

The variance around the means of the age-classes provides an estimate of the expected range of visual threshold of normal persons of different ages. This is expressed in the figure and table as the limits enclosed within plus and minus twice the standard deviation from the mean of each age class. It is seen that both the mean and its variance increase with age, though the lower limit of the range rises more slowly than the higher. The lower limit in fact represents the physiological optimum of the visual threshold measured under these conditions, and the progressive deterioration of the older age-classes is mainly due to the increased frequency of poor dark adaptation among elderly persons. Dark-adaptation tests of this type therefore are less sensitive for detecting pathological states in older than in younger persons.

Age class	No. of subjects	Mean age of class	Mean visual threshold $\pm$ standard deviation (log. $\mu\mu L$ )	Normal range expressed as mean $\pm 2 \times$ S.D. (log. $\mu\mu L$ )
1. 10 and under	79	8.3	1.872 $\pm$ 0.193	1.48 to 2.26
2. 11-20	258	16.2	1.777 $\pm$ 0.193	1.39 to 2.17
3. 21-30	139	25.1	1.844 $\pm$ 0.146	1.47 to 2.21
4. 31-40	89	34.7	1.889 $\pm$ 0.137	1.61 to 2.16
5. 41-50	43	44.5	2.007 $\pm$ 0.222	1.56 to 2.45
6. 51 and over	20	54.4	2.170 $\pm$ 0.256	1.66 to 2.68
Classes 1, 2 and 3 pooled	628			
	476	17.5	1.812 $\pm$ 0.182	1.45 to 2.18

The units of brightness in which these data were measured hold true for the conditions of this particular test only. The relative differences between the age-classes, however, are valid for all tests of this type, and provide a scale for defining the normal limits of visual threshold for persons of various ages. It is suggested that the best estimate of the normal range of persons less than thirty years of age is obtained by combining the data of the three youngest age classes (see bottom of table), the differences between the means of which do not reach the 5 per cent level of significance. The range of visual threshold expected at any greater age may then be expressed by adding a correction to this value.

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<sup>1</sup> Wald, G., *J. Opt. Soc. Amer.*, 31, 235 (1941).

<sup>2</sup> Steven, D., and Wald, G., *J. Nutr.*, 21, 461 (1941).

### Need for the Development of Tropical Ecological Stations

THE letter of Dr. V. J. Chapman and his associates in *Nature* of November 24, 1945, will be warmly welcomed by all who, like myself, have endeavoured to contribute to the study of tropical ecology. The necessity of fundamental ecological knowledge to the progress of forestry and agriculture, in fact to any rational scheme of land utilization in the tropics, is so clear that it need not be further argued; it is also evident that much of our current teaching in ecology, as well as in other branches of biology, would be set in a truer perspective if more consideration were given to tropical vegetation and the conditions for plant growth in the tropics. As van Steenis<sup>1</sup> has pointed out, in attempting to study vegetation and to arrive at generalizations which will serve to relate the various plant communities to one another, it would be more logical to begin with the floristically rich vegetation of the tropics than, as we now do, with the impoverished vegetation of northern Europe and North America. W. H. Brown<sup>2</sup> wrote in much the same strain in 1919.

With regard to the practical proposals by Dr. Chapman *et al.*, there are a few comments I should like to make:

(1) The authors complain that the ideas on tropical ecology which they gained at British universities were faulty. This is scarcely surprising when the few references to tropical vegetation which occur in university courses are mainly derived from works as long out of date as the English edition of Schimper's "Plant Geography". There is a great need for at least some of our universities to develop, probably at the post-graduate level, introductory courses in tropical botany, including ecology; such courses would be valuable both as a preparation for men about to take up posts in tropical countries and as refresher courses for those already working there.

(2) I should like to support the plea for frequent exchanges of workers between the forestry departments in the Colonies and the home universities, but exchanges between different colonies would be even more valuable. My own researches<sup>3</sup> have demonstrated that plant communities of similar habitats in countries as far apart as Borneo and British Guiana may be remarkably similar in both their structure and their ecological relationships. Such similarities are only apparent to those who have had experience of more than one tropical region. The man whose experience is limited to one colony or region will be unable to distinguish the general from the purely local features of the communities he studies.

(3) The writers of the letter rightly urge the need for writing more papers on tropical problems, but they do not consider where such papers are to be published. Papers on tropical ecology at the present stage of its development are largely descriptive and therefore necessarily long. Even when the present stringency in paper and printing has passed, the editors of such journals as the *Journal of Ecology* may be unwilling to publish a large number of papers on tropical ecology,

however excellent, because many readers may not be interested in the subject. There seems a strong case for some kind of subsidy from the Colonial Office or the Colonial governments which would enable long papers to be published as supplements to established journals.

(4) The need for a central ecological bureau analogous to the Imperial Agricultural Bureaux is undoubted; it was suggested in 1940<sup>4</sup>. Whether such a bureau would be best sited in India seems to me less certain.

(5) Dr. Chapman and his friends do not seem to appreciate the extent to which the advance of tropical ecology must be dependent on the further development of systematic botany in the tropics. It is undoubtedly true that much valuable ecological work can be done without anything approaching a complete list of the species in the communities studied; it is also true that an improved system of classifying tropical plant communities can only be arrived at by paying more attention than at present to their structure and physiognomy and less to their floristic composition, but with the statement that "the description of tropical forests in terms of detailed floristics or quadrats is of very little value" I emphatically disagree. To take only one example: only by a study of floristic composition in relation to the factors of the environment can we deal with such problems as the causes underlying the dominance of single species in certain types of tropical forests, a problem of obvious importance to the forester who is trying to grow a pure crop of one or a few economically valuable species of trees. The difficulties in the way of accurate floristic studies are great, but they are not insuperable. The writers of the letter are not helping to remove them by suggesting that "when the ecologist or forester arrives in the tropics he will find that one or other department has a trained systematist who can prepare any list he desires". Certainly there are some excellent systematists in the Colonies, but is there even one Colony with a 'flora' really adequate by modern standards, or where the systematics of even the commoner trees are sufficiently known, even to the 'trained systematist'?

(6) It will be generally agreed that one or more tropical field stations for ecological research are greatly needed. The value of such stations, especially to visiting workers from home universities, is sufficiently shown by the important scientific results obtained at the laboratories at Buitenzorg and Tjibodas in Java, until recently the only stations of their kind. The value of such stations would be much increased if samples of undisturbed natural vegetation in their neighbourhood could be set aside as nature reserves. It is often not realized that the forest reserves in the Colonies are only reserves in the sense that they are protected against unregulated felling of timber. The area of virgin tropical rain forest and of other climatic climax communities in the tropics is rapidly decreasing and it is essential in the interests of ecological research, if for no other reason, that samples of them should be preserved before it is too late.

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<sup>1</sup> van Steenis, C. G. G. J., *Tectona*, 30, 625 (1937).

<sup>2</sup> Brown, W. H., "Vegetation of Philippine Mountains" (Manila, 1919), p. 43.

<sup>3</sup> Richards, P. W., *J. Ecol.*, 24, 1, 340 (1936).

<sup>4</sup> Richards, P. W., Tansley, A. G., and Watt, A. S., *J. Ecol.*, 28, 224 (1940).

In *Nature* of November 24, a letter appeared concerning the need for the development of tropical ecology, with a suggestion for co-operation from tropical foresters. My experience in Malaya during the last sixteen years tells me that this appeal is only a small part of a much greater problem and no way to succeed. The need is for the development of tropical biology in every branch by 'pure', not applied, biologists in proper biological institutes in the tropics.

It seems absurd to write such an obvious thing, but consider botany. From the arctic circle to the equator, the abundance and variety of plants increase in geometrical proportion. Their science has grown up between latitudes 40° and 60° N., and botanical text-books omit the majority of them. No other science, perhaps, has become so unbalanced through the neglect of its tropical aspect.

But where can a British botanist learn tropical botany? In all the extent of our tropical Colonies and Protectorates there is only one botanical department: the Gardens' Department of the Straits Settlements; and it cannot be said that any botanist other than those of its minimal staff has ever been to its Botanic Gardens for research. No botanist, moreover, could be found to relieve the director or myself, after our struggle to preserve the Department during the Japanese occupation. Indeed, it may now lose its status through apathy.

In the case of zoology, where is there a 'zoo' in a British Colony, and how many marine aquaria? Not a zoologist, either, could be found to relieve those of us at Raffles' Museum who struggled to maintain it during the occupation.

One must conclude that, in consideration of its enormous territorial advantages, British science has done little to develop tropical biology.

It must be obvious that tropical biology cannot be studied in temperate institutes any more than temperate biology can be studied at the equator. Somehow or other, we must not only establish tropical biological institutes but also secure large tropical nature reserves under their immediate direction so that tropical biology can flourish and tropical life can be preserved. British science should lead, yet the neglect of Singapore is to me a sad indication of the times—a weary struggle against petty finance and indifference; too remote for help from Great Britain.

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