

cent that of nitrate-nitrogen (ERIKSSON, 1952). When allowance, using this value, is made for the content of nitrite-nitrogen, a value of 1:2.4 is obtained for the ratio of nitrate- to ammonia-nitrogen in the precipitation at Malham Tarn Field Centre.

These results for the relationship of nitrate-

and ammonia-nitrogen in the precipitation are similar to those presented by KASNER (1926), HUTCHINSON (1944), ÅNGSTRÖM & HÖGBERG (1952), DROVER & BARRETT-LENNARD (1953), and WEINMANN (1955) but are discordant with the findings of many workers.

REFERENCES

- ÅNGSTRÖM, A., and HÖGBERG, L., 1952, On the content of nitrogen ($\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$) in atmospheric precipitation. *Tellus*, 4, pp. 31-42.
- DROVER, D. P. and BARRETT-LENNARD, I. P., 1956, Accessions of nitrogen (ammonia, nitrate and nitrite) in western Australian wheat belt rains. *J. Aust. Inst. agric. Sci.*, 22, pp. 193-197.
- ERIKSSON, E., 1952, Composition of atmospheric precipitation. 1. Nitrogen compounds. *Tellus*, 4, pp. 215-233.
- GAMBELL, A. W., and FISHER, D. W., 1964, Occurrence of sulfate and nitrate in rainfall. *J. geophys. Res.* 69, pp. 4203-4210.
- HORA, F. B., and WEBBER, P. J., 1960, A source of serious error in the determination of nitrates by the phenoldisulphonic acid method and its remedy. *Analyst*, 85, pp. 567-569.
- HUTCHINSON, G. E., 1944, Nitrogen in the biogeochemistry of the atmosphere. *Amer. Scientist*, pp. 178-195.
- KASNER, C., 1926, *Wolken und Niederschläge*, Leipzig, Quelle and Meyer.
- SCHARRER, K., and FAST, H., 1951, Investigations on plant nutrients supplied to soil in precipitation. *Z. Pflernähr. Düng.*, 55, pp. 97-106.
- Standard Methods for the Examination of Water and Wastewater*, 10th ed., 1960, New York, American Public Health Association, Inc.
- VIRTANEN, A. J., 1952, Molecular nitrogen fixation and nitrogen cycle in nature. *Tellus*, 4, pp. 304-306.
- WEINMANN, H., 1955, The nitrogen content of rainwater in Southern Rhodesia. *S. Afr. J. Sci.* 52, pp. 82-84.
- ZUBER, R., 1963, Plant nutrients from the atmosphere. *Mitt. Lebensm. Hyg. Bern*. 53, pp. 499-507.

BOOK REVIEW

Cloud Structure and Distributions over the Tropical Pacific Ocean. By J. S. Malkus and H. Riehl, Univ. of California Press, Berkeley and Los Angeles, 1964 (229 pp.), \$7.50.

In spite of its (handsome) appearance this book is not a text, but rather a progress report; it contains substantially the same material previously issued as a Contract Report from the Woods Hole Oceanographic Institution.

In the summer of 1957 time-lapse ciné photographs were made of the sky during three trans-Pacific flights, at the initiative of the authors, and in this report these well-known leaders in the study of tropical weather discuss in some detail what can be learned from them about the organisation and working of tropical clouds and cloud systems. Such simple photographic reconnaissance, which surely could be realised over most of the globe, is shown to be a most useful and rewarding technique.

The principal conclusions are, first, that here as elsewhere, amongst endless complication there is evidence of strong organisation, so that one must

suspect the existence of some simple keys with which what may at first seem chaos could readily be resolved. Secondly, there is a very close relation between the small-scale cloud development and the synoptic-scale structure of the atmosphere. As is recognised in the conclusions, this association could have been better confirmed and exploited had there been available more soundings, perhaps best of all drop-sondes released by the aircraft. As it is, it is clear that a "state of sky" code can be sufficient to summarise cloud observations, and the authors present one of their own devising.

Amongst a number of criticisms listed by the reviewer, he now thinks only one worth mentioning, that perhaps too often the writers imply that the large-scale circulations control the clouds, rather than vice versa, or that they should be regarded as inseparable. The detailed description and illustration are full of interest for the diligent reader, and it is no adverse criticism to say that the final impression is that such work must be done again, and again, with additional facilities, and not only in the Pacific.

F. H. Ludlam

K. Ya. Kondrat'yev, Radiative Heat Exchange in the Atmosphere. Translated by O. Tedder, translation edited by C. D. Walshaw. $x + 411$ pp., 105 figures, bibliography with 583 quotations, *Pergamon Press*.

This book deals with the transfer of thermal energy by long-wave radiation in the atmosphere and with the radiation-balance of the earth's surface and of the atmosphere. It has been written by one of the best experts of this field who is well acquainted with all the relevant international literature in this line. Thus, it comprises the theoretical developments as well as the observations and their interpretation by calculation of models. This is done, both in remarkable details and by a thorough and thoughtful working. The book considers in 8 chapters the basic laws of the absorption of long-wave radiation, the radiation diagrams, the atmospheric downcoming and the outgoing infrared radiation in various climates and seasons, the influence of cloudiness and of the inclination of the radiating slope, the radiation balance of the ground and of the atmosphere as well as temperature changes in the atmosphere caused by radiative heat exchange, and much more.

There are two passages in this book where the original character of a textbook for Russian students becomes particularly evident: (1) The theory of only two radiation instruments of Russian origin is explained here. Among these two is the instrument developed by Yanishevskii, which calls for the most complicated theory because it does not provide any compensation for wind influences. The other instruments, widely in use in western countries, are but briefly mentioned. (2) Only two radiation diagrams are discussed which cannot be obtained outside Russia and which perhaps do not even belong to the most perfect ones available.

Surveying the performance of theory and its application on observations it becomes strikingly obvious that the theory is much farther developed than is needed for the interpretation of the observa-

tions, or, one should preferably say, for the interpretation of observations available in 1955.

The original version may be written in 1955, the English translation came out ten years later. This, however, is a much too long an interval of time for a field which is so rapidly developing in its theory as well as experimental measurements as the investigation of the atmospheric radiation. The importance of the spectroscopy of long-wave infrared radiation, its quantum-theoretical interpretation, the processes of radiation in the stratosphere and mesosphere have not been discussed in this book, although these are fields, in the investigation of which the author was involved in a great deal during the last ten years. One can be convinced that today the author would have written quite another book under the same title. And this, too, cannot be altered by the fact that he has added a completion of the bibliography up to the year 1960, because the quotations have not been inserted into the text of the book. They form a separate reading and are of minor use.

The translation of the book is excellent. Author, translator and editor obviously enjoyed a very good co-operation in order to avoid misinterpretations of the text and to reject misprints which (unfortunately) very often can be found in the Russian literature. Nevertheless, in chapter II there are still some of these misprints (a_n , α_c and a_c , pp. 52 and 53, have the same meaning; likewise φ and ψ , p. 93 and fig. 9). Also the names, as far as they had to be retranslated from the Russian phonetic language, are written in the right way (with the exception of Hanne for Hann and H. Phillips for Philipps).

It is very regrettable that the publishers had not succeeded in bringing out the English translation shortly after the Russian original had come out. At that time the book would have led up to the border line of research, but today it can serve only as a first informing introduction for students.

F. Möller