

attractively bound in green cloth and is printed on good quality paper. Forest research workers, students, and teachers will find the collection valuable, but it should also serve effectively as a means of educating the growing number of forest managers who are seriously con-

cerned with improving the productivity and usefulness of the lands under their care.

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Science Books for Young People

Developing authentic science materials for children to read, material that will sharpen their observations of the natural world, currently interests many nationwide elementary school science curriculum committees. Studies by these committees have shown that children are tremendously interested in their natural environment. Any parent or teacher knows the endless number of questions they ask with very little encouragement.

Unfortunately, children often receive answers that are invalid, superficial, and lacking in explanations. Adults seldom suggest to children that by observations and simple experiments they could learn at least part of the answer themselves. It is becoming increasingly apparent that young people can learn and understand more than adults realize. How much they can understand depends on the organiza-

tion and presentation of the material; this, in turn, requires a knowledge of how children learn.

Edwin B. Kurtz, Jr., and Chris Allen, the authors of **Adventures in Living Plants** (University of Arizona Press, Tucson, 1965. 128 pp., \$4.95), are a scientist (Kurtz) and an elementary school teacher (Allen) who have combined their efforts to produce an elementary botany book for children, ages 11 to 13 years. The manuscript and the sections on "things to do and think about" were read and tested by children, revised, and then tested again. (Most authors of children's books could profitably use this technique.) The efforts of Kurtz and Allen have resulted in an authentic, exciting, and readable children's book about plants. Illustrations are plentiful and appealing without being gaudy. The drawings convey their intent somewhat better than the photo-

graphs, but both are used to advantage.

The authors have organized their material into a series of plant "adventures" built around the structure and life activities of plants: the plant body; cells; photosynthesis; respiration; nutrition; circulation; growth; reproduction; heredity; the plant kingdom; and ecology. New words and how to pronounce them are considered in the final section. Each "adventure" is accompanied by a series of simple experiments and investigative activities designed to stimulate children to further observations and explorations into a topic. The authors have presented the subject of botany through a naturalistic and descriptive approach; however, they have been able to maintain a coherent explanation of the living plant, its structures, physiology, and ecology.

The book is suitable for a home library and should be in elementary school and children's libraries. It could be used as a textbook in the upper levels of the elementary school but will probably become a reference book.

There should be more books on science which represent "good" science and at the same time appeal to young people. The present volume is an effort in the right direction.

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ECONOMICS AND THE SOCIAL SCIENCES

Colombian Prehistory Comes of Age

Donald W. Lathrap

Only since World War II has a systematic picture of Colombian prehistory begun to emerge. Previously there had been reports of archeological work at particular sites or in restricted areas and some discussion of stylistic variation among the various regions of Colombia, but a sense of time depth and a feeling for the place of Colombia in a coherent scheme of New World cultural evolution was lacking. The phenomenally rapid change in

this situation during the last 20 years has occurred almost entirely as the result of the efforts of Gerardo Reichel-Dolmatoff and his wife Alicia Dussan de Reichel. Their work has been reported in a splendid series of technical monographs and articles, mainly in Spanish. Now their many basic contributions are consolidated and summarized in a lucidly written and beautifully produced book: **Colombia** (Praeger, New York, 1965. 231 pp.

\$7.50) by Gerardo Reichel-Dolmatoff. The volume is Number 44 in the Ancient Peoples and Places Series, edited by Glyn Daniel.

It is worth stressing the degree to which the modern synthesis of Colombian prehistory presented in this book is the result of the Reichel-Dolmatoff's own research, since the author is engagingly modest in his presentation and extremely generous about crediting and discussing at length the contributions made by others.

This is a "popular" book. The technical jargon of the trade is either eschewed or carefully explained. There is a sense of form, style, and closure that is rare in the publications of most other New World archeologists, even when they are assaying popular writing. It can be read with pleasure and profit by any intelligent layman, but the large quantity of important facts

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and principles which are conveyed by this elegant and relatively brief text make it of highest value to the student and to the professional directly engaged in South American prehistory.

The structure of the book is simple. An introductory chapter presents the rationale for studying Colombian archeology and a brief history of the discovery and investigation of Colombian antiquities. An excellent outline of Colombian geography is given in the second chapter. Since numerous highly sophisticated ecological interpretations are the most consistently successful characteristic of the book, this chapter is the true keystone of its structure.

The relatively few finds that might shed some light on the initial peopling of Colombia are discussed in chapter 3. A handful of bifacially flaked projectile points found at widely separated locations show a generic relationship to the early, big game hunting cultures that are better represented in other areas of North and South America. Crude and relatively amorphous assemblages of unifacially flaked stone tools from Pomares, San Nicolás, and other locations are described. Reichel-Dolmatoff suggests that such assemblages might relate to the "Pre-Projectile Point Stage" proposed by Krieger. An alternative explanation which I would favor is that these undifferentiated, crude stone tools are the imperishable fraction of a rather evolved technology in which perishable materials were used in making the projectile points, more refined cutting tools, and perforating tools. Cane, palm wood, long bones, fish jaws, sting ray spines, and thorns were the typical materials used for such tools over much of Lowland South America at the time of the first European contact, and there is every reason to suspect that this is a very ancient pattern of ecological adaptation.

The shellfish collecting economy that appeared along the Caribbean coast of Colombia around 3000 B.C. is described in chapter 4. Pottery, technologically crude but occasionally provided with elaborate modeled and incised decoration, is a consistent feature of these shell midden sites, and it appears to be the oldest pottery so far discovered in the New World. The description of the economic pattern and its probable social concomitants is excellent.

An illuminating discussion of the nature of the early, highly developed systems of root crop agriculture that appear before 1000 B.C. in the flood plains of several of the larger rivers of Northern Colombia is presented in chapter 5. The tight ecological relationship of these cultural patterns to the riverine environment is developed in a most satisfactory way. Reichel-Dolmatoff reviews the evidence relating to the introduction of the Mexican cultigen, maize, into these systems sometime before the birth of Christ.

Chapter 6 deals with the expansion of agricultural systems out of the Northern Lowlands onto the slopes and uplands of the Andes. The author makes an excellent case for the view that such an expansion may have been related to a shift in climate and almost certainly was related to the introduction of maize and other Mexican crops. Some of the more famous and complex Colombian cultural traditions such as San Agustín and Tierradentro were aspects of this upward colonization, which was under way by 600 or 700 B.C. The author argues that all of these cultures show a strong Mesoamerican component not only in their agriculture but in most other cultural domains.

Discussion of the nature of the later cultural systems in the Northern Lowlands of Colombia (chapter 7) precedes a presentation of the archeological background of the two most complex cultures encountered by the Spanish—that of the Tairona of the slopes of the Sierra Nevada de Santa Marta and that of the Chibchan groups on the highlands around Bogotá. The author's use of the results of his own ethnographic study of the modern Cogui to illuminate Tairona archeology is an outstanding example of the direct historical approach to archeology.

It would be difficult to imagine a clearer statement of the basic economic factors responsible for the development of Indian cultures in pre-Hispanic Colombia, or a more masterful discussion of the interrelationship of these factors with the peculiarly complex geographic background that Colombia presented. Only within such a framework does the tremendous diversity of the Indian cultures of Colombia become explicable.

Both author and publisher deserve congratulations for having produced a book that is as handsome as it is in-

formative. The illustrations, both line drawings and photographs, are most appropriate to the text and are beautifully reproduced.

Any general summary of the prehistory of a large and complex area such as Colombia must oversimplify certain points and gloss over various problems if it is to communicate to any but the specialist. It seems appropriate to discuss a couple of these unresolved problems which are crucial to future investigations of South American prehistory.

Though he offers occasional cautions, much of what Reichel-Dolmatoff writes in chapters 4 and 5 suggests that the shellfish collecting economy as represented at Puerto Hormiga, Canapote, and Barlovento forms both an economic stage and a chronological period prior to and antecedent to the pattern of intensive root crop cultivation in the flood plain environment, the pattern best represented by Malambo and Momil I. The rather simplified chronological table, Fig. 5, could be construed as reflecting such a view. What needs to be emphasized is that the riverine agricultural-and-fishing societies were a highly complex adjustment to an environmental setting quite distinct from the coastal environment favoring shellfish collecting. Archeological remains indicating a pattern of adaptation essentially identical to that of Momil I and Malambo are now known from the same kind of environmental setting in widely separated parts of Tropical South America: Saladero on the lower Orinoco flood plain in Venezuela and Early Tutishcainyo on the Ucayali flood plain of Eastern Peru. For Saladero a date of about 1000 B.C. is indicated and for Early Tutishcainyo a date closer to 2000 B.C. All of these cultures share enough elements of their ceramic traditions so that it is hard to believe that they are completely unrelated historically. Furthermore, Saladero, Momil I, and Malambo do not represent an incipient manioc economy but a fully developed economy, based on bitter manioc (the more evolved cultigen of the cultivated varieties), in which the aim was to produce a storable and marketable surplus of flour and bread. The available evidence suggests that the agricultural adjustment to the tropical flood plains began almost as early as the shellfish collecting adjustment to the coast. I feel that Reichel-Dolmatoff, in the attempt to stack all of the cultures of the

Northern Lowlands in a single chronological column, has seriously understated the amount of chronological variability in the materials from Momil I and greatly underestimated the duration of the occupation of Momil I.

A more serious group of problems is raised by Reichel-Dolmatoff's tendency to derive almost all later innovation in Colombia's culture history from Mesoamerica. It is clear that maize came from that direction, but a case of comparable strength cannot be made for any of the other elements that Reichel-Dolmatoff suggests were introduced from Mexico. The theme is repeated in various parts of the book but receives its fullest expression on page 115: "It seems that Mesoamerican influences in Colombia date from as early as about 1200 B.C., when such elements as the jaguar cult, maize cultivation, burial mounds, monolithic sarcophagi, and obsidian mirrors were introduced by sporadic settlers. . . ." With the exception of maize cultivation, and possibly burial mounds, none of the above elements can be dated securely in Mesoamerica as early as 1200 B.C., but the cat motif is found in various examples of Peruvian art which are that old or older. Reichel-Dolmatoff goes on to say that "About 500 B.C., a second period of major Mesoamerican influence began, bringing in its wake such elements as deep-level shaft graves with lateral chambers, elaborate figurines, occipito-frontal head deformation, pottery with multiple supports, perhaps double-spouted vessels, flat and cylindrical stamps, elaborate spindle whorls, and biomorphic whistles." For many of these elements the distribution of dated occurrences favors a South American origin. Double-spout and bridge bottles occur in the Barrancas and La Cabrera complexes of Venezuela, 500 to 1000 B.C.; in Early Tutishcainyo, 1500 to 2000 B.C., in the jungles of eastern Peru; in Kotosh Waira-jirca, 1500 to 2000 B.C. in the Highland of Peru; and in Hacha, 1000 to 1500 B.C., on the South Coast of Peru. Tall solid vessel supports occur in Reichel-Dolmatoff's Momil Ia materials as well as in Early Tutishcainyo. Hollow, mammiform vessel supports occur in Early Tutishcainyo. Flat pottery stamps occur in Momil Ia, and cylindrical stamps are found on the Upper Pachitea in eastern Peru before 500 B.C. Elaborate spindle whorls are present in some of the preceramic cultures of Coastal Peru as well as in

the very early ceramic tradition, La Florida, of the central coast of Peru.

Two other elements of ceramic decoration that are rather consistently present in the elaborate pottery styles of Reichel-Dolmatoff's Sub-Andean Cultures—resist painting and tall annular bases—are also dated far earlier in South America than in Mesoamerica. Resist painting occurs in Hacha on the South Coast of Peru and in Momil Ia, while tall annular bases are characteristic of Hacha, Barrancas, and Momil Ia. Reichel-Dolmatoff makes an excellent case for the theory that the close similarities between the figurine traditions on the South Coast of Colombia and North Coast of Ecuador, on the one hand, and those of the West Mexican Coast (Nayarit-Jalisco-Colima), on the other, indicate a close historical relationship. But the dates that he presents favor a South to North movement rather than the reverse.

It is clear that from 1200 or 1000 B.C. Colombia shared a progressively greater number of cultural elements with Mesoamerica. Some of these—for example, maize—clearly moved from North to South. On the other hand, the precocious and complex development of metallurgy in Colombia (see cover on this issue of *Science*), which precedes the introduction of that art into Mesoamerica by at least 1000 years, suggests that through most of this time Colombia was a center of rapid technological evolution rather than a passively receptive peripheral

zone. All of the evidence cited suggests that cultural exchange between Colombia and Mesoamerica was by no means as one-sided as some passages in this book suggest.

It was the revival of the Spinden hypothesis (that all New World high culture was the result of the spread of a single uniform neolithic base from a single source) which focused the attention of archeologists during the 1950's on the areas between Peru and Mexico. In a sense, then, the very existence of this book is a result of that revival so we should be grateful that Spinden's formulations were disinterred. However, some of the presentation in this book appears to be forced so as to conform to the idea that most significant elements of New World high culture had their source in a localized area of Mesoamerica.

New World archeologists still have a long way to go before they fully understand the net of cultural interaction that connected Mexico, Peru, and all of the areas in between. None of the problems mentioned above have been solved definitely. What can be said without fear of contradiction is that during the last 20 years no other scientists have made a more solid contribution to our understanding of these problems than have Reichel-Dolmatoff and his wife. Through this book something of the scope of their contribution can now be appreciated by those students who confine their reading to the English language.

Mathematics and the Behavioral Sciences

Mathematical Explorations in Behavioral Science (Irwin and Dorsey Press, Homewood, Ill., 1965. 396 pp., \$7.95), edited by Fred Massarik and Philburn Ratoosh, is a symposium volume. The occasion was a 4-day conference for researchers in psychology, sociology, business administration, political science, and economics, and the "desired emphasis was on conceptual innovations, supported by data, rather than on purely formal models or techniques of data analysis; contributors reported empirical findings when available, or indicated possible approaches to the empirical testing of a model or theory." As the editors are well aware, the 19 contributions vary as widely in meeting this desire as they do in their content. Some intend to

serve only as a brief introduction to a given topic, but others assume that the reader is immersed in their field.

Statistical decision theory is discussed by two contributors. Hunt uses a Bayesian approach for formally deciding among alternative behavioral theories. Scheff gives an informal survey of how physicians in practice seem to weight type 1 errors against type 2 errors.

Strategic decisions are treated variously in an empirical study of two- and three-person games (Lieberman), a model for negotiations (Bartos), and simulation of international relations (Guetzkow).

The processing of information is given a purely formal model in "Semantic information and message evalua-