with general conditions of propagation. The refractive index structure of the atmosphere—turbulence and layering—is treated extensively, and theories of mixing in gradients and of turbulent mixing are briefly described. Other subjects treated in this chapter are refraction, reflection, diffraction, and absorption. Geometric optic and wave optic methods are both used, with considerable emphasis being placed on ray-tracing techniques. The discussion on atmospheric noise is really a consideration of the contributions of all types of noise, including receiver, man-made, and cosmic noise. The author prefers the concept of equivalent noise temperature to the use of a noise factor.

The next chapter is concerned with experimental trans-horizon measurements, all made prior to 1961. The data have been selected to show trends and variations with distance, time, frequency, antenna height, and from path to path. Antenna gain and beam-width performance in trans-horizon measurements are summarized, as are the conclusions of various investigators. Statistical analyses, including the Rayleigh distribution, autocorrelation, and power spectra analyses of phase-interference fading phenomena, are briefly discussed, and data on frequency-selective fading measurements and bandwidth limitations are presented.

In the remainder of the book, the author gives theoretical interpretations. He starts with the development of theories of smooth-earth diffraction in a homogeneous atmosphere and then brings in irregularities and nonhomogeneities. Emphasis is placed on explaining the approaches of various theoreticians in modeling and formulating propagation theories. The author's own attempt to synthesize scattering and reflection into a unified theory is discussed in some detail. The final section of the book deals with practical methods for determining attenuation. A number of loose graphs are included in a back cover pocket; these are useful in predicting propagation attenuation for cases of free space and of plane, cylindrical, and spherical diffraction, as well as in accounting for the effects of geometry, meteorology, frequency diversity, coupling loss, and other factors. The methods are original with the author, although brief descriptions of the theoretical and empirical methods of others are given in an appendix. Although the author carefully points out that accuracy in the estimates is of prime importance, a basic weakness of the book is the lack of any comparison of the accuracy of predictions made by his methods with that of predictions made by other available methods.

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Two Symposiums on Chromosomes

Chromosomes Today. Proceedings of a symposium (Oxford, England), July 1964. C. D. DARLINGTON and K. R. LEWIS, Eds. Plenum, New York, 1966. 286 pp., illus. $11.50.

Chromosome Manipulations and Plant Genetics. Contributions to a symposium held during the Tenth International Botanical Congress (Edinburgh), August 1964. RALPH RILEY and K. R. LEWIS, Eds. Plenum, New York, 1966. 131 pp., illus. $8.

During the summer of 1964 two conferences were held on the subject of chromosomes. The proceedings of both of these were published during 1966. The larger volume, *Chromosomes Today*, contains the papers presented at the First Oxford Chromosome Conference. In introducing this conference, its president, C. D. Darlington, wrote an engaging piece on "The chromosomes as we see them." The "we" in this sentence should be regarded as either presidential or editorial, since the article is pure Darlington as cytologists have come to know him. He begins with a brilliant, succinct, and penetrating statement of the structural and functional complexity of chromosomes as organelles in their own right which should be regarded neither as mere aggregates of genes nor as completely dependent parts of organisms to be studied as wholes. He then proceeds through a statement of Weismann's pre-Mendelian views to a characterization of modern biologists as he sees them. These are neatly categorized into five types: the anatomist, the chemist, the experimental breeder, the mathematical geneticist, and the naturalist. Each of these types is made into a straw man of narrow outlook whose ideas are easily bowled over, leaving the field of biology to the preeminence of the chromosome cytologist. The fact that few modern biologists fit into his types is a disturbing element which Darlington conveniently ignores.

Most of the other 31 papers in the volume are brief reports of new research on chromosomes. They are most noteworthy for their diversity, the lack of connection between them, and the fact that for the most part they are embellishments of well-worn themes. Four of those on plants deal with the much studied but still imperfectly understood B chromosomes; two deal with special examples of polyploidy; one with translocations; and three with the mechanics of meiosis. All represent sound, careful work which is of a technical level much higher than that of cytology 10 to 20 years ago. As additions to our knowledge about chromosomes, none of them is of major significance. The unusual giant chromosomes which D. U. Gerstel and J. A. Burns report in certain hybrids of *Nicotiana* are the only real surprise in this section, and certainly deserve further attention. Eva Sansome calls our attention to the probable but unexpected diploid condition in a primitive group of fungi, the Oömycetes.

The second section, on nuclear structure, centers largely about the relations between DNA synthesis, chromosome breakage, and mutations. It contains a number of valuable contributions to the now voluminous literature in this field. The analysis by B. A. Kihlman of the effects of various nucleotide analogues is perhaps the most significant paper of this group. Remarkable filamentous structures in the nucleoli of plant endosperm tissue are illustrated by L. F. La Cour. These will deservedly attract much attention and may eventually provide a basis for a better understanding of the function and metabolism of these once mysterious but now more comprehensible organelles.

The final section of the volume contains ten papers on animal chromosomes. Noteworthy among them is that by Oswald Hess on the structure and activity of normal and modified Y chromosomes in *Drosophila*. Two papers, one by D. T. Hughes and the other by J. S. S. Stewart and R. C. G. Killean, attempt quantitative comparisons of karyotypes with the use of the digital computer. This new technique will undoubtedly gain in importance as cytologists seek to make more precise their morphological comparisons be-

tween chromosomes. The other papers of this section are either revised repetitions of material published elsewhere or else report interesting novelties in some specialized areas of animal cytology.

The smaller volume, *Chromosome Manipulations and Plant Genetics,* contains the proceedings of a symposium held at the Tenth International Botanical Congress at Edinburgh. In it, the most recent information on the cytogenetics of six important crop plants—tobacco, tomato, potato, wheat, oats, and cotton—is in each case presented and analyzed by a cytogeneticist who has spent his life with and is a world authority on the plant species in question. Plant cytogeneticists who have followed this literature will find little that is new, but for those who have not done so, this is a most convenient volume. Of particular value are the comparisons between different crop species which are undertaken by many of the authors in their discussion sections. The final résumé by D. U. Gerstel and T. J. Mann is most helpful and forms a fitting conclusion to the volume.

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Directions of Cultural Diffusion

Ecuador. BETTY J. MEGGERS. Praeger, New York, 1966. 220 pp., illus. $7.50.

"All paths lead to Ecuador," says Betty Meggers, and in this unique book on Ecuadorian prehistory (one of the series Ancient Peoples and Places) she goes far to prove it. A mere 15 years ago very little was known of the now demonstrated importance of this country to New World archeology. Most excavations had been carried out in the highlands and produced little in the way of a usable chronology.

This situation has been reversed by the remarkable excavations undertaken by the team of Meggers and her husband Clifford Evans, working in close collaboration with the late Emilio Estrada, a millionaire amateur of archeology whose abiding passion was to unravel the prehistory of the Ecuadorian coast. Their findings have attracted worldwide attention and stirred up considerable debate among prehistorians. *Ecuador* is a clear, well-written, and (considering the author's involvement in the controversy) unperturbed summary of the coastal sequence as it now stands. Meggers bravely attempts to include the highlands in her survey, but the information from there is so fragmentary and confusing (stemming mainly from the outmoded excavations of Jijón y Caamaño, who inflicted such monstrous phase names as "Proto-Panzaleo I" upon the scholarly world) that, except for the Inca and other historically documented groups, that region might have been omitted altogether.

What makes ancient Ecuador so exciting is not its level of cultural development—for, Meggers' enthusiasm notwithstanding, it has nothing comparable to the high civilizations of Mesoamerica or Peru—but its extraordinarily early move toward fully settled life and its intensive and long-term contacts with Mesoamerica and other, closer areas such as Colombia and Peru. Meggers compares it, geographically speaking, to a keystone in the arch of the northern Andes, but it might just as well be called a keystone of New World prehistory. Coastal Ecuador is strategically placed to receive marine travelers from both north and south, and it is no accident that the greatest aboriginal seafarers of the New World, the Manteño, were found on its shores.

The story begins with the Preceramic period, for which there is little evidence beyond the important highland site of El Inga, which has produced a Paleo-Indian obsidian industry with strong affiliation to the fluted-point complexes of North America and to the fish-tail-point horizon of southern South America. There is an effective gap in the archeological record between the Preceramic period and the early ceramic culture of Valdivia on the coast, with which Meggers' Formative Period begins (at about 3000 B.C.). As just about everyone must now know, Meggers and Evans propose that a boatload of Jomon fishermen from Neolithic Japan were blown off course and landed in Ecuador, thereby introducing ceramics to the New World. However, few of their colleagues, even those most sympathetic to hypotheses of long-distance diffusion, have accepted this explanation, and I suspect that the reason is that it has by no means been proved that a local pottery-making antecedent for Valdivia does not exist somewhere on the coast. Until Meggers and Evans show us that there is a *preceramic* culture extending right up to the beginnings of Valdivia, with a sudden appearance of a Jomon-like ceramic complex, we will remain unconvinced. Furthermore, on the Caribbean coast of Colombia there is another ceramic phase, Puerto Hormiga, which has equal claims of antiquity, and unless the relations between it and Valdivia are solved one could just as easily propose that Valdivia arose from a native, Puerto Hormiga–like development as from an accidental introduction from across the wide Pacific.

I think that there is much more enthusiasm among other New World archeologists for interareal diffusion between Ecuador and Mesoamerica, mainly because the evidence is better and has, in fact, been cumulative. These relations extend from the Late Formative Period (1600–500 B.C.) until the Spanish conquest. The pioneer Andean archeologist Max Uhle at one time would have ascribed them to continued migration from Mesoamerica, but today the general feeling is that there was a two-way exchange based upon maritime trade. The traits on which this hypothesis is based are generally not found in the Intermediate Area (from Nicaragua through Colombia), and it has therefore been concluded that coastal traffic, probably by means of great sea-going, sail-driven rafts such as those used by the Manteño, was the principal route of diffusion. Certainly many parts of Mesoamerica were involved—Pacific coastal Guatemala, western Mexico, and, particularly in the case of the Tolita culture of the Regional Developmental Period (500 B.C.–A.D. 500), southern Veracruz. This implies, of course, some overland trading. A good case can be made for the introduction from Ecuador to Mesoamerica of metallurgy and such ceramic techniques as iridescent painting, rocker-stamping, and negative painting and such traits as stirrup-spouts and the pottery mold. Coming in the other direction would be napkin-ring ear spools, chili-grater bowls, clay roller-stamps, the very odd three-pronged censers, and a host of other things.

But of course adjacent Peru remained the most powerful influence on Ecuador (and probably vice versa). Less impressive are the relations with Amazonia, for the artistically exciting Napo culture of the eastern lowlands, in spite of Meggers' claim of a highland derivation, is part of a widespread horizon style that is found on a late