

species). It is disappointing to find that the author has constructed a natural key to the subgeneric groups. Such a key is unnecessary since the species in the descriptive part are taxonomically arranged and, in the opinion of the reviewer, this has made the introductory key difficult and hazardous to use. Thus, under the second choice, we are asked to make a decision between cups and axils open, at least in part, or closed leading to Sects. *Cladonia* and *Clausae* respectively. For someone who is not a specialist, this is a most difficult choice to make correctly because of the notorious variability of the character. The author is aware of the problem of species with "Poorly developed podetia with neither cups nor axils present . . ." and in a footnote he explains that they "will have to be keyed out under both choices and the microchemistry compared carefully." He might have added that such species as *Cladonia apodocarpa* and *C. caespiticia* either never have podetia, or have such minute podetia that they can easily be overlooked. An artificial key to the species which consist predominantly of basal squamules could surely have been provided somewhere; it is too much to ask a student to key out both choices at such an early stage. By contrast, the keys to species within each group are a pleasure to use and few difficulties should be encountered here. All the keys are of the indented type.

Professor Thomson must take credit for the concise and clear way in which he has condensed the description of previous monographers of the genus. Taxa of sub-specific rank are listed, or in the case of the most variable species, keyed out after the species diagnoses. The nomenclature of these taxa has been rationalised, but in view of the fact that they are so poorly understood one wonders if it would not have been better to discard the majority of them and to have given more space to a brief discussion of variation within species and the distinctions between the taxonomically difficult ones. The author clearly has not thought it his task to make taxonomic decisions although he has done so in the Subsect. *Cladinae*. Prospective users of this book should note that *Cladonia sylvatica* is separated from *C. mitis* primarily by the presence of fumarprotocetraric acid rather than by morphological characters, and that the widely accepted epithet *arbuscula* has been rejected in favour of the old name *sylvatica*. The distribution of the species is described by listing the outlying states. Dot maps would have been more informative, particularly for the northern regions, but

with our present incomplete distributional knowledge their inclusion probably could not be justified in terms of the higher printing costs this would have involved.

The importance of this book will immediately be recognized by lichenologists, and it must be warmly recommended to all biologists whose interests bring them into contact with lichens. The inclusion of an artificial key would have made the book easier to use, but both the author and the publishers are to be congratulated on providing us with so much detailed information about this difficult genus; it can only serve to stimulate further research.

J. W. Sheard

STRUCTURE OF ANTARCTIC WATERS BETWEEN 20°W AND 170°W. BY ARNOLD L. GORDON. *Antarctic Map Folio Series Number 6*. New York: American Geographical Society, 1967. 11 x 17 inches. 10 pages of text, 14 plates. \$6.00.

At a time when electronic data logging systems are greatly increasing the sensing and recording capacity of research vessels, the publication of a professional synthesis in the form of a folio of charts and profiles of oceanographic parameters is a welcome addition to the library of the practicing oceanographer. On occasion, the sophistication of our new measuring systems has resulted in a backlog of information which has proved overwhelming, even to the research staff who produced it.

The objective of the American Geographical Society Antarctic Map Folio Series is to summarize in a succinct manner our present knowledge of the Antarctic. This folio is the sixth in a series which will eventually consist of some twenty publications and is the first to be prepared on Antarctic oceanography. The work does not treat the entire Antarctic Ocean but is limited to the region south of 50°S between 20°W and 170°W; it includes the Weddell Sea, Drake Passage, and the Southeast Pacific Ocean.

In all, there are fourteen large folded plates illustrating the positions of the stations and the distribution of temperature, salinity, and oxygen on a number of surfaces, differentiating the structure of the three major Antarctic water masses. Three maps show the dynamic topography for the sea surface and the 1,000 d.b. level relative to the 2,500 d.b. level, as well as the configuration of the latter with reference to the 4,000 d.b. surface. Another chart shows a

number of temperature sections across the Antarctic polar front zone, and the final plate delineates the surface extent of this zone. With the exception of the temperature sections the plates are all on a polar stereographic projection at a nominal scale of 1:11,500,000.

The data used in the preparation of the maps include hydrographic stations reported by fourteen expeditions dating from the *Discovery I* cruise of 1926. Over 1,700 of the more than 2,000 stations were recorded by the *Discovery* and *William Scoresby*, the icebreaker cruises of the US Operation Deep Freeze, and the *USNS Eltanin*. The *Eltanin* data have been used extensively in determining the structure and dynamics of Antarctic waters, since the ship's track was planned in order to obtain a uniform network of oceanographic stations; a high proportion of these observations extend to the bottom. The Lamont Geological Observatory has been responsible for the collection and processing of the *Eltanin* physical oceanographic data. All the material, with the exception of the *Bratigg* cruise of 1947-48, are in the Marsden square files of the National Oceanographic Data Centre (NODC), Washington.

The observations have been divided into two categories; the *Eltanin* material and the other records held in the NODC. The *Eltanin* observations were subjected to extensive checking before and after the data were reduced, and therefore have been given more weight in contouring than the data of the other expeditions. It is interesting to note that, in addition to the normal computer techniques used in oceanographic data processing, the *Eltanin* core layer values were chosen by computer and in most cases computer-plotted directly onto the polar stereographic projections.

The paper entitled "Structure of Antarctic Waters Between 20°W and 170°W" by Arnold L. Gordon is published as a separate folio monograph, and is included in the portfolio along with the fourteen unbound maps. This work presents a most useful oceanographic background for each of the maps and enlarges on the theory of the Antarctic circulation.

The oceanographic discussion is based on the premise that each of the three major water masses surrounding Antarctica, the Antarctic Surface Water, the Circumpolar Deep Water, and the Antarctic Bottom

Water, reflects the process of its formation and contains a core layer in which the original characteristics are most pronounced. These layers are identified by maximum or minimum values of salinity, temperature, or oxygen, and following the method introduced by Wüst, the decrease in intensity of the characteristic parameter as a result of processes of mixing can be interpreted as an indication of the distance from the source region. In this way the distribution and dispersal of water masses can be examined and information gained on the meridional exchange between the Antarctic circumpolar ocean and the major water bodies to the north.

Most judiciously, several profiles of temperature, salinity, and dissolved oxygen are included in the text. These diagrams make it possible for the careful, informed reader to follow the gist of the discussion and benefit from the constructive analysis of the data. Without these aides-mémoire, the unfortunate plethora of cumbersome water mass names would be quite enough to discourage the most ardent student. The amount of information presented on these maps demands careful interpretation if full use is to be made of this folio. Though the cartography is clear and well planned, each parameter and relevant symbol must be clearly identified if the meaning of the map is to be fully understood. The subjective treatment of the data in the production of the charts will likely cause some traditionalist to wish that there were at least one plate devoted to a series of sections of temperature and salinity on which the actual measurements were recorded.

The folio presents a most useful analysis of over 2,000 Antarctic oceanographic stations. It represents the first attempt at the compilation of this material, and combines a commendable examination of the data with an interesting and functional presentation of oceanographic charts. From a professional point of view, there is much to be said in favour of the folio format in contrast to a bound publication since the loose charts allow a close inspection of the plate in association with other working diagrams. The folio is not designed as an entertaining publication but must be considered an essential tool of the practicing marine scientist interested in Antarctic waters.

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