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Riehl, Herbert, *Introduction to the Atmosphere*. McGraw Hill Book Co., New York, 1965, 365 pages.

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Il existe plusieurs centres de photo-interprétation, mais ceux-ci sont nettement spécialisés comme l'Institut français du Pétrole qui, chaque année, met l'accent sur une spécialité comme la géologie, la géomorphologie, la végétation, l'agronomie ou la pédologie. Or la photographie aérienne, qui est un instrument de synthèse, peut et doit jouer un rôle important dans l'enseignement. En effet, la photo-interprétation est le moyen par excellence de développer l'esprit d'observation. Elle nécessite des déplacements nombreux entre le laboratoire et le terrain ainsi qu'une interprétation de diverses techniques. Il est de plus en plus nécessaire que de tels cours soient dispensés dans tous les départements de géographie où les étudiants pourraient, au cours de l'année universitaire, aborder la photo-interprétation d'une région donnée et vérifier leurs résultats sur le terrain l'année suivante, dans le cadre d'un stage.

Germain TREMBLAY

CLIMATOLOGIE

CRITCHFIELD, Howard J., **General Climatology**. Second Edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1966, 420 pages.

RIEHL, Herbert, **Introduction to the Atmosphere**. McGraw Hill Book Co., New York, 1965, 365 pages.

Here are two introductory textbooks in climatology for geography students. A quick glance at chapter headings might suggest that these two books cover the same ground; superficially this is true, but the treatment of the subject matter is so different in each case that the two books in fact complement each other.

Dr. Critchfield is Professor of Geography at Western Washington State College, and this is a revision of his book first published in 1960. The work is divided into three parts: Part I deals with the elements of weather and climate, and the related atmospheric processes that involve the transfer of heat, moisture and momentum. Part II is devoted to the pattern of world climates and the explanatory description of the major types. In Part III, applied climatology is the theme; the elements of weather and climate are related to the biotic environment and to human activities. This section ends with a chapter on large-scale climatic change. Reading lists, usually excellent, are provided at the end of each chapter, and a general bibliography with a list of periodicals is given in the Appendix. The Appendix also contains abridged meteorological tables, and supplementary climatic data for a number of stations in each continent. There is an index.

Critchfield defines climate as the conditions resulting from the processes of exchange of heat and moisture between the earth and atmosphere over a long period of time, and in Part I, sets out to explain the temporal and spatial variations of the major climatic elements and airmasses in terms of these processes. In each of the three basic chapters, on heat and temperature, atmospheric moisture and motion in the atmosphere, respectively, the author skilfully integrates material on the measurement of the basic elements, their global distribution and physical interrelationships. In the final chapter of this section, airmasses and storms, Critchfield seeks a synthesis by the introduction of the concept of airmass types and by a discussion of the principal weather systems; this chapter ends with a brief, illustrated mention of daily weather maps, airmass analysis and forecasting.

Part I shows both the advantages and the drawbacks of attempting to range over so much material; it is strong on well-selected, general information and distributions, weak in explanation. This observation applies both to the text and illustrations. To this reader, the basic criticism of the author's handling of this section is the lack of discussion of the vertical dimension:

I. Although the definition of climate is based on the processes of exchange of heat and moisture between the earth and atmosphere, these processes are not adequately explained in the text;

II. The lack of an adequate, integrated treatment of the vertical temperature distribution and vertical motion (including the deferment of the treatment of stability and instability of the final chapter 5, page 104) has created unnecessary difficulties in explanation and understanding.

III. The absence of an overall three-dimensional view of the general circulation in the troposphere (in which the surface systems are studied in relation to the upper air flow), lends a static, unreal quality to the description, leaves opportunity for misconception and provides a rather poor basis for the explanation of world climates in Part II.

Additions or changes in the text along these lines would, I believe, make this section both easier to understand, and to apply in Parts II and III.

The first chapter in Part II deals with the controversial question of climatic classification, and provides useful tabulated summaries of two of the major classifications used by geographers, that of Köppen, and Thornthwaite's first classification of 1931. Critchfield's own approach to the description of world climates is not a rational one ; it is based on the concept of airmasses : « In as much as the world distribution of climatic types is primarily the result of heat and moisture regimes, climate may be classified into broad categories based upon the interrelated effects of heat and moisture upon air masses, which in turn dominate the climates of different regions. »

His major climatic types are thus : 1) climates dominated by equatorial and tropical air masses ; 2) those dominated by tropical and polar air masses ; 3) climates dominated by polar and arctic-type air masses. A final group includes highland climates. A coloured map of the distribution of the climatic types is published at the front of the book ; the author closely follows Köppen with respect to the major categories.

In the following chapters of Part II, the world climates are described. Descriptive climatology is difficult and can so easily become tedious. These chapters are concise, with good selection of material, and generally very well illustrated with maps and graphs. Again, the weakness lies in the explanation. The airmass concept is much favoured by geographers, although less so by meteorologists. It is limited in its possibilities and easily leads to a flat, static, unsatisfying, partial explanation. Again, more light might have been shed by invoking a unified system of three-dimensional circulation.

Part III is devoted principally to applied climatology. After a chapter on climate and the world pattern of vegetation and soils, subsequent chapters deal with climate and water resources, climate and agriculture, relations of weather and climate to transportation, communication and industry, weather, climate and housing, climate and the human body, and climatic change and cycles with applications in extended forecasting. In covering such a wide range of subjects the treatment has necessarily had to be quite general, but it certainly will introduce the student to the enormous variety and fascination of this subject, and to the unlimited possibilities for further work by geographers. The main weakness is again the explanation, and partly springs from the inadequate treatment of process in Part I. This section is extremely well illustrated with maps, charts and photographs.

Dr. Riehl is Professor of Atmospheric Science at Colorado State University, and his introductory text « Introduction to the Atmosphere » was written for nonspecialist science students following a geophysics programme. It is for « students desiring a concise yet thorough view of the field ... The author hopes, further, that it will prove useful as a volume for study and reference to engineers and other professional men and women, whose work requires some understanding and judgment about the atmosphere. » This is a rare and brilliant book and I believe that no geographer can afford to be without it. The treatment is somehow rigorous, lucid and yet non-mathematical, and it includes the latest advances in the field. The book itself has been elegantly produced ; the layout of the text and diagrams shows an unusual sense of style that makes it a joy to turn the pages.

The unifying theme in Riehl's book is the general circulation, and the author manages to convey an uncanny sense of three-dimensional motion. This provides a master key both to knowledge of world climates and to everyday changes in the weather. In his introductory chapter, the author begins straight away with a survey of the general circulation, followed by an outline of the vertical structure of the atmosphere and a discussion of the principal atmospheric variables. Part I is devoted to the study of the physical processes : radiation heating and cooling, vertical mixing of air below the clouds, evaporation, condensation and clouds, precipitation and severe storms, and large-scale motion. The treatment, though thorough, never lacks reality and there is

a minimum of technical language ; what could be more expressive of the principle of continuity than the statement « there are no holes in the atmosphere. »

The text itself is progressive, and a thorough study of Part I is required before continuing with the second Part, on weather disturbances in middle and high latitudes, and in the tropics. With a firm grasp of Parts I and II, one is well-prepared to study climates and their variations in Part III. This latter section begins with a chapter on the mechanisms of the general circulation, the mean patterns, the variations, and the influence of land and water surfaces and of large mountain ranges ; this is followed logically by a discussion of large and small-scale climates. On large-scale climates, Riehl discusses examples of world climates under the headings : the Equatorial trough, the Monsoon, the Trade winds, the western edge of the continents (subtropics and higher latitudes), the eastern edge of North America, and middle — and high — latitude continental interior (there is, unfortunately, no mention of polar climates). The chapter on small-scale climate deals with the influence of mountains and water bodies, forest climates, city climate and the climate near the ground.

In Part IV, Weather and Applied Climate, the author has elected to discuss just a few selected topics — weather and water management, aerospace weather and the weather factor in design and operations — and does so concisely and to the point.

The book has three appendices : on reading weather maps, conversion tables and a list of data sources, books and periodicals ; there is a subject index and a geographical index. One of the outstanding features of this publication is the wealth of excellent diagrams.

The publisher's blurb states that « with the exception of the high atmosphere, the student who comprehends this book will be able to help himself when he comes up against a problem related to weather, that is not covered in the book. » This sounds true, because the text offers a sound basis of physical understanding of the systems and processes of the atmosphere and earth-atmosphere. The geographer today requires this knowledge from at least three practical viewpoints :

I. That he can no longer afford to ignore the question of the physical possibilities and limits of weather modification from region to region, and the impact of such actions on the life and economy ;

II. That the ability to understand the nature of climatic hazards, and to assess the climate as a resource, is of great importance in the minimization of costs in a regional or national economy ; this is especially so where an area is seasonally marginal to human life and activity ;

III. That the immediate influence of climate on human life and activity is on a micro- or local scale, and involves the processes of energy exchange between the atmosphere and the earth's surface (and living things at the surface) in the first few hundred feet above the ground. Comparatively little is really known of these small-scale climates, and it is here that geographers are becoming increasingly active in the field. The growing interest in urban climates is a case in point.

On a no less practical plane, given a deeper understanding of the atmosphere and interaction between earth and atmosphere, gone is the need for so much of the sheer drudgery of memorizing tedious descriptions, which plagued the geographer's climatology in the past and dulled his interest and wits. This approach is not only more satisfying but more fun (as Riehl suggests in his forward). Furthermore, there is no question here of the geographer stepping beyond his legitimate field, merely that of strengthening his inherited position.

It is now probably clear how these two textbooks complement each other. Their combined price, however, inhibits the use of both books as obligatory texts in a single course. One excellent solution is the use of Dr. Critchfield's text in physical geography in high schools or pre-university institutes, and the adoption of Dr. Riehl's book in a first year university climatology course.

Unfortunately the problem of an introductory climatology text in the French-speaking world still exists. One sincerely hopes that the publishers may see fit to produce French translations ; the market is assured.

Cynthia WILSON