students of domestic animals (33 and 4 more under the heading of animal husbandry); conservationists (2); zoology teachers (37). Others, presumably 'pure', branches of zoology, are represented by these figures: morphology (75); physiology (55); embryology (78); zoogeography (9); general ecology (3); ecology of vertebrates (301); (no heading for ecology of invertebrates); invertebrate zoology (39); vertebrate zoology (68); ornithology (140); teriology (108); herpetology (24); ichthyology (342); malacology (12); protistology (19); human anatomy (4); soil zoology (10); history of zoology (11); histology (48). A very low number of geneticists (8) is, perhaps, less surprising to see than only five "Darwinists", and there are no more than two biophysicists and two biometricians; there are, apparently, no biochemists (unless they are listed as physiologists) and only one experimental zoologist. When all groups are added to-

gether, the total number is 3,250, that is, about 500 more than in the alphabetical list; this is because many persons indicated more than one speciality.

The system of classification is such that it is almost impossible to see what proportion of zoologists is carrying out basic research and what is engaged in practical applications. A glance through the list of entomologists and the institutions where they work suggests that, probably, more than half of them are engaged in pest control. If the same applies to zoologists and ecologists working, for example, on rodents and other economic animals, it appears that the great majority of Soviet zoologists is engaged in applied work.

Although admittedly incomplete and somewhat out of date, the list will be useful to zoologists in other countries who may wish to exchange publications with their Soviet colleagues.

COMMONWEALTH SCHOLARSHIP COMMISSION

THE second annual report* of the Commonwealth Scholarship Commission shows that there were 168 Commonwealth scholars studying at United Kingdom universities and colleges during 1960-61. In the 1961 competition, 232 candidates have accepted the offer of scholarships, 40 of them coming from India, 28 from Canada and 22 from both Australia and Pakistan.

One feature of the report will lead to some disquiet. The Commission made a preliminary examination of the problem which it is likely to face in considering applications for extension of tenure in and after the third year of the Commonwealth Scholarship and Fellowship Plan. A number of scholars have accepted two-year awards and has been admitted to courses of research for which three years of study are needed if the holder is to obtain the doctorate at which he aims. For such scholars to return to their country with their research half-completed, and without a qualification, will engender frustration and militate against the realization of the aims for which the Commonwealth Scholarship and Fellowship Plan was instituted. At the Commonwealth Education

Conference in 1959 it was anticipated that most candidates would, on taking up awards, have already had some postgraduate experience which would enable them to obtain a higher degree in the United Kingdom with two years further work. It is found, however, after two years experience of selection of candidates for United Kingdom awards, that a majority of them enter the competition in the final year of their course for a first degree or its equivalent and are judged to need at least three years further work if they are to proceed to a Ph.D. on their scholarship. It is therefore expected that a substantial number of the 1960 scholars will have good grounds for asking for an extension of tenure for a third year. The Commonwealth Scholarships Act, 1959, prescribes that not more than 500 awards may be held at any one time. If the statutory limit remains unaltered, and during 1961-62 the Commission wishes to extend the tenure of a substantial number of the 1960 awards for a third year (that is, tenure during 1962-63), it will have to choose between granting such third-year extensions and making, in the 1962 competition, the total of 250 fresh awards which it would normally seek to make. There would thus be a clash between the claims of existing scholars and the expectations of the several countries making new nominations.

* Commonwealth Relations Office; Colonial Office. Second Annual Report of the Commonwealth Scholarship Commission in the United Kingdom for the year ending 30th September 1961. Pp. 36. (London: H.M.S.O., 1962.) 2s. 3d. net.

FORESTRY RESEARCH IN BRITAIN

THE report* on forest research for the year ended March 1960, issued by the Forestry Commission, contains accounts of the research work carried out by the Forestry Commission research staff and by workers attached to universities and other institutions, most of whom are aided by grants from the Forestry Commission. In it there are a number of good photographs, but some of these would have been improved by the inclusion of an object to provide a comparison of size. The general trend of the research work is in keeping with the developmental stage the Forestry Commission has reached, and it is also indicative, in some measure, of what is likely to become normal practice in the fairly near future.

Afforestation is still a dominant work in which the Forestry Commission is engaged, and must hope to be engaged for some time to come. Afforestation problems are being investigated on difficult sites, including disused sand and gravel workings, on areas overlying impermeable clay and on exposed and elevated sites. But more and more attention is now being directed to the problems of existing forests such as their improvement, stand structure and regeneration. Large areas of forest have been established on peat, and this medium contains particular difficulties which are not easy to overcome. It requires draining; few tree species can be grown on it; the stability of the trees is often precarious; and there is now evidence, after some years, of a deficiency of potash and other elements in pine stands established successfully by deep draining and cultivation of the peat and aided

* Forestry Commission. Report on Forest Research for the year ended March 1960. Pp. viii + 203 + 16 plates. (London: H.M.S.O., 1961.) 12s. net.

by phosphatic fertilizers applied at the time of planting. It is also realized that some pure stands may be improved by transforming them into mixtures, and so long-term experiments have been established for this general purpose which also include a comparison of the effect of pure and mixed stands on soil conditions.

Considerable attention to the soil is being given by way of fertilizer trials on sand dunes and on deep peat, by soil analyses and studies of the breakdown of litter by the soil microfauna. The effect of wind on Britain's forests is a major consideration and so studies continue to be made on windblows, the stability of trees and stands and the recording of air-flow in relation to shelterbelts.

Nylon netting, as a cheaply erected alternative to conventional netting, and wire-strand fencing for exclusion of deer from regeneration areas are showing encouraging results. Another line of research in

forest protection is the use of herbicides to maintain efficient, non-inflammable firebreaks. Although successful results have been obtained, a limiting factor to their use is the expense, and thus it seems unlikely that they will be used except for particular cases where the high cost can be justified.

After eleven years of experience of pruning conifers by disbudding, the conclusions reached are that it has been a failure with some species and not sufficiently successful with the others to warrant it being applied on a forest scale. So Britain's new forests are no longer in danger of having grotesque tufted poles scattered through them.

Those responsible for directing and implementing the research work of the Forestry Commission are to be congratulated on the good results that have been obtained and on publishing them in such an attractive manner.

C. J. TAYLOR

INTERSTELLAR COMMUNICATION AND HUMAN EVOLUTION

By PROF. ROBERT ASCHER

Department of Sociology and Anthropology, Cornell University

AND

PROF. MARCIA ASCHER

Department of Mathematics and Physics, Ithaca College, New York

G. COCCONI and P. Morrison have recently entertained the possibility of interstellar communication¹.

More recently a search for signals from other civilizations was considered by von Hoerner². In the later article it is pointed out that the potential of a search is largely dependent on the adequacy of guesses about the probability of the existence of extraterrestrial technical civilizations, the probable stage of development of a civilization which we might contact, the longevity of attempts at contact following success or failure, and the result of possible contact and exchange. Attention is given to the determination of these and other factors and some numerical estimates are suggested. Presumably this and similar investigations will form the basis for the design of listening and sending apparatus. This ambitious and expensive endeavour may benefit by using models founded on human evolution as well as extraterrestrial data, and constructed with the end of increasing the reasonableness of the guesses. This article indicates initial steps in this direction.

The use of a model or series of models which involve human evolution is necessarily based on two assumptions. We assume that throughout hominid history, since the origin of hominids and culture, there has existed sufficient curiosity to motivate attempts to contact self-conscious life-forms and some means of doing so. Secondly, we assume that the effectiveness of the barriers which separated different populations during prehistoric times was equivalent to the effectiveness of the barrier which now separates Earth civilization from possible extraterrestrial civilizations. The first assumption is supported in interpretations of the archaeological and fossil hominid records and in behavioural studies of the higher primates and other advanced mammalian forms. The second assumption is tenable because for most of prehistory the only means of communication was bipedal locomotion. Extensive

bodies of water, in particular, were restrictive to contact between small terrestrial populations. Both assumptions are related by opposition; curiosity encouraged contact and effective barriers inhibited it.

In order to construct the proposed models some definitions used in the recent article in *Science* are re-cast. There, a technical civilization is defined by the "presence of highly advanced radio techniques"; here, a technical civilization is defined by the presence of barrier-surmounting techniques, irrespective of the barrier or the techniques. This reformulation is not only necessary for the inclusion of relevant information but is also necessary for the entire endeavour. It would be shortsighted and inhibiting to future ideas on communication to view possible extraterrestrial civilizations ethnocentrically, or rather, electrocentrically, by supposing that the highest form of communication now reached on Earth is the highest form that will be reached here or can be reached elsewhere. Along with this, we substitute contact activities for contact signals. Even if within-vision devices, such as large fires, were used as contact signals in prehistoric times, they would be difficult for the prehistorian to locate, impossible to interpret with confidence, and are not directly relevant to the barrier-surmounting problems with which we are concerned. On the other hand, evidence of contact activities such as intrusive tools are the data with which the student of human evolution is familiar.

Within the context of the present problem, we tentatively divide prehistory into two technical orders and call the first early prehistory and the second, later prehistory. The principal criterion for this division is the barrier-surmounting technique or techniques which existed during each order. The analogy between prehistoric contact and exchange, and hypothesized extraterrestrial contact and exchange, is suggested in the following description.

Early prehistory begins with the origin of hominids and technology more than 1,000,000 years ago and