explanation of the map this particular memoir is too long and as a reference source of all the geological information needed for practical purposes it falls short.

It also seems desirable to consider again the desirability of publishing the maps in a pocket with the memoirs. Too often the memoirs are used ineffectively, for example, in libraries, because the maps are not there. More attention might be drawn to the 6 inch : 1 mile maps. These are not mentioned in the list on the dust jacket and the reference in the preface to the page where they are listed is incorrect. They are very valuable maps which could be more widely used. R. M. SHACKLETON

MACHINE TRANSLATION

Machine Translation

Edited by A. D. Booth. Pp. ix + 529. (Amsterdam: North-Holland Publishing Company, 1967.) 180*s*.

SOME years ago, machine translation (MT for short) was regarded as one of the more important and promising applications of computers. However, promise was not backed up by performance, and gradually, as public interest waned, MT disappeared from view. Indeed, one would have been inclined to describe it as dead were it not for the appearance of this volume, like Petrouchka's ghost defiantly shaking its fist at an unbelieving world. The volume includes contributions from all the currently active groups in the field, and shows the state of development of the subject around 1965, when most of the articles were written. I was immediately struck by the fact that most of the groups here represented have been active in MT from its inception, displaying a product loyalty stronger than is usually found in the computer field.

The papers in this volume cover a wide range of topics, from highly detailed accounts of specific projects to more general surveys of the work of some groups.

Although interesting, the paper by M. Levison on the computer in literary studies is out of place, for it is not concerned with MT. Also, the paper by K. H. V. Booth on machine aided translation with a post-editor has an inappropriate title, for it is concerned chiefly with statistical studies of the frequency of occurrence of word combinations as an aid to efficient translation. The paper includes extensive tables obtained by an analysis of extracts from the Canadian Hansard. No attempt has been made by the editor to arrange the papers in functional groups. If there is any common factor to be discerned in these papers it is the importance of predictive methods of analysis and the use of a statistical approach to pick out commonly related groups of words. But in the main there are no broad conclusions to be drawn, save perhaps that nobody has so far got anywhere near a completely automatic translation system. The paper most likely to interest the lay reader is that by V. H. Yngve on MT at MIT, 1965. The other papers are of interest only to specialists: indeed, the whole volume will be required reading for anyone starting research in MT. But the lay reader or computer man who wants to know what MT is about will have to look elsewhere.

D. W. BARRON

University News

Mr B. C. Leighton, King's College Hospital Medical School, London, has been appointed to the chair of orthodontics tenable at that school.

Dr S. Gregory, University of Liverpool, has been appointed to the second chair of geography in the **University of Sheffield.**

CORRIGENDUM. In the communication "Formation of Polymeric Carbon Suboxide during Gamma Radiolysis of Liquid Carbon Monoxide at 77° K" by J. P. Briggs and P. G. Clay (*Nature*, **218**, 355; 1968) the last three lines of Table 2 should read:

4	1·46	0·97
5	1·43	0·96
Average	1·49 ± 0·05	0·98 ± 0·03

ERRATUM. In the communication "Structure of Chymotrypsinogen *B* compared with Chymotrypsinogen *A* and Trypsinogen" by L. B. Smillie, A. Furka, N. Nagabhushan, K. J. Stevenson and C. O. Parkes (*Nature*, **218**, 343; 1968) the sentence beginning on the seventeenth line of the second paragraph should read: "High-voltage electrophoresis on paper has been the principal means of peptide purification in this work, giving low yields, and so considerable importance has been attached to the isolation of the appropriate overlapping sequences". The second sentence of the fifth paragraph should read: "It has been shown that the autolytic cleavage of the leucine-13 to alanine-14 peptide bond in chymotrypsin *B* does not occur". In Table 1 the three amino-acid sequences are shown in the order Chymotrypsin *A*, Chymotrypsin *B*, Trypsinogen. Ref. 22 is a manuscript in preparation and not in the press.

CORRESPONDENCE

New Name for the Kilogram

SIR,—C. W. Allen discussed a new name for the kilogram in his letter published in *Nature* (**218**, 209; 1968). If a new name for kilogram is required beginning with "q", why not adopt the Portuguese name for kilogram which is quilo ?

Yours faithfully,

M. FULTON

Amancay,
Colwinston,
Cowbridge, Glamorganshire.

Biosatellites are a Waste of Money

SIR,—Your leading article (**217**, 899; 1968) contained a number of errors of fact and a number of misinterpretations. The article attempted to make a case that NASA was proceeding with a Biosatellite Programme which was not supported by the scientific community, and that the results so far are of little value. We would like to address ourselves to these points and ignore the unpleasant insinuations which, even if answered, would contribute little to scientific understanding.

Early in NASA's history, American scientists urged that biological research be conducted in the space environment because space flight offered two conditions unobtainable in laboratories on Earth. One, of course, is sustained weightlessness, and the other is the absence of cyclic disturbances associated with the rotation of the Earth.

The establishment of the Biosatellite Programme was recommended by the Space Science Board of the National Academy of Sciences–National Research Council.

A large number of bioscientists were notified of the opportunity to propose experiments and almost 200 scientists submitted proposals for experiments to be carried in the Biosatellite Programme. The experiments to be flown were selected on the recommendation of panels of outstanding specialists throughout the scientific community.

Approximately half a year after the first successful Biosatellite flight, in response to numerous requests for information on the results, a symposium was held at the

National Academy of Sciences to present preliminary results of the mission.

Significant scientific results were reported at this symposium. For example, one set of Biosatellite II experiments concerned the interaction of radiation and weightlessness.

Previous observations, both by the USSR and US, in flights of biological material had revealed greater effects of radiation than would have been expected from studies on Earth. These prior observations were not rigorous enough to be satisfactory. So the Biosatellite II experiments were designed to explore this phenomenon under very carefully controlled conditions. An onboard radiation source was used to give an exact, predetermined radiation dose. Organisms of thoroughly known sensitivity to radiation were used for the study.

The results presented at the symposium showed convincingly that there is an interaction between radiation and one or more factors encountered in flight. This interaction, depending on the organism used, varied between increasing the effects of radiation fourfold to decreasing the effect slightly but significantly.

The comment in *Nature* on March 9 stated that vibration encountered during the launch of Biosatellite II was greater than anticipated. This is not true. Preflight control experiments subjected samples to forces up to more than two times greater than experienced during the flight. Perhaps your correspondent was misled by the conservative statements of scientists who did not want to claim—despite these controls—that they were certain that vibration played no part in the effects observed. Furthermore, the proposals for extensive post-flight control experiments do not imply repudiation of the results. The desire of scientists to refine and re-refine their investigations is a matter of rigour, not repudiation.

Another set of experiments was designed to study the biological effects on simple organisms of weightlessness alone. One result was partial confirmation of a simulation method used by botanists for more than a century. This classical simulation method consists of rotating plants on a clinostat so that, over a period of time, the force of gravity affects the plants in opposing directions approximately equally. The Biosatellite experiments indicate that in already developed plants clinostat rotation probably influences the distribution of intracellular constituents in the same way that weightlessness does.

Now there is need to go on to determine the intimate effects of weightlessness on organisms that are not ordinarily oriented to gravity in a single direction. It is known that changes in body structure and composition occur in higher animals in orbital flight. In 1969 a primate will fly in Biosatellite to help clarify these phenomena. The third series of Biosatellite flights planned for 1970 or 1971 will explore the biological effects of weightlessness using rats, human tissue cultures, and also plants that will go through a full life cycle from seed to seed, in space.

Findings from the Biosatellite experiments have stimulated a number of new investigations to resolve provocative anomalies like the following:

1. Not all of the responses of plants—in-flight and ground control on clinostats—were consistent. There were cytological differences in the wheat seedling grown in the spacecraft compared to the clinostat controls.

2. The pepper plants that developed in orbit were much slower in re-establishing a normal orientation than the clinostat controls. Does this mean that in the difference between balanced gravity and weightlessness there are yet-to-be-discovered factors of biological significance?

3. Comparisons of flight and clinostat data have led to research to sharpen the parameters of clinostat design. What, precisely, are the peculiarities of various axes of rotation? What, precisely, are the interactions that should govern the selection of a rotation rate?

4. The observed synergism of radiation and weightlessness has stimulated intensive radiobiological studies using clinostats. Additional studies explore the effects of vibration and acceleration in combination with radiation.

5. Scientists are requesting additional Biosatellite flights with an onboard centrifuge to provide 1*g* controls in the same environment with the weightlessness experiments.

In addition to its bioscience mission, the flight of Biosatellite II had a purpose of engineering qualification of the spacecraft for future research. All of the telemetry available was utilized for spacecraft qualification purposes. Experiments had to be complete in 3 days, and examination after recovery was the sole means of data collection. Nevertheless, the experiments aboard Biosatellite II were remarkably sophisticated with precise environmental control and with automated laboratory procedures occurring in space.

The question of whether the 21-Day Mission in 1970 or 1971 should be altered in the light of Biosatellite II results was discussed at length by our Space Biology Subcommittee immediately following the symposium. In this discussion it was brought out that the opportunity to study the growth and reproduction of human tissue in weightlessness (perhaps with the addition of a radiation source) is a natural follow-on to Biosatellite II results, and one of considerable urgency for human flight.

The seed-to-seed plant experiment will evaluate many factors in the role of gravity in plant growth and development, rather than only the two simple parameters studied in Biosatellite II.

The 21-Day Mission includes multiple-purpose studies with rats. This will be the first closely controlled experiment to learn what happens to biological rhythms when a "day" shrinks from 24 h to about 90 min. In addition, the rat experiments will include the most careful investigation to date of changes in body composition and body structure during space flight.

The experiments in the planned series of Biosatellite missions were selected originally to supplement rather than reinforce one another. Together they constitute a fairly broad survey of the effects on biological systems postulated for space flight.

One final point we would like to make is that the cost of space research is high because it involves the work of many people. Space bioscience experiments involve not only biologists but physical scientists, engineers and a great many people responsible for production and operation of the flight systems. There is no escaping this cost because there is no way to ascertain the biological effects of the space environment other than to conduct biological experiments in space.

Sincerely,

ORR E. REYNOLDS,
Director Bioscience Programs,
Office of Space Science and Applications.

JOHN E. NAUGLE,
Associate Administrator for
Space Science and Applications.

National Aeronautics and
Space Administration,
Washington, DC.

The leading article of which Drs Reynolds and Naugle complain argued that the results of the Biosatellite II experiments were inconclusive and not worth the expenditure of $50 million. It is good to learn of the ways in which Biosatellite II has suggested new experiments, but the statement now that vibration during launching was not excessive does not explain why it has been necessary to repeat the control experiments. Estimating the value of a set of experiments like these is necessarily a subjective process, but the symposium in Washington left many sceptics unconvinced.—Editor, *Nature*.