to have demonstrated the existence of a mechanism, presumably enzymatic, causing the rapid degradation of fragments *in vivo*, and discuss at some length the physiological implications of this finding. Neither the authors nor the reviewer consider an alternative explanation, that the fragments might have been released from the bacteria into the medium and in this way have escaped detection by the methods used. There is in fact some evidence for this explanation, from earlier experiments with alkaline phosphatase nonsense mutants of *E. coli*; phosphatase fragments were found to be rapidly released into the medium, an average time of about 20 minutes being required for a fragment to appear in the medium after being synthesized intracellularly[4,5]. The behaviour of phosphatase fragments could represent a special case, because the phosphatase enzyme in a standard strain of *E. coli* is localized in the region between the outer cell wall and the inner membrane (the periplasmic space); consequently phosphatase fragments might escape from a cell more readily than fragments of other proteins. Nevertheless, in the absence of evidence to the contrary, the intracellular disappearance of fragments of any protein might result, not from degradation, but rather from the passage of the fragments into the surrounding medium. Until this possibility has been tested, the conclusion that *E. coli* protein fragments are degraded *in vivo* must be regarded as speculative.

Yours faithfully,

ALAN GAREN

Department of Molecular Biophysics and Biochemistry,
Yale University,
New Haven, Connecticut

[1] Goldschmidt, R., *Nature*, **228**, 1151 (1970).
[2] Platt, T., Miller, J. H., and Weber, K., *Nature*, **228**, 1154 (1970).
[3] *Nature*, **228**, 1137 (1970).
[4] Suzuki, T., and Garen, A., *J. Mol. Biol.*, **45**, 549 (1969).
[5] Natori, S., and Garen, A., *J. Mol. Biol.*, **49**, 577 (1970). Reference to the loss of phosphatase fragments from cells is specifically made on page 587 of the second article, and the experimental details have been submitted for publication in *J. Mol. Biol.*

THIS letter has been shown to our correspondent, who replies :

The idea that cells might extrude unwanted nonsense fragments is appealing, but seems unlikely to apply for β-galactosidase and lactose repressor mutants. Neither of these proteins is located in the periplasmic space; this must imply that a special (enzyme) system would be needed to transport the nonsense fragments out of the cell. This seems more complicated than merely degrading the fragments, and would in any case demand the type of recognition mechanism which the authors discussed to discriminate mutant from normal proteins. An extrusion mechanism does not, therefore, seem to possess any theoretical advantage, and experimentally Goldschmidt was able to detect and identify a protein fragment which is probably produced by the postulated endopeptidase degradation of the β-galactosidase nonsense fragment.

Neuromythology ?

SIR,—Is the large daily loss of neurones from the brain, which figures in all the textbooks and provides the basis for Dawkins's[1] ingenious model of memory, as well established as he suggests? I write because the matter, which was the subject of a fair amount of controversy at a recent American research course on ageing, is of considerable importance for models of psychological and psychiatric ageing as well.

Leaving aside insect work, the prime authority for a massive loss is Brodie[2], whom Dawkins quotes, though the original mammalian claim was made by Hatai[3] for the rat, and repeated by Vogt and Vogt[4]. The loss of Purkinje cells from rat brain found by Inukai[5] has not been discovered in ageing hamsters[6]. With regard to the cortex, which would appear to be the critical site for Dawkins's purpose, some loss is reported[7] but in the rat it appears to be trifling[8]. The most recent title indicates no loss whatever with age from the human cochlear nucleus[9].

In view of the importance of the subject and the categorical nature of the textbook statement, the matter of cell loss with age among fixed postmitotics is due for careful re-examination, in spite of the tiresome task of cell counting which it involves. It would be of interest to know whether studies of this kind in mammals are already in progress.

Yours faithfully,

ALEX COMFORT

Director of Research, Gerontology,
University College London

[1] Dawkins, R., *Nature*, **229**, 118 (1971).
[2] Brodie, H., *J. Comp. Neurol.*, **102**, 511 (1955).
[3] Hatai, S., *J. Comp. Neurol.*, **12**, 107 (1902).
[4] Vogt, C., and Vogt, O., *Nature*, **158**, 304 (1946).
[5] Inukai, T., *J. Compar. Neurol.*, **45**, 1 (1928).
[6] Wilcox, H. H., *J. Gerontol.*, **11**, 442 (1956).
[7] Wright, E. A., and Spink, J. M., *Gerontologia*, **3**, 277 (1959).
[8] Brizzee, K. R., Sherwood, N., and Timiras, P. S., *J. Gerontol.*, **23**, 289 (1968).
[9] Konigsmark, B. W., and Murphy, E. A., *Nature*, **228**, 1355 (1970).

ESRO Satellite

SIR,—It was not our intention to imply that a satellite needs to be stabilized to the same accuracy with which one desires to locate the X-ray sources. There is, however, a relation between the two as illustrated by the example of Sco X-1 given by Dr Gursky[1]. As he correctly states, the requirement is to know, with high precision, the attitude, at the same time maintaining a stability commensurate with the field of view of the instrument. For the HEAO mission to which Dr Gursky refers (that carrying modulation collimators, not the large X-ray telescope planned for a later mission) he claims a limiting accuracy in location of several arc seconds.

If this can be achieved, the two missions would give complementary results in the location of sources since the occultation satellite, although in principle capable of higher precision, locates a smaller fraction of the observed sources. On the other hand, an important characteristic of the occultation method is that the angular dimensions and relative structure of extended sources can be obtained with even higher accuracy than that of location, down to small fractions of an arc second.

We should finally note that the terms "complex" and "expensive" are, of course, relative rather than absolute, and should be read in the context of the ESRO budget which does not at present envisage satellites of the HEAO type.

Yours faithfully,

J. ORTNER

The ESRO Mission Definition Group
for the Highly Eccentric X-ray
Astronomy Lunar Occultation Satellite

[1] Gursky S., H., *Nature*, **228**, 1121 (1970).

Neural Nomenclature

SIR,—In 1933, Dale[1] suggested the terms "adrenergic" and "cholinergic" for the two types of autonomic nerve fibre known at that time. He introduced these terms "to assist clear thinking, without committing us to precise chemical identifications, which may be long in coming".

In the early 1960s powerful nerves were found to supply that gut which were neither cholinergic nor adrenergic[2-4]. Since then, there have been a number of reports concerning details of their distribution, structure and function[5-7], but their description as non-adrenergic, non-cholinergic nerves is clumsy and somewhat negative. Evidence has recently been presented that the transmitter substance released from these nerves may be ATP or some related purine nucleotide[8]. It would therefore seem suitable, for the same reasons put forward by Dale in 1933, to propose that the new nerves be termed "purinergic".

Yours faithfully,

G. BURNSTOCK

Department of Zoology,
University of Melbourne, Parkville, 3052,
Victoria, Australia

[1] Dale, H. H., *J. Physiol.*, **80**, 10 (1933)
[2] Burnstock, G., Campbell, G., Bennett, M. and Holman, M. E., *Nature*, **200** 581 (1963).
[3] Burnstock, G., Campbell, G., Bennett, M., and Holman, M. E., *Intern. J. Neuropharmacol.*, **3**, 163 (1964).
[4] Burnstock, G., Campbell, G., and Rand, M. J., *J. Physiol.*, **182**, 504 (1966).

[5] Burnstock, G., *Pharmacol. Rev.*, 21, 247 (1969).

[6] Campbell, G., in *Smooth Muscle* (edit. by Bülbring, E.), 451 (Edward Arnold, London, 1970).

[7] Burnstock, G., and Iwayama, T., in *Progress in Brain Research* (Elsevier, Amsterdam, in the press).

[8] Burnstock, G., Campbell, G., Satchell, D. G., and Smythe, A., *Brit. J. Pharmacol.*, 40, 11 (1970).

Milliard or Gillion?

Sir,—When a word has become ambiguous it should be discarded. Attempts to reimpose precision could ultimately be successful, but there will be an inconvenient phase in which, though a writer may know what the word should mean, there is no certainty that readers will be in the same happy state. The word billion seems to be irrevocably lost. Boroughs's suggestion (*Nature*, 229, 142; 1971) that the vague word "milliard" should be defined as 10^9 is unsatisfactory because it is already current and readers will not, for a time, know whether it is being used precisely or not. May I repeat the suggestion (*Nature*, 220, 312; 1968) that we should make use of the lucky accident that M is both the internationally agreed symbol for 10^6 and the initial letter of million. G and T are the symbols for 10^9 and 10^{12} and could be used to form the new and therefore unambiguous words gillion and tillion.

Yours faithfully,

N. W. PIRIE

42 Leyton Road,
Harpenden,
Hertfordshire

Obituary

Professor A. S. Besicovitch

ABRAM SAMOILOVITCH BESICOVITCH, Rouse Ball professor of mathematics at Cambridge from 1950 to 1958 and a Fellow of Trinity College, died on November 3, 1970.

He was born in 1891 and studied at St Petersburg, later teaching there and at Perm. He left the USSR in 1925 and worked in Copenhagen with Harald Bohr, who had recently built up his theory of continuous almost-periodic functions. In collaboration with Bohr and independently, Besicovitch enlarged the concept of almost periodicity to wider classes of functions. With an appropriate definition, a generalized almost-periodic function possesses a Fourier series and it satisfies Parseval and Riesz–Fischer theorems and also a Cantor theorem of uniqueness. Besicovitch brought all these investigations into a book in 1932.

Besicovitch was one of the most powerful mathematical analysts of his generation. He has been described as a master of intricate construction. An early illustration of this gift was his example—published in 1922 in a Russian journal which did not reach other countries—of a plane set made up of linear segments of length 1, one in every direction, having zero Jordan measure. He saw later that this set could be adapted to solve Kakeya's problem of finding the figure of least area in which a segment of unit length can be rotated through a complete revolution. By rotating a pencil on a table, the reader may guess that the figure sought is a three-cusped hypocycloid, having area $\pi/8$. The paradoxical truth is the existence of figures of arbitrarily small area.

In the 1930s Besicovitch wrote many papers on plane sets of points which have finite length in the sense of Carathéodory's linear measure. The density of such a set E at a point x can be defined by the limit of the linear measure of the part of E within a circle centre x divided by the diameter of the circle. Sets may be regular or irregular. A regular set behaves like a rectifiable curve, having a tangent at almost every point. An irregular set has positive density in every sector drawn from almost every one of its points. The first proofs of such theorems were long and complicated and they exemplify one of Besicovitch's aphorisms, "A mathematician's reputation rests on his bad proofs". In later papers he replaced some of his pioneering bad proofs by more elegant good proofs.

Hausdorff measure was a topic to which Besicovitch returned repeatedly, using the concept to refine results about sets of points and real functions. Suppose, for instance, that x is a number for which infinitely many rationals m/n exist differing from x by less than $1/n^q$, where q is less than one; then the set of x has Hausdorff dimension $2/q$.

In 1945 Besicovitch's gift for intricate construction led him, to his own surprise, to another paradox. He defined in space a surface homeomorphic with a disk (or a sphere), which has three-dimensional measure equal to 1 (say) but arbitrarily small surface area in the Lebesgue–Fréchet sense of the lower bound of approximating polyhedra. This led him to the view that results based on the Lebesgue–Fréchet notion of area must be recast in terms of Hausdorff plane measure. He and his pupils carried out a large part of this programme.

In trying to convey an impression of Besicovitch's magnificent mathematical gifts, no one could forget that they were matched by gifts of humanity which endeared him to pupils and friends and especially to young children.

Announcements

University News

Professor G. Slaney has been appointed to the Barling chair of surgery, **University of Birmingham**, in succession to Professor A. L. d'Abreu who retires this year. **Professor O. L. Wade** has been appointed to the newly established chair of clinical pharmacology and **Dr E. H. Ashton** to a chair of anatomy established for one tenure only. The title of professor of reproductive endocrinology has been conferred on **Dr P. Eckstein**.

Dr S. R. Stitch has been awarded a personal professorship in steroid endocrinology by the **University of Leeds**.

Dr H. Smith, University of Manchester, has been appointed to the chair of plant physiology in the Faculty of Agricultural Science, **University of Nottingham**.

Dr A. T. Cowie has been appointed head of the Physiology Department, National Institute for Research in Dairying, **University of Reading**, in succession to the late **Professor Folley**.

Appointments

Professor Alwyn Williams, Queen's University of Belfast, has been appointed a trustee of the **British Museum (Natural History)**, in succession to **Professor O. M. B. Bulman**.

Dr Philippe Shubik, Eppley Institute for Research into Cancer, University of Nebraska, and **James S. Gilmore, jun.**, Gilmore Broadcasting Corporation, Kalamazoo, have been appointed to the **National Advisory Cancer Council of the US National Institutes of Health**.

The following have been appointed vice-presidents of the **Royal Society: Sir Frederick Bawden**, Rothamsted Experimental Station; **Sir Bernard Katz**, University College London; **Sir Harrie Massey**, University College London; **Sir Harold Thompson**, University of Oxford; **Professor W. R. S. Doll**, University of Oxford; **Professor F. Hoyle**, University of Cambridge; **Dr J. M. Menter**, Tube Investments Limited.

Miscellaneous

Professor P. M. Maitlis, McMaster University, has been awarded the **1970**