of artifacts, including some fashioned from such perishable materials as grass, permitted an excellent view of an Eskimo society which had occupied the site fairly continuously from the 12th to the 18th century A.D.

But it was the Iyatayet site that extended the Eskimo sequence far beyond the boundary of anything previously known. Iyatayet was not as extensively frozen as Nukleet and, further, its stratified levels did not reflect continuous habitation, but rather separate occupations, widely spaced in time, of three ultimately related but quite different societies. Just under the sod lay a relatively thin deposit of Nukleet culture remains. Below this was a layer, ranging to 3 feet in depth, which yielded artifacts and features of a much older Eskimo culture which Giddings calls "Norton." The Norton layer contained, among other artifacts, a variety of flaked stone arrowheads, lance points, side blades, adz blades, and scrapers, and also, interestingly enough, edge-ground modified burins like those in Dorset and in Okvik-Old Bering Sea. A number of Norton implement types have almost their exact counterparts in Ipiutak culture, and since Norton developed about 400 B.C. it can be assumed that it is an early, Ipiutak relative.

Finally, at the very bottom of the Iyatayet site, and separated from the Norton layer by sterile silts, Giddings found hundreds of small, delicately flaked stone artifacts: the tools and weapons of the Denbigh Flint Complex. These remains have a maximum age of at least 5000 years and, while among them there are a few puzzling types that seem to have analogues in very early American hunting cultures, the collection as a whole relates unmistakably to Eurasia. Among Denbigh manufacturing techniques or implement forms, which are known to have originated in the Paleolithic, Mesolithic, or Neolithic of the Old World, the author notes (i) burins, which originated in the Eurasian Upper Paleolithic; (ii) microblades, which are typical of the Eurasian Mesolithic; (iii) fine, bifacial flaking of semilunar, triangular, or lanceolate flints that were hafted in weapon heads and other tools as side blades or points, a technique which originated in the Eurasian Mesolithic and Neolithic; and (iv) particular techniques of removing, from stone cores, oval and parallel-edged flakes that were subsequently fashioned into scrapers and other tools, techniques which originated in the Eurasian Middle Paleolithic.

The roots of the Denbigh Flint Complex, therefore, lie far to the west, but obviously extend to several sources in that area, and the particular constellation of traits which makes up Denbigh—the exquisite workmanship and the forms and varieties of its artifacts—sets it quite apart from any other very old prehistoric culture known from either side of the ocean. Its traits thus appear to reflect a distinctive economic expression, based on an aggregate of diverse cultural ways, and specifically adapted to the natural world of the Bering Sea. They also identify some American relatives of the Denbigh Flint Complex.

Norton, Ipiutak, Dorset, and pre-Dorset contain a range of traits that are also found in Denbigh. In all of them there are types of stone scrapers, end blades, side blades, and other forms which are closely similar to those in Denbigh, and in Dorset and pre-Dorset there are, in addition, microblades and burins. Further, in Dorset, in Norton, and even in Okvik-Old Bering Sea, there occur modified burins, the small, edge-ground gravers. In broader context, these seemingly few traits have, in reality, long been basic to essential portions of the most northerly societies, for they have to do with the edging of weapons, including some types of harpoon heads, the particular forms of certain knives and other cutting tools, the manufacture of implements from hard organic substances, and the preparation of hides for a variety of purposes.

The implications of the age and tool kit of the Denbigh Flint Complex are, therefore, obvious. And this raises my only quarrel with *The Archeology of Cape Denbigh*. A few years ago William N. Irving proposed the so-called Arctic Small Tool Tradition, a valuable concept that illuminates the relationships among a number of far northern archeological components which are genetically connected, and which are eventually basic to modern Eskimo culture. Earliest of its known components is the Denbigh Flint Complex. The Arctic Small Tool Tradition is now generally accepted and widely employed by archeologists, but Giddings does not use it, nor does he mention it, in this book. In view of its common use in the recent arctic literature, this lacuna would seem to deserve an explanation.

As it has moved upward through time, that column which stands for Eskimo culture has expanded and changed in a variety of ways. Some of this metamorphosis has resulted from internal invention and discovery; much more, in all likelihood, has come from borrowing. For example, there are the previously noted Asian elaborations in Okvik-Old Bering Sea, and in Ipiutak, and surely, through the centuries, the Eskimos have adopted some traits from American Indians. But this hardly means that one must beat the woods of either continent in order to find the earliest Eskimos. For, although we shall probably be looking for the ultimate origins of *specific* Eskimo traits until doomsday, Giddings shows us that Eskimo culture seems to have begun on the shores of a far northern sea.

Chemistry

Elements of the Theory of Gases. Sidney Golden. Addison-Wesley, Reading, Mass., 1964. 160 pp. Illus. $5.

Fast Reactions in Solution. E. F. Caldin. Wiley, New York, 1964. xii + 306 pp. Illus. $7.50.

Elements of the Theory of Gases is for "intermediate students of chemistry" and "is concerned with gases and the kinetic-molecular theory which has been developed to account for their properties." The author, Sidney Golden, likes logic for its own sake, and his discussion is systematic and easy to follow. The mathematics used makes only modest demands on the reader. Interesting experimental results on gases are introduced and interpreted in the light of the theory.

The titles of the five chapters are "Properties of uniform gases," "Properties of nonuniform gases," "Kinetic molecular theory of ideal gases," "Molecular distributions," and finally "Nonideal gases." The book is a balanced presentation of the basic parts of kinetic theory. It serves as a good introduction to advanced treatises in kinetic theory as well as to certain aspects of statistical mechanics.

Caldin's book, *Fast Reactions in Solution*, is primarily concerned with experimental methods and some of the interesting experimental results. In chapter 12, the last chapter, he intro-

duces some theory but goes very little beyond Arrhenius. As a result, the generalizations and simplications that come from a thoroughgoing application of statistical mechanics to reaction mechanism are lost.

The first 11 chapters treat most of the available experimental methods for measuring fast reactions. In the first chapter, which is the introduction, the theoretical treatment of diffusion controlled reactions is quoted. Typical of the methods of measuring reaction rates, which are treated in considerable detail, are quenching methods, flow methods, relaxations from temperature, pressure and voltage jumps, ultrasonic-adsorption, flash photolysis, electron spin, and nuclear magnetic resonance. The book is an interesting and useful presentation of the rapidly growing field of fast reactions.

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Agricultural Research

The Principles and Practice of Agricultural Research. S. C. Salmon and A. A. Hanson. Leonard Hill, London, 1964. xii + 384 pp. Illus. 75s.

The authors are senior, capable, United States agronomists. As a basis for their book they have used largely agronomic material liberally spiced with horticulture, animal husbandry, range management, animal feeding, animal breeding, farm management, and marketing.

The book consists of five parts plus a bibliography and an index. The parts are Historical (3 chapters, 73 pp.); The Philosophy of Research (5 chapters, 67 pp.); Statistical Methods (6 chapters, 104 pp.); Techniques of Agricultural Research (6 chapters, 103 pp.); Appendix, Statistical Formulae, and Tables (7).

The book is intended for undergraduate students who are preparing for careers in research, especially for students in or from developing countries. Those who study it will be well repaid; so will their teachers, who perforce may read or even study it. Nonstudents and nonteachers seriously concerned with agriculture, whether in the rather limited scope of this book or in broader terms, will also profit from reading this concisely written volume. The first chapter, "Agriculture and the development of civilization," covers the topic in 16 pages; covers it with enough specific illustrations to provoke interest and to verify the essential limitation placed on civilization by the available supply of food and the determining role played by technology resulting from discovery, experience, and systematic research on the abundance of that supply.

The second chapter describes the origin and development of agricultural research. Major beginnings were formulated by Leibig, who (about 1840) developed the mineral theory of plant nutrition and by Boussingault, who demonstrated by field experiment and chemical analysis that legumes are able to obtain nitrogen from sources not available to other plants. Boussingault's work was carried out at Alsace, the first agricultural research station, in 1834.

The third chapter, "The twentieth century revolution in agriculture" sketches the research-based events that have enabled agriculture in the developed countries to increase food production more rapidly than required to meet domestic requirements. In the United States, the farm population dropped from about 60 percent of the total population in 1860 to less than 10 percent in 1960, but the amount of food and fiber produced on the farm showed a fivefold increase. Mechanization, the control of insects, weeds, and diseases, commercial fertilizers, improved animal health and nutrition, hybrid corn, rust-resistant wheat, and adapted soybeans are among the items described.

Part 2, on the philosophy of research, is excellent, and sometimes provocative, material for new and old researchers. The authors consider the nature of basic and applied research, and identify the essential interdependence of the two, although this is done by describing basic research as an inseparable part and concomitant of all effective research. There are sections on science and mathematics; science and art; science and politics; science and certainty. The senior author is a devotee of statistics but at the same time properly skeptical about placing too great reliance on such data.

Chapter 5, "Methods of research" describes, defends, and criticizes many methods—the scientific, the empirical, the experimental, the case, the survey, the historical, and the synthetic method. I doubt that there are so many distinct roads to Rome, but it is interesting to read about them. Of particular validity and importance are the author's criticisms of the scientific method. Subsequent chapters deal with how discoveries are made, perhaps better with how they were made. Illustrations are attributed to accident and observation (including serendipity) as well as to planned research. There are chapters on the reasons for error and the nature of proof. The argument is not always persuasive, but it is always provocative.

Part 3, Statistical Methods, is adequate through the description of Fisher's methods. Since research is learned by doing it, the treatment is necessary as a part of research training. It may be questioned whether in the future agricultural, even agronomic, research will use the methods that are described here or newer ones, which are not described. The same question may be raised with respect to part 4, on the techniques of agricultural research. In any case, these techniques must be understood in order to understand much of the research literature on agronomy.

In summary, I recommend this book, although it describes agricultural research in a narrow sense that was. The implication that, as it was, so it is and should be, I question.

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Colorimetry

The Measurement of Colour. W. D. Wright. Van Nostrand, Princeton, N.J., ed. 3, 1964. x + 291 pp. Illus. $11.

The second edition of this highly praised work on colorimetry was rewritten in a logical and lucid manner [reviewed in *Science* **128**, 588 (1958)]. Wright's treatment of the algebra of color-mixture equations, the greatest contribution that book made, and all other parts of the second edition—radiation, photometry, color-vision theory, the Commission International de l'Eclairage (CIE) tristimulus system and the applications of that system—were so directly and succinctly written that specialists and nonspecialists alike found the science of color understandable.