reviews

Meteorology and the Migration of Desert Locusts. By R. C. Rainey, WMO Technical Note No. 54. Geneva, Switzerland, World Meteorological Organization, 1963. 115 pp. 25 Sw. Fr.

This report is another example of the power that can be brought to bear upon fundamental problems by the cooperative effort of cognizant scientists. The problem of whether the productivity of an area shall be used to feed the human populace or the locust swarms is an ancient one in the deserts of Northern Africa, the Middle East and India. For all its history, only recently have observations on swarm movements of locusts been assembled and analyzed so that they make sense.

Dr. Rainey shows convincingly the danger of being misguided by "single station" observations of locust swarm movements. Because of the extent of the swarms (0.03 to 150 km^2) and the social behavior of individuals and groups within the swarm, flight patterns observed within a swarm may bear no relation whatever to the advance of its leading edge. Between the small scale observing problem of the confusing short flights of individuals within swarms and the larger scale problem of the possible confusion between swarms from day-to-day, the finding that swarms tend to advance downwind at a rate ordinarily well below the wind speed represents a *tour de force* in field observing technique.

The additional verification of these movements in terms of the necessary association of oviposition and hatching with adequate water supplies is indeed impressive. The downwind migration systematically converges the locusts with the air to the regions of intertropical convergence where water, if any, will be precipitated. Inasmuch as the locust population finds survival value in downwind migrations, it is not surprising that occasional migrations are misled by extratropical disturbances which carry them out to sea.

The practical aspects of this research for locust control in the affected areas are of undoubted significance. The course of the research, the nature of the problems encountered and solved, and the effectiveness of interprofessional collaboration in attacking what might by a theoretician be called ". . . a rather messy natural phenomenon . . ." are points that might well be studied by all naturalists (including atmospheric naturalists) whether they encounter locusts or not.

There is no doubt that the substance of the report could have been assembled in a smaller, easier to read, package. It is at times too detailed and too repetitious so that one gains the impression that the author is pressing a personal argument. This is unfortunate.

Also there is a ponderousness of writing style that predominates throughout. Such sentences as ". . . The limitations of the range of conditions covered by the hour-to-hour movements presented in sections 2.1.1 and 2.1.2 have already been indicated (p. 17); and considerable importance accordingly attaches to the data of sections 2.2, provided by the track followed by each individual swarm throughout the period of days (sometimes weeks) for which the aircraft were able to maintain contact with it, as evidence of the extent to which the relationship between swarm-movement and wind-direction indicated by the hour-to-hour observations is likely to have been maintained throughout these longer periods." . . . tend to beat a reader into unconsciousness. Phrases such as ". . . the aircraft data may merely have been insufficiently extensive . . ." indicate a choice of high-flown in preference to straightforward language (". . . too limited . . ." would do quite well).

The plates and figures are beautifully done, colors being used quite effectively in most of the maps and charts, and halftones giving excellent resolution of the pertinent details. The type is clean and the printing sharp, the only criticism on this point being that a larger type could have been used to advantage for the figure legends.—*A. Nelson Dingle*

Thermodynamics of Clouds. By Louis Dufour and Raymond Defay. New York and London, Academic Press, 1963, xiii + 255 pp. $10.00.

Every topic discussed in this book is handled with great rigor, sophistication and elegance. Several thermodynamic questions touching on the physics of clouds are treated here for the first time. The book is well organized and systematically laid out. Despite its containing mathematically intricate symbolism, and despite its being a translation, the text seems remarkably free from errors. Clearly, this book has been prepared with great care by authors thoroughly versed in their fields.

Yet, for all these merits, the book is disappointing: I wonder if a dozen persons will read entirely through it; I doubt strongly that more than two or three dozen will. And when they do, they will probably ask, as I did on finishing it, whether there is any real point in such high-powered theorizing on so many low-powered problems. Through more than half the distance, the authors seem to be hunting rabbits with elephant guns. Admiration for the great power of the weapons does not quite distract one's attention from the evident smallness of much of the prey.

The chapters likely to be most useful to students and workers in cloud physics are chapters 1, 11, 12, and 13. The first chapter presents a compact and clear summary of some basic concepts of surface physics. (I read that lucid chapter with mounting enthusiasm for what promised to be an outstanding book. But chapters 2 through 10 proved breach of promise.) The last three chapters give a fairly comprehensive summary of homogeneous nucleation theory applied to both droplet condensation and freezing, and parts of them may be helpful to students specializing in cloud physics.

But I find it impossible to speak glowingly of the other ten chapters of this rather curious book. That those other ten chapters are meticulously prepared and that they contain nothing but the most impeccable thermodynamics, I should be quick to concede. Those chapters are written in

the idiom of the De Donder school of chemical thermodynamics, which will pose an immediate obstacle for most meteorological readers since many key concepts will be quite unfamiliar. One might take the time to secure the requisite familiarity, say by some lengthy preliminary sessions with Prigogine and Defay's *Chemical Thermodynamics,* but one could be persuaded to take these pains only if he sensed that the end-results of the authors' ponderous analyses were important enough to justify it. Most of the results, regrettably, simply are not that important.

The lack of significance in many of the authors' lengthy analyses will not at first be apparent, even to the moderately sophisticated meteorological reader, since the authors usually fail to give the reader any guideposts or clues as to what is going on in their mathematical machinery (save in their very helpful introduction which no reader can afford to skip). When, after staying with the authors through a long and heavy analysis, one takes time to sit back and try to put into simple physical terms what has been accomplished in the analysis, he is due for disappointment and chagrin more often than not. To be sure, the reflective reader cannot fail to admire the technique and elegance, the sure hand of the authors, and the unprecedented rigor of the development; yet when he finally sees through their analysis (with precious little assistance from the authors' comments) he will wonder how the authors could possibly have felt justified in devoting so much elaborate analysis to so trivial a problem. The analysis centering around Table X, parts I through 4, pp. 123–129, constitutes a good case in point. The review reader should try to figure out for himself what the authors are getting at in all this; those who lack the perseverance can find out by consulting a paper by E. Wall (*Meteor. Zeit,* 59, 15 (1942)), who said whatever can be usefully said about the matter, and said it far more understandably. An even better illustration of the authors' readiness to obscurely belabor the trivial may be found in the analysis of the "stability of equilibrium of a droplet," pp. 91–95. This analysis unfolds via lengthy examination of the sign of the partial derivative of "the affinity of condensation with respect to its advancement," a recipe calling for ingredients which I feel sure are unknown to most meteorologists. If, despite the scare one gets from a timorous look at the beginning of that particular analysis, one sticks it out and gropes for insight into the unfamiliar concepts that are introduced without a word of clarification, he finally arrives at the authors' Eq. 8.75. Hope kindles; it looks interesting and new. But then as the tired reader sits back for that indispensable attempt to deduce *a posteriori* what has been going on in the preceding pages, it slowly dawns on him that the authors' hard-won stability criterion could have been deduced in only a few lines of argument based on a couple of very simple cloud physics principles. And, once he senses the latter, he quickly realizes (as the authors evidently did not) that the criterion really does not apply to the meteorologist's clouds at all, so nothing useful has been accomplished. Many such puzzling swindles are enigmatically carried off by the authors—so many that one is driven to the conclusion that they, themselves, must never have engaged in the kind of reflection that the reader must resort to in order to keep one foot on the ground. Too much of that sort of thing annoys conscientious readers; for my part, I found myself being annoyed again and again at trivia laced and veiled in obscure rigor.

The preface contains the disarming suggestion that the authors have sought to prepare a treatment of cloud thermodynamics "requiring only a little knowledge of general thermodynamics." Ridiculous—though I note that several reviewers less dilatory than I have dutifully reiterated this more-than-normally farfetched bit of prefatory optimism. In point of fact, the reader had better know a good deal of thermodynamics (and speak De Donder fluently) if he hopes to follow the authors very far: Concepts such as *affinity of adsorption, affinity of transfer, advancement of reaction, lateral surface entropy, lateral chemical potential,* are freely brought in with not a word of definition or of explanation. Sheer weight of (beautifully rigorous and astonishingly accurate) notation will bog down most students who might profit a bit from a few sections of the book; three and often four subscripts and superscripts bristle from many symbols. It won't be believed by the reader of this review until he checks for himself, but in one awesome discussion the first law of thermodynamics is extended to such utterly useless generality that it takes *two-thirds of a page of text* to write it out! Doubters check p. 51. Does it say anything useful? No. A multi-storied (because uselessly over-generalized) version of the saturated adiabatic equation runs from p. 100 to p. 101. Scarcely a glimmer of physical meaning will come through to students who stare at it with glazed eyes after reaching that climax. What is the point of this sort of thing? Who is supposed to get anything out of it?

I predict that this book will stand seldom-used on departmental bookshelves as a monument to rigor and generality, impressive but not very useful. I wish I had the authors' courage and a fraction of their rigorous command of thermodynamics; if I did perhaps I, too, would come out with an awe-inspiring but largely useless book.—*James E. McDonald*

Arizona Climate. Edited by Christine R. Green and William D. Sellers. Tucson, Arizona, The University of Arizona Press, 1964. 503 pages. $10.00.

This book brings together, summarizes, and arrays a wealth of climatological information in a convenient form, not only for the professional climatologist and forecaster working with Arizona and southwestern climates, but also for those making weather dependent decisions in industrial planning or those just considering winter vacations or year-round retirement in the Southwest.

Arizona climate is treated in two ways: (1) a general climatological treatment for the state as a whole and (2) individual climatological summaries for 91 Arizona temperature and precipitation stations and 19 precipitation stations. The individual station summaries are in the format of the U. S. Weather Bureau Climatography of the United States No. 20 and thus are directly comparable with those prepared for other weather stations in the United States. Each station summary has a table of temperature and precipitation means and extremes for the period of homogeneous record; a narrative climatic summary for the locality, recapping the more important climatic characteristics and a brief synoptic "why"; sequential tables of monthly and annual mean temperatures and total precipitation from the beginning of record through 1963; and a station history. These independent station summaries, with an excellent cross reference index of station names, comprise 439 of the 503 pages of the volume and provide the reader with a concise climatology on whatever specific locality is desired, be it Flagstaff, Cochise, Casa Grande National Monument, or one of the other 107 stations in the summary network.

Sellers' very readable general climatology of the state treats the physical features and individual weather elements within six climatically similar sections. Specific elements treated are precipitation, temperature, relative humidity and the temperature-humidity index, surface winds, cloudiness, and evaporation. In addition to the usual area charts of average annual precipitation, July and January average temperature, seasonal and diurnal marches of precipitation and relative humidity, the authors have included some "idealized" sea-level and 500-mb synoptic charts associated with the development of widespread summer afternoon thunderstorm activity in Arizona, heaviest summer and winter precipitation, heaviest winter snowfall, the coldest winter weather, and the warmest summer weather in Arizona. These charts, with a discussion of the moisture sources for Arizona precipitation, the reasons for its observed seasonal and geographic distribution, and the incorporation of micro- and meso- climatology into the explanation of observed temperature and wind patterns, make this general summary well worth reading for the Arizona professional or do-it-yourself forecaster and climatologist.

Finally, the authors have included summary tables of diurnal wind direction and speed for the six first order Weather Bureau stations, and summary and sequential tables of existing wind and evaporation data from the Weather Bureau Class A pans for 25 stations.—*Robert F. Dale*