches not found in existing types using metal-to-metal contacts ; but, on the whole, better speech transmission could be given by electronic systems using the connector switches described in the paper.

In the discussion, which followed the reading of the paper, several speakers emphasized the need for caution before too hurriedly adopting these new techniques, since cost and effective life are major items for consideration. A modern telephone exchange is expected to last for at least twenty-five years, and, as Mr. Flowers pointed out, it would be necessary to guarantee at least a five-year life for the components, including the valves, if the effect of failures on the service and the cost of replacing faulty parts are not to be prohibitive. The meeting provided a very useful introductory outline on the possibilities of electronic automatic telephone exchanges, and, whatever may be the outcome, there appears to be enough encouraging evidence to justify proceeding with the development of such exchanges.

COSMIC-RAY EXPEDITION TO THE HIMALAYAS

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THE University of Ceylon recently sponsored a cosmic-ray expedition to the Garhwal Himalayas. Early in 1951 various high-altitude experiments were designed by Dr. V. Appapillai and me, and a grant from the research committee of the University was obtained to enable these to be carried out. Accounts of the experimental work will be published in due course as the results become available. The purpose of the present note is to communicate some general information concerning the expedition, which, it is felt, will be of interest to cosmic-ray physicists and perhaps to others.